...ANDARD
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...STRALIA

...cturing radio re-
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...finer radio.

...ation, makers of
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...Ltd.

...ers Co-Distributors:
...Traders Ltd. Pty.
...Karchow, Chalmers

Radio Trade Annual

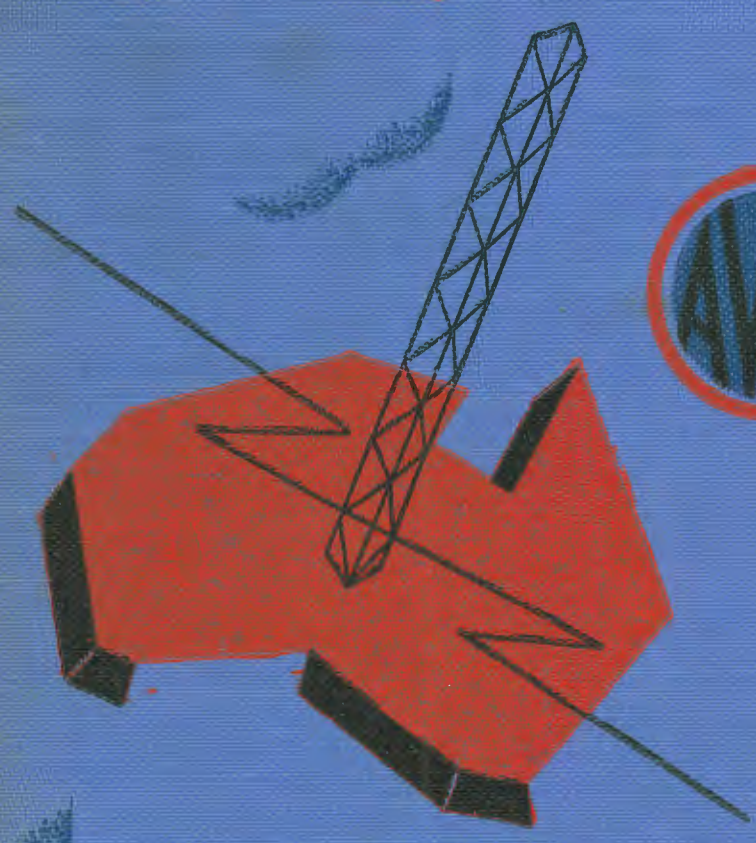
RADIOTRON

RADIO TRADE ANNUAL OF AUSTRALIA 1934

21 YEARS

Leadership

OF THE AUSTRALIAN WIRELESS INDUSTRY



AWA

Beam Wireless
Coastal Radio
Wireless Telephony
Broadcasting
Marine Wireless
Pacific Islands Radio
World-wide Communications
Wireless Research
Radio Manufacture
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AMALGAMATED WIRELESS
(AUSTRALASIA) LIMITED

AUSTRALIA'S NATIONAL WIRELESS ORGANISATION

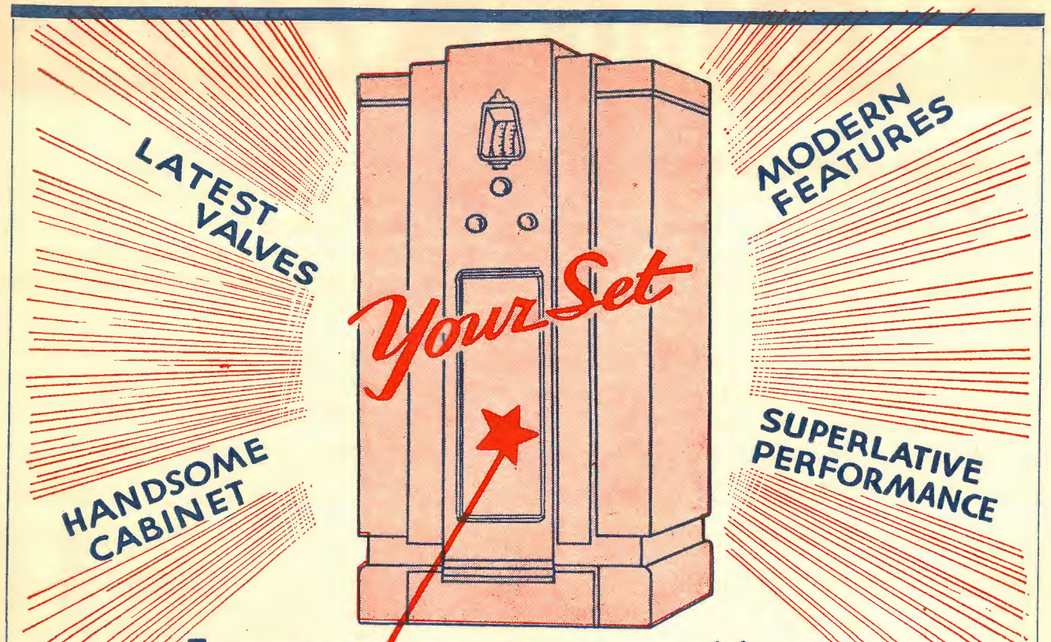
ALS LEAD DOWN to Mullard Valves

million aerials
be wrong . . . .

Once upon a time the demand was for Battery Valves . . . and in that field the Mullard Master Valves rapidly became predominant. Year after year from before the birth of broadcasting saw more and more Mullards in use. Every development in Battery Receiver construction found Mullard in step, with new types of Valves to meet every demand. Mullard Valves are giving longer, cheaper, and more satisfactory service than any other Valve in the world.

To-day when the radio world is producing achievement after achievement in A.C. receivers, and more exacting demands are being made upon the valves, Mullard still meets every radio need. Mullard is the largest organisation in the world entirely devoted to the manufacture of radio valves, and Mullard Master Valves are supreme in every class and for every purpose.

ard Master Valves



Just One Thing More to Make it a Winner!

You plan your set to face powerful competition. Don't let one little thing mar its chance of success—see that it has a Rola Dynamic Speaker! Retailers and buyers alike know Rola Speakers. They know their perfect reproduction and amazing reliability. They have confidence in Rola equipped sets.

Rola is now the world's largest manufacturer of dynamic speakers—that alone is proof of quality! There is a range of models to suit every type of set.

Rola

DYNAMIC SPEAKER

ROLA CO. (Aust.) Pty. Ltd., 359 Little Lonsdale St., Melbourne

There's Money in DIAMONDS

FOR CONTINUED SALES AND 100% CUSTOMER SATISFACTION . . . STICK TO AUSTRALIA'S MOST POPULAR SELLING LINE. Illustrated Price Lists and Advertising Material always available on request.

Write Factory Direct . . .

Widdis Diamond Dry Cells Pty. Ltd.

MILLERS PT., SYDNEY HAWKE STREET, MELBOURNE

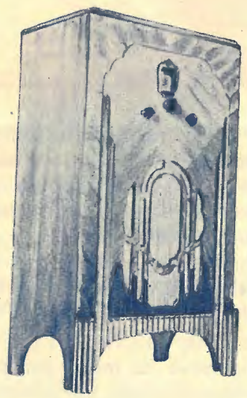
Always first with

---that's one of the many advantages enjoyed by Stromberg-Carlson dealers

NOT once, nor twice, but in practically every instance, it is Stromberg-Carlson who has introduced the important radio advancements to Australia.

Stromberg-Carlson were the first in Australia to produce an All-Electric Radio Receiver. Again they were first to master the intricacies of mass producing Superheterodyne Receivers. Their laboratories are to be thanked for the design of Superheterodyne circuits working with as few as five and, ultimately, four valves.

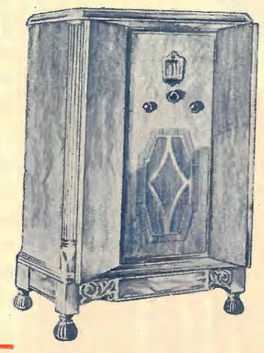
Models 53 and 54.—This is Stromberg-Carlson's "Younger Set" as described below—(lower centre), supplied in a handsome book-case cabinet. Model 53 is for A.C. operation; Model 54 for either A.C. or D.C. operation.



Model 403.—A 4-valve battery - operated superheterodyne, remarkable for its long range and daylight reception. In tone and volume it is the equal of all-electric receivers.

Stromberg-Carlson

STROMBERG-CARLSON (A[illegible] LIMITED,
72 William Street, [illegible]y.



Model 833.—A.C.—Aptly named "The Masterpiece." An 8-valve Superheterodyne, embodying every proved modern feature. Special Audio System and Dual Speakers. 200-265 volts.

Model 53.—A.C. [illegible] Younger Set"—a ba[illegible] only in size. In tone, [illegible] and selectivity it gi[illegible] big-set reception.

Model 54.—Similar to 53, with the added ad[illegible] of operating from eith[illegible] or D.C. mains. 200-2[illegible]

he latest—

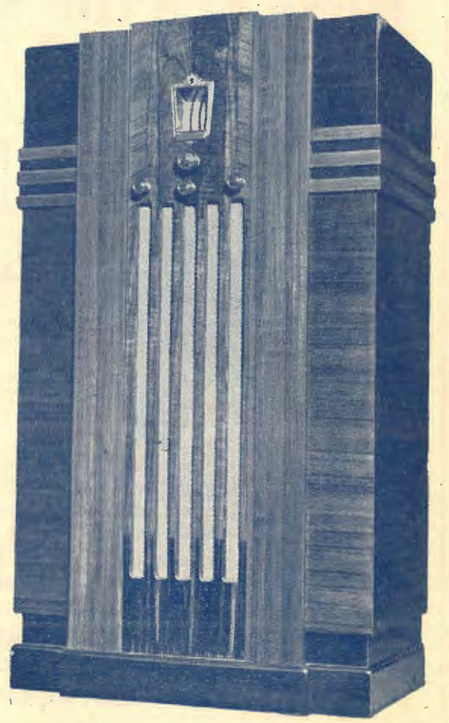
[illegible]omatic volume control was another Stromberg-Carlson [illegible]ovation, and this triumph was quickly followed by the intro-[illegible]tion of such notable developments as visual and silent [illegible]ing, between stations muting and automobile radio receivers. [illegible]mberg-Carlson's newest achievement, one which has [illegible]ght praise from the radio trade and radio-buying public [illegible], is the amazing All-wave Receiver, some details of which [illegible] given on the right.

[illegible]turally, by always being first to offer the latest, Stromberg-[illegible]lson dealers enjoy an immense advantage—an advantage [illegible]ch, as well as building lasting goodwill, means quicker sales [illegible] greater profit.

Model 704.—A 7-valve battery-operated Superheterodyne. This set is bringing to country listeners the range, tone, volume, and daylight efficiency achieved up to now only by all-electric sets.

Model 534.—A.C.—"Focussed Radio." A 5-valve Superheterodyne, embodying the recently-discovered principles of sound-focussing.

Model 544.—Operates on either A.C. or D.C. mains. Similar in other details to Model 534. 200-265 volts.



ALL-WAVE RECEIVERS

The All-Wave Receivers introduced by Stromberg-Carlson early in 1934 marked as important a step forward as did their first All-Electric circuits. These are genuine All-Wave sets—both the short-wave and standard-wave lengths being tuned in on the same dial. These sets are offered in three models :—

Model 734—A.C.—Featuring 7 valves, visual tuning, automatic volume control, push-pull audio system, "focussed" reception.

Model 734—A.C.—is obtainable also as a combination phono-radio.

Model 554—A.C.—Featuring 5 valves, automatic volume control, and "focussed" reception.

Here are the Speakers You Can Sell on Sight

"MONITOR"

Perfectly Balanced Speakers

No matter what circuit is used—what number or power of valves you employ—perfect reproduction is possible only when a perfectly balanced speaker is installed. The "Monitor" Speakers have been specially designed and built to a standard of accuracy of tone and volume, to meet every demand by those who desire perfection in radio reception. Only the finest components are used in their manufacture.

WE HAVE NO HESITATION IN RECOMMENDING THIS LINE—PRICES ARE RIGHT, LEAVING A GOOD MARGIN OF PROFIT.

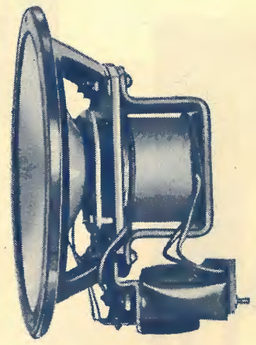
Fuller particulars may be obtained from our Sydney Representative.

"Monitor" speakers may be had in two sizes, 6in. and 8in. cone—There is no better speaker on the market for the motor car radio than the 6in. "Monitor."

Call, see and ask for a demonstration. Every speaker carries a definite guarantee.

All New South Wales enquiries to be made to our Sydney Representative, P. A. Morse, Bradbury House, 55 York Street, Sydney. Phone: BW 6803.

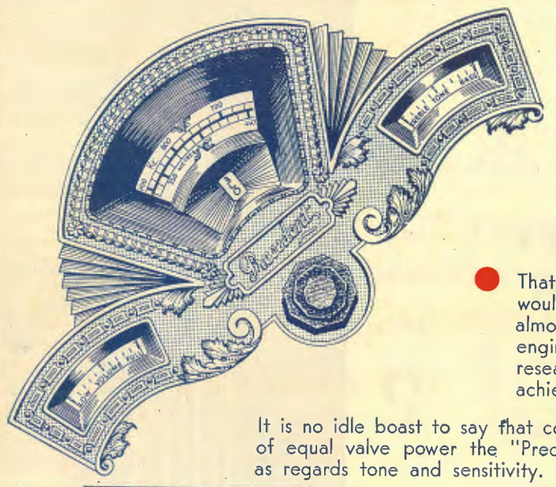
South Australian Representative, D. Harris & Co., 140 Rundle Street, Adelaide.



A PRODUCT OF

Firth Brothers Pty. Ltd.

149-163 LITTLE LONSDALE STREET, MELBOURNE, C.1.
'Phones: F4127 — F 4128 — F 6554



The name of

PRECEDENT

is accepted as the Hall Mark of quality

That such advanced ideas in radio development would be possible in such a short period seemed almost beyond the longest dreams of radio engineers a few years ago—but through patient research the "Precedent" Laboratories have achieved a result that is almost staggering.

It is no idle boast to say that compared with any other make of receiver of equal valve power the "Precedent" range will out-perform all others as regards tone and sensitivity.

Illustrated is the Model "F34", 5-valve Superheterodyne—Features of this receiver are—Dash-board control with micromatic tuning by a graduated cam-action giving visual volume and tone control. Positively micrometrically centred coils housed in bayonet locking coil shields ensure maximum sensitivity and perfection of performance. The valve bases are so constructed that it is impossible to fit valves in places other than as guided by the construction.

EXCLUSIVE FULL VENTILATED VALVE SHIELDS GREATLY PROLONG THE LIFE OF ALL VALVES BY ENSURING EFFECTIVE COOLING AND PREVENTING DESTRUCTIVE OVER-HEATING.

RECEIVER GUARANTEED 12 MONTHS

The "Precedent" speaker as used in this astounding receiver has been specially designed and manufactured to match the receiver—hence the "Precedent" tone. An exclusive feature of this remarkable receiver is the graduated variable stepless tone control which enables the operator to secure clear tonal reception and with progressively smooth and easy action.
The cabinet is of modern design and is specially constructed to the same standard as this high quality receiver, beautifully veneered, and with satin duco finish.

INTERSTATE RECEPTION IS GUARANTEED

Also available for immediate delivery is the "Precedent" 6-valve Superheterodyne with automatic volume control fitted with twin speakers.
7-valve Superheterodyne with push pull 15 watts, undistorted out-put, fitted with twin speakers.

Over 10,000 "Precedent" Receivers have already been sold in Victoria, and now for the first time "Precedent" Receivers are available in all States—Reputable Dealers are wanted in all States to handle these outstanding Receivers.

A PRODUCT OF

FIRTH BROTHERS PTY. LTD.

149-163 LITTLE LONSDALE STREET, MELBOURNE, C.1.
'Phones: F 4127, F4128, F 6554

. . . The . . .

RADIO TRADE ANNUAL

OF AUSTRALIA

Second Edition

1934

Compiled by the Staff of

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Formerly The RADIO RETAILER

Oswald F. Mingay, Managing Editor

Price - - - - 5/-

Post Free in Australia

OVERSEAS PRICE 7/6

PUBLISHERS:

AUSTRALIAN RADIO PUBLICATIONS LTD.

HEAD OFFICE: 15 Castlereagh Street, Sydney, N.S.W. 'Phone: B 2549

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PREFACE . . .

THIS 1934 Edition of the Radio Trade Annual of Australia is published with the fullest realisation of its importance to the Radio Industry throughout Australia. The generous acceptance accorded the 1933 edition exceeded our most optimistic ideas. Nothing like it had ever been attempted in the past, and therefore it was very difficult for those professionally engaged in radio to even visualise the completed book.

This second publication of the Annual is in many instances a decided improvement on the previous edition. Several new sections have been introduced and some sections have been printed on different coloured paper to facilitate ready reference.

It is still very difficult to obtain all of the desired information, due in part to reticence and also to the great distances between capital cities. Another factor is the rapid rate of change in radio which militates against obtaining the data and compiling it in an Annual before the subject is out of date. Therefore, any errors or omissions which may have crept in must be overlooked on those and other accounts, but readers can rest assured that no effort has been spared to include in this huge book the most reliable information relating to radio in Australia. So far as we can ascertain, it is the largest book appertaining to radio ever published in Australia.

Our best thanks are tendered to all persons, Companies, and the P.M.G.'s Department for their co-operation, enabling us to present a larger, and in our opinion, even better Radio Trade Annual for 1934.

O. F. MINGAY, Editor.

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Turn to Page 358 for further details.

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Trade Discount Ready Reckoner

DISCOUNT RATE %.

Amount	2½	3	3½	5	6	7½	10	12½	15	17½	20	25	27½	33⅓
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6				6 0	7 3	9 0	12 0	15 0	18 0	1 1 0	1 4 0	1 10 0	1 13 0	2 0 0
5				5 0	6 0	7 6	10 0	12 6	15 0	17 6	1 0 0	1 5 0	1 7 6	1 13 4
4				4 0	4 16	6 0	8 0	10 0	12 0	14 0	16 0	1 0 0	1 2 0	1 6 8
3				3 0	3 12	4 10	6 0	7 10	9 0	10 10	12 0	15 0	16 6	1 0 0
2				2 0	2 8	3 0	4 0	5 0	6 0	7 0	8 0	10 0	11 0	13 6 8
1				1 0	1 4	1 10	2 0	2 10	3 0	3 10	4 0	5 0	5 10	6 13 4
19/-				19	1 3	1 9	1 18	2 7	2 17	3 6	3 16	4 15	5 5	6 6 8
18/-				18	1 2	1 8	1 16	2 5	2 14	3 3	3 12	4 10	5 1	6 0 0
17/-				17	1 1	1 7	1 14	2 3	2 11	3 0	3 8	4 5	4 16	5 5 4
16/-				16	1 0	1 6	1 12	2 0	2 8	2 16	3 4	4 0	4 12	5 3 4
15/-				15	19	1 5	1 10	1 17	2 5	2 13	3 0	3 15	4 7	5 1 8
14/-				14	18	1 4	1 8	1 15	2 2	2 10	2 16	3 10	4 2	4 13 4
13/-				13	17	1 3	1 6	1 12	1 19	2 7	2 13	3 5	3 17	4 6 8
12/-				12	16	1 2	1 4	1 10	1 17	2 3	2 10	3 0	3 12	4 0 0
11/-				11	14	1 1	1 2	1 8	1 14	2 0	2 6	2 15	3 7	3 13 4
10/-				10	13	1 0	1	1 6	1 12	1 17	2 3	2 10	3 2	3 6 8
9/-				9	12	19	18	1 4	1 10	1 15	2 0	2 5	2 16	3 0 0
8/-				8	10	18	16	1 2	1 8	1 13	1 18	2 5	2 11	2 13 4
7/-				7	9	17	14	1	1 6	1 11	1 16	2	2 6	2 6 8
6/-				6	8	16	12	19	1 4	1 9	1 14	1 19	2 1	2 0 0
5/-				5	6	15	10	18	1 2	1 7	1 12	1 17	1 19	1 13 4
4/-				4	5	13	8	16	1	1 5	1 10	1 15	1 17	1 6 8
3/-				3	4	11	6	14	18	1 3	1 8	1 13	1 15	1 0 0
2/-				2	2	9	4	12	16	1 1	1 6	1 11	1 13	1
1/-				1	1	7	2	10	13	18	1 4	1 9	1 11	1
11d.				11	11	6	1	8	11	16	1 2	1 7	1 9	1
10d.				10	10	5	1	7	10	14	1	1 5	1 7	1
9d.				9	9	4	1	6	9	12	15	1 4	1 6	1
8d.				8	8	4	1	5	8	11	14	1 2	1 4	1
7d.				7	7	3	1	5	7	9	12	14	1 3	1
6d.				6	6	2	1	4	6	8	10	12	13	1
5d.				5	5	2	1	3	5	7	8	10	11	1
4d.				4	4	1	1	2	4	5	6	8	8	1
3d.				3	3	1	1	2	3	4	4	6	6	1
2d.				2	2	1	1	1	2	2	3	4	4	1

Progress of Radio in Australia during 1933

The year 1933 will go down in Australian radio history as the "Patent Year" despite the fact that there were more broadcast receivers made and sold throughout Australia in 1933 than ever before in one year.

ON March 1st, 1933, the Commonwealth Government gave 12 months' notice of cancellation of an agreement (made 22/12/27), with Amalgamated Wireless (A/sia) Ltd., (Part II, see page 65 of Radio Trade Annual 1933), whereby Amalgamated Wireless received threepence per listener's licence per month (3/- per annum) from the Government for the use of all patents owned and controlled by A.W.A. This threepence per licence per month came out of the annual licence fee of 24/- paid by listeners.

From 1927 to 1933 the radio industry throughout Australia was able to build up a substantial national industry which, during 1933, sold approximately £3,500,000 of radio receiving apparatus to the public. Considering the population of this country (⅛th that of Great Britain and 1/20th that of U.S.A.), that figure compares most favourably, particularly considering the world-wide depression and the depressed price of wool for that year.

The Federal Government through the Postmaster-General (Hon. Archdale Parkhill) announced on April 26th, 1933:—

"That the Government had exhaustively examined the patent position in regard to radio business and had decided that it was time it should cease to hand over to one company a sum of money considered reasonable to meet the whole patent rights' liability of the radio industry of the Commonwealth. The payment amounted to between £60,000 and £70,000 a year. Although A.W.A. controlled a considerable number of patents, there were several other interests which owned important patents necessary for the radio business of the Commonwealth. It is clear therefore, that it would be inequitable to allow the existing policy to continue."

Almost immediately, Neutrodyne Pty. Ltd., a Melbourne company owning the Australian rights of Hazeltine radio patents, announced that it was prepared to licence manufacturers to use their patents. Several manufacturers signed a licence with Neutrodyne, but the Sydney trade resisted and formed a protective body registered as Radio Interests Ltd., under the N.S.W. Company law. The vast majority of interested traders in other States and some in Melbourne also joined Radio Interests.

IN June, 1933, Neutrodyne issued several writs and the legal contest commenced. Standard Telephones and Cables (A/sia) Ltd., also entered the arena as patent holders and advertised their Anderson patent 20984/24 as being available under licence. Nothing could be done by A.W.A. until March 1st, 1934, as that Company was still receiving full payment from the listeners' licence fees.

Radio Interests Ltd., was formed primarily to investigate the whole patent position in regard to receiver patents. They endeavoured to get all patent holders into one pool, and while they were successful in getting A.W.A.—S.T.C. and Philips to form a patent group, Neutrodyne refused to join unless they received 5/- per chassis. This apparently the other patent holders were not prepared to admit. Radio Interests were thus faced with extensive and expensive litigation in the Victorian Supreme Court, initiated by Neutrodyne, while on the other hand they endeavoured to negotiate some form of settlement with the Sydney group (known as A.R.T.S and P.—Australian Radio Technical Services and Patents Ltd.)

After months of endless meetings and conferences, the Directors of R.I.L. completed what to them was a satisfactory form of licence and presented same to their shareholders in December. With modification this was accepted by the shareholders and also agreed to on December 21st by A.R.T.S. & P. (patent holders). The final draft of that licence is published in this Trade Annual.

Since December 1933, and up to March 1934, that particular licence and its enactment has been the subject of further negotiations. Further conferences have also been held between the Sydney patent group (ARTS) and the Melbourne group (Neutrodyne), with a view to the complete amalgamation of all patent holders which, if successful, will no doubt lead to a new form of licence.

The first legal action taken by the A.R.T.S. Group was the issue of a writ out of the Supreme Court of N.S.W. in February 1934, against Stromberg Carlson (A/sia) Ltd. by Standard Telephones Cables (A/sia) Ltd., in respect to the Anderson patent 20984/24.

Up to the end of March no patent action had come on for trial in either Victoria or N.S.W.

Biggest Radio Year.

It is reliably estimated that over 150,000 radio sets were made and sold in Australia during 1933. At an average retail price of at least £20, this represents a figure of £3,000,000, to which must be added replacements and accessories which is estimated to reach another £500,000. Those figures are claimed by the Editor to be a very close approximation of the turnover for 1933, and are substantiated by the fact that during the year over 160,000 new wireless licences were issued by the P.M.G.'s Department.

Superheterodyne Year

For the first time in the Australian radio trade, every set manufacturer made superheterodyne broadcast receivers. Even two of the largest companies who retained Tuned Radio Frequency sets, in 1932, switched over to superhets in 1933.

Midget receivers made a great hit during 1933 and eventually some individual lines were selling as low as

£8/10/-, but the average price was from £14 to £18 for Nationally known brands. The same chassis was generally used in Console cabinets in order to attract the public.

Of special note in the Superheterodyne broadcast receiver was the general introduction of Visual Indicators and A.V.C. (Automatic Volume Control) and Dual Dynamic speakers. The introduction of the midget set brought about a rapid change in the size of receiver set chassis. The small size chassis necessary to fit small cabinets demanded re-design of many well known sets. This craze for everything midget created the midget loudspeaker, and the midget variable condenser.

The year 1933 witnessed the initial introduction of what is known as "All Wave" broadcast receivers, and which are now (1934) becoming very popular. **Auto Radio Sets** designed and built along modern lines, incorporating A.V.C.—remote control units—motor generators or vibrator power units, were successfully introduced in the latter part of the year. While there were a few thousand sold, the 1934-35 summer season should see greater success in the auto radio field.

Cabinet trend was interesting in that there was a swing from the hitherto dull duco finish to a "piano" finish among the more popular class.

Valve Progress

Valves again revealed improvement, but not quite so many types were released on to an already "type saturated" market as in some previous year. The introduction of the indirectly heated pentode 47-59-2A5, provided improved output performance with less hum and more rugged cathodes. The Diode-Duplex types 55 (Triode Amplifier)—2B7 (Screen Grid Amplifier)—2A6 (High Amplification Triode), providing 2 valves in one glass envelope capable of performing in a most efficient manner. The Diode detection system permitted almost perfect rectification of the R.F. Signal, and followed by an amplifier in the same envelope, gave wonderful results. The Electron Coupled 2A7 released late in 1933 permitted great improvement in superheterodyne receivers.

Made in Australia

A meritorious event well worthy of recording, was that in October, 1933, modern valves, with a performance efficiency equal to the best from overseas, were first produced in Australia solely by Amalgamated Wireless Valve Co. Ltd. So far as Valve policy is concerned, it is strikingly evident that the British Valve manufacturers have failed to appreciate the requirements of not only Australia, but of other countries, and this is very evident when the valve importation figures are considered, which show that Australia imported more U.S.A. valves in 1933 than Great Britain exported to the entire world.

Broadcast receivers in general during 1933 displayed two opposing characteristics, namely, "Performance going up—Prices going down." Prices dropped by 25 per cent. as compared to 1932. The standard size all-electric chassis became the 4 valve and rectifier and the small set such as 2 and 3 valve, was eliminated as a big seller.

One other big departure from previous policy was the introduction by almost every manufacturer of more than one release of new models. At least 2 releases, one early and the other about October, were made by even the big companies. This is a further nail in the coffin of a radio season.

Broadcasting

One of the most important events during 1933 in broadcasting circles was the completion and putting into service of special overland carrier circuits from Adelaide to Perth on June 12th, which not only permits speech between telephone subscribers in Eastern and Western States, but by way of a special carrier wave circuit National programmes originating in Eastern States can be relayed to Perth, W.A., and from there broadcast over 6WF.

The other big event was the letting of seven contracts for regional stations in the National Service to be erected in all States except South Australia, which already is equipped with a most modern station, 5CK.

The Commercial or 'B' Broadcasting stations continued to make rapid progress both in public acceptance and advertising support. Several stations have improved their equipment, built new transmitters, replaced amplifying equipment, fitted out new studios, made such programme changes as were found necessary or desirable, and definitely established their claim as being most efficient and a necessary and important part of the broadcasting system in Australia.

In the National Broadcasting Service, many innovations were successfully introduced. The success of the broadcasting structure in Australia can best be appreciated when it is stated that whereas at December 31st, 1932, there were 419,180 listeners' licenses in operation, that number was increased to 518,628 by December 31st, 1933. That takes into consideration that there were over 50,000 cancellations and actually over 160,000 new licences were issued during 1933.

It is believed that the Australian Broadcasting System of National and Commercial stations ('A' class and 'B' class as they are commonly known), is the best system that has yet been devised anywhere in the world. The National System, subscribed to by listeners all over Australia by payment of an annual fee of 24/- is somewhat akin to the British System, while the Commercial stations, whose revenue is derived solely from advertising, is a counterpart of the U.S.A. system. There is no desire to change this Australian composite system, and it is recognised that the Commercial stations, while competing among themselves, do very effectively compete with the National service, and materially play an important part in preventing a monopolistic policy of "Laissez Faire" being adopted by the Australian Broadcasting Commission in its National service.

Conclusion

The future of the radio industry in Australia is extremely promising. There still remain over one million homes to be equipped with broadcast receivers plus a market for replacement of at least 250,000 sets that are now obsolete. The introduction during 1934 of the seven new high powered National stations, the improvement in Commercial stations, the Australian Cricketers' visit to England, the Melbourne Centenary and the Royal Visit will provide a wonderful incentive for the Australian radio industry to reach higher levels, and further establish itself as a most important industry and service to the people of Australia.

BROADCASTING TIME SCHEDULE—ALL STATIONS

Call Sign	Metres	
2CO	535.7	7-8.30 a.m., 9.30-11.30 a.m., 12-2.15 p.m., 3-4.15 p.m., 5.30-11 p.m.
7ZL	517	7.30-8.30 a.m., 11-2 p.m., 3-5 p.m., 5.45-11 p.m.
3AR	492	7-9.30 a.m., 11.30 a.m., 2-5.45 p.m., 6.15-10.30 p.m.
5CK	472	7.30-8.30 a.m., 11-2 p.m., 3-4.30 p.m., 6-11 p.m.
2FC	451	7-8 a.m., 9.30-11.30 a.m., 12-2 p.m., 3-4.15 p.m., 5.30-10.30 p.m.
6WF	435	7.30-8.30 a.m., 11-2 p.m., 3-4.30 p.m., 6-11 p.m.
5CL	411	7.30-8.30 a.m., 11-2 p.m., 3-4.30 p.m., 6-11 p.m.
4QG	395	7.30-8.30 a.m., 11-2 p.m., 3-4.30 p.m., 5-11 p.m.
3LO	375	7-8 a.m., 9.30-11.30 a.m., 12-2 p.m., 3-4.15 p.m., 5.30-11.30 p.m.
2BL	351	7-9.30 a.m., 11.30-5.30 p.m., 6.15-10.30 p.m.; Sundays, 10.55-3 p.m., 4.30-10 p.m.
6PR	341	7-8.30 a.m., 10.30-12 noon, 4-10.30 p.m.
7HO	337	8-9 a.m., 12-2 p.m., 5.45-6.30 p.m.; Sunday, 8-9.30 p.m.
3MA	333	Mon. to Sat., 12.30-1.30 p.m.; Mon., Tues., 6.30-10.30 p.m.; Wed., 6-10.30 p.m.; Thurs., Fri., 6.30-10.30 p.m.; Sat., 6.30-11 p.m.; Sun., 2-3.30 p.m.,6.30-10 p.m.
4RK	330	7.30-8.30 a.m., 11-2 p.m., 3-4.30 p.m., 6-11 p.m.
3UZ	323	Mon.-Thurs., 7-2 p.m., 3-11.30 p.m.; Friday, 7-2.30 p.m., 3-11.30 p.m.; Sat., 7-12.30 p.m., 6 p.m-midnight; Sundays, 10.30-12.30 p.m., 5.45-10 p.m.
2GB	316	7 a.m. to 11.30 p.m.
5DN	312	Mon.-Fri., 7.15-10 a.m., 11 a.m.-11.15 p.m.; Sat., 7.15-1 p.m., 6-11.15 p.m.; Sun., 6.45-10.30 p.m.
3BO	309	Mon.-Fri., 11.30-1.30 p.m., 5.30-10.30 p.m.; Sat., 11.30-10.30 p.m.; Sunday, 7-10 p.m.
4GR	300	Mon.-Fri. 8.30-9.30 a.m., 12 noon-2 p.m., 6-10 p.m.,; Sat., 8.30-9.30 a.m., 6-10 p.m.; Sun., 10-1 p.m., 7-10 p.m.
3HA	297	Mon.-Fri., 7-9 a.m., 11-4.15 p.m., 5.45-10.30 p.m.; Sat., 7-9 a.m., 11-1.15 p.m., 6.30-10.30 p.m.; Sun., 11-4.30 p.m., 6-11 p.m.
2UE	293	6-1.30 p.m., 2.30-11 p.m., Mon.-Fri.; Sat., 6-11 a.m., 12 for racing to 11 p.m.; Sun., 8-12 noon, 1.30-4.30 p.m., 6-11 p.m.
5PI	288	Monday to Saturday, 5-10 p.m.; Sunday, 7-10 p.m.
2CA	286	(Not available.)
3YB	283	6.30-10.30 p.m. week days, and 7-10 p.m. Sunday.
4MB	283	Mon.-Fri., 8.30-10 a.m., noon-2 p.m., 6.30-10 p.m.; Sat., 8.30-10 p.m., noon-2 p.m.; Sunday, special occasions only.
2KY	280	6.45-12 noon, 1-3.30 p.m., 4.30-11.30 p.m.
3SH	277.8	Mon.-Sat., 7-10.30 p.m.; Sundays, 12.15-2.15 p.m., 4.15-6 p.m., 7.15-10 p.m., 11-11.30 p.m.
7LA	273	Mon.-Fri., noon-2 p.m., 5.30-10.30 p.m.; Sat., 2-5 p.m., 6-10.30 p.m.; Sun., 6-10 p.m.
2HD	270	6-8.30 a.m., 9.30-2 p.m., 3-4 p.m., 5.45-10.30; midnight, Sat. and Sun.
2UW	267	7 a.m. to 12 midnight.
6ML	264	Mon.-Fri., 7-8.30 a.m., 11-3 p.m., 5-10.30 p.m.; Sat., 7-8.30 a.m., 11-2 p.m., 3-5 p.m., 6-10.30 p.m.; Sun., 7-10 p.m.
4BC	262	Mon., Tues., Thurs., Fri., 6.30-9 a.m., 10-3.30 p.m. 5.30-11 p.m.; Wed., 6.30-9 a.m., 10 a.m. to 11 p.m.; Sat., 6.30-9 a.m., 1-11 p.m.; Sun., 10-11 a.m., 5.45-10 p.m.
2WG	260	Mon.-Sat., 7.45-8.30 a.m., noon-1 p.m., 7-10.30 p.m.; Sundays, 9-10 a.m.
4TO	256.4	Mon.-Fri., 12.30-1.30 p.m., 5.30-6.30 p.m., 7.30-10.30 p.m.; Sat., 12.30-6.30 p.m., 7.30-10.30 p.m.; Sun., 7.15-10 p.m.
3DB	254	Mon.-Fri., 7-9 a.m., 10.30-1.45 p.m., 2-10.30 p.m.; Sat., 7.30-9.15 a.m., 2 p.m.-Midnight; Sun., 10-12.15 p.m., 2.30-4.30 p.m., 6-10 p.m.
4MK	252	Mon.-Sat., 7-10 pm.; Thurs., add 2.30-5 p.m.; Sun., 2.30-5, 7-10 p.m.
5KA	250	Week-days, 6.30-8.30 a.m., 10 a.m.-2 p.m., 5.30-11 p.m.; Sun., 10-11 a.m., 3-4 p.m., 4.45-5.45 p.m., 6.30-11 p.m.
2CH	248	7-9.30 a.m., 10-1.30 p.m., 3-11 p.m.
6KG	246	Mon.-Fri., 7.30-8.30 a.m., 11 a.m.-2 p.m., 3-4.30 p.m., 6-10.30 p.m.; Sat., 7.30-830 a.m., noon-5 p.m., 6.30-11 p.m.; Sun., 9.30 a.m.-noon, 3-5 p.m., 7-10 p.m.
2GF	246	Every day 1-2 p.m., 5.30-10.30 p.m.
2NC	241	7-11.30 a.m., 12-2 p.m., 3-5 p.m., 5.30-11 p.m.
3WR	238	Mon.-Fri., 11 a.m.-noon, 2.30-3.30 p.m., 7.30-10 p.m.; Sat., 1-6 p.m., 7.30-9.30 p.m.; Sun., 8.30-10 p.m.
2SM	236.1	7-9 a.m., 12 noon-10.30 p.m.
3TR	234	Mon.-Fri., 10.30 a.m.-1.30 p.m., 6-10.30 p.m.; Sat., 10.30 a.m.-1 p.m., 6-10.30 p.m.; Sun., 6.30-10.30 p.m.
4BK	233	7 a.m.-2 p.m., 3.30-11 p.m. daily; Sat., until midnight; Sun., 6.30-10.30 p.m.
3BA	230.8	Mon.-Fri., 7-9 a.m., 7-10.30 p.m.; Sat., 7-9 a.m., 7-11 p.m.; Sun., 12.45-3 p.m., 6.30-10 p.m.
5AD	229	Mon.-Fri., 7-8.45 a.m., 10 a.m.-11 p.m.; Sat., 7-8.30 a.m., 9 a.m.-11 p.m.; Sun., 5.30-10 p.m.
2MO	227	Mon.-Sat., 7.45-9 a.m., 1-1.30 p.m., 6.30-9 p.m.; Sun., 6.30-9 p.m.; Tues. only, to 9.30 p.m.
4RO	225.56	Mon.-Sat., 6-10 p.m.
2XN	224	Week-days, 7-8 a.m., 2-3 p.m., 6-10 p.m.; Sat., 11-12 noon additional; Sun., closed.
3KZ	222	7 a.m.-1.45 p.m., 2.30-4.30 p.m., 5.15-11.30 p.m.; Sat., 7-10.45 a.m., 12.15 p.m.-1 a.m.; Sun., 2.30-4.30 p.m., 6-10 p.m.
3HS	218.9	Mon., Wed., Thurs., 6.30-10.30 p.m.; Tues. and Fri., 6-10.30 p.m.; Sat., 6.30-11 p.m.; Sun., 7-11 p.m.
4BH	217.3	7-9 a.m., 11 a.m.-1 p.m., 5.30-10.30 p.m.; Mon.-Fri., to 11 p.m.; Sat., Sun., 12 noon-3 p.m., 6.30-10.30 p.m.
2GN	216	Mon.-Thurs., 12.15-1.45 p.m., 6.30-10 p.m.; Fri., 12.15-1.45 p.m. only; Sat., 6.30-10 p.m.; Sun., 7.30-9.30 p.m.
3GL	214	Mon.-Tues., 7.45-9.15 a.m.; Wed., 1-2 p.m.; Thurs.-Fri., 5.30-10.30 p.m.; Sat., 7.45-9.15 a.m., 6-11 p.m.; Sun., 7-10 p.m.
2KO	212	10 a.m.-12, 1-2 p.m., 3-4 p.m., 5.30-10.30 p.m.
3AW	210.5	6.30-9.30 a.m., 10.45-11 p.m.; Sat., 6.30-9.30 a.m., 10.45-11.30 p.m.; Sun., 4.30-10.30 p.m., 10.30-12.30 p.m.
2WL	209.06	Mon.-Sat., 6.30-10 p.m.; Sun., 7-9 p.m.
7UV	205.5	Mon.-Fri., 7.30-9 a.m., 5.30-10.30 p.m.; Sat., 7.30-9 a.m., 12-2 p.m., 5.30-11 p.m.; Sun., 12-2 p.m., 5.30-10 p.m.
6IX	204	Mon.-Fri., 8.30-11 a.m., 3-5 p.m., 6-11 p.m.; Sat., 8.30-12 noon, 6-12 midnight; Sun., 9.30-12 noon, 1.30-3 p.m., 4.30-6 p.m., 7-10.30 p.m.
2AY	203	Every day, 5.30-10.30 p.m., except Friday.
3AK	200	5-7 a.m., 1-2 p.m., 11.30 p.m.-3 a.m.

General and State Broadcasting Managers

MR. E. T. McCANN.
Acting Manager for Tasmania

MAJOR W. T. CONDER
General Manager
Australian Broadcasting Commission

MR. H. G. HORNER
Manager for N.S.W.

MR. E. J. LEWIS
Manager for Queensland

MR. T. W. BEARUP
Victorian Manager

MR. C. M. HOSKING
Manager for South Australia

Australian Broadcasting Commission
General and State Managers

Major W. T. Conder, General Manager. Born Tasmania, educated Church of England Grammar School, Launceston, and Tasmanian University. Served with the A.I.F. 1914-15. Was invalided home severely wounded; O.C. Langwarrin (Vic.) Camp, 1915-18. Thereafter Governor of Pentridge (Vic.) Gaol, and later Inspector-General of Prisons. Resigned in 1923 to join executive staff of J. C. Williamson. When this company became interested in broadcasting, Major Conder was appointed General Manager of the Broadcasting Company of Australia Ltd., and subsequently of Dominion Broadcasting Co. Ltd. He resigned from J. C. Williamson's in 1933 and became organiser of the Melbourne Centenary Celebrations, and then accepted the position of General Manager of the Australian Broadcasting Commission in the same year.

Horner, H. G., Manager for N.S.W. Educated at King's College, Canterbury; thereafter for a period of approximately three years travelled extensively, visiting every British Colony and many other parts of the world. He finally settled in Canada for a period of four years, came to Australia in 1914, and has been in this country ever since. A qualified accountant and secretary, and has held the following positions: Secretary William Atkins Ltd., Secretary Palmolive Company, Assistant Secretary Sun Newspapers Ltd., Manager Broadcasters (Sydney) Ltd., Secretary Australian Broadcasting Co. Ltd., Manager N.S.W. Branch Australian Broadcasting Commission.

Bearup, Thomas William, Manager for Victoria Joined Amalgamated Wireless (A/sia) Ltd. in 1916. Appointed to the Marine Staff, and travelled to many parts of the world, serving on various ships. 1921-2, attached to Experimental Staff Amalgamated Wireless (A/sia) Ltd. 1923: Visited England to investigate, inter alia, developments in broadcasting. December, 1923: Joined 2FC at its opening. March, 1924: Research Staff Amalgamated Wireless (A/sia) Ltd. October, 1924-July, 1929: Studio Manager 3LO/3AR, Melbourne. July, 1929-June, 1932: Victorian Manager Australian Broadcasting Co. Ltd. Since July, 1932: Victorian Manager Australian Broadcasting Commission.

Lewis, E. J., Manager for Queensland. Born in South Wales in 1891. Came to Australia for health reasons about twenty-three years ago. Joined the 1st Division of the A.I.F. at the outbreak of War, saw service at Gallipoli and was invalided back to Australia. Was in the State Public Service of Victoria for some time, and later joined the Broadcasting Company of Australia Ltd., at 3LO, in 1924. Became Director of Programmes under that Company and with the Dominions Broadcasting Pty. Ltd. In 1929 joined 3DB, Melbourne, when that station was taken over by the "Herald & Weekly Times" from the Druleigh Business College. Appointed Manager of 7ZL, Hobart, in April, 1930. Later appointed Manager under the Australian Broadcasting Company in December, 1930, and remained in that position until the station was taken over by the Australian Broadcasting Commission in 1932. Was transferred to Brisbane in January, 1934.

Hosking, Charles Martin. Manager for South Australia. Prior to the advent of broadcasting most of the career of Charles Martin Hosking was spent in the legal profession in Victoria. As interesting interludes, he journeyed to the Nor'-west with Explorer Carr-Boyd and later explored the one-time waste and unsurveyed mallee. He knows intimately the great outback in all its varying moods of depression and prosperity—its droughts and its productiveness.

Between times he was General Organising Secretary of the last big Federal Referenda Compaign. He did a course in art, and acted as Honorary Secretary of that most exclusive Society of Artists—The Australian Art Association.

Always actively associated with the theatre, Mr. Hosking wrote several plays, one of which was produced in London by Charles Arnold. He was for some years a musical and dramatic critic and free-lance journalist.

When the glamour of broadcasting swept the world Mr. Hosking became associated with 3LO, Melbourne, and since the year 1927 he has served at various "A" class stations in a managerial capacity.

His uncompromising slogan is "The Programme's the Thing," and his never-ending advice to radio performers is, "What matters is not—how well you can do things, but how well you can please people."

McCann, E. J., Acting-Manager for Tasmania. One of a family of professional musicians, his father being for many years organist at St. Mary's Cathedral, West Melbourne. Mr. E. J. McCann grew up in a musical atmosphere, and played the violin when nine years old. Had lessons from Herr Paans, of Melbourne. Under Mr. C. S. Childe, organist of St. David's Cathedral, Hobart, studied harmony, counterpoint, orchestration and conducting. Entering the theatrical world, he played with many of the J. C. Williamson companies, and conducted at several of the Union Theatre Houses, in the days of larger theatre orchestras. For eight years he was choirmaster and conductor at St. Mary's Cathedral, Hobart, where he produced many of the great Masses. He later became musical director of the Hobart Comic Opera Company, and produced many works, including "Ma Mie Rosette," "The Arcadians," "The Quaker Girl," and many of the Gilbert and Sullivan Operas. In 1925 he was appointed musical director of the Prince of Wales Theatre, Hobart. His experience of broadcasting began with the founding of Tasmanian Broadcasters Ltd., for whom he was Musical Director. When that station passed into the hands of the Australian Broadcasting Company, he was retained in the same capacity, and when in turn the Australian Broadcasting Commission took charge, he was appointed to the position of controller of programmes.

He organised the Wireless Choir, the A.B.C. Orchestra, and was joint organiser with Mr. Robert Atkinson of Music Week in Tasmania for two years in succession. He was appointed to his present position early in 1934

Australian Broadcasting Commission

First Annual Report, Year ending 30th June, 1933

Furnished to THE MINISTER for presentation to both HOUSES of the PARLIAMENT in accordance with the provisions of Section Thirty-two of the Australian Broadcasting Commission Act of 1932.

To The Honourable Archdale Parkhill, M.P.,
His Majesty's Postmaster-General of the Commonwealth of Australia.
Sir:

CONSTITUTION:

On the 1st July, 1932, by virtue of the Australian Broadcasting Commission Act of that year, the Commission assumed control of the provision and rendition of programmes from the "A" Class Broadcasting Stations of the Commonwealth and now has the honour to present to you its First Annual Report, relating to the twelve months ended 30th June, 1933.

HISTORY:

Since its introduction approximately ten years ago, wireless broadcasting has made rapid and continuous progress in this country. From the small beginnings of amateur experimenters it soon passed to the stage when private companies were granted "A" Class and "B" Class licences to broadcast, and when those citizens who owned receiving sets paid fees for the privilege of listening to the programmes provided.

This system has, in the main, continued to the present day. Two important events, however, have influenced its development: first, in 1929, the Commonwealth Government, through the Postmaster-General's Department, purchased the "A" Class Stations in all States—a step which led easily to the introduction of what is known as the "National Network" system of relaying programme-items of more than ordinary interest from one "A" Class Station to all or any of the others. For three years the programmes were provided under contract by the Australian Broadcasting Company Limited and then, at the beginning of the year under review, the control of the programmes was vested in a public body—the Australian Broadcasting Commission—and the foundation laid for their future development in the interests solely of the people of Australia. Those interests have been and will continue to be the guiding consideration in the Commission's policy.

INAUGURATION:

The change from the programme administration of the Company to that of the Commission was effected without difficulty, disorganisation, or interruption of service; for this, full acknowledgment must be made to the Company's courtesy and generosity in making available its wide experience and its excellent personal and material equipment. Of this the Commission was happy to take advantage and secured the studio and office accommodation almost in its entirety; it also took into its employment, with scarcely any alteration, the then existent staff of well-trained men and women, many of whom had had association with broadcasting in Australia practically since its inception.

STAFF:

Little change has since been made in this regular staff, which now total 265 throughout Australia and which has given loyal and competent service to the Commission. Of that number, eleven have been engaged upon the preparation of dramatic productions to be broadcast, 130 upon actual performing and announcing work, 124 upon general administration.

APPOINTMENTS:

Some important appointments, however, had to be made. From a large number of applicants the late Mr. H. P. Williams was selected as General Manager, and the Commission now records its appreciation of the excellent services which he rendered in that position and its deep regret that his sudden death should have brought them to an end.

Mr. W. T. Conder has since been appointed to carry on the duties thus relinquished.

The position of Secretary and Accountant to the Commission was filled by the appointment of Mr. A. L. Holman; and Mr. Arthur Mason was engaged to act as London Representative.

STATIONS:

The Commission has supplied programmes for the twelve "A" Class Stations in Australia, namely:—4RK (Rockhampton), 4QG (Brisbane), 2NC (Newcastle), 2FC (Sydney), 2BL (Sydney), 2CO (Corowa), 3LO (Melbourne), 3AR (Melbourne), 7ZL (Hobart), 5CL (Adelaide), 5CK (Crystal Brook) and 6WF (Perth).

Of these, 5CK is purely a relay station; 4RK, 2NC and 2CO supply, in varying degrees, portion only of their programmes, but the remaining eight stations provide almost entirely their individual services. Accordingly, for the greater part of the broadcasting time the Commission has furnished simultaneously eight separate programmes.

The total broadcasting time of the twelve Stations during the year concluded was 49,133 hours (the equivalent of approximately five and two-thirds years). Each Station was thus broadcasting, on an average, for 4,094½ hours in the year, or nearly 11¼ hours per day.

Therefore, with eight separate programmes being broadcast, there has been the extraordinary total of ninety hours of programme-time to be filled by the Commission every day, requiring no fewer than 54,755 different microphone appearances for the year.

The provision of so many programmes over so wide an area is a task undertaken by scarcely any other single broadcasting authority at present in existence; which fact, combined with Australia's natural isolation from the acknowledged centres of the world's artistic output, has made it by no means easy to ensure that a uniformly high standard was maintained, without

exceeding the comparatively small revenue available. In spite of this, however, the Commission believes that its function is essentially Federal and that it must not neglect the States in which the progress of broadcasting has been retarded and in which the number of licence-holders is still small. Every effort has been made to encourage these States by the improvement of studios, the organisation of orchestras, the formation of educational committees and similar bodies, the sending out of touring units and the regular relaying of programmes from other cities.

AUSTRALIAN CONDITIONS:

The Commission has spent much time in making a special study of Australian conditions. The lessons willingly learned from older wireless organisations in other parts of the world have had to be modified for application in this country. The huge area and the scanty population; the wide divergence in climatic conditions between tropical Cape York and Hobart, the last port of call on the voyage to the South Pole; the populous and progressive cities; the broad and sparsely peopled primary-producing districts; the standards and facilities for entertainment; the keen national interest in sport; our position as part of the British Empire and British race; the many events abroad, which affect and interest us and of which we can know only comparatively little; the small local output of music and literature; the limited number of adequately talented artists and speakers; the necessity of encouraging local men and women and at the same time of setting them standards commensurate with those prevailing overseas; the restricted revenue and the almost prohibitive cost of importing distinguished performers from abroad—all these things have required and received closest attention. The Commission has endeavoured to hold the balance equitably between all interests and all competitive points of policy. It has learned much concerning the public wishes and the public needs; and it has endeavoured at once to appeal to those wishes and to fulfil those needs.

LICENCES:

(A) **Australian Improvement.**—That it has succeeded to some extent at least is indicated, if not proved, by the gratifying increase recorded—in spite of adverse economic conditions—in the number of licences issued during the year. At 30th June, 1932, the number of licences in force was 369,945, which was equivalent to 5.67% of the population of the Commonwealth. At 30th June, 1933, that total had risen to 469,477, or 7.14%. The increase of 99,532 was the greatest increase recorded in any one year in the history of the Commonwealth.

In every State there was a remarkable improvement; there were few cancellations and, even after deducting these, the new figures show an advance of 62 for every hundred licences previously in force in Western Australia, 35 in South Australia and 32 in Tasmania. The lowest percentage increase was 23% in Victoria. The average for the whole Commonwealth was actually 27%.

The following list sets out in detail the licences in force at the 30th June each year since 1925 in each State and in the Commonwealth; the ratio of licence-holders to each 100 of population; the percentage of the previous total represented by the increase or decrease in each case; and the names of the organisations which supplied the "A" Class programmes during each of the periods mentioned (see next page).

From these figures it will be seen that Australia's percentage is sixth among those of the world, second in the Empire and first of the Dominions. Which, in view of the difficulties enumerated, must be regarded as eminently satisfactory. Australia has risen rapidly on the list during the year and is steadily overtaking all rivals in the popularising of broadcasting. Backed by such knowledge, the Commission intends to continue its present policy of steadily improving the standard, tone, variety and human appeal of programmes and of endeavouring to provide a uniformly efficient and attractive service through all its Stations.

ARTISTS:

The Commission was happy to be able to give employment, whether regular or temporary, direct or indirect, to many thousands of Australian musical, dramatic and literary artists and in that way to encourage local writers, playwrights, composers, singers, musicians, actors, producers and speakers. By this means the general burden of unemployment has been materially lightened at a critical stage in our country's history.

In addition to the 130 performers already cited as regular members of the staff, 17,067 musicians and singers, 1,559 actors and 1,343 speakers, making a total of 19,969, appeared on the programmes on temporary engagements. The grand total of performers was thus 20,099, and the sum of £173,452 was paid for their performances—an average of £8/12/7 per performer.

ORCHESTRAS, Etc.:

The Commission early set to work upon the formation and development of permanent musical combinations. By the end of the year it had secured the regular services of the following accomplished musical units:

SYDNEY:

A.B.C. (Sydney) Symphony Orchestra, A.B.C. (Sydney) Concert Orchestra, A.B.C. (Sydney) Military Band, A.B.C. (Sydney) String Quartet, A.B.C. (Sydney) Wireless Chorus, A.B.C. (Sydney) Radio Choir, A.B.C. (Sydney Male (Vocal) Quartet.

MELBOURNE:

A.B.C. (Melbourne) Symphony Orchestra, A.B.C. (Melbourne) Concert Orchestra, A.B.C. (Melbourne) String Quartet, A.B.C. (Melbourne) Wireless Chorus, A.B.C. (Melbourne) Military Band, A.B.C. (Melbourne) Old Time Dance Band, A.B.C. (Melbourne) Symphonic Dance Orchestra.

In addition to the above, employment was given from time to time to 18 orchestras, 15 brass or military bands, 64 choirs, 20 quartets, 9 trios, 20 dance bands and 14 novelty ensembles.

LISTENERS' MAIL:

Throughout the year the public displayed a very real and consistent interest in the Commission's work in every State. Letters were received dealing with various aspects of programme-compilation, administration, equipment, reception, and all other aspects of broadcasting. In all, 189,749 letters were received (at an average of 101 per State per day) and particular care was taken to give answers in every case. Many of the correspondents put forward suggestions of value, a number of which were adopted as suitable opportunity occurred.

A gratifying feature of the mail was the interest displayed by children of every age, and from them no fewer than 57,601 letters were received, averaging 31 per State per day.

PROGRAMMES:

When the Commission assumed control, it effected no radical alteration in the length, composition or presentation of programmes. A strong foundation had been laid during the decade in which broadcasting had been in existence in Australia and the general principles therein set out were followed. Attention was focussed upon the steady improvement of the items being put before the public rather than on the introduction of new features. The Commission has taken the view that the

Licence Analysis by the Commission

NEW SOUTH WALES:

Year Ended 30th June	Licences in Force	Ratio to 100 of Population	Increase (—Decrease) Number	Increase (—Decrease) %	Organisation Supplying Programmes
1925	34,857	1.54	—	—	Broadcasters (Syd.) Ltd.—Farmer & Co. Ltd.
1926	37,082	1.61	2,225	6	Broadcasters (Syd.) Ltd.—Farmer & Co. Ltd.
1927	59,880	2.55	22,798	61	Broadcasters (Syd.) Ltd.—Farmer & Co. Ltd.
1928	80,197	3.34	20,317	34	Broadcasters (Syd.) Ltd.—Farmer & Co. Ltd.—2FC Ltd.*
1929	101,012	4.13	20,815	26	Broadcasters (Syd.) Ltd.—N.S.W. Broadcasting Co. Ltd.†—2FC Ltd.—N.S.W. Broadcasting Co. Ltd.†
1930	111,253	4.49	10,241	10	N.S.W. Broadcasting Co. Ltd.—Australian Broadcasting Co. Ltd.‡
1931	122,748	4.91	11,495	10	Aust. Broadcasting Co. Ltd.
1932	141,745	5.63	18,997	16	Aust. Broadcasting Co. Ltd.
1933	178,387	7	36,642	25	Aust. Broadcasting Com.

NOTES.—*2FC Limited (Station 2FC) from 1/12/27.
†N.S.W. Broadcasting Co. Ltd. (Stations 2FC and 2BL) from 14/8/28.
‡Australian Broadcasting Co. Ltd. (Station 2FC) from 16/7/29; (Station 2BL) from 21/7/29.

VICTORIA.

1925	20,290	1.22	—	—	Associated Radio Co.—Broadcasting Co. of Australia Pty. Ltd.
1926	64,587	3.83	44,297	218	Associated Radio Co.—Broadcasting Co. of Australia Pty. Ltd.
1927	118,965	6.95	54,378	84	Associated Radio Co.—Broadcasting Co. of Australia Pty. Ltd.
1928	137,758	7.91	18,793	16	Associated Radio Co.—Broadcasting Co. of Australia Pty. Ltd.—Dominion Broadcasting Co. Ltd.*
1929	142,750	8.11	4,992	3	Dominion Broadcasting Co. Ltd.
1930	140,072	7.88	–2,678	–2	Dominion Broadcasting Co. Ltd.—Australian Broadcasting Co. Ltd.†
1931	137,265	7.66	–2,807	–2	Aust. Broadcasting Co. Ltd.
1932	139,592	7.75	2,327	2	Aust. Broadcasting Co. Ltd.
1933	171,318	9.46	31,726	23	Aust. Broadcasting Com.

NOTES.—*Dominion Broadcasting Co. Ltd. (Stations 3LO and 3AR) from 1/3/28.
†Australian Broadcasting Co. Ltd. (Station 3LO) from 21/7/29; (Station 3AR) from 7/8/29.

QUEENSLAND.

1925	1,267	.15	—	—	Queensland Radio Service.
1926	8,450	.98	7,183	567	Queensland Radio Service.
1927	23,249	2.63	14,799	175	Queensland Radio Service.
1928	25,287	2.82	2,038	9	Queensland Radio Service.
1929	24,744	2.7	–543	–2	Queensland Radio Service.
1930	23,335	2.51	–1,409	–5	Queensland Radio Service—Aust. Broadcasting Co. Ltd.*
1931	24,216	2.55	881	3	Aust. Broadcasting Co. Ltd.
1932	29,060	3.02	4,844	20	Aust. Broadcasting Co. Ltd.
1933	36,314	3.72	7,254	25	Aust. Broadcasting Com.

NOTE.—*Australian Broadcasting Co. Ltd from 29/1/30.

SOUTH AUSTRALIA.

1925	3,331	.62	—	—	Central Broadcasters Ltd.
1926	12,657	2.27	9,326	279	Central Broadcasters Ltd.
1927	16,791	2.96	4,134	32	Central Broadcasters Ltd.
1928	20,319	3.53	3,528	21	Central Broadcasters Ltd.
1929	24,021	4.15	3,702	18	Central Broadcasters Ltd.
1930	25,729	4.43	1,708	7	Central Broadcasters Ltd.—Aust. Broadcasting Co. Ltd.*
1931	30,333	5.21	4,604	18	Aust. Broadcasting Co. Ltd.
1932	37,235	6.36	6,902	22	Aust. Broadcasting Co. Ltd.
1933	50,261	8.49	13,026	35	Aust. Broadcasting Com.

Note.—*Australian Broadcasting Co. Ltd. from 13/1/30.

WESTERN AUSTRALIA.

Year Ended 30th June	Licences in Force	Ratio to 100 of Population	Increase (—Decrease) Number	Increase (—Decrease) %	Organisation Supplying Programmes
1925	3,562	.97	—	—	Westralian Farmers Ltd.
1926	4,000	1.07	438	12	Westralian Farmers Ltd.
1927	3,903	1.03	–97	–2	Westralian Farmers Ltd.
1928	3,774	.96	–129	–3	Westralian Farmers Ltd.
1929	3,890	.96	116	3	Westralian Farmers Ltd.—Postmaster-General's Department*.
1930	5,755	1.38	1,865	48	Postmaster-General's Dept.—Aust. Broadcasting Co. Ltd.†
1931	9,144	2.17	3,389	59	Aust. Broadcasting Co. Ltd
1932	12,746	3.02	3,602	39	Aust. Broadcasting Co. Ltd.
1933	20,604	4.87	7,858	62	Aust. Broadcasting Com.

NOTES.—*Postmaster-General's Department from 20/12/28.
†Australian Broadcasting Co. Ltd. from 21/7/29.

TASMANIA.

1925	567	.26	—	—	Associated Radio Co.
1926	1,281	.58	714	126	Associated Radio Co.
1927	2,461	1.14	1,180	92	Associated Radio Co.
1928	3,172	1.46	711	29	Associated Radio Co.—Tas. Broadcasters Pty. Ltd.*
1929	4,782	2.21	1,610	50	Tas. Broadcasters Pty. Ltd.
1930	6,048	2.76	1,266	26	Tas. Broadcasters Pty. Ltd.
1931	8,263	3.74	2,215	36	Tas. Broadcasters Pty. Ltd.—Aust. Broadcasting Co. Ltd.†
1932	9,567	4.28	1,304	16	Aust. Broadcasting Co. Ltd
1933	12,593	5.59	3,026	32	Aust. Broadcasting Com.

NOTES.—*Tasmanian Broadcasters Pty. Ltd. from 19/7/27.
†Australian Broadcasting Co. Ltd. from 13/12/30.

COMMONWEALTH OF AUSTRALIA.

Year Ended 30th June	Licences in Force	Ratio to 100 of Population	Increase Number	Increase Percentage
1925	63,874	1.08	—	—
1926	128,060	2.14	64,186	100
1927	225,249	3.68	97,189	76
1928	270,507	4.33	45,258	20
1929	301,199	4.75	30,692	11
1930	312,192	4.88	10,993	3
1931	331,969	5.12	19,777	6
1932	369,945	5.67	37,976	11
1933	469,477	7.14	99,532	27

(B) Comparison With Other Countries.—The percentage improvement of 27% in the number of licences held in Australia compares very favourably with the 21.5% shown in Great Britain. On ratio of licences per one hundred of population, also, Australian figures compare well with the latest available from other parts of the world, set out in the following list:—

COMPARISON OF BROADCAST LISTENERS LICENCES IN AUSTRALIA AND PRINCIPAL FOREIGN COUNTRIES

Country.	Licences.	Licences per 100 of Population.	Date (at end of)
Denmark	514,273	14.7	April, 1933
* United States of Amer.	17,004,781	14.6	Dec., 1932
Great Britain	5,498,850	12.3	March, 1933
Sweden	632,840	10.3	March, 1933
Austria	481,721	7.2	April, 1933
Australia	469,477	7.1	June, 1933
Germany	4,555,426	7	April, 1933
Canada	716,458	6.9	Jan., 1933
New Zealand	95,549	6.3	March, 1933
Switzerland	256,538	6.3	April, 1933
Norway	132,067	4.7	April, 1933
Belgium	382,827	4.7	April, 1933
Hungary	322,163	3.7	April, 1933
South African Union .	53,912	2.9	March, 1933
Japan	1,419,966	1.6	April, 1933
Italy	329,102	.7	March, 1933
Yukoslavia	33,634	.2	April, 1933
Morocco	7,200	.1	April, 1933

(*) In the case of United States of America, the figures in column 2 represent the number of receivers in operation, there being no wireless licence system in that country.

function of its Members—as distinct from that of its Staff—is to supervise rather than to create programmes and to safeguard the interests and the wishes of the public in the manner more of trustees than of entrepreneurs. The staff employed has had long experience of programme-building and it was believed from the beginning, as it is believed now, that, in general, its output has reflected accurately the desires of the listeners, restricted—and in some cases expanded—by the facilities of the radio.

The appended table illustrates the average composition of the programmes presented throughout the year from the 12 National Stations. Brief attention may be drawn to the high percentage carried by musical items of various types: music is so naturally suited to presentation by wireless that it has easily held, in all countries, the leading position among the programme-items. Doubtless it will continue to do so. Since however, the first days of broadcasting, dramatic productions, whether musical or non-musical, have advanced considerably in radio adaptation and accordingly in the amount of programme-time occupied by them, but there is yet much to be learned concerning their best method of presentation over the air, in order that the fullest possible compensation may be made for the absence of the visual qualities which have always formed so large a part of their attraction. The Commission has fully appreciated the value of this work and is making a careful study of all its aspects.

PROGRAMME ANALYSIS.

Items	Percentage of Total Programme Time.	
Musical:		
Classical	17.61%	
Popular	29.47%	
Modern Dance	5.68%	
....		52.76%
Dramatic:		
Operatic	1.93%	
Musical Comedy, Revue, etc.	3.08%	
Plays	2.87%	
....		7.88%
Lectures (Speeches, etc.)		10.35%
Sport		9.04%
Descriptions (Non-Sporting)		.72%
News, etc.		3.87%
Reports (Weather, Market, etc.)		4.21%
Children's Sessions, etc.		4. 6%
Church Services, etc.		3.29%
Community Singing		.87%
Announcements		2.41%
		100%

The above table represents the Commission's compromise between its ideals and its resources, the material available, the many diverse wishes of listeners of all types and classes and the present scope of practical broadcasting.

DISTINGUISHED SPEAKERS:

During the year the voices of some of the leading men of the World speaking from overseas were heard in Australia through the National Stations. Among them were His Majesty King George V., His Royal Highness the Prince of Wales, His Royal Highness the Duke of Connaught, His Holiness Pope Pius XI., His Excellency the Governor-General of Canada (The Earl of Bessborough, P.C., G.C.M.G.), His Excellency the Governor-General of New Zealand (The Right Honourable Lord Bledisloe, P.C., G.C.M.G.), the Admiral of the Fleet (Earl Jellicoe, G.C.B., O.M., G.C.V.O.), The Prime Minister of England (Right Honourable J. Ramsay MacDonald), The Chancellor of the German Reich (Herr Adolph Hitler), the Australian Resident Minister in London (Right Honourable S. M. Bruce, C.H., P.C., M.C., M.P.), the Right Honourable W. M. Hughes, P.C., K.C., M.P., and the authors Mr. J. B. Priestley and Mr. G. K. Chesterton

In addition, the distinguished men who appeared before the Commission's microphones in Australia included Their Excellencies the Governor-General of Australia (Sir Isaac Isaacs, P.C., G.C.M.G.), the Governor of New South Wales (Sir Philip Game, G.B.E., K.C.B., D.S.O.), the Governor of Queensland (Lieutenant-Colonel the Right Honourable Sir Leslie Orme Wilson, P.C., G.C.I.E., C.M.G., D.S.O), the Governor of South Australia (Sir Alexander Hore Ruthven, K.C.M.G., V.C.), the Lieutenant-Governor of Victoria (Sir William Irvine, K.C.M.G.), the Lieutenant-Governor of South Australia (Sir George Murray, K.C.M.G., K.C.), the Lieutenant-Governor of Western Australia (Sir John Northmore, K.C.M.G.), the Lieutenant-Governor of Tasmania (Sir Herbert Nichols, K.C.M.G.), and the Lieutenant-Governor of New Guinea (Sir Hubert Murray, K.C.M.G.), His Majesty's Commonwealth Ministers the Prime Minister (Right Honourable J. A. Lyons, M.P., P.C.), the Attorney-General (Right Honourable J. G. Latham, C.M.G., M.P., P.C., K.C.), the Postmaster-General (the Honourable Archdale Parkhill, M.P.), the Minister for Trade and Customs (the Honourable Sir Henry Gullett, K.C., M.P.), the Assistant-Treasurer (Senator the Honourable Sir Walter Massey Greene, K.C.M.G.), and the Vice-President of the Executive Council (Senator the Honourable A. J. McLachlan).

(Then followed in the report the names of many other well known public men and personalities.—Ed.).

The Commission was also able to secure many famous artists to appear in its programmes.

OUTSTANDING BROADCASTS:

The report also included a list of the principal broadcasts which took place during the year under review.

AUSTRALIAN COMPOSERS' COMPETITION:

The extent of the encouragement given to performers of various kinds has already been indicated, and to this may be added the weekly symphony concerts and the season of grand opera provided for music-loving listeners. The Commission has, however, also felt it to be within its province to stimulate and to foster creative musical art in Australia. In doing so, it has hoped to lay the foundation of an essentially national musical literature, which will reflect worthily the spirit and the aspirations of our people. The principal step taken by the Commission toward this goal was the holding, in the latter half of the year, of a comprehensive competition for Australian composers of all types of music. Substantial prizes were offered and in the various sections more than eight hundred original works were submitted by representatives of all parts of the Commonwealth. The adjudicators, men of high standing in the musical profession, expressed the confident opinion that the general standard of the work submitted was most meritorious, and that one at least of the compositions was worthy of being sent to London for publication and performance overseas. The Commission is well satisfied with the success of the experiment, and intends to organise similar competitions in the future. In addition, it proposes to arrange a competition for one-act plays, in order to give encouragement to original dramatic writing.

EDUCATIONAL BROADCASTING:

The Commission has realised that it has a certain responsibility in the matter of public education, since it controls a facility for spreading information upon every subject to thousands of citizens. Consideration has accordingly been given to the manner in which this duty may best be discharged. One of the conclusions arrived at is that the most satisfactory method of education is the enlargement of interest rather than the mere presentation of information, and at no stage has the Commission lost sight of this important point. However, it was felt, too, that direct assistance could be rendered to those who were engaged upon the great work of education in its more limited and more popular sense. Accordingly, conferences with all leading educational authorities were held and, as a result of them, a number of honorary committees, comprising men and women of high academic standing, were appointed, one for each State. With the advice and assistance of these committees, a system of "school" broadcasts was evolved and put into operation. Competent speakers selected by those committees were entrusted with the delivering of informative lectures upon subjects actually being studied in the schools. It may at once be made plain that the guiding rule upon which both the Committees and the Commission are working is that these lectures must endeavour to supplement, so far as is possible, but never to supplant, the work of the teacher in the school. Even at this early stage it is clear that the idea has been favourably received by a large number of educational bodies and that the purchasing of receiving sets and licences by schools themselves, for the purpose of taking full advantage of the added means of education, is definitely spreading. Whether or not the plan is persevered with, will, however, depend entirely upon the measure of support received from schools; and this the future alone can decide.

WOMEN'S INTERESTS:

It has been recognised that a high percentage of all listeners, particularly listeners to day-time programmes, are women. Their special interests, in consequence, have not been neglected, and subjcts such as house-keeping in all its many forms, preparation for, care of and upbringing of children, knitting, sewing and fancy work, interior decoration and other matters of essentially feminine appeal have been freely discussed by speakers. An examination of the programmes reveals the fact that 5.58 per centum of the total broadcasting time has been devoted exclusively to women's particular interests; but, although this figure may seem unduly small, it must be remembered that their general interests are served by the remainder of the programmes; in fact, it has been the continual aim to eliminate to the fullest possible extent the broadcasting of any single item which is not likely to be acceptable to almost any listener.

CHILDREN'S HOUR:

Another subject to which much thought has been directed is the entertainment and education of children by means of broadcast programmes. Children's Hours have found their places regularly in the programmes of Stations in each capital city to the extent of 4.6 per cent. of the total broadcasting time and, in addition, the issuing of cards and puzzles to interest and amuse children has been widely encouraged. Their response has been most gratifying and, apart from the great number of letters received from children themselves, the frequent reports of parents have indicated that they are among the keenest and most appreciative of wireless audiences.

It cannot be assumed that the form of Children's Hours has yet been satisfactorily settled. Experimental work in this branch is being carried on all over the world and not least in Australia. This work will continue until the Commission is satisfied that the results being obtained cannot be bettered.

COUNTRY INTERESTS:

Full attention has been paid also to Australia's extensive country interests and widely scattered rural population. A comprehensive service of reports likely to be useful to the primary producer has been maintained: daily lists of market prices, weather conditions, river levels, etc., have been furnished. News services and similar forms of information have been particularly designed to assist the family which is, to some extent, cut off from other sources of such knowledge. Descriptions of events of special rural interest, such as agricultural shows; lectures capable of useful application by those on the land; educational sessions for children—all have been potent factors in lessening the normal isolation of the country-dweller. Beyond which, the very restriction of other modes of entertainment has rendered the remainder of the wireless programme of redoubled interest and value to those who live far from our great cities.

RELAYS:

It was indicated earlier in this Report that the acquisition of Stations in all States by one authority made possible the interchange of programme-items by what is now gaining ground and favour as the "Relay System." The Commission has been alive both to the advantages and the disadvantages of this system. Whenever items of outstanding interest have been broadcast in any one State they have been relayed by land-line to the remaining Stations or to such as desired to receive them. At the same time, care has been taken to avoid the discouragement of effort in the smaller States by the continual carrying to them of programmes from Sydney and Melbourne; hence, whenever a suitable occasion has arisen, reciprocity has been encouraged. Perhaps the greatest advantage of the system has been the standard of comparison afforded in this way between local programmes and those of other Stations—a comparison valuable to both Station officials and local performers. There is no doubt in the Commission's mind that these occasional relays have been desired and appreciated by listeners, adding, as they have done, to the novelty and to the scope of the service.

Perth.—Until almost the end of the period under review, facilities for the transmission of programmes from the Eastern States to Perth were limited by the absence of a land-line capable of carrying music satisfactorily. This, among other facts, retarded the development of Station 6WF, since it was only possible to relay thither an equivalent of 2.55% of its programmes. Such a line, however, was eventually installed, and has since been operating extremely well and has permitted the introduction of all the advantages of the relay system—to the immense satisfaction of listeners in the West.

Hobart.—Unfortunately, there is no telephonic communication between the mainland and Tasmania, so that Station 7ZL has been unable, up to the present, really to come within the National Network. This difficulty has been met, at least to a considerable extent, by the fairly successful "picking up" of programmes broadcast from the other Stations. This has made possible the re-broadcasting from Hobart of a large number of items, originally broadcast from other States, which were of particular interest to listeners in Tasmania. Although not perfect, the service has shown such good results that re-broadcast items actually occupied 10.03% of Station 7ZL's total programme-time.

Overseas Broadcasts.—The report included a list of items re-broadcast from short-wave transmissions from overseas. These items had novelty and, in one or two cases, real programme-value. None the less, it must be admitted that short-wave transmission has been as yet merely in an experimental stage. Obscured by "surge," interrupted by fading and received for the most part at inconvenient hours, these broadcasts have demanded of listeners sacrifices which they are prepared to make only in exceptional cases. The Commission has, however, appreciated the usefulness of these experiments and has been anxious to assist them by full co-operation with the British Broadcasting Corporation and other bodies. At an early stage, too, endeavours will be made to institute a reciprocal service, although at the same time the present imperfections must be realised and admitted.

CO-OPERATION WITH THE B.B.C. AND OTHER ORGANISATIONS:

Every effort has been made to co-operate with the leading broadcasting authorities of other countries. In particular, the B.B.C. has been approached both directly and through the Commission's London Representative. In addition, Dr. Wallace took advantage of a recent trip to England to meet representatives of the Corporation, to discuss with them problems of mutual interest and to see their work from every angle. Arrangements have been made for the interchange of experimental data upon subjects such as studio accommodation and arrangement, programme-composition and engagement of artists; for the securing of plays, musical productions and speeches owned by the Corporation; and for the reciprocal forwarding of publications.

Similar approaches have been made, also, to the leading Canadian and American organisations, both of which Dr. Wallace was able to visit. The Commission hopes, in this way, to keep pace with radio developments in all parts of the world and, by the careful investigation of new ideas in relation to Australian conditions, to overcome one disadvantage of Australia's geographical position.

B.B.C. RECORDED PROGRAMMES:

One important instance of the value of such co-operation was afforded in the latter stages of the year under review, when the Official Representative of the B.B.C. (Mr. Malcolm Frost) visited this country and brought with him samples of the Corporation's programmes recorded for the purpose of being re-broadcast in the various parts of the Empire. The Commission has made arrangements to secure for the National Stations in each State copies of ten such programmes (amounting to seven and a half hours of programme-time). As further recordings become available they will also be procured and re-broadcast from the various Stations. In taking this step, the Commission believed that the majority of listeners would appreciate the opportunity of hearing the outstanding items presented by the B.B.C., and would also profit by the opportunity of comparing the work of the Commission and of their own performers with what was being produced abroad. At no time, however, will the local programmes be overloaded with these records, nor will the engagement of Australian artists be restricted.

TECHNICAL SERVICE:

The technical services necessary in connection with the presentation of programmes to the listener were undertaken by the Postmaster-General's Department in accordance with the provisions of the Act. Time and experience will alone show whether this arrangement is the most efficient possible, but meanwhile the Commission desires to express its deep appreciation of the efficient manner in which this work was carried out and of the courteous advice, assistance and co-operation uniformly extended to it by the departmental officers with whom it came in contact. Particular attention may well be drawn to the magnificent work performed in the laying of a special land-line adapted to the transmission of any type of programme-item between Adelaide and Perth. The line now extends continuously from Perth to Rockhampton and makes possible the satisfactory relaying of programmes from any one mainland Station to any, or all, of the others.

Attention may be drawn, too, to the following details concerning the technical services afforded during the year by the Department, since they have been inseparably connected with the work of the Commission:—

Technical Staff.—The total number of members of the Department's Technical Staff, who, during the twelve months ending the 30th June, 1933, were employed in Studios and Stations solely in connection with Broadcasting matters, was eighty. This number does not include any of the staff employed on the clearing up of interference with broadcasting reception or on any kindred activities, nor does it include the staffs employed on the trunk lines used for the transmission of the programmes.

Phonograph Reproduction.—Considerable attention has been paid to the question of improving technique for the reproduction of phonograph records. An investigation has been made to ascertain the most suitable electro-magnetic pickup for Studio use and, in addition, much thought has been given to the choice of suitable phonograph turntables. As a result of these investigations, it will in future be possible to secure improved results from the various recordings.

Microphones.—Until recently various types of carbon and condenser (electro-static) microphones have been used almost exclusively in the studios of the National Network. During the last two or three years there has been an intense development overseas in the design and construction of microphones for broadcasting. These developments have been followed very closely, with the result that improved types of microphones have been made available. In particular, the moving-coil type has advantages which make it suitable for general use; amongst these advantages are its robustness, its very good frequency response and the fact that its input-impedance is of a low order —quite an important point when comparing this type with the condenser type, which up till now has been used very extensively where high quality reproduction has been desirable.

Another interesting microphone that has recently been made available is the velocity microphone. Its particular advantage is that its response can be made directional, a feature which has been found to be very useful in certain types of studio productions.

A further class of microphone introduced is the "lapel" type. This is a microphone with a comparatively high output, and is used by speakers who do not desire to be restricted to standing in front of a fixed type of instrument.

Recording Equipment.—Investigations into the matter of recording equipment for use in studios have been pursued. Consideration has been given to various methods, including sound on film, impression on wax cylinders and electromagnetic recording on steel wire or tape, similar to that used by the British Broadcasting Corporation with the Blattnerphone. The last-mentioned system has the big advantage of permitting immediate play-back of the recorded matter, although it is doubt-

ful whether the quality of the reproduction is comparable with that obtained from other systems. A steel-wire recording machine has been installed for trial purposes in one of the Melbourne studios.

Ultra High Frequencies.—Considerable attention is being paid throughout the world to the use of ultra high frequencies for broadcasting and other radio purposes, particularly Television. Experimental transmitters and receivers operating on radio frequencies between 50 and 100 megacycles have been constructed and observations made on various propagation phenomena at these frequencies.

Empire Broadcasting.—The development of the Empire Broadcasting scheme has been followed very closely, and the results of reception in Australia carefully recorded and forwarded to the British Broadcasting Corporation. The reception of the programme has been effected through an experimental radio reception centre at Mont Park, in Victoria, where a specially designed high frequency receiver and a directional receiving aerial bearing on Daventry have been installed. The British Broadcasting Corporation programmes picked up at this site have been relayed on several occasions through the National Network, as is shown elsewhere in this Report.

Programme Transmission Lines.—During the past twelve months, the mainland programme-transmission line-network has been extended to enable all stations from Rockhampton to Perth to be linked up for the simultaneous broadcasting of programmes generated at any one point. Efforts are being made to increase the transmission band-width on these lines from the present upper limit of 5,000 cycles per second to 8,000 cycles per second. Although this may not be perceptible to the average listener, it will unquestionably be of very great interest to the more critical and will react favourably upon the transmission of the National programmes.

NATIONAL BROADCASTING NETWORK:

From the tables set out below one may form some idea of the size and range of the present organisation of Broadcasting Stations which is known as the National Network, for it will be seen that the twelve stations, eleven of which are connected to one another by a total of 4,300 miles of land-line, are situated at intervals around the Australian coast-line through the six States of the Commonwealth and hold in their aerials a combined unmodulated carrier power of 41.5 kilowatts.

Station.	Unmodulated Carrier Power in the Aerial.	Operating Frequency.	(Wave Length).
	kw.	kc.	
2CO, Corowa	7.5	560	(approx. 535 metres)
7ZL, Hobart	1	580	„ 516 „
3AR, Melbourne	4.5	610	„ 491 „
5CK, Crystal Brook	7.5	635	„ 472 „
2FC, Sydney	2.5	665	„ 450 „
6WF, Perth	3.5	690	„ 435 „
5CL, Adelaide	2	730	„ 411 „
4QG, Brisbane	2.5	760	„ 395 „
3LO, Melbourne	3.5	800	„ 375 „
2BL, Sydney	3	855	„ 351 „
4RK, Rockhampton	2	910	„ 329 „
2NC, Newcastle	2	1,245	„ 241 „

Programme Transmission Lines.—The lengths of land-line between Rockhampton and Perth, capable of use for programme-transmission purposes, are as follow:—

Rockhampton to Brisbane	400 miles
Brisbane to Sydney	656 „
Sydney to Newcastle	150 „
Sydney to Melbourne	590 „
Melbourne to Corowa	250 „
Melbourne to Adelaide	477 „
Adelaide to Crystal Brook	150 „
Adelaide to Perth	1,627 „
Total	4,300 miles

New Stations.—Extensive as the work already is, consideration has been given to its enlargement, in order that reception throughout the continent may be made more uniform. As a first step, tenders have been called for the building of new stations in or near the following centres, with the power-rating indicated in each case:—

Station.	Power Rating (unmodulated carrier power in the aerial).	
	Initial kw.	Ultimate kw.
Townsville, Queensland	5	20
Grafton, N.S.W.	5	20
Sale, Victoria	2	10
Launceston, Tasmania	2	10

RADIO TRADE:

At this stage, also, it may be well to refer briefly to the progress of the radio trade during the year under review, since this must influence, and be influenced by, the work of the Commission; and at the same time it is desired to make acknowledgment to the helpful interest and ready co-operation of those engaged in the making and selling of wireless receiving sets and fittings.

Types of Receiving Set.—The most notable factor of progress in the radio trade for the year ended June 30th, 1933, was the complete change in the production of broadcast-receivers from the long-standing "tuned radio frequency" principle to that of the more modern "superheterodyne." Whereas in the latter part of 1932 only a very few established manufacturers had successfully produced these somewhat complicated receivers on any kind of reasonably massed-production basis, the early part of 1933 witnessed a complete turning by manufacturers to the superheterodyne in every size. It had previously been the general practice to produce superheterodynes in nothing less than a 6/7 valve all-electric set or in a 6-valve battery set. At the close, however, of the period covered by this Report, the 4/5 valve superheterodyne set, in a mantel-type cabinet, was sold in large numbers in all places at a price ranging from £14 to £20. This adoption of the superheterodyne has considerably improved the programme-service offered to the listener, as it permits a wider choice of programmes, even though the receiver is installed in the same area as a transmitting station.

Tonal Quality.—The question of tonal quality has not been neglected by receiver manufacturers and the majority of sets now sold possesses a quality of tonal reproduction which is pleasing to the purchasers, for the introduction of dual-dynamic loud-speakers, combined with a scientific consideration of acoustics in relation to cabinets, has greatly improved the reception of broadcast programmes.

Valves.—During the period under review more than 20 types of valve have been released on the Australian market. While the material advance in electronic valves has compelled set manufacturers to change their models—probably too often from an economic aspect—nevertheless the improvement in performance, with the consequent satisfaction of listeners, has out-weighed that disadvantage.

Price Levels.—Price levels for the smaller and popular models have been considerably reduced during 1933. Many sets, which previously were sold for between £20 and £30, have fallen to between £15 and £25, the majority costing from £19 to £20 per set. Country residents have had the benefit of improved technique in the superheterodyne type battery-receiver. The consumption of battery power has been reduced, while the Australian-made batteries have materially improved in quality and have thus attained to longer life.

Exhibitions.—Early in 1933, a Radio and Electrical Exhibition was held at the Sydney Town Hall and the record number of 59,483 people attended it (as compared to 27,065 in 1932) A similar Exhibition which took place in Melbourne was attended by over 35,000, in Adelaide an attendance of 30,000 was recorded and in Perth, where two exhibitions were held, 5,694 persons were present. The Commission assisted the organisers of each of these Exhibitions, feeling that such displays were of public value and in the general interest of broadcasting, and, in addition to the making of announcements, included in its programmes relevant speeches and descriptions of the proceedings.

EFFECT OF BROADCASTING ON CERTAIN ACTIVITIES

The Commission has given careful consideration to the effect of its activities upon certain private enterprises. Its attitude has been first and foremost, the proper fulfilment of the functions enthrusted to it, but at the same time every effort has been made to avoid entering into unnecessary competition with private persons or organisations. In particular may be mentioned:—

(a) **Publications.**—The Commission has from time to time issued gratis, to listeners who expressed a desire to receive them, publications directly relating to its broadcasting activities. These publications fall naturally into three divisions, namely:—

(i) those calculated to render programme-items more intelligible and so more interesting to listeners;

(ii) those intended to preserve in a more permanent form things which have already been broadcast and which have appeared to be worthy of preservation;

and (iii) those relating to particular broadcasts and likely to secure publicity and goodwill.

The Commission feels that such publications, which are essentially within the proper scope of its activities, are not in any way calculated to affect the business of private publishers and it intends, in the future, to develop more fully this method of rendering service to listeners.

(b) **Sporting Descriptions.**—The Commission has made arrangements with bodies controlling all sports in which listeners have seemed likely to be interested, for the broadcasting of descriptions of the events organised by them. On occasion, some opposition has been encountered from those bodies and the suggestion has been made, not infrequently, that the describing of the events may detract from attendances. Experience, however, has repeatedly shown that the broadcasting of descriptions is a most efficient method of stimulating public interest and has almost invariably greatly increased the average number of spectators present on similar occasions thereafter.

All principal sporting contests throughout the year were described by experts for the benefit of listeners and, where necessary, were relayed to other States. Commentaries were given before and after events of importance and results were broadcast as they came to hand. Horse racing, cricket, football of all kinds, tennis, athletics, boxing, wrestling, rowing, cycling, hockey, lacrosse, golf, baseball, basketball, polo and many other types of sport have been included in the programmes and the public has been quick to express its appreciation of this feature.

TOURING UNITS:

In order to add variety to the programmes broadcast from each centre, to provide a more uniform level of performance throughout Australia, to offer to local artists representative standards with which to compare their own work, and to direct more particular attention to the Commission's activities, the idea of sending special Touring Units from State to State has been put into operation. This method has a distinct advantage—particularly in the all-important question of human appeal—over the Relay system. Care has been taken in the selection of such Touring Units and their destinations have been determined by the particular requirements of the various stations. Without in any way jeopardising the chances of employment of local artists, the Commission intends to develop this Unit System in the future and has already received sufficient indication of approval from listeners to justify its so doing.

S.O.S. MESSAGES:

The Commission was happy to place its extensive facilities at the disposal of the public and to broadcast from time to time as the occasion arose S.O.S. messages of varying types. No fewer than 1,745 such messages were delivered to listeners during the year. Of these, 1,343 were broadcast on behalf of the police, 85 related to bush fires, 70 were requests for volunteers for blood transfusions in urgent cases and the remaining 247 messages were of miscellaneous kinds requiring speedy communication. Of them, 1,172 (or 67.16%) are understood to have been successful in their object, 216 are known to have failed and the results of the other 357 have not been ascertained. Details are as follow:—

Type.	Successful.	Unsuccessful	Unknown	Totals
Police	988	186	169	1,343
Bush Fires	85	—	—	85
Blood Transfusions	55	7	8	70
Miscellaneous	44	23	180	247
Totals	1,172	216	357	1,745

CHARITIES:

Although not strictly within the province of the Commission, the cause of Charity has not been forgotten. Wherever possible, the ordinary broadcasting functions have been used to assist hospitals, homes, relief committees, kindergartens and similar charitable institutions which depend for their existence upon the generosity of the public. By means of concerts, community singing sessions, birthday greetings, dances and announcements, the sum of £8,015/14/1 in cash has been raised and paid to the appropriate authorities, while innumerable parcels of blankets, clothing, jam and other commodities have been gathered together and passed on to those in need of them. Many other appeals, too, have been made in which neither goods nor money was actually handled, but in which the use of the radio to reach possible subscribers was of considerable benefit.

The efforts of the Adelaide Branch in raising £4,213/1/3 during the year deserve special notice. The Sydney office assisted to the extent of £2,055/5/10, while Melbourne collected £1,496/3/2.

The Commission intends to continue this useful work in the future.

ACCOMMODATION:

When the Commission assumed control of the provision of programmes from "A" Class Stations, it did not attempt to purchase either studio or office accommodation, except in Adelaide, where it acquired the then existing 5CL premises from the Postmaster-General's Department.

In all other cases short-term leases of the premises previously occupied by the Australian Broadcasting Company Limited were obtained. The majority will expire during the coming year. The rent of the premises, exclusive of furniture, paid to the 30th June, 1933, amounted to £5,993/10/8. £303/4/2 was paid in rates. For the most part the premises have proved satisfactory for the Commission's purposes, but in both Perth and Hobart they were found to be inadequate. For this reason, land has now been acquired in each of the two cities named, and in them the Commission expects shortly to enter upon the construction of new studios and offices. It is felt that the more suitable accommodation planned will improve the service given to listeners by each Station and that the additional outlay required will be well justified by results.

In the case of Newcastle, also, it was decided that the premises at first occupied would render impossible the development of local programmes. Fortunately, larger and more adaptable quarters were recently obtained on lease and the work of building and equipping a pleasing and efficient studio and control room has now been completed.

The Commission must be prepared to undertake certain constructional work in the various States from time to time, because the growth of broadcasting will probably render the present premises inadequate and because additional Stations are expected to be built as occasion offers. For this reason it has been necessary that some provision, by way of building fund, should be made to meet such emergencies.

PERFORMING RIGHTS:

The question of Copyright and Performing Right has been a difficult and troublesome one. It is virtually impossible for any broadcasting authority in Australia to conduct its business without being called upon to pay a considerable sum for the right to broadcast a large proportion of the items which appear on its programmes. By far the greater part of usable music of any type is subject to this restriction. The same may be said of the majority of plays, musical comedies and other dramatic performances of even reasonable merit. The position is complicated, too, by the uncertainty which exists in respect of the ownership of the rights of very many such items, with the result that it has not been infrequent for identical claims to be made from several sources.

Australasian Performing Right Association Ltd.—The Commission has not as yet concluded a satisfactory agreement with the Australasian Performing Right Association Limited, a body which controls the broadcasting rights in Australia of the majority of works used by the Commission. The Royal Commission appointed by the Commonwealth Government to enquire into matters relating to Performing Rights stated, inter alia, on page 44 of its Official Report:—

> " . . . The Commission has assumed that . . . it "may be unfair to express any definite opinion as to the "reasonableness or otherwise of the charges claimed and "the conditions sought to be imposed by the Australasian "Performing Right Association and the Associated Record "Manufacturers. All that the Commission is inclined to "report is that, on the evidence now before it, the follow-"ing opinions may be expressed:—
>
> "(1) The claims for payment of performing right fees " made on the Australian Broadcasting Commission are " excessive and the offer made by the Commission, if " increased to 6% of its revenue, would be reasonably " fair."

The matter is still subject to negotiation, but the Commission is anxious to conclude an agreement with this organisation which will be fair both to the Composers and Publishers concerned and also to the listening public of Australia.

Miscellaneous Copyright.—Apart from the Association's claims, the Commission has paid a considerable sum in miscellaneous copyright charges.

FINANCE:

The revenue received by the Commission for the year ended 30th June, 1933, was £250,618/10/-. To this sum New South Wales and Victoria each contributed over 90,000, or approximately 36%. Western Australia and Tasmania, on the other hand, each contributed less than £10,000 (or 4%)—a consideration which the Commission, while fully seized of the federal nature of its functions, could not overlook in allocating grants to the various States for the provision of their programmes.

Principal expenditure has been that required for artists' fees, programme expenses and staff salaries, under which heading the sum of £159,243/5/11 has been paid; communication both within the Service and also with outside points was another substantial item and the sum of £12,211/5/8 was paid to the Postmaster-General's Department on this account; rent of offices and furniture absorbed an additional £6,770/4/6.

The year ended with a surplus of assets over liabilities to the amount of £19,328/12/6. In that sum, however, is included the value of property which has been acquired and, further, the Commission has had to make provision out of it for the securing and equipment of other studios from time to time in the future. After serious consideration, a building reserve fund has been created for that and similar purposes.

After the allocation of sums for specific objects, such as that of building, all surplus revenue has been and will be directed to the improvement of programmes. Temporary provision may be made as occasion demands for obtaining programme-items of particularly heavy cost—provided that that cost appears justifiable—but in the main all increase of revenue will be reflected immediately in the programmes themselves.

FUTURE POLICY:

Briefly stated, the Commission's policy for the future is the improvement, in every sense of that word, of its service to the listener. No radical changes are contemplated, since the encouraging increase in licences for the year, sets the seal of public approbation on the work that is being done. While full attention will be given to the important national duty of improving standards of culture and education in Australia, the inseparable element of entertainment will at no stage be overlooked. The audience is not compellable; the turning of a dial or the throwing of a switch by the listener can put an immediate end to any item which is being broadcast, however edifying it may be. If good work is to be done it must be done by pleasing listeners. Enlightenment must come through entertainment. The Commission therefore aims to develop side by side its two ideals of pleasing and benefiting, and this it hopes to do by continually striving to render its service pleasing and its pleasing serviceable; it will seek to appeal not to each section of the community in turn, but to all sections at all times; by presenting the best items of each type in their most attractive form, it will endeavour to enlarge the interest and the appreciation of its listeners; and at the same time it will ever improve in quality that which it places before them.

(Signed by all Commissioners.)

Australian Broadcasting Commission

BALANCE SHEET, 1932-1933

And Profit and Loss Account

LIABILITIES

	£	s.	d.
Loan from Commonwealth Treasury	8,100	0	0
Sundry Creditors	30,726	13	7
Reserve for Buildings	17,500	0	0
Accumulated Funds:			
Balance from Profit and Loss Account	1,828	12	6
	£58,155	6	1

W. T. CONDER, General Manager.
A. L. HOLMAN, Secretary.

ASSETS

	£	s.	d.			
Land and Buildings	10,293	0	0			
Less Depreciation	46	12	5			
				£10,246	7	7
Office furniture, musical instruments and equipment	9,576	19	1			
Less Depreciation	1,328	2	9			
				£8,248	16	4
Stores and stationery				943	16	0
Sundry Debtors:						
Postmaster-General for Licence fees	20,428	10	0			
Other	133	1	5			
				£20,561	11	5
Payments in Advance				982	9	0
Preliminary expenses				2,709	8	10
Cash at Bank and on hand				14,462	16	11
				£58,155	6	1

Chas. Lloyd Jones, Chairman of Commission examined and found to be in accordance with the books and documents presented.

C. J. CERUTTY, Auditor-General for Commonwealth.
14th November, 1933.

Profit and Loss Account

To:	£	s.	d.
Artists' fees and programme expenses	126,691	19	9
Copyright fees	37,489	15	5
Broadcasting rights	2,438	15	9
Rental of Telephone Lines for Broadcasting and Outside Pick-up Costs	6,501	8	2
Commissioners' fees	1,800	0	0
Staff salaries	25,719	10	4
Rent of offices and furniture	6,770	4	6
Publicity	4,343	17	5
Depreciation	1,374	15	2
Preliminary expenses written off	1,356	15	8
Other expenses	16,802	15	4
Balance carried down	19,328	12	6
	£250,618	10	0

To:	£	s.	d.
Reserve for Buildings	17,500	0	0
Balance to Accumulated Funds	1,828	12	6
	£19,328	12	6
By Revenue from Licence Fees	250,618	10	0
	£250,618	10	0
By Balance brought down	19,328	12	6
	£19,328	12	6

EXPENDITURE ANALYSIS

Expenditure Analysis

Artists fees and programme expenses	6/0¾d.	5.55
Copyright fees	1/9½d.	14.95
Broadcasting rights	-/1¼d.	0.9
Rental of lines and pick-up costs	-/3¾d.	2.5
Commissioners' fees	-/1d.	0.71
Staff salaries	1/2¾d.	10.2
Rental of lines and pick-up costs	-/3¾d.	2.5
Publicity	-/2¾d.	1.7
Depreciation	-/0¾d.	0.54
Preliminary expenses written off	-/0¾d.	0.54
Other expenses	-/9¾d.	6.7
Balance carried down	-/11d.	7.7

(The above calculated expenditure per licence was on the basis of 417,700 licences).

Programmes, expenses, copyright, rights required 66.4 per cent. of revenue, other overhead expenses, 25.59 per cent. and profit 7.7 per cent. It is interesting to note that copyright cost 14.95 per cent. of total revenue.

Annual Report of the Auditor-General upon the Treasurer's Statement of Receipts and Expenditure of P.M.G.'s Dept. during the year ended June 30, 1933

Wireless and Broadcast Activities

Amalgamated Wireless (A/sia) Ltd.

The published accounts of the Amalgamated Wireless (Australasia) Limited for the year ended 1932-33 disclose a net profit of £82,172 from Wireless Services. Patents and Trading. This amount represents a return of £11/0/9 per cent. on the paid-up capital of £744,283, and is £5,013 greater than the net profit for the previous year. Dividends at the rate of 8 per cent. per annum absorbing £59,543 have been paid, the Commonwealth receiving £28,000/1/2 based on its capital holding of £350,000/14/0—500,001 shares paid to 14/-.

Under the Wireless Agreement Act 1927, the Company received the sum of £99,558 from the Government, on account of the year 1932-33. This sum consists of £36,281, the Commonwealth's nett payment towards the maintenance of the coastal and island radio stations, and £63,277 patent royalties. The royalty payments commenced on 1st November, 1927, and to 30th June, 1933, totalled £278,214. Dividends paid by the Company for the six years ended 30th June, 1933, amounted to £323,068. The Company paid no dividends during the five years prior to 1928.

Notice of intention to determine the arrangement relating to patents has been given to the Company by the Commonwealth, to take effect on 1st March, 1934, when the royalty payment to the Company is to cease.

Broadcasting

Broadcasting services in Australia are supplied by two classes of stations, the National stations provided and maintained by the Commonwealth, and the "B" class stations operating for profit. There are twelve National stations, eight originating stations in the metropolitan areas, and four regional stations. The regional stations are situated away from the capital cities and are designed to serve country centres of population. The bulk of the programmes broadcast from regional stations are received over land lines from the metropolitan stations.

Forty-eight "B" class stations were broadcasting at the end of the financial year.

Licensed broadcast listeners at 30th June, 1933, numbered 468,430—approximately 100,000 more than the number twelve months before. Important factors contributing to the increase are better and cheaper receiving sets, improved programmes from both National and "B" class stations, and the activities of the Postmaster-General's Department. During the year 1,711 unlicensed listeners were convicted, fines and costs totalling £3,811.

Listeners' Fees — Receipts and Expenditure

Out of the broadcast listener's license fee of 24s. a patent royalty of 3s. per annum is paid to Amalgamated Wireless (Australia) Ltd., 12s. per annum is made available to the Australian Broadcasting Commission and the remaining 9s. is paid into Consolidated Revenue.

The following statement shows the Broadcasting transactions relating to listeners' fees for the year 1932-33:—

INCOME

Balance of undistributed fees in Trust Fund, Other Trust Moneys at 30th June, 1932	£129,977	18	6
Licence fees received from Broadcast Listeners and Experimenters during 1932-33	£562,517	10	0
	£692,495	8	6

EXPENDITURE

Payment Royalty to Amalgamated Wireless (Australasia) Ltd.	£63,276	14	0
Australian Broadcasting Co. Ltd. (Final Payment)	337	15	6
Australian Broadcasting Commission	£247,426	3	0
Revenue	£210,409	15	0
Balance undistributed fees in Trust Fund Wireless Broadcasting Account*	£171,045	1	0
	£692,495	8	6

*This amount has been reconciled with the Treasury balance of £186,840/5/9.

AUSTRALIAN BROADCASTING COMMISSION

The Australian Broadcasting Commission, incorporated by the Australian Broadcasting Commission Act 1932, commenced its activities on 1st July, 1932. The Commission receives 12s. per annum from each listener's licence fee, and is required to provide studios, offices and other necessary accommodation and certain minor expenditure of broadcasting, and to provide and broadcast programmes for the National broadcasting stations.

The accounts of the Commission have been subjected to inspection and audit by me, as required by Section 31 (1) of the Act. A continuous audit has been imposed, the examination extending to the Branch payments in all States.

The accounts were found to be satisfactory and the Balance-sheet in the form prescribed has been certified by me.

Including £3,192/7/0, the estimated amount due on account of licences renewed late, the total revenue from licence fees for the year ended 30th June, 1933, amounted to £250,618/10/0, the total expenditure being £231,289/17/6. The excess of revenue over expenditure was, therefore, £19,328/12/6, of which £17,500 has been transferred to a Building Reserve, and the balance, £1,828/12/6 carried to Accumulated Funds.

Many of the Commission's charges have been grouped in the Profit and Loss Account, providing insufficient information. The view is expressed that the Profit and Loss Account should be published in full for the information of Parliament and listeners generally. Artists' Fees and Programme Expenses, £126,692, and Other Expenses, £16,803, cover at least 29 expense items.

Programmes for the National Broadcasting Service were supplied during the previous three years by the Australian Broadcasting Company Ltd., on terms somewhat similar to those of the Commission. The main exception is that the Commission provides the studios previously supplied by the Postmaster-General's Department. The Commission's income is free from income tax and Directors' fees, but Commissioners' salaries are paid. The above factors have been considered for the purpose of comparison, and the Company's expenditure for 1931-32, £193,041, has been reduced by £6,334 to £186,707. The comparison shows large increases in both revenue and expenditure in 1932-33, the increase in expenditure of £44,583 being equivalent to 23.87 per cent. of that for the previous year.

	Revenue	Expenditure
	£	£
A.B.C.—1932-33	250,619	231,290
A.B. Co. Ltd.—1931-32	207,348	*186,707
Increase	43,271	44,583

*Adjusted figure.

The shareholders in the Company received a profit of £14,309, the Commission's surplus of £19,329 is retained for the benefit of the National Broadcasting Service.

The increase in expenditure has been general, but Artists' Fees and Programme Expenses which include payments to artists, orchestras, lecturers, announcers, accompanists, production costs and phonograph records written off, account for £35,668 of the increase. Copyright fees increased by £5,319. The personnel of the administrative and office staffs, including announcers, accompanists and producers, increased by 32.3 per cent. from 130 officers at 1st July, 1932, to 172 at 9th September, 1933. The total amount paid to these officers in 1932-33 was £43,054/10/1.

Publicity, £4,344, includes salaries £1,420, programmes and advertising posters £1,726, press photographs, £363, photographs of His Majesty the King £141, educational talk booklets £147, and other items.

Legal expenses include £300, compensation paid under Section 33 of the Act to the widow of the late General Manager (Mr H. P. Williams). This sum represents the estimated value of Mr. Williams' service in placing the Commission's case before the Royal Commission on Performing Rights.

The increase of £44,583 in the expenditure, as compared with the adjusted figure for the previous year, calls for special attention. It represents an increase of almost 23 per cent. and appears to be a very high price to pay for such improvement as has been made in the programmes. The increase of 32 per cent. in the number of staff in twelve months also calls for notice, particularly having regard to the fact that the Commission took over from the old company a complete establishment. The expenditure for 1932-33 was at the rate of over £600 per day. Roughly, the daily cost of the chief items was—

Artists' Fees and Programme Expenses	£350
Copyright Fees	£100
Commissioners' Fees and Salaries	£75

The charge of publicity, viz., £4,344, may be seriously questioned, both on the ground of necessity and its great cost.

The rapid growth in both revenue and expenditure suggests the necessity for limiting the Commission's revenue to an amount estimated to cover all reasonable requirements each year. Power to do this is vested in the Minister under Section 26 (2) of the Act.

The Balance-sheet is satisfactory. The Commission commenced operations with advances of £16,200 made by the Treasury without interest. Preliminary expenses totalled £4,066, of which £1,357 has been written off to Profit and Loss. Liabilities to Creditors, £38,826, were only £2,819 greater than Current Assets, and Fixed Assets, £19,439, were offset by the Commission's total reserves of £19,329. Sundry Creditor, £30,726, consists of £5,135, ordinary trade creditors, and £25,591 provision for payment to the Australasian Performing Right Association Limited; the actual payment to be made is subject to agreement between the Commission and the Association.

The Balance-sheet and Profit and Loss Account are printed in Appendix H.

Allowance to General Manager.—The Commission approved of the payment to the General Manager of an allowance of £5 per week to meet out-of-pocket and entertainment expenses. Under the Act, the approval of the Governor-General is required to the payment of the salary of the General Manager and I raised the question as to whether payment of the allowance could be made without the Governor-General's approval. As the Commission desired to continue the allowance in that form, the opinion of the Solicitor-General was sought as to the legality of the payment. In the opinion given by the Solicitor-General, he expressed the view that as the entertainment expenses were incurred on behalf of the Commission, and there was thus a restriction on the discretion of the General Manager, the approval of the Governor-General was not necessary.

A copy of the opinion and of the correspondence on this subject is printed under Appendix J.

WIRELESS BRANCH ACCOUNTS

The Postmaster-General's Department administers the Wireless Act generally, and, in particular, supervises the issue of listeners' and other licences and collects the revenue, provides and maintains broadcasting station and studio technical equipment, and makes available both permanent programme lines to serve the regional stations and lines for relayed programmes mutually agreed upon with the Commission.

Much of the expenditure on wireless activities is included in the ordinary departmental appropriation and is not recorded separately in the Treasury accounts. The annual reports of the Postmaster-General however, show the following surpluses in the Wireless Branch Account, after making provision for depreciation, interest and superannuation:—

1930-31 .... £35,148
1931-32 .... £30,932

Wireless equipment appears in the balance-sheet at 30th June, 1932, as £129,902, subject to a depreciation reserve.

APPENDIX J.

AUSTRALIAN BROADCASTING COMMISSION

Allowance to General Manager

Copy of letter from the Chairman to the Auditor-General, dated 3rd October, 1933:
Dear Sir,

ALLOWANCE TO GENERAL MANAGER

Replying to your letter of the 31st August, 1933 (No. 120/33/824); in the first place, the commission appreciates the spirit in which you bring before it the matter under discussion.

The payment is an out-of-pocket and entertaining allowance, and must not be construed as an increase in salary. The Commission went very carefully into the question, to determine what the amount should be, and, after deliberation, agreed upon the sum named.

For your information, I would point out that the position of General Manager of a Broadcasting Commission is one closely allied to that of an entrepeneur; that he has to deal with many people, and is called upon to extend to them the courtesies of the Commission.

The Commission holds the view that in character and function the work of the Commission is essentially different from a Government Department in that it is a business, and must be conducted and judged on business lines. Moreover, it is not an unusual practice for people in responsible positions to be paid an entertaining and out-of-pocket allowance.

The Commission is, therefore, prepared to accept the responsibility of its action.

Yours faithfully,
Australian Broadcasting Commission,
(Sgd. CHAS. LLOYD JONES,
Chairman.

Copy of letter from the Auditor-General to the Chairman, dated 12th October, 1933:

ALLOWANCE TO GENERAL MANAGER

Dear Sir,—

I thank you for your note of the 3rd October, on the abovementioned subject.

2. The legality of this allowance without the Governor-General's approval is still, in my opinion, open to great doubt. While I agree that there are occasions on which the General Manager (and State Managers) may be called upon to extend courtesies, the payment of a fixed allowance may be criticised from some aspects.

3. In the first place, although broadcasting may be regarded as a business, it is a non-competitive one, and for that reason the Commission is somewhat different from an outside trader seeking business. Artists are paid by the Commission for their services, and any additional cost should be treated as ordinary expenditure of the Commission and not placed in the category of private entertainment by the General Manager.

4. It is questionable whether the General Manager should be put in the position of benefiting or not benefiting personally according to whether he does not, or he does, spend money in entertainment. The fact that expenditure in this direction will come out of his own pocket may result in a smaller sum being expended than the Commission itself may consider reasonable.

5. From the point of view either of the Commission or the General Manager, the present position can hardly be considered satisfactory, and in my opinion it is obviously wrong and likely to lead to criticism.

6. For these reasons, I would suggest that, instead of receiving a fixed allowance, it would be preferable for the General Manager to furnish a list of his expenditure periodically for the approval of and reimbursement by the Commission. If the Commission cannot see its way to adopt this course, I shall be constrained to ask the Solicitor-General for his opinion as to whether a fixed allowance should not be regarded as constituting, to some extent, an addition to salary, and therefore requiring approval of the Governor-General under Section 15 of the Act.

Yours faithfully,
(Sgd.) C. J. CERUTTY,
Auditor-General for the Commonwealth.

Copy of letter from the Chairman to the Auditor-General, dated 30th November, 1933:—
Dear Sir,

ALLOWANCE TO GENERAL MANAGER.

Your letter of the 12th October, on the above-mentioned subject was discussed at the full meeting of the Commission on 21st instant, and my Commission, having taken into consideration the content of paragraphs 3, 4, 5 and 6 of your letter, still feel that it has acted as it thought best in granting this allowance.

However, in view of your letter, I shall be glad if you would refer the matter to the Solicitor-General for his opinion as to whether it is a matter requiring the approval of the Governor-General under Section 15 of the Australian Broadcasting Commission Act, and advise me in due course.

Yours faithfully,
Australian Broadcasting Commission,
(Sgd.) CHAS. LLOYD JONES,
Chairman.

OPINION

The Auditor-General for the Commonwealth has forwarded the following memorandum for advice:—

The Australian Broadcasting Commission has authorised payment to the General Manager of an allowance of £5 per week to meet out-of-pocket and entertaining expenses incurred on behalf of the Commission. The General Manager is not required to produce vouchers or to account to the Commission for such expenditure.

(2) Under Section 15 of the Act (No. 14 of 1932), the salary payable to the General Manager is approved by the Governor-General.

(3) It appears to me that the payment of this allowance may be regarded as constituting, to some extent, an addition to salary and therefore, requiring approval of the Governor-General under Section 15.

(4) If the action of the Commission in this matter be legally permissible, it would be possible for the Commission to grant allowances, not only to officers, but also to members of the Commission itself, with the result that emoluments would be increased in a manner clearly not contemplated by Parliament.

(5) I shall be glad if you will be good enough to advise me of your opinion on the legal point raised.

Section 15 of the Australian Broadcasting Commission Act 1932, reads as follows:—

15.—(1) The Commission shall appoint a general manager and such other officers and such servants as it thinks necessary.

(2) The salaries payable to the general manager and the next six most highly paid executive officers of the Commission shall be subject to the approval of the Governor-General.

(3) Officers and servants appointed by the Commission shall not be subject to the provisions of the Commonwealth Public Service Act 1922-1931, but shall be subject to such conditions (including tenure of office) as are determined by the Commission.

In my view, sub-section (3) authorises the Commission to determine in respect of officers appointed by it (and the general manager is so appointed) conditions which may involve the payment of allowances. The provision in subsection (2) as to the necessity for the approval of the Governor-General of the salary of the general manager is specifically limited to salary and, unless the allowances in question are in the nature of salary, sub-section (2) will not apply to them.

The manner in which a salary may be disbursed is generally in the discretion of the person by whom it is earned. As indicated in the above memorandum, the allowance is to meet out-of-pocket and entertaining expenses "incurred on behalf of the Commission." There is thus a restriction on the discretion of the general manager as to the purpose for which the allowance in question may be expended, and, provided it is spent in the manner authorised by the Commission, it is not, in my view, in the nature of an addition to salary.

In my opinion, therefore, there does not appear to be any necessity for obtaining the approval of the Governor-General for the payment of the allowance to the general manager.

With regard to the view expressed in paragraph 4 of the Auditor-General's memorandum, it is pointed out that sub-section (1) of section 8 provides that the salaries and allowances of Commissioners shall, subject to that section, be such as the Governor-General determines. The only other provision in that section relates to the maximum amounts of the salaries of Commissioners. The Commission would not, therefore, be in order in granting allowances to its members.

(Sgd.) GEO. S. KNOWLES,
Solicitor-General,
23rd January, 1934.

The Auditor-General for the Commonwealth.

Control of Wireless in Australia

As in all other countries, wireless activities in Australia are under Governmental control. With wireless transmission recognising no national boundaries it is obvious that some form of control is necessary. Consequently the various nations of the world work together under a form of agreement—the International Tele-communication Convention and its Regulations—to ensure freedom from interference.

In the Commonwealth, the Postmaster-General's Department administers the required control and supervision under the powers of the Wireless Telegraphy Act and Regulations. The Act places the responsibility on the Postmaster-General of conducting wireless services or licensing other people to do so. Therefore, no person is permitted to erect, establish or maintain apparatus capable of transmitting or receiving wireless signals unless he is in possession of a licence from the Postmaster-General. The Wireless Telegraphy Regulations set out the detailed conditions under which licences are obtained.

There are various types of licences covering the activities of the different classes of services. The licences issued by the Postmaster-General's Department are:—

Coast Station	Broadcast Listeners'
Ship Station	Portable
Land Station	Experimental Station
Broadcasting Station	Aircraft Station

and

Special Licences covering such services as the Beam Service, and other services for which specific licences are not provided.

With the exception of Broadcasting Station Licences and Special Licences, the applicant meets with scarcely any difficulty, provided that the required conditions are complied with. The name of the licence generally indicates the type of service to be covered which, with the exception of Broadcasting Station Licences, refer mainly to commercial wireless telegraph or telephony services.

It is very important, however, for all persons contemplating the installation of wireless apparatus to obtain full particulars from the Radio Inspector.

The issue of Broadcasting Station Licences is a matter of greater complexity because the number of such licences is necessarily limited by technical considerations In accordance with an International agreement only a certain number of broadcasting frequencies or wavelengths is available for broadcasting services if interference, both national and international, is to be avoided. In the interests of listeners it is essential that the wavelengths of the different stations have a minimum frequency separation compatible with the performance of average broadcast receivers. Consequently the obligation rests on the Department, and it is viewed very seriously, to see to it that the stations are properly placed within the spectrum of frequencies comprising the broadcast band. And as the first demands on these frequencies must necessarily come from the national stations, it follows that only a limited number of broadcasting channels or wavelengths are left for the stations established by private enterprise, known as Licensed Broadcasting Stations. Therefore, the grant of such a licence gives to the licensee something of a monopoly and consequently the Department must select very carefully from the applicants those to whom licences are to be granted, keeping in view the essential factor that service to listeners must be the paramount consideration.

Inspection of Stations.

When licences are granted, regular inspections are made by officers of the Department in order to ensure that the conditions of the licence are complied with. Those conditions may be referred to shortly as the stipulated service to be given and adequate precautions to be taken to avoid interference with other services.

Operators' Certificates of Proficiency.

Under the international and local wireless laws, the Department stipulates the conditions pertaining to the issue of Operators' Certificates of Proficiency. These certificates are issued, after appropriate examinations have been passed, to candidates who desire to operate particular types of stations; the examination being conducted with the object of allowing the candidates to demonstrate their possession of the required knowledge of proficiency.

The examinations are held periodically for the following certificates:—

Commercial Operators' First Class
" " " Second "
Limited " (Telephony), Limited " (Telegraphy),
Amateur Operators.

Interested persons should communicate with the nearest Radio Inspector for full details.

Broadcast Listeners' Licences

This is the type of licence which in recent years has obviously become the most popular one owing to the progress of the broadcasting services. There are several differences between this type of licence and the others. Broadcast listeners are not required to sign any document as in other cases and the licence fee is on a different basis. In all other cases the licence fee is a nominal amount, sufficient to defray the administrative costs incurred by the Department.

In the case of Broadcast Listeners' Licences, however, the fee includes not only the administrative costs but also an amount forming a method of payment for the services which the listener receives, which may be described as a subscription to the service. Only a small portion of the licence fee covers the administrative costs, the far greater part being what might be termed the subscription fee.

Control of Wireless (Continued)

The annual fee of 24/- for Broadcast Listeners' Licences applies to all listeners situated within an area of about 250 miles from a National Broadcasting Station; that area is known as Zone 1. Outside that area, in Zone 2, the annual fee is 17/6 per annum.

The licence fee is divided between the Australian Broadcasting Commission which receives 12/- for the provision of programmes, and the Postmaster-General's Department which retains the balance for:—

(a) the provision of the technical services of the National Broadcasting Stations (installation, erection and operation);
(b) the inter-connecting telephone circuits between the various National Stations;
(c) other technical services, including the investigation of radio inductive interference and research; and
(d) administrative costs in connection with the issue and recording of licences.

Despite the obligation on listeners to obtain a licence it is unfortunately necessary for the Department to maintain a permanent staff in each State for the purpose of locating unlicenced listeners. When these listeners are detected they are brought before the Police Magistrates and during the year 1933 there were more than 2,500 convictions for this offence.

Payment of Listeners' Licence Fees by Postage Stamps.

The Department has introduced a scheme whereby persons may make provision for their broadcast listeners' licence fees by purchasing postage stamps and affixing them to cards which are provided for the purpose. The following notes, which are printed on the back of the card, state the conditions under which the Department permits licence fees to be paid in this manner—

Postage stamps not otherwise used or defaced, of an individual face value of 6d. or more, when affixed in the spaces provided on this card, will be accepted at any Post Office Licence Issuing Office in partial or full payment for a new listener's licence or for the renewal of an existing licence.

Stamps to the value of more than 24/- must not be affixed to this card.

Should the licence fee at any time be less than the sum of 24/-, only stamps equivalent to the actual cost should be affixed to the card. Nevertheless, the value of the stamps affixed beyond the cost of the licence will be refunded in full at the time of issue of the licence.

This card does not take the place of a listener's licence, and, even if it contains stamps to the value of a licence, it is illegal to use a receiving set until the actual licence has been obtained.

If, after certain stamps have been affixed, the owner of this card does not wish to purchase a broadcast listener's licence, the stamps so affixed will be re-purchased at the G.P.O. in any State, but a discount of 10% (minimum 2d., maximum 2/-) will be charged.

No wireless set may be used until the user is actually in possession of a Broadcast Listener's Licence.

Free Broadcast Listeners' Licences for the Blind

The Postmaster-General's Department has arranged for the issue of free broadcast listeners' licences to any blind person over the age of 16 years. These licences are granted to—

(a) blind pensioners;
(b) blind soldiers in receipt of a pension;
(c) any other person over the age of 16 years on production of a Certificate from a qualified medical practitioner stating that he or she has no useful vision.

Forms of application may be obtained from the Radio Inspector.

Radio Inductive Interference.

The department endeavours to give as much service as possible to broadcast listeners and one of these services which has received special attention during recent years is that of the investigation of radio inductive interference. This form of disturbance to broadcast reception has unfortunately increased, with the introduction of receivers obtaining their power from the house lighting system and the Department has energetically extended its activities in combating the nuisance. Specially qualified Radio Inspectors in each State undertake the investigation of complaints received from groups of listeners in different localities. The investigations have been responsible for considerable success in determining the cause of the interference and in almost every case it is possible for the Inspectors to demonstrate the method of eliminating or reducing the interference by the installation of suppressors.

The installation of the suppressing equipment, which is comparatively inexpensive, is obviously not a responsibility of the Department. The cause can be diagnosed, the curative measures to be taken can be demonstrated and it only remains for the owners of the offending electrical equipment to take the necessary steps to install the suppressors. While in many cases the Department gladly records the co-operation which has been afforded by electric authorities and private owners of offending equipment, it is unfortunate that in some cases the desired co-operation has not been forthcoming.

Radio dealers can be of great assistance in this connection, particularly in country districts where they are familiar with the conditions and have business or other contacts with the listeners and the owners of electrical equipment. By a recognition of a reasonable community spirit, the co-operation could be fostered by the tactful action of radio dealers, whose interests, of course, would be served by listeners generally being more satisfied with their broadcasting services.

The Department is anxious to hear from listeners who are experiencing any trouble in connection with radio inductive interference and invites them to inform the Department of their conditions by filling in a Wireless Reception Questionnaire Form, obtainable from any Post Office, and sending it completed to the Radio Inspector. In every case the Radio Inspector communicates with the complainant and it is pleasing to note that in most cases a satisfactory result has followed.

"During the past twelve months the Department has augmented its staff to enable the ever-increasing volume of complaints to be handled expeditiously. Nearly 6,000 cases were reported by listeners during the year and received attention."

Demonstrations by Radio Dealers.

A broadcast listener's licence obtained by a radio dealer in respect of a particular address does not entitle the dealer to demonstrate or in any other way use a receiver in the home of a prospective buyer. This is a point which many dealers have overlooked. The Department, however, has always endeavoured to assist radio dealers in the conduct of their business, recognising that the radio trade has a very important part to play in the development of broadcasting.

It is recognised that the dealers must give demonstrations away from their shops and the Department grants the concession of allowing these demonstrations to be conducted without the obligation of obtaining a licence. The conditions under which these special arrangements can be made may be learned by consultation with the Radio Inspector. Generally, it is the practice to permit a demonstration period of three days in the metropolitan area and one week in country districts.

During 1933 the Department was reluctantly compelled to take action against several dealers who failed to comply with its conditions covering the demonstration of receivers. In some instances receivers were seized and forfeited to the Commonwealth.

Radio Inspectors' Addresses.

The addresses of the Radio Inspectors in each capital city are as follows:—

Sydney: Mr. W. T. S. Crawford, Haymarket Post Office Chambers, 635 George Street, Phone: M 3402.
Melbourne: Mr. J. M. Martin, Treasury Gardens, C.2, Phone: Central 5551.
Brisbane: Mr. T. Armstrong, General Post Office, Phone: BY 8371.
Adelaide: Mr. H. W. Harrington, General Post Office, Phone: Central 6100.
Perth: Mr. G. A. Scott, General Post Office, Phone: B 6023.
Hobart: Mr. E. J. G. Bowden, Telephone Buildings, Harrington Street, Phone: Central 5081.

Full particulars relating to Departmental Wireless Matters can always be obtained from any of the Radio Inspectors listed above.

Technical Progress in Radio Broadcasting

An Account of the Activities of the Postmaster-General's Department in the Radio Broadcasting Field in Australia.

The principal technical function with which the P.M.G.'s Department is charged in connection with broadcasting is the provision of the technical services for the National Broadcasting system. The programmes for this system are provided by the Australian Broadcasting Commission.

It is important that the reader should appreciate that the provision of technical services by the Department involves very much more than merely providing Radio Stations and the technical equipment required for use in broadcasting studios. Although the radio aspect presents itself to the public as the outstanding feature of the service, it, in fact, involves no greater difficulties, nor quantities of plant and staff, than do other sections, such as the provision of the great networks of special programme lines which frequently have to be set up for the relaying of programmes to every State on the Mainland.

Research

For instance, a necessary adjunct to the provision of technical services for broadcasting is some adequate means whereby technical developments in other countries may be continuously watched, where any such developments giving promise of usefulness in this country may be tested, and where local problems arising in the engineering, operation or maintenance of radio systems may be investigated. The Department has met this need by gathering together in its Research Laboratories a group of Physicists, Engineers, and other officers specially qualified for this type of work.

Separate premises have been set aside to accommodate this staff and its equipment. These premises provide some 16,500 square feet of floor space, accommodating upwards of 40 officers continuously engaged on the various problems relating to radio and the other engineering activities of the Department; and housing research equipment valued at approximately £23,000.

In addition to the main Laboratories housed at 59 Little Collins Street, Melbourne, there are two Field Laboratories used mainly for radio investigations; one at Mont Park, and the other at Lyndhurst, both in Victoria. This portion of the Department's organisation dealing with broadcasting also maintains close contact with the Radio Research Board, a course designed to ensure the maximum of mutual assistance, and the avoidance of any overlapping.

The bulk of the technical problems met with in broadcasting are basically similar to problems met with in modern telephone engineering, and are susceptible to attack along the same lines and with the same equipment as the latter. The association of the radio research and investigation work with the work already being done by the Department in connection with its telephone and telegraph services, therefore, avoided the unnecessary duplication of expensive equipment, and brought to the radio work, research facilities on a scale which would not otherwise have been possible.

Fundamental Broadcasting Plan.

An organisation having been established for the investigation of broadcasting problems it followed that it should be used first of all to prepare a fundamental plan upon which the whole national broadcasting system could be built up with the assurance that the ultimate objective of placing high quality programmes within the reach of listeners all over Australia would be achieved in the most economical manner.

Technical Progress (Continued)

The necessity for a plan to ensure ordered development was obvious, but its preparation for a country such as Australia was found to be a matter of considerable intricacy and difficulty. The scattered population outside the principal cities makes very difficult the planning of a service capable of giving to every listener at least one programme without fading, and with sufficiently high programme to noise ratio.

Such a plan was, however, prepared in 1929, and it was hoped to complete it within a five year period. The first portion of the plan contemplated the provision of an efficient service to country areas, as the large cities were already provided with programmes, although some of the stations were equipped with apparatus which fell below modern standards. As an immediate step forward with the plan, therefore, tenders were called for the supply of five new stations to be known as regional stations, to be located in country centres, and to derive a large proportion of their programmes from the main metropolitan stations. Unfortunately the financial crisis made it necessary to cancel the orders placed for one of these Stations, and has since considerably retarded the further development of the National System under the plan.

"Considerable progress will, however, be made with the plan during 1934. By the end of this year, it is expected that seven new regional stations will have been put on the air or be under construction.

Frequency Allocation.

Another technical function of the Department is the allocation of the available frequencies of broadcasting stations.

Under the Radio Telegraph Regulations framed by the International Radio Convention of Washington, 1927, the frequencies allotted for broadcasting purposes are those lying between 550 and 1,500 K.C./sec., and in certain instances 160 to 224 K.C./sec. To date, in Australia, use has only been made of the former band, which makes available some 91 channels to be shared by national and licensed stations. The allocation of frequencies of broadcasting stations requires constant and careful consideration. Geographically adjacent stations must be separated sufficiently in the frequency band to facilitate receiver design and avoid mutual interference, channels must be so allotted as to avoid heterodyne interference from broadcasting stations in Japan, China, New Zealand and other countries, and at the same time an equitable distribution of frequency as between the various States of the Commonwealth has to be preserved.

National Stations.

Between September, 1934, and March, 1935, it is anticipated that seven new regional stations will have been brought into service. Orders have already been placed by the Department for the transmitters and associated equipment. Details of these new stations are as follow:

Designation of Station	Location	Frequency (Kilocycles per second)	Wave Length (Metres)	Rated Unmodulated carrier in the aerial (Kilowatts)
Northern Regional	Kelso, near Launceston (Tas.)	630	476	7
Townsville	Townsville (Qld.)	640	469	7
South West Regional (W.A.)	Not yet determined	560	536	10
North Coast Regional (N.S.W.)	Grafton (N.S.W.)	660	455	7
Central Regional (N.S.W.)	Not yet determined	550	545	10
Gippsland Regional	Sale (Vic.)	830	361	7
West Victoria Regional	Not yet determined	580	517	10

The stations will probably be brought into service in the order listed above. The frequencies (wave lengths) allocated to these new stations are in some cases the same as or close to those now used by existing National Stations. This will be adjusted by rearranging the frequencies (wave lengths) of the existing stations in conformity with a frequency allocation plan which has been prepared. Each of the new stations has been planned to admit of a considerable extension of its power, should such a course be found desirable at some future time.

When a new station is being planned, great care is taken to ensure the selection of a suitable locality and site; and measurements of field strength are made, using a portable transmitter and portable measuring equipment. The portable transmitter is operated from each of a number of sites selected as likely to be satisfactory, and the resulting field strength is measured at various points in the area which the proposed station is designed to cover. A comparison of the measurements, together with a consideration of other factors, such as the availability of power supply, etc., is then made to finally determine the location of the station.

Then, wherever possible, field strength studies of the actual radiation from each new Station are made. Extensive measurements of this kind have been made on the Melbourne Stations, Station 2CO, Corowa, and Station 6WF, Perth. These studies enable the effectiveness of the stations to be correctly estimated, and also provide valuable data for use in connection with the extension of the system, and the selection of sites for future stations. In addition to the work just described, a considerable amount of reconstruction work has also been done on the other National Stations in the Capital Cities —resulting in increased depth of modulation and generally improved quality and reliability.

Technical Progress (Continued)

In most cases also serious danger hazards have been eliminated by the re-arrangement of equipment, and the provision of safeguards within the stations.

Broadcasting Studios

The Studios providing the programmes to be broadcast over the national stations are located in each State in the Capital City. Even when the programme to be broadcast originates and is picked up at some point outside the studio, as, for instance, in the case of a race or sports meeting, it is passed to the Radio Broadcasting Station through and under the control of operators in the studio. Each studio, therefore, acts as a collecting house for the programmes to be broadcast from the particular station which it serves. The choice of studios and their general design, and the supply of fittings and furnishings, is a function of the Australian Broadcasting Commission, which, since taking control, has considerably improved the studio accommodation. The technical equipment for these studios is, however, provided by the Department. This involves the provision of microphone amplifiers and all monitoring and switching equipment. In the Department's Research Laboratories is carried out a continuous study of this class of sound transmitting and reproducing equipment, items such as microphones, loud speakers and electrical gramophone equipment being constantly under review.

Operation and Maintenance of Stations and Studios.

The operation and maintenance of the national stations and of the technical equipment in the studios with the exception of two rented stations and studios is also carried out by the Department. In connection with this phase of its work, the Department was able to make very satisfactory and economical arrangements for staffing. The work involved is in many respects closely similar to and no more difficult than that carried out by the large technical staff of mechanics employed by the Department in connection with its telephone and telegraph services. This technical staff is therefore used as a pool from which can be readily drawn as required an adequate supply of officers already possessed of a considerable part of the necessary technical training and experience. From so large a staff it is also possible to select officers having a natural bent for radio work. The staff organisation is so planned also that the officers regularly employed on the broadcasting work are relieved when necessary by mechanics normally employed on telephone work. This system materially reduces the number of officers who would otherwise have to be retained solely on broadcasting work, and at the same time serves to build up a staff trained in that work.

Of the stations now operating under the Department's control, all, with the exception of the four regional stations, 4RK Rockhampton, 2NC Newcastle, 2CO Corowa and 5CK Crystal Brook, and the newly installed 6WF station at Perth, were constructed by or to the order of their original owners, and although very extensive alterations and improvements to them have been made by the Department since taking them over, nevertheless their equipment and arrangement is generally very dissimilar and far from standard. This adds very materially to the problems and costs involved in running them. In the design of new stations—including those just mentioned—very close attention is given to the question of standardisation and of ease in operation and maintenance.

The work itself falls naturally into two divisions, that of studio operation and maintenance, and that of station operation and maintenance—although the officers employed on each class of work are mutually interchangeable and must possess an adequate knowledge of both classes. Briefly the officers attached to the studio technical staff are concerned mainly with the pick up, switching and production side of broadcasting work, while the station staff is concerned chiefly with transmission, operation and maintenance as affecting power radiation from the station.

In the studio, and outside it when items are to be picked up from some external point, the studio operators co-operate closely with the officers of the Commission in the selection of suitable types of microphone and their placement in relation to the artists and performers. To a very large extent the quality and balance of the programme as finally transmitted over the air is dependent on this work. Several types of microphone are in general use in the studios, each having characteristics which determine its suitability or otherwise for any particular class of work. Studio operators must possess a knowledge of these characteristics and an appreciation of the results which are obtained from each one when used to pick up different items of programmes under different conditions of placement. Another officer in the studio —the control operator—is required to monitor the programme continuously and to control its transmission to the radio station itself. The differences in volume between soft (pianissimo), and loud (fortissimo) passages in a performance are sometimes very great, and it is the function of the control operator to ensure that these sounds do not fall below the limits of audibility in the receiver on the one hand, and on the other hand do not overload the transmitter at the broadcasting station; at the same time preserving the light and shade of the original performance. Special equipment in the form of level indicators is provided to assist the control operator in this work but here again the exercise of a considerable degree of care and judgment is necessary if a loss in quality of these programmes is to be avoided.

The development of broadcasting work, calling for a continually varying type of programme, and variety of other associated work, has demonstrated the necessity for the highest possible grade of maintenance in connection with the technical equipment if the failure of apparatus and consequent interference with programmes is to be avoided. In the studios a special routine for testing amplifiers, batteries, valves, microphones and cables has been laid down. All items are tested at predetermined intervals and a system of fault recording has been evolved which enables special attention to be devoted to those items of equipment which are found to be most liable to fail in service.

Technical Progress (Continued)

In addition to these routine tests an overall frequency test is made each morning by the control operator from the studio to the transmitter. On this test all transmission levels are adjusted and the circuits are prepared for the broadcasting work of the day.

The work in the transmitting station has also been closely organised and routined. Each morning all motor generators—both high and low voltage—are thoroughly examined and cleaned, duplicate and standby equipment is given a trial run, and batteries are inspected and tested. Within the transmitter enclosure all high tension insulators, busbars and arresters are cleaned free of dust and their mechanical condition examined. In particular, all failure alarms such as water flow, water temperature and overload relays are tested for effective operation. At specified intervals also the electrical characteristics of each valve in the station are measured to ensure that they have not deteriorated. In each station response measuring equipment is provided for the measurement of modulation depth and of station response over the transmission band from 35-8000 cycles/second to ensure that so far as the station equipment is concerned there is no deterioration in the quality of transmission.

An important phase of station routine which receives close attention is the maintenance of the correct station frequency. In each station has been provided measuring apparatus which enables it to be seen when the station is deviating materially from its assigned frequency. In addition to this in the Research Laboratories of the Department in Melbourne multi-vibrator equipment is installed which enables the frequency of any station to be measured with a precision of 50 parts in one million. Each week an accurate measurement of all stations is made with this equipment, and the engineering officers maintaining the stations are advised of the results.

Another matter of importance in the maintenance of a reliable broadcasting service is the provision of spare parts and equipment for emergency purposes, and of tubes, etc., required to replace those reaching the end of their useful life. This has been organised on a Commonwealth wide basis and standardised as far as the diversity of the station equipment will permit. Such a course naturally makes for economy and an increased degree of reliability.

Studio and Station Programme Lines.

Main broadcasting studios are generally located well within the city boundaries for the convenience of performers and as a central point to which can be sent programmes picked up at external points. As against this it is generally desirable to locate the transmitting station itself, with its aerial system, outside the city boundary. There is, therefore, in the majority of cases, a considerable distance between the studio and its associated station. This has to be bridged by a telephone line specially designed and corrected to make it suitable for the transmission without distortion from studio to station of musical and vocal items as well as speech. To meet this requirement the Department has provided special metallic lines having properly designed amplifiers at the studio end and equalisers at the station end. The amplifiers enable the studio control operators to maintain the correct input of power to the line to ensure proper modulation without overloading at the station. The line equalisers correct the tendency of the line to cause distortion of the programme by attenuating the high frequencies to a greater extent than the low frequencies. The equaliser for each line is designed separately—the designs being based on special transmission measurements—and these special programme lines connecting together studios and stations, with their equalisers, transmit all frequencies from 35 cycles/sec. up to above 5,000 cycles/sec. with negligible distortion.

Pick-up Lines and Equipment.

A fundamental feature of the broadcasting organisation is the use of the studio associated with each station as a central collecting and control point for the various items making up the complete programme. This applies equally to items produced in the studio or at some external point. In the latter case recourse has to be had to telephone lines to connect the pick up equipment, consisting of microphones and amplifiers, to the studio control equipment. When items have to be frequently picked up at the same point permanent pick up lines are established connecting that point with the broadcasting studio. All these lines pass through the test room of the Central trunk exchange, although they are not switched at that point. This practice is convenient from the plant viewpoint as it greatly facilitates the use of ordinary telephone lines for pick up purposes and thereby makes for economy and flexibility. It also enables the highly specialised and expensive testing equipment provided at the trunk test room to be used for testing and maintaining them.

Considerable progress has been made during the past year or so in providing improved pick-up equipment. Purchases have been made of moving coil type, velocity type and lapel type microphones, resulting in satisfactory improvements in the quality of the programmes, whether of speech or music, and the use of these high quality microphones is being extended as additional purchases come to hand.

In providing staff for pick up work, the Department follows the same practice as in the case of the studios and stations, i.e., it draws selected officers from its mechanical staff normally engaged on telephone work. In this way it has secured and can maintain a reserve of staff adequately trained in all classes of broadcasting work from pick up to station duties.

Relayed Programmes and Programme Lines.

One of the outstanding features of the operation of the National Broadcasting system is the very extensive and continually increasing use made of items or programmes relayed over suitable land lines to a number of broadcasting stations. This practice makes for economy in the provision of programmes and enables items of special merit or interest to be made available beyond the locality or State in which they originate.

As the public body operating the telephone system of the Commonwealth and also supplying the technical service for the National Broadcasting System, the Department is in a particularly favourable position to co-ordinate the use of lines, equipment, and staff for the dual

Technical Progress (Continued)

purpose of providing the country's normal telephone service and providing service for the relaying of broadcast programmes.

At the present time use is made of the trunk line system every night for the relaying of programmes between at least two and very often four stations. In the relatively common-place case of a programme relayed between main stations in Brisbane, Sydney, Melbourne and Adelaide, and the four regional stations of Rockhampton, Newcastle, Corowa and Crystal Brook, a total length of over 2,600 miles of trunk line—of a capital value in excess of £170,000—is involved. If such a relay were extended to Perth, as sometimes happens, an additional 1,630 miles of line would be used and the capital value—for line plant alone—would rise to something of the order of £300,000.

The problem of providing this class of service is rendered more complex by the fact that a telephone line as ordinarily arranged is not suitable for the transmission of vocal items or music, although it can be used for relays involving only speech. Telephone lines are designed to transmit frequencies lying between 300 cycles/sec. and 2,800 cycles/sec.—a band of frequencies which give satisfactory telephone conversation. The relaying of vocal items or music, however, requires the transmission with a comparatively flat characteristic of frequencies from about 50 cycles/sec. up to at least 5,000 cycles/sec. and preferably higher. To meet this requirement special programme transmission amplifiers and line equalisers have been provided at terminals and repeaters on the trunk lines, and are substituted for the equipment normally connected on those lines whenever a musical programme is to be transmitted. Very considerable expenditure has been incurred by the Department in providing this special equipment, and apart from the inevitable demand for continuous improvement in the quality of the programmes transmitted, a fair degree of completeness has been achieved. Equipment was installed during 1933 which enabled musical programmes from the Eastern States to be relayed for broadcasting in Perth. This equipment consists of a special uni-directional carrier telephone channel transmitting in the direction Adelaide to Perth. It transmits a band of frequencies approximately 5,000 cycles wide, and was probably the first of its kind in the world. To reduce the cost, the existing carrier telegraph repeaters in use along the 1,630 miles of line between Adelaide and Perth were modified by the Department's engineers to enable them to transmit satisfactorily the higher frequencies used by the special carrier system. In this way the provision of much expensive equipment at each of seven repeater stations along the line was avoided.

With the installation of this equipment, the Department completed programme transmission lines between all the capital cities on the mainland.

A development of considerable importance in this field is the production of a reversible uni-directional programme carrier system operated with a carrier frequency of 42.5 k.c., which is above that of any other carrier system operated by the Department over its lines. This system transmits the frequencies from 30 to 8,000 cycles per second, and therefore provides a programme channel which can be used for the transmission of high quality musical items. On account of the high frequencies at which the system transmits, it can be operated over telephone lines which are also carrying three channel carrier telephone systems. One of these systems is being obtained and will shortly be installed between Sydney, Grafton and Brisbane, to provide a programme line to the new regional station to be installed at Grafton, and to augment the existing programme transmission facilities between Sydney and Brisbane. A second system is on order for installation between Sydney and Melbourne, and it is probable that additional systems will be obtained to provide channels to some of the new regional stations, the equipment for which has been ordered.

A further development affecting the relaying of programmes is the decision of the Government to call tenders for a telephone cable to connect Tasmania with the Mainland. The specification for this cable calls for the provision of a high quality channel for programme transmission, and when it has been installed, the system of broadcasting lines will extend to every State in the Commonwealth.

A feature of this portion of the technical services not generally appreciated, is the extremely close co-operation necessary between officers arranging the lines and adjusting the equipment on the actual programme transmission circuits between States, the officers operating the control equipment at the various studios, and, in order to avoid serious interference with the trunk telephone service, the Department's telephone traffic staff. The first two groups of officers are essentially one group insofar as control is concerned, with exactly similar technical training, experience, and general outlook. All three groups are in continuous touch with each other in the course of their ordinary work, and they have at their disposal the whole resources of the telephone and telegraph system with, in many cases, special telegraph order wires to enable them to arrange the setting up and alteration of lines and equipment. But for this, the problem of securing satisfactory programme relays would be extremely difficult, and failures resulting from the complexity of the organisation would almost inevitably occur from time to time. Especially would this be so in the more intricate cases where relays are concurrent or follow each other at very short intervals, and extensive re-arrangement of lines and equipment has to be made in the minimum of time.

The problem is moreover frequently complicated by the requirements of the licensed stations (B class) among which there is a rapidly increasing demand for programme relaying facilities similar to those provided by the Department for the national service.

While considering this portion of the technical services provided by the Department for the National Broadcasting System, it is of interest to note that permanent programme transmission lines have been provided to connect each regional station to its main station in capital cities. These permanent lines total approximately 935 miles in length, and with their special equipment involve a capital cost of about £65,000.

Short Wave Service

During recent months there has been considerable activity in connection with short wave work directed towards the picking up and re-broadcasting of programmes from overseas. The British Broadcasting Corporation has inaugurated an Empire short wave broadcasting service from Daventry, England, and efforts are being made to improve reception to the stage where the programmes from overseas will afford items of high quality and interest for broadcasting over the national system in Australia. A number of very successful re-broadcasts of special items from overseas have in fact already taken place. In the case of a number of speech broadcasts, the London-Australia telephone service has been successfully used. This short wave work is being carried out at the Department's experimental short wave stations at Lyndhurst and Mont Park, Victoria.

Services to Licensed Stations (B. Class).

The licensed stations (otherwise known as "B" class) make a constantly increasing use of the Department's trunk line service for relaying special items and programmes between stations. These stations are in general, separate and independent entities but there exists —usually between city and country stations, or between stations situated in different States—mutual arrangements and understandings out of which arise the demand for relayed programmes. The technical requirements to be met in the case of these relays are the same as in the case of the relays between national stations, i.e., special high quality channels have to be provided for the transmission of musical items.

The rapid increase in the demand for relay lines for both the national and the licensed stations combined with the requirements of the ordinary trunk telephone service has resulted in a number of cases in insufficient programme channels being available, but it is anticipated that, with the installation of the programme carrier systems previously mentioned, it will be possible to meet all ordinary requirements, and the Department is now planning the provision of additional channels of this type between the capital cities by means of special carrier systems somewhat similar to that to be installed between Adelaide and Perth. These special systems are of only recent development, and have in fact been designed only in consequence of the Department's demand for equipment of this nature.

Australian National Broadcasting Stations

Station. 1.	Approximate Location. 2.	Frequency kC. 3.	Wavelength m. 4.	Power Watts (a) 5.	Service Commenced (b) 6.
2BL, Sydney	Coogee, 4½ miles S.E. of G.P.O.	855	351	3,000	13. 11. 1923 (22. 7. 1929)
2CO, Corowa	3½ miles N.N.E. of P.O., Corowa.	560	536	7,500	16. 12. 1931
2FC, Sydney	Pennant Hills, 11¼ miles N.W. of G.P.O.	665	451	3,500	5. 12. 1923 (17. 7. 1929)
2NC, Newcastle	Beresfield, 11½ miles W.N.W. P.O., Newcastle	1,245	241	2,000	19. 12. 1930
3AR, Melbourne	North Essendon, 8 miles N.W. Eliz. St. P.O.	610	492	4,500	26. 1. 1924 (8. 8. 1929)
3LO, Melbourne	Braybrook, 5¾ miles W. Elizabeth Street, P.O.	800	375	3,500	13. 10. 1924 (22. 7. 1929)
4QG, Brisbane	25 chains S.W. of G.P.O.	760	395	2,500	27. 7. 1925 (30. 1. 1930)
4RK, Rockhampton	6 miles S.W. of P.O.	910	330	2,000	29. 7. 1931
5CK, Crystal Brook	2½ miles N.E. of P.O.	635	472	7,500	15. 3. 1932
5CL, Adelaide	Brooklyn Park, 3¼ miles W. of G.P.O.	730	411	2,000	20. 11. 1924 (14. 1. 1930)
6WF, Perth	7 miles N. of G.P.O.	690	435	3,500	4. 6. 1924 (1. 9. 1929)
7ZL, Hobart	Radio Hill, 1¾ miles S.W. of G.P.O.	580	517	1,000	17. 12. 1924 (14. 12. 1930)

(a) Column 5—indicates unmodulated aerial power.

(b) Stations 2BL, 2FC, 3AR, 3LO, 5CL, 6WF and 7ZL were formerly operated by private enterprise under licence granted by the Postmaster-General. 4QG was formerly operated under licence issued to the Queensland Government. These stations were transferred to the N.B.S. on the dates shown in brackets.

Communication Services of the Postmaster-General's Department

Australia is a land of vast distances with a few widely separated rather densely populated areas of small extent and extensive territories carrying extremely small densities of population.

The area of the Continent is roughly 3 million square miles and its present population is about 6½ millions, 3¼ millions of whom are resident in the six State capital cities. The average distribution of the remainder is therefore only one per square mile. To traverse the boundaries of the Continent one would have to travel 12,000 miles. A mental picture of these conditions is helpful in forming a conception of the nature and magnitude of the problem of providing comprehensive communication services. The problem is mainly one of economics resulting from the necessity to maintain long lines of communication—postal, telegraphic and telephonic—for the transaction of comparatively small volumes of business. Almost anything may be achieved if the cost need not be counted.

The Post Office has managed to establish mail services of so extensive a character that it is doubtful whether there is any locality permanently inhabited by so few as two or three white people which is not systematically served with letter delivery. Neither the telegraph nor telephone can claim to be so far reaching, but as will appear later their ramifications are remarkably extensive.

The internal postal system depends upon scheduled despatches over 27,000 miles of railway and in addition makes use of 5,000 independent road services to localities which have not railway facilities. These road services are maintained under contract conditions and cover 130,000 miles of route. The frequency of the journeys varies in the aggregate from once daily to once a week with a comparatively small percentage extending to once a fortnight or slightly more. It will be realised, therefore, that the journeys during a year would total many millions of miles. Over the road routes mail matter is conveyed by motor vehicle, horsedrawn vehicle, on horse-back, pack-horse, and occasionally by camel. For many miles in the outlying parts roads are not available and somewhat indefinite tracks point the way.

Coastal vessels sailing over the entire circuit of the Continent are also used in the regular transportation of mails.

The air mail services cover roughly 6,000 miles of route, the journeys over which total 907,000 miles per annum.

Mail steamers provide a weekly mail service in each direction between Australia and the United Kingdom, these ships running to schedule so that they may effect connection with railway services and air services at various places both at the terminal ports and at intermediate calling places. Letters are landed at Fremantle and conveyed by rail to Adelaide (1,698 miles), Melbourne (2,181 miles), Sydney (2,771 miles), and Brisbane (3,384 miles).

The articles of mail matter posted in the Commonwealth total 850,000,000 per annum and the incoming items from overseas which require distribution over the whole Continent reach 36,841,000 per annum.

The telephone system comprises 492,000 telephones and apart from about 14,000 in Tasmania there is almost complete intercommunication over the whole Continent; a subscriber in Cairns, Queensland, can talk to a subscriber in Geraldton, Western Australia, over lines 4,800 miles in length, possibly a world's record for a continuous land-line circuit.

Four hundred million local and 30 million trunk line calls are established annually through 6,000 telephone exchanges by the use of 2½ million miles of wire.

The aerial lines are supported by 25 million insulators carried on 3 million poles.

199,000 telephones are provided with dials and connected to automatic exchanges.

The capital value of the telephone equipment and buildings is £43,500,000.

Direct radio telephone services are established from Australia to the United Kingdom, to New Zealand and to Java. There are few places in the world to which it is impossible to telephone from Australia. Out of a total of 35 million subscribers in the world 92 per cent. are in countries accessible to Australian subscribers and in addition it is possible to telephone to passengers aboard transatlantic liners whilst on their journey between England and the United States.

The telegraph service is conducted from 10,000 offices interconnected by 169,000 miles of circuit. It deals with 15 million telegrams per annum. Like the telephone service it has been completely modernised and uses every device which will aid in securing speedy and accurate service with lessened cost. Automatic direct printing telegraph apparatus is used extensively and long distance circuits, such as Perth to Sydney (2,770 miles), are equipped with this system. The typing of a message on a typewriter keyboard in Perth results in an almost simultaneous replica being produced in Sydney.

Carrier circuits which are derived by impressing a continuous train of moderately high frequency electrical oscillation on a metallic circuit have been established extensively for both telephone and telegraph purposes with great benefits from the technical, traffic and economic aspects. The various technical methods of providing for the simultaneous transmission of a number of messages over one metallic circuit have been exploited to the utmost. As a case in point, over one pair of wires between Sydney and Melbourne 36 telegrams are transmitted by machine printing system simultaneously with a telephone conversation. If the traffic offering were sufficient to warrant more carrying capacity the output could be increased to 88 telegrams and one simultaneous telephone conversation.

Pictures of high quality are also transmitted over 600 miles of carrier circuit between Melbourne and Sydney and it is possible for a photograph of, say, a Melbourne Cup to be available in Sydney within about an hour of the running of the race.

Broadcasting services also are of an extensive character. They are divided into two groups. One comprises the national service—Government owned—the programmes being supplied by the Australian Broadcasting Commission and the technical services by the Post Office, the other consisting of licensed stations operated by private enterprise. There are eight national stations in the capital cities and four in the country areas. The number of regional stations in the country areas will be added to substantially in the near future. These stations form a network designed to provide extensive coverage and on completion of the scheme will be sufficient to service effectively about 95 per cent. of the total population.

The land line telephone circuits have been equipped to make them suitable for broadcasting transmissions, and any desired grouping of broadcasting stations can thus be arranged for the simultaneous radiation of any particular programme. From the Rockhampton station in Queensland to the Perth station in Western Australia the circuit distance is 3,800 miles and on several occasions programmes have been simultaneously broadcast at these extreme distances with many other of the intermediate broadcasting stations transmitting the same programme at the same time.

The privately owned group consists of 46 broadcasting stations which are distributed in the more densely populated areas of the Commonwealth. Frequently, by mutual arrangements amongst the managements of a number of these stations, extensive simultaneous broadcasting is effected. In a recent instance there were no less than 42 privately owned stations simultaneously transmitting by means of the Post Office telephone trunk system an opera from one of the Melbourne theatres.

The Post Office employs 40,000 people to conduct its postal, telephone, telegraph and radio activities. In 1931-32 its working expenses were £9,180,000, and its earnings £12,482,000, and its turnover £138,383,000. The capital value of fixed assets and plant on 30th June, 1932, was £52,634,000.

RATES OF POSTAGE

Within the Commonwealth and to Lord Howe Island, Norfolk Island, Papua, the Territory of New Guinea, and the following islands in the Pacific, viz.: Bismarck Archipelago (New Britain, New Ireland, New Hanover, Admiralty Islands, etc.), Nauru, Bougainville, and Buka (Solomon Islands).

Letters and Lettercards.—2d. per oz.

Postcards—1½d. each.

Second Class Matter—(a) Commercial Papers, Patterns, Samples and Merchandise, 1d. per 2 oz., (b) Printed Matter (comprising Printed Papers, Circulars and Catalogues, and Books, Periodicals and Newspapers not registered at a General Post Office) 1d. per 4 oz.

NOTE.—Commercial Papers include partly printed routine communications as prescribed, and formal documents such as accounts, invoices, etc.

Printed Matter includes wholly printed communications such as acknowledgments of the receipt of correspondence, orders or remittances, and notifications of the despatch of goods, etc., also catalogues containing samples of material subject to prescribed conditions.

Permit Mail, i.e., large quantities of circular letters posted in sealed envelopes under permit previously obtained—Printed matter rate plus special fee of ½d. per article.

Third Class Mail Matter (comprising books, periodicals and Newspapers registered at a General Post Office for transmission as such).—1d. per 6 oz.

Beyond the Commonwealth.—Letters and Lettercards. To places within the British Empire, and to New Hebrides, Banks and Torres Islands.—2d. per oz.

To all other places.—3d. first oz., 2d. each additional oz.

Postcards.—To places within the British Empire and to New Hebrides, Banks and Torres Islands.—1½d. each.

To all other places—2d. each.

Commercial Papers.—To New Zealand and the islands annexed thereto, and Fiji—1d. per oz.

To all other places.—1d. per 2 oz., with a minimum of 3d.

Printed Matter.—To places within the British Empire, and to New Hebrides, Banks and Torres Islands—1d. per 4 oz.

To all other places—1d. per 2 oz.

Newspapers.—To New Zealand and the islands annexed thereto, and Fiji—1d. per 6oz.

To the United Kingdom and Irish Free State.

via France or America.—1d. per 4 oz.
via All Sea Route. —1d. per 6oz.

To all other places Printed Matter Rates apply.

Samples.—To places within the British Empire, and to New Hebrides, Banks and Torres Islands.—1d. per 2 oz.

To all other places.—1d. per 2 oz., with a minimum of 2d.

Merchandise.—To New Zealand and the Islands annexed thereto, and Fiji only.—1d. per 2 oz.

Small Packets (transmissible to certain countries only).—2½d. per 2 oz., with a minimum of 6d.

Postal Notes.—1/- to 2/6, 1d.; 3/- to 5/-, 1½d.; 5/6 to 7/6, 2d.; 10/- to £1, 3d.

COMMONWEALTH
Telegraph Information

Urgent Rate Telegrams. Urgent rate telegrams are treated with the utmost expedition at all stages, being given precedence over ordinary rate telegrams.

Ordinary Rate Telegrams. The ordinary rate telegram constitutes the normal telegraph service. The Department aims at giving a uniformly high grade of service in the treatment of this class of telegram.

Press Telegrams. Press telegrams are transmitted at specially low rates.

Lettergrams. Lettergrams are accepted at any hour, at telegraph offices which are open after 7 p.m., for delivery as letters on the following day. Exceptionally low rates—½d. per word with a minimum charge of 1/3d. for 30 words—are applied to these messages.

Multiple Telegrams. A telegram addressed to a number of persons at one telegraph destination is accepted at greatly reduced rates. The sender need prepare only one copy of the telegram and a list of addresses for delivery in any one town or locality served by the same telegraph office. Each addressee receives a separate copy of the telegram.

Reply-Paid Telegrams. The sender of a telegram may prepay the charge for a reply.

Collect Telegrams. The charge for a telegram may be collected on delivery if the sender gives a guarantee.

Acknowledgment of Delivery. The sender may obtain an acknowledgment of delivery.

Local Telegrams. Messages may be lodged for delivery to places within the delivery area of the telegraph office, the charge being 16 words for 9d., each additional word 1d.

Repetition Telegrams. A sender may have his telegram repeated back to him from the office of destination.

Registered Telegraphic Code Address. Telegraph code addresses may be registered, the fee for Commonwealth telegrams being £2 2s. 0d. per annum and for International telegrams 10s. 6d. per annum.

Deposit Accounts for Telegrams. Under the Deposit Account System the charges on telegrams lodged may be paid periodically instead of payment being made for each individual message at time of lodgment.

Transmission of Telegrams by Telephone. Telegrams and lettergrams may be telephoned to a telegraph office for onward transmission. Telegrams addressed to a telephone number will be telephoned to the addressee.

Radiotelegrams. Messages may be lodged at any telegraph office for transmission to vessels at sea, the rates varying from 6d. to 11d. per word.

Telegraph Rates Within the Commonwealth

Ordinary Telegrams	Town and suburban, or within 15 miles of sending station (within the State).	Other places within the State	Interstate.
Not exceeding 16 words (including address and signature ....)	9d.	1/-	1/4
Each additional word	1d.	1d.	1d.

Urgent Rate Telegrams. Double the ordinary rates. Double rates are also charged on Sundays, Christmas Day, Good Friday and after hours.

Lettergrams. Not exceeding 30 words 1/3
Each additional word ..... ½d.
(Double rates on Sundays, Christmas Day and Good Friday.)

To the United Kingdom

Classification.	Rate per Word. By Cable via Pacific or via Eastern.	Rate per Word. By Wireless via Beam
	s. d.	s. d.
Ordinary rate	2 0	1 8
Urgent rate	4 0	3 4
Deferred	1 0	0 10
Daily letter telegram	0 8	0 6 2-3
	(Minimum charge 16 8d.)	(Minimum charge 13 11d.)

Picturegrams. Pictures, photographs and documents may be transmitted by the picturegram service between Melbourne and Sydney, the charges for a picturegram 4 in. X 4 in. are 35s. (A grade) and 30s. (B grade); for a picturegram 7 in. X 5 in. the charges are 45s. (A grade) and 35s. (B grade); while the rates for a picturegram 7 in. X 10 in. represent 60s. (A grade) and 40s. (B grade).

Telephone Services and Rates

Exchange Services

The base annual rental for an exclusive service to any exchange situated within the telephone networks of the various State capital cities is—

Sydney and Melbourne	£5 10 0
Brisbane, Adelaide and Perth	£5 7 6
Hobart	£4 17 6

The tariff for a service installed in a private residence and which is used substantially for social and domestic purposes is £1 less in each case.

The rentals for services connected to country exchanges are lower and they vary according to the number of subscribers with whom a subscriber may converse without payment of trunk line fees.

Auxiliary Facilities

Private branch exchanges, private lines, extension services, fire alarm lines, and burglar alarm circuits are provided, the charges being dependent upon the nature and extent of the service. Full information regarding the facilities obtainable and the rates therefor may be obtained from the Superintendent, Telephone Branch, in each capital city.

Local Calls

The charge for each effective local call is:—

Metropolitan networks—

Business service—1¼d. each.

Residence service—1½d. each for the first 240 calls in any quarterly accounting period; or the first 480 calls in any half-yearly accounting period if the accounts are issued at six-monthly intervals. 1¼d. each for additional calls.

Country districts—

Where not more than 300 subscribers' lines are available at the unit fee—1d. each. In other cases—1½d. each.

The charge for a local call from a public telephone is uniformly 2d.

Trunk Line Calls

Calls on week days are charged for at the rates shown in the following table:—

Radial distances between exchanges or networks not exceeding—	Each **three minutes** or part thereof. (Between 9 a.m. and 6 p.m.) Day rate.	(Between 6 p.m. and 9 p.m. and 7 a.m. and 9 a.m.) Intermediate Rate.	(Between 9 p.m. and 7 a.m.) Night rate.
	s. d.	s. d.	s. d.
10 miles	0 2	0 2	**0 2**
20 ,, ...	0 4	0 4	**0 4**
30 ,, ...	0 6	0 5	0 4
40 ,, ...	0 8	0 6	0 4
50 ,, ...	0 10	0 8	0 5
60 ,, ...	1 0	0 9	0 6
80 ,, ...	1 3	1 0	0 8
100 ,, ...	1 6	1 2	0 9
150 ,, ...	2 0	1 6	1 0
200 ,, ...	2 6	1 11	1 3
250 ,, ...	3 0	2 3	1 6
300 ,, ...	3 6	2 8	1 9
350 ,, ...	4 0	3 0	2 0
400 ,, ...	4 6	3 5	2 3
500 ,, ...	5 3	4 0	2 8
600 ,, ...	6 0	4 6	3 0
700 ,, ...	6 9	5 1	3 5
800 ,, ...	7 6	5 8	3 9
900 ,, ...	8 3	6 3	4 2
1000 ,, ...	9 0	6 9	4 6
Each additional 150 miles or portion thereof	1 0	0 9	0 6

The rates specified are in addition to the unit call fee.

On Sundays, Christmas Day and Good Friday the rates are equal to those charged on other days, excepting that the normal day rate applies between 7 a.m. and midnight. There is no intermediate rate, and the night rate applies only to calls between midnight and 7 a.m.

Where a call is ordered for connection to a particular person at the required number a person-to-person fee of 3d. on calls of 100 miles or less and 6d. on calls beyond 100 miles is charged.

Calls may be made to residents who are not telephone subscribers. If practicable, the Department will send a messenger to advise the called party that he is required on the telephone. A fee of 3d. is charged when the person resides within the usual radius of free delivery of telegrams; beyond that distance the porterage fees for the delivery of telegrams are charged in addition to the fee of 3d; alternatively, advice that his attendance is desired at the telephone will be delivered to the resident with his mail matter. The person-to-person fee is charged in each case.

Overseas Radio Telephone Services, as at 31/1/34.

Canadian and American Telephone Zones

CANADA (via Montreal).

First Zone:

Province of Quebec and the South-eastern portion of the Province of Ontario, including Ottawa, Toronto, Hamilton, Kingston, and Niagara Falls.

Second Zone:

Provinces of New Brunswick, Nova Scotia, and Manitoba, Prince Edward Island, and the Western half of the Province of Ontario, including Brantford, Fort William, London, and Windsor.

Third Zone:

Provinces of Alberta and Saskatchewan.

Fourth Zone:

Province of British Columbia.

United States of America (via New York)

First Zone:

States of Connecticut, Delaware, Florida, Georgia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Vermont, Virginia, and West Virginia, and District of Columbia.

Second Zone:

States of Alabama, Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Michigan, Mississippi, Missouri, Ohio, Tennessee, Minnesota, and Wisconsin.

Third Zone:

States of Colorado, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming.

Fourth Zone:

States of Arizona, California, Idaho, Nevada, Oregon, Utah, and Washington; Mexico and Cuba.

South America (via Buenos Aires)

First Zone:

ARGENTINA—City and Province of Buenos Aires.

Second Zone:

The remainder of Argentina; URUGUAY—Colonia, Montevideo, Rosario, and Colonia Suiza only.

Third Zone:

CHILE—Valparaiso, Vina del Mar, and Central Santiago only.

Countries With Overseas Telephone Service Limited to Certain Towns

Canary Islands.

The Islands of Grand Canary and Teneriffe only.

Egypt (via Cairo).

Alexandria, Assouan, Cairo, Luxor, and Port Said only.

India (via Poona).

Akola, Amraoti, Bombay, Calcutta, Delhi, Indore, Mahabaleshwar, Matheran, Nagpur, Poona and Simla.

Palestine (via Cairo).

Gaza, Haifa, Jaffa, and Jerusalem.

South Africa (via Cape Town).

Bloemfontein, Cape Town, De Aar Junction, Durban, Johannesburg, Kimberley, Pietermaritzburg, Port Elizabeth, Pretoria, and the principal towns within the triangle bounded by Cape Town, De Aar Junction, and Port Elizabeth.

Trans-Atlantic Ships

"Empress of Britain," "Homeric," "Leviathan," "Majestic," and "Olympic" whilst at sea.

OVERSEAS RADIO TELEPHONE SERVICES

Countries to Which Telephone Service from Australia may be Obtained

Country	Date Service was Opened	Minimum Charge (3 minutes' conversation)	Each Extra Minute	Report Charge
		£ s. d.	£ s. d.	£ s. d.
Argentina (Buenos Aires Province)	8/4/31	9 0 0	3 0 0	1 0 0
,, (other towns)	8/4/31	9 18 0	3 6 0	1 0 0
Austria	26/5/30	6 12 0	2 4 0	0 16 0
Balearic Islands (Majorca Is. only)	22/7/32	6 18 0	2 6 0	0 18 0
Belgium	14/5/30	6 6 0	2 2 0	0 14 0
Brazil (Rio de Janeiro only)	9/9/31	9 0 0	3 0 0	1 0 0
*Canada—				
1st zone	31/10/30	9 0 0	3 0 0	1 0 0
2nd ,,	31/10/30	9 12 0	3 4 0	1 0 0
3rd ,,	31/10/30	10 4 0	3 8 0	1 0 0
4th ,,	31/10/30	10 16 0	3 12 0	1 0 0
†Canary Islands	22/7/32	7 10 0	2 10 0	1 2 0
*Chile	8/4/31	10 16 0	3 12 0	1 0 0
Cuba	27/10/30	10 16 0	3 12 0	1 0 0
Czecho-Slovakia	23/5/30	6 12 0	2 4 0	0 16 0
Danzig Free City	22/5/30	6 12 0	2 4 0	0 16 0
Denmark	16/5/30	6 12 0	2 4 0	0 16 0
†Egypt	19/9/32	7 4 0	2 8 0	0 16 0
Finland	20/6/30	7 13 0	2 11 0	1 3 0
France	12/6/30	6 6 0	2 2 0	0 14 0
Germany	19/5/30	6 12 0	2 4 0	0 16 0
Gibraltar	28/6/30	6 18 0	2 6 0	0 18 0
Great Britain	30/4/30	6 0 0	2 0 0	0 12 0
Holland	15/5/30	6 6 0	2 2 0	0 14 0
Hungary	27/5/30	6 18 0	2 6 0	0 18 0
†India	22/5/33	9 0 0	3 0 0	1 0 0
Irish Free State (Dublin only)	3/2/31	6 6 0	2 2 0	0 14 0
Italy	21/7/30	6 18 0	2 6 0	0 18 0
Java	23/12/30	6 0 0	2 0 0	0 12 0
Jugo-Slavia	1/12/33	6 18 0	2 6 0	0 18 0
Latvia	1/4/31	6 18 0	2 6 0	0 18 0
Lithuania	1/8/30	6 18 0	2 6 0	0 18 0
Luxemburg	22/5/30	6 6 0	2 2 0	0 14 0
Mexico	27/10/30	10 16 0	3 12 0	1 0 0
Morocco (Ceuta only)	22/7/32	7 4 0	2 8 0	1 0 0
New Zealand	25/11/30	3 0 0	1 0 0	0 6 0
Northern Ireland (and Isle of Man)	30/4/30	6 6 0	2 2 0	0 14 0
Norway	21/5/30	6 18 0	2 6 0	0 18 0
†Palestine	7/4/33	7 10 0	2 10 0	0 18 0
Poland	22/5/30	6 18 0	2 6 0	0 18 0
Portugal (Lisbon only)	5/12/32	6 18 0	2 6 0	0 18 0
Roumania	9/11/31	7 16 0	2 12 0	1 4 0
†South Africa	26/6/33	9 0 0	3 0 0	1 0 0
*South America—				
1st zone	8/4/31	9 0 0	3 0 0	1 0 0
2nd ,,	8/4/31	9 18 0	3 6 0	1 0 0
3rd ,,	8/4/31	10 16 0	3 12 0	1 0 0
Spain	28/6/30	6 18 0	2 6 0	0 18 0
Sweden	20/5/30	6 18 0	2 6 0	0 18 0
Switzerland	13/5/30	6 12 0	2 4 0	0 16 0
†Trans-Atlantic Ships	1/11/31	7 4 0	2 8 0	0 16 0
*Uruguay	8/4/31	9 18 0	3 6 0	1 0 0
*U.S.A.—				
1st zone	27/10/30	9 0 0	3 0 0	1 0 0
2nd ,,	27/10/30	9 12 0	3 4 0	1 0 0
3rd ,,	27/10/30	10 4 0	3 8 0	1 0 0
4th ,,	27/10/30	10 16 0	3 12 0	1 0 0
Vatican State	6/4/31	6 18 0	2 6 0	0 18 0

* See details of zones on page 3.
† See page 4 for further details.

At present for calls other than to New Zealand and Java a sur-charge of 1/6 in the pound, assessed on the total cost of the call, is added over exchange.

Mr. Reader! Your suggestions in regard to any improvement that might be made in this Radio Trade Annual next year, will always be welcomed by the publishers, Box 3765 G.P.O., Sydney, N.S.W.

Important Facts Revealed in P.M.G.'s 22nd Annual Report for 1931-1932

The Twenty-Second Annual Report of the Postmaster-General's Department covering the period of 1931-1932 Financial Year contains many interesting facts relating to Broadcasting Activities

(This was issued too late for inclusion in the 1933 Radio Trade Annual)

Capital Investment. Amount expended and charged to capital account for Wireless equipment during the year was £35,190.

Profit and Loss. The accounts of the Wireless Branch show a surplus of £30,932 compared with surplus of £35,148 for 1930-31.

Revenue Collection. The Department's proportion of listener's fees collected amounted to £168,197 and the expenditure was £72,422. The excess of revenue collected over expenditure being £95,775.

Trunk Line Channels Used. During period 1/7/31 to 30/6/32, trunk line channels were utilised on 1365 separate occasions to permit simultaneous broadcasts from two or more stations. The National Service used 914 and the "B" stations 451.

New Stations. During this period, three additional regional stations were opened, viz.:—

4RK Rockhampton (Queensland) on July 29th, 1931.
2CO Corowa (N.S.W.), on December 16th, 1931.
5CK Crystal Brook (S.A.) on March 15th, 1932.

Eight National stations were in operation at 30/6/32 in capital cities and four in country districts. Total hours of operation 43,000 per annum. Licensed "B" stations at June 30th, 1932, totalled 50, 22 being located in city areas and 28 in country districts.

Inspections and Prosecutions. The Radio Inspectors inspected 48,836 stations. Convictions against listeners not licensed totalled 598.

Radio Inductive Interference. During the period the following cases of Radio inductive interference were investigated.

	Investigated	Rectified
N.S.W.	426	380
Vic.	405	285
Queensland	115	40
S.A.	104	68
W.A.	500	250
Tas.	86	66
Total	1,636	1,089

SUMMARY OF FINANCIAL RESULTS

Wireless Branch

	N.S.W.	Vic.	Q'ld.	S.A.	W.A.	Tas.	Tot. Com. 1931-32	Tot. Com. 1930-31
Earnings	59,248	64,255	12,017	15,762	5,045	4,249	160,576	150,253
Working Expenses (exclusive of Interest)	40,251	29,243	16,353	14,890	9,007	6,399	116,143	110,827
Earnings compared with Working Expenses—Surplus	18,997	35,012	—	872	—	—	44,433	39,426
Deficit	—	—	4,336	—	3,962	2,150	—	—
Interest on Capital including Exchange thereon	4,799	1,370	3,035	2,680	1,065	552	13,501	4,278
Result, after providing for Working Expenses and Interest—Surplus	14,198	33,642	—	—	—	—	30,932	35,148
Deficit	—	—	7,371	1,808	5,027	2,702	—	—
Percentage of Working Expenses to Earnings	67.94	45.50	136.08	94.47	178.57	150.60	72.34	73.76

General Profit and Loss (Table 3)

Expenditure as per branch accounts, £116,142/13/5.
Surpluses, exclusive of interest carried down, £44,433/1/9.
Interest and exchange charges £13,501.
Surplus after charging interest, £30,932/1/9.
Revenue, £160,575/15/2.

Balance-sheet (Table No. 2)

Sundry Creditor. Wireless fees paid in advance £213,917/10/-.
Assets. Fixed and plant. Wireless equipment £129,902/1/7.

Depreciation Reserve. (Wireless Plant)

N.S.W., £2,565; Vic., £710; Q'ld., £2,349; S.A., £2,562; W.A., £682; Tas., £310; Total, £9,178.

Summary of Depreciation in Profit and Loss Account

Depreciation of stores in stock and miscellaneous plant: N.S.W., £27; Vic., £47; Q'ld., £6; S.A., £7; W.A., £3; Tas., £2; Total, £92.

Depreciation Reserve

N.S.W., £2,652; Vic., £715; Q'ld., £2,391; S.A., £2,614; W.A., £701; Tas., £324; Total, £9,397. Totals: N.S.W., £2,679; Vic., £762; Q'ld., £2,397; S.A., £2,621; W.A., £704; Tas., £326. Total for Commonwealth, £9,489.

FIXED ASSETS—Wireless Plant

DESCRIPTION.	Value on July 1, 1931	Expenditure, 1931-32	Gross Value on June 30, 1932	Dismantled Assets Depreciation written off, and Assets Transferred 1931-32	Net Value on June 30, 1932
	£	£	£	£	£
National Station Equipment	69,455	28,098	97,553	658	96,895
National Studio Equipment	14,510	3,248	17,758	360	17,398
National Miscellaneous Assets	71	3,316	3,387	92	3,295
National Studio Furniture	3,397	300	3,697	150	3,547
Other Broadcasting and Wireless Assets	8,539	228	8,767	—	8,767
Total Wireless Plant	95,972	35,190	131,162	1,260	129,902

ANALYSIS OF GENERAL PROFIT AND LOSS RESULTS—Wireless Branch

The results of working the Wireless Branch are as follow:

STATE.	1931-32 Deficit.	1931-32 Surplus.	1930-31 Deficit.	1930-31 Surplus.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
New South Wales	—	14,198 1 1	—	13,297 6 5
Victoria	—	33,642 13 4	—	36,086 5 2
Queensland	7,370 16 5	—	2,723 15 8	—
South Australia	1,808 1 8	—	408 5 8	—
Western Australia	5,027 13 9	—	9,181 14 10	—
Tasmania	2,702 0 10	—	1,921 9 11	—
	16,908 12 8	47,840 14 5	14,235 6 1	49,383 11 7
Total Net Surplus, 1931-32				£30,932 1 9
Total Net Surplus, 1930-31				£35,148 5 6

Statement of Net Revenue for Years Ended 30th June, 1930, to 1932

This statement represents actual collections for the year as shown by records kept for Treasury purposes. The earnings of the Department for the same period are shown in the Profit and Loss Accounts.

	Year ended 30th June	Radio Revenue
		£
Central Office	1932	2,729
	1931	1,858
	1930	1,425
New South Wales	1932	63,384
	1931	54,691
	1930	64,550
Victoria	1932	62,816
	1931	61,832
	1930	83,076
Queensland	1932	12,600
	1931	12,789
	1930	6,169
South Australia	1932	16,870
	1931	16,821
	1930	6,953
Western Australia	1932	5,524
	1931	4,006
	1930	4,198
Tasmania	1932	4,274
	1931	3,675
	1930	476
Totals	1932	168,197
	1931	155,672
	1930	166,847

Coastal Wireless Station

Expenditure, 1929-30 £69,800
„ 1930-31 £74,790
„ 1931-32 £72,422

TABLE No. 7

Profit and Loss Account of Wireless Branch For Year Ended 30th June, 1932

EXPENDITURE.	Percentages of Net Income.	£ s. d.	REVENUE.	£ s. d.	£ s. d.	Percentages of Net Income.	£ s. d.
Upkeep and Operation of Broadcasting Stations	23.58	37,871 3 9	Gross Revenue	—	419,726 8 11		
Upkeep and Operation of Broadcasting Studios	15.71	25,226 16 6	Less— Payments to Amalgamated Wireless Limited	51,455 14 9	—		
General Supervision and Cost of Issuing Licences	20.46	32,859 15 9	Payments to Australian Broadcasting Co. Ltd.	207,694 19 0	259,150 13 9		
Telephone Circuits used for Broadcasting and Miscellaneous Expenditure	4.33	6,941 5 9	Net Revenue: Licence Fees, Fines, &c.			100.00	160,575 15 2
	64.08	102,899 1 9					
Proportion of Administration Expenses	.69	1,110 0 0					
Depreciation (See Table 8)	5.91	9,488 11 8					
Proportion of Superannuation Liability and Pensions	1.65	2,645 0 0					
	72.33	116,142 13 5					
Surplus exclusive of Interest, carried down	27.67	44,433 1 9					
	100.00	160,575 15 2				100.00	160,575 15 2
Interest and Exchange Charges ..	8.41	13,501 0 0					
Surplus, inclusive of Interest, transferred to General Profit and Loss Account	19.26	30,932 1 9	Surplus, exclusive of Interest, brought down			27.67	44,433 1 9
	27.67	44,433 1 9				27.67	44,433 1 9

Australian Broadcasting Commission

An Act relating to Broadcasting. No. 14 of 1932. (Assented to 17th May, 1932.)

BE it enacted by the King's Most Excellent Majesty, the Senate and the House of Representatives of the Commonwealth of Australia, as follows:—

Part 1.—Preliminary.

1. This Act may be cited as the **Australian Broadcasting Commission Act, 1932.**

2. This Act shall commence on a date to be fixed by Proclamation.

3. This Act is divided into Parts, as follows:—

Part I.—Preliminary.
Part II.—Establishment and Constitution of Commission.
Part III.—Powers and Functions of the Commission.
Part IV.—Finance.
Part V.—Issue of Debentures by the Commission.
Part VI.—Miscellaneous.

4. In this Act, unless the contrary intention appears—

"Commission" means a member of the Commission;

"National broadcasting stations" means stations made available by the minister for the purpose of the transmission of the National Broadcasting Programmes;

"the Commission" means the Australian Broad casting Commission appointed under this Act; and

"the Fund" means the Australian Broadcasting Commission Fund established under this Act.

Part 2.—Establishment and Constitution of the Commission.

5. (1) For the purposes of this Act, there shall be a Commission, to be known as the Australian Broadcasting Commission, which shall be charged with the general administration of this Act.

(2) The Commission shall be a body corporate with perpetual succession and a common seal, and may acquire, hold and dispose of real and personal property and shall be capable of suing and being sued in its corporate name.

(3) All Courts, Judges and persons acting judicially shall take judicial notice of the seal of the Commission affixed to any document or notice and shall deem that it was duly fixed.

6. (1) The Commission shall consist of five Commissioners, one of whom shall be a Chairman, and one of whom shall be a Vice-Chairman.

(2) The Commissioners shall be appointed by the Governor-General, and shall hold office, during good behaviour, for the period for which they were appointed.

7. (1) Subject to this Act, the period for which the Commissioners first appointed under this Act shall hold office shall be, in the case of the Chairman, not exceeding five years, in the case of the Vice-Chairman, not exceeding four years, and in the case of each of the remaining Commissioners not exceeding three years.

(2) After the appointment of the five Commissioners first appointed under this Act, each further appointment shall be for a period not exceeding three years.

(3) Each person who is appointed a Commissioner shall, upon the expiration of the term for which he was appointed, be eligible for re-appointment.

8. (1) Subject to this section, the Commissioners shall receive such salaries and allowances as the Governor-General determines.

(2) The salaries of the Commissioners shall not exceed the following:—

in the case of the Chairman	Five hundred pounds per annum;
in the case of the Vice-Chairman	Four hundred pounds per annum; and
in the case of each other Commissioner	Three hundred pounds per annum.

9. (1) In case of the illness or absence of the Chairman, the Vice-Chairman, if present, shall act as Chairman.

(2) In case of the illness or absence of both the Chairman and the Vice-Chairman, the Commissioners present may appoint one of their number to act as Chairman:

Provided that the Governor-General may, if he thinks fit, appoint a person to act as Chairman for such period as the Governor-General specifies.

(3) If the Governor-General appoints a person to act as Chairman the appointment shall be at such salary as is determined by the Governor-General, not exceeding the maximum salary fixed by section eight of this Act.

10. (1) In case of the illness or absence of any other Commissioner, the Governor-General may, if he thinks fit, appoint a person to perform the functions of the Commissioner during such illness or absence.

(2) The salary of any person so appointed shall be determined by the Governor-General but shall not exceed the maximum salary fixed by section eight of this Act in respect of that office.

11. In the event of the absence of any Commissioner, the Governor-General may determine the conditions as to remuneration or otherwise upon which leave may be granted.

12. The Governor-General may terminate the services of a Commissioner or an acting Commissioner for inability, inefficiency or misbehaviour, or for neglect or failure to carry out any of the provisions of this Act.

13. A Commissioner shall be deemed to have vacated his office—

(a) if his appointment is terminated by the Governor-General in pursuance of this Act;

(b) if he becomes bankrupt or compounds with his creditors or makes any assignment of his salary for their benefit or takes advantage of any provision of any Act relating to bankruptcy;

Australian Broadcasting Commission Act—(Continued)—

(c) if he becomes of unsound mind;

(d) if he resigns his office by writing under his hand addressed to the Governor-General and the resignation is accepted by the Governor-General;

(e) if he absents himself (except on leave granted by the Governor-General) from all meetings of the Commission held during two consecutive months; or

(f) if he, in any way, otherwise than as a member, and in common with the other members, of an incorporated company consisting of more than twenty-five persons—

(i) becomes concerned or interested in any contract or agreement made by or on behalf of the Commission; or

(ii) participates, or claims to participate, in the profits of any such contract or agreement or in any benefit or emolument arising therefrom.

14. (1) The Commission shall hold such meetings as, in the opinion of the Chairman or at least three other Commissioners, are necessary for the efficient conduct of its affairs.

(2) At meetings of the Commission three Commissioners shall form a quorum, and the Chairman shall have a deliberative vote, and, in the event of an equality of votes, a second or casting vote.

15. (1) The Commission shall appoint a general manager and such other officers and such servants as it thinks necessary.

(2) The salaries payable to the general manager and the next six most highly paid executive officers of the Commission shall be subject to the approval of the Governor-General.

(3) Officers and servants appointed by the Commission shall not be subject to the provisions of the **Commonwealth Public Service Act,** 1922-1931, but shall be subject to such conditions (including tenure of office) as are determined by the Commission.

Part 3.—Powers and Function of the Commission.

16. The Commission shall provide and shall broadcast from the national broadcasting stations adequate and comprehensive programmes and shall take in the interest of the community all such measures as, in the opinion of the Commission, are conducive to the full development of suitable broadcasting programmes.

17. For the purpose of the exercise of its powers and functions under this Act, the Commission may compile, prepare, issue, circulate and distribute, whether gratis or otherwise in such manner as it thinks fit, such papers, magazines, periodicals, books, pamphlets, circulars and other literary matter as it thinks fit (including the programmes of national broadcasting stations and other stations):

Provided that, prior to the publication of any programme in pursuance of this section, a copy of the programme shall be made available at an office of the Commission on equal terms to the publishers of any newspaper, magazine, or journal published in the Commonwealth.

18. (1) Subject to this Act, the Commission may—

(a) acquire by lease or purchase any land, buildings easements or other property, rights or privileges which it thinks necessary for the purposes of this Act; and

(b) sell, exchange, lease, dispose of, turn to account or otherwise deal with any property, rights or privileges of the Commission.

(2) The Commission shall not, without the approval of the Minister—

(a) acquire any property, the cost of acquisition of which exceeds the sum of Five thousand pounds, or in any manner dispose of any property having an original or book value exceeding the sum of Five thousand pounds; or

(b) enter into any lease for a period exceeding five years.

19. (1) The Commission shall provide such studios, offices and other accommodation as it thinks necessary for the purposes of this Act, and such accommodation in relation to the studios as the Minister requires for the proper carrying out of the technical services to be provided by the Minister, and shall take over, as arranged by the Minister and at the valuation determined by him, any existing studios, buildings, sites, fittings, furniture or other assets controlled by the Minister which are used for broadcasting purposes, and shall accept an assignment of any leases relating thereto, and of the rights and liabilities of the Minister under any agreements relating thereto.

(2) The location of any studios to be provided by the Commission in pursuance of this section shall be subject to the approval of the Minister.

20. (1) The Commission shall transmit free of charge from all of the national broadcasting stations, or from such of them as are specified by the Minister, any matter the transmission of which is directed by the Minister as being in the public interest.

(2) The Commission shall not, without the permission of the Minister, transmit or receive for transmission any message the transmission of which would, without the authority of, or licence granted by, the Minister administering the **Post and Telegraph Act,** 1901-1923, or the **Wireless Telegraphy Act,** 1905-1919, contravene the provisions of either of those Acts.

21. (1) The Commission shall not broadcast advertisements.

(2) Nothing in this section shall be construed as preventing the Commission from broadcasting, if it thinks fit—

(a) any announcement of its own future programmes;

(b) a programme supplied by any organisation, firm or person engaged in artistic, literary, musical or theatrical production or in educational pursuits; or

(c) a programme supplied by any organisation, firm or person, provided the programme is not, in the opinion of the Commission, being used as an advertisement.

22. The Commission may collect in such manner as it thinks fit news and information relating to current events in any part of the world and may subscribe to news agencies.

Australian Broadcasting Commission Act—(Continued)—

23. The Commission shall, as far as possible, give encouragement to the development of local talent and endeavour to obviate restriction of the utilisation of the services of persons who, in the opinion of the Commission are competent to make useful contributions to broadcasting programmes.

24. The Commission shall endeavour to establish and utilise, in such manner as it thinks desirable in order to confer the greatest benefit on broadcasting, groups of musicians for the rendition of orchestral, choral and band music of high quality.

25. The Commission may, if it thinks fit, appoint Committees to advise it in relation to all or any matters connected with the provision or rendition of broadcasting programmes, or the exercise of any powers, duties or functions conferred or imposed upon it by this Act.

Part 4.—Finance.

26. (1) There shall be an Australian Broadcasting Commission Fund into which shall be paid from time to time out of the Consolidated Revenue Fund, which is hereby appropriated accordingly, an amount which represents such portion of the fees received from broadcast listeners' licences as is fixed by or under this Act.

(2) For the year commencing on the first day of July, One thousand nine hundred and thirty-two, the amount referred to in the last preceding sub-section shall be twelve shillings in respect of each broadcast listener's licence fee received, and this amount shall continue to be paid in each subsequent year unless some other amount is fixed by the Minister.

(3) The payments provided for by the preceding provisions of this section shall be made monthly, and as soon as possible after the last day of each calendar month, and shall in each case represent an amount approximating the appropriate sum relating to the licences in force during the previous month.

(4) The final adjustments shall be made as soon as conveniently possible after the end of each quarter.

(5) Any account certified by such officer of his Department as is designated for that purpose by the Minister and forwarded by the Minister to the Commission purporting to set out the sum payable to the Commission in pursuance of the foregoing provisions of this section shall be final and conclusive for all purposes.

(6) There shall also be paid into the Fund any other revenue or money received by the Commission.

(7) Income derived from the investment of any portion of the Fund shall form part thereof.

27. The moneys paid into the Fund shall be applied by the Commission as follows:—

(a) In payment of the expenses, charges and other obligations incurred or undertaken by the Commission in the exercise of its powers, duties and functions under this Act;

(b) In payment of the salaries, wages and allowances of Commissioners and of officers and servants of the Commission; and

(c) In investment in any securities of, or guaranteed by, the Government of the Commonwealth or of any State.

28. Moneys held in the Fund, uninvested by the Commission, may be lodged either in an account at call or on fixed deposit, or partly in an account at call and partly in an account at fixed deposit, with the Commonwealth Bank, and while in such Bank shall be held to be moneys of the Crown.

29. Cheques drawn on any account referred to in the last preceding section shall be signed in such manner as the Commission directs.

30. (1) For the purpose of enabling the Commission to defray any expenses incidental to its establishment and operation, the Treasurer may advance, out of the Consolidated Revenue Fund, which is hereby appropriated accordingly, such amounts not exceeding in all the sum of Thirty thousand pounds as are, in the opinion of the Minister, required by the Commission.

(2) In addition to the moneys advanced in pursuance of the last preceding sub-section, the Treasurer may advance to the Commission such sums, if any, as are from time to time appropriated by the Parliament for the purpose.

(3) The terms and conditions of any advances made in pursuance of this section, including the security and basis of re-payment shall be as determined by the Treasurer.

31. (1) The accounts of the Commission shall be subject to inspection and audit, at least once yearly, by the Auditor-General for the Commonwealth.

(2) The Auditor-General shall report to the Minister the result of each inspection and audit.

32. The Commission shall, as soon as possible after the expiration of each financial year, prepare a profit and loss statement and balance-sheet in the form prescribed, and shall forward them, together with a report on the operations of the Commission during that year, to the Minister, for presentation to both Houses of the Parliament.

33. The payment by the Commission of compensation exceeding in any individual case, One hundred pounds to members of the Commission, its officers or servants, or other bodies or persons, shall not be made without the approval of the Minister.

34. The income, property, and operations of the Commission shall not be subject to any rates, taxes or charges, under any law of the Commonwealth or a State, to which the Commonwealth is not subject.

35. (1) The Commission shall exercise the powers and functions conferred and imposed upon it by this Act, in such a manner that its operations will be financially self-supporting.

(2) The Commission shall establish such sinking funds as are in the opinion of the Treasurer, necessary to enable the Commission to meet repayment of loans and other obligations and to meet losses and depreciation in assets, and may set aside out of its revenue such sums as it thinks proper as a reserve fund for such purposes as the Commission deems desirable (not being purposes for which any sinking fund has been established).

Part 5.—Issue of Debentures by the Commission.

36. (1) Subject to this section, the Commission may, from time to time, issue debentures to such amount,

Australian Broadcasting Commission Act—(Continued)—

bearing such rate of interest and subject to such conditions, as the Treasurer and the Minister approve.

(2) The total amount of debentures so issued, and current at any one time, shall not exceed Fifty thousand pounds.

37. Debentures shall be in accordance with the form approved by the Treasurer, and shall be under the seal of the Commission and shall be signed and countersigned in such manner as the Treasurer directs.

38. The Commonwealth by this Act guarantees the payment by the Commission of the principal and interest due in respect of any debenture issued by the Commission in pursuance of this Act, and the Consolidated Revenue Fund is hereby appropriated for the purpose of this section.

39. (1) Every debenture issued in pursuance of this Act shall be payable to the bearer thereof, and shall pass by delivery only without any assignment or indorsement, and the bearer of a debenture shall have the same rights and remedies as if he were expressly named therein.

(2) At the request of the bearer of a debenture, the Commission may in lieu thereof issue to him inscribed stock of the same currency, and bearing the same interest, and transferable only in manner prescribed.

(3) At the request of the holder of any inscribed stock of the Commission, the Commission may in lieu thereof issue to him debentures of the same currency and bearing the same interest.

40. The Commission may sell debentures, or cause them to be sold, at such times and at such places and in such sums and on such conditions as the Treasurer approves.

41. A trustee, executor or administrator may invest any trust moneys in his hands in the purchase of debentures issued by the Commission.

42. (1) Any person who, with intent to defraud—

(a) forges any security of the Commission, or
(b) utters any forged security of the Commission, or
(c) makes any instrument for forging any security of the Commission, or
(d) has in his possession any such intrument, or
(e) has in his possession any forged security of the Commission,

shall be guilty of an indictable offence.

Penalty: Imprisonment for ten years.

(2) Any person who, without authority, proof whereof shall lie upon him—

(a) makes any form of security of the Commission,
(b) has in his possession any form of security of the Commission, or
(c) makes or has in his possession any instrument or thing by which any distinctive mark or signature on any security of the Commission may be made or imitated,

shall be guilty of an offence.

Penalty: Imprisonment for two years.

(3) In this Part "security of the Commission" means any Commission debenture, Commission inscribed stock, or any coupon, warrant or document for the payment of interest thereon, and includes any transfer of any Commission inscribed stock, and any indorsement on any coupon, warrant or document for the payment of interest on any security of the Commission.

43. All forged securities of the Commission, and all unauthorised forms of security of the Commission, and all unauthorised instruments and things by which any distinctive mark or signature on any security of the Commission, may be unlawfully made or imitated, shall be forfeited to the King and may be seized by any member of the police force of the Commonwealth or of a State.

Part 6.—Miscellaneous.

44. The Postmaster-General shall undertake the provision and operation of all technical services associated with the transmission of programmes, including any transmission and reception for the interchange of programmes with other broadcasting administrations which is mutually agreed upon between the Commission and the Postmaster-General.

45. (1) For the purpose of providing and operating the technical services referred to in this Act, the Postmaster-General, or any person acting under the authority of the Postmaster-General, may—

(a) erect, place and maintain any electric line which is, in the opinion of the Postmaster-General, necessary for conveying electric current to a Broadcasting station, and in respect of the erection, placing and maintenance of any electric line, the Postmaster-General and any person acting under his authority shall have the same powers, and be subject to the same obligations, as are conferred or imposed under Part IV. of the **Post and Telegraph Act**, 1901-1923, in relation to the erection, placing and maintenance of telegraph lines; and
(b) arrange for and obtain from any person the supply of any electric current which, in the opinion of the Postmaster-General, is necessary or advisable for the working of any broadcasting station or the operation of any apparatus for the transmission or reception of programmes.

(2) In this section "electric line" includes all means used for the purpose of conveying, transmitting, transforming or distributing electricity and any casing, coating, covering, tube, tunnel, pipe, pillar, pole, post, frame, bracket or insulator enclosing, surrounding, or supporting the same or any part thereof or any apparatus connected therewith.

46. The Postmaster-General shall provide free of cost to the Commission—

(a) the transmissions emanating from recognised National Broadcasting Service studios which are to be radiated from the national broadcasting stations, including such simultaneous transmissions from two or more stations as are mutually agreed upon; and
(b) microphones, pick-up equipment and all other necessary portable apparatus for occasional or periodical transmission from various places within the Commonwealth.

47. The Postmaster-General shall provide, at the expense of the Commission—

Australian Broadcasting Commission Act—(Continued)—

(a) for the installation and operation of the apparatus referred to in paragraph (b) of the last preceding section;
(b) the circuits required to connect the various pick-up points with the recognised relevant studios; and
(c) apparatus required permanently for pick-up purposes or for other purposes affecting the rendering of programmes where such apparatus is to be installed at any place other than a recognised National Broadcasting Service studio.

48. Notwithstanding anything contained in this Act, the Commission shall not be empowered to enter into any agreement involving any expenditure in excess of Five thousand pounds, or extending over a period of more than five years, unless the approval of the Minister thereto has first been obtained.

49. The Commission shall at all times indemnify and keep indemnified the Postmaster-General against any action claim or demand brought or made by any person against the Postmaster-General or against any officer of the Postmaster-General's Department in respect of any act done by the Postmaster-General or by such officer on behalf, at the request, or in the interests, of the Commission.

50. The control of the provision and rendition of broadcasting programmes by the Commission shall commence on the first day of July one thousand nine hundred and thirty-two, but the Commission may exercise, prior to that date, any powers or functions conferred on it by this Act for the purpose of enabling it to assume full control on that date.

51. (1) The Minister may from time to time, by notice in writing, prohibit the Commission from broadcasting any matter, or matter of any class or character, specified in the notice, or may require the Commission to refrain from broadcasting any such matter.

(2) The Minister may at any time revoke or vary any requirement made in pursuance of the last preceding sub-section.

52. The Commission shall have the power to determine to what extent and in what manner political speeches may be broadcast.

53. The Governor-General may, whenever any emergency has arisen, which, in his opinion, renders it desirable in the public interest so to do, authorise the Minister to exercise during the emergency complete control over the matter to be broadcast from the national broadcasting stations, and, thereupon and so long as the emergency continues such persons as are thereto authorised in writing by the Minister shall have access at all times to any premises controlled by the Commission and may exercise full authority over all rights and privileges possessed by the Commission.

54. Nothing in this Act shall be deemed to diminish or affect the rights of any person under any contract or agreement made prior to the commencement of this Act to which the Commonwealth is a party.

55. The Governor-General may make regulations, not inconsistent with this Act, prescribing all matters required or permitted to be prescribed, or which are necessary or convenient to be prescribed, for carrying out or giving effect to this Act and in particular for providing for the issue, inscription, transfer, transmission, and redemption of inscribed stock of the Commission, and all matters in relation thereto.

AMALGAMATED WIRELESS

Agreement with Commonwealth Government— Wireless Agreement No. 37 of 1927.

An Act to approve the Agreement made between His Majesty's Government of the Commonwealth of Australia and Amalgamated Wireless (Australasia) Limited. (Assented to 22nd December, 1927.)

BE it enacted by the King's Most Excellent Majesty, the Senate, and the House of Representatives of the Commonwealth of Australia, as follows:—

1. This Act may be cited as the **Wireless Agreement Act**, 1927.

2. The Agreement made between His Majesty's Government of the Commonwealth of Australia and Amalgamated Wireless (Australasia) Limited (a copy of which is set forth in the Schedule to this Act) is approved.

3. The Consolidated Revenue Fund is hereby appropriated for the purpose of this Act to the extent necessary for the purpose of carrying out the Agreement on the part of the Commonwealth.

The Schedule

AN AGREEMENT made the fifteenth day of November One thousand nine hundred and twenty-seven between THE COMMONWEALTH OF AUSTRALIA (hereinafter called "the Commonwealth") of the one part and AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED of Sydney in the State of New South Wales (hereinafter called "the Company") of the other part WHEREBY it is agreed as follows:—

Part 1.—Preliminary.

1. This Agreement shall have no force or effect and shall not be binding upon either party unless and until it is approved by the Parliament of the Commonwealth of Australia.

2. This Agreement shall commence and come into full force and effect upon the date upon which it is so approved by the Parliament of the Commonwealth of Australia.

3. This Agreement shall be read and construed as supplemental to and amending the existing Agreements between the same parties dated the 29th March, 1922, and 20th August, 1924, respectively, and unless the context otherwise requires, as one with the said existing Agreements.

4. (1) In this Agreement, unless the context otherwise requires—

"Commercial Wireless Services" includes wireless telegraphy, wireless telephony and all further developments of wireless transmission or reception for commercial purposes;

"Post and Telegraph Act" means the **Post and Telegraph Act,** 1901-1923, and includes any amendments thereof;

"Principal Agreement" means the Agreement dated the 28th March, 1922, made between the parties hereto as amended by the Agreement of the 20th August, 1924, between the same parties;

"Wireless Telegraphy Act" means the **Wireless Telegraphy Act,** 1905, and includes any amendments thereof;

"Wireless telephone broadcasting station" means a station operating under licence under the Wireless Telegraphy Act for the purpose of the transmission of speech or music intended for simultaneous reception by all listeners as distinct from point to point communication.

(2) In this Agreement the words "terminal charges," "transit charges" and "land-line charges" have the same meanings respectively as in the International Telegraph Convention and Regulations thereunder and the International Radio-Telegraph Convention and Regulations thereunder.

Part 2.—Provisions Relating to Broadcasting and to the Use of Patents

This Part 2 of the Agreement was terminated as from March 1st, 1934.

Part 3.—General Provisions.

12. (1) The Company shall retain all stations taken over by it under Clause 5 (h) of the Principal Agreement (hereinafter referred to as the "said Stations") and shall complete, within three years from the commencement of this Part, the reorganisation of the said stations, including the modernisation of the equipment of the said stations, and shall continue to operate those stations in accordance with the Principal Agreement and this Agreement.

(2) In lieu of the method of payment for the said stations which is set out in Clause 6 of the Principal Agreement, the Company shall, on completion of the transfer of the said stations, pay to the Commonwealth the amount of the assets valuation thereof namely the sum of £56,500, the method of payment to be by deduction from payments due by the Commonwealth to the Company.

(3) As from 28th March, 1927, the Commonwealth shall pay to the Company as a contribution towards the maintenance of the said stations an annual subsidy of £45,000 per annum, and the Company shall pay to the Commonwealth thirty per centum of the revenue earned by the Company in the continuance of the services which were carried on by the said stations at the commencement of the Agreement made on the 28th. day of March, 1922, between the parties to this Agreement.

(4) For the purposes of the last preceding sub-clause revenue earned by the Company from traffic of a kind which would at the commencement of the Principal Agreement have been carried on by one or more of the said stations, but which is diverted by the Company to another station, shall be deemed to be revenue earned by the Company in the continuance of the services which were carried on by the said stations at the commencement of the Agreement made on the 28th day of March, 1922, between the parties to this Agreement.

(5) The second paragraph of Clause 7 of the Principal Agreement is amended by omitting the words "seven years" and inserting in their stead the words "five years."

13. In operating the stations referred to in the Principal Agreement, and in establishing and operating any new stations which may be licensed by the Commonwealth, the Company shall comply with the provisions of any International Radio Convention, International Telegraph Convention, and International Convention for the Safety of Life at Sea, to which the Commonwealth is for the time being a party, and the Wireless Telegraphy Act. In particular, the Company shall comply, as from 28th March, 1926, with the requirements of the Telegraph Convention and the Radio Convention concerning the fixing and the payment to the Commonwealth of terminal or transit or land line charges on all messages received at or despatched from the Company's wireless stations.

14. (1) Clauses 4 and 13 of the Principal Agreement are hereby defined to mean that the Company is entitled, subject to the terms of the licences granted or to be granted by the Commonwealth to the Company, and to the provisions of any International Radio Convention, or International Convention for the Safety of Life at Sea to which the Commnwealth is for the time being a party, and to the Wireless Telegraphy Act, to establish and operate commercial wireless services between Australia and ships at sea, between Australia and commercial or private aircraft (except aircraft trading or operating exclusively within Australia), between Australia and any Territory under the authority of the Commonwealth (not being part of the Commonwealth), and between Australia and other countries, and to negotiate and enter into agreements for the conduct of such wireless services, and in such cases the licences and permits (other than licences for wireless telephone broadcasting stations and dealers' licences) shall be free of charge.

(2) Nothing in this clause shall affect the provisions of the Principal Agreement as regards feeder stations or the development and manufacture or sale of wireless apparatus by the Company.

(3) Notwithstanding anything contained in sub-clause (1) of this Clause the Commonwealth retains the right to determine whether or not any service which the Company proposes to carry on in addition to the proposed services between Australia and Fiji and any service which is in existence at the date on which this Agreement is approved by the Parliament are necessary in the public interest.

(4) Clause 5 (h) of the Principal Agreement is hereby defined as including an obligation on the Company to transmit and receive all official meteorological messages, and such messages shall in each year be transmitted and received by the Company without charge until the number of words contained in those messages exceeds by five per centum the number of words contained in similar messages transmitted and received by the Company free of charge during the previous year.

(5) Notwithstanding anything in Clause 11 of the Principal Agreement, the fixation of all rates for traffic to be charged by the Company shall be subject to the approval of the Commonwealth.

(6) Clause 15 of the Principal Agreement is hereby defined to mean that the Commonwealth shall not impose any conditions or restrictions of any kind upon the Company which exceed the conditions and requirements of the International Radio Convention, the International Telegraph Convention, the Wireless Telegraphy Act and the Post and Telegraph Act, and no Department of the Commonwealth shall carry on any commercial wireless service in competition with the Company.

(7) Clauses 17 and 18 of the Principal Agreement are to be read and construed as if the words "the Prime Minister" and "the Prime Minister of the Commonwealth" were deleted and the words "the Minister for the time being administering the Wireless Telegraphy Act" were substituted therefor.

(8) Clause 4 of the agreement of 20th August, 1924, between the parties to this Agreement is to be read and construed as if the words "and will pay to the Postmaster-General such amounts as may be due at standard tariff rates in respect of messages handled by the Post Office" were deleted.

15. (1) The Commonwealth shall, if so requested by the Company, provide for the Company the necessary land line connections for the operation of its wireless stations and shall transmit over the internal communication service of the Commonwealth any overseas messages handed in by the public at any post office or handed over to the Commonwealth by the Company for such transmission and the Company shall pay to the Commonwealth for such line and such services the usual rates charged by the Commonwealth.

Provided that no charge shall be made to the Company for lines from the Company's coastal stations to the local post office, or, at the Company's option, to the Company's local office, and provided that in all cases where terminal transit or land line charges are paid to the Commonwealth in accordance with Clause 13 of this Agreement no further charge shall be made for transmission of messages over the internal communication service of the Commonwealth.

(2) In this Clause "overseas messages" means messages received from or intended for transmission to—

(a) a ship; or

(b) a place outside Australia; or

(c) commercial or private aircraft (other than aircraft trading or operating exclusively within Australia).

16. (1) The Company shall be entitled at all times, subject to the requirements of the Post and Telegraph Act, to accept from and deliver to the public through its own offices and agencies any overseas messages intended for transmission or received for delivery through its commercial wireless services and to relay such messages from one part of the Commonwealth to another through its wireless stations and/or land line connexions as it may consider most expedient, and where necessary, to a ship at sea, subject to payment of the terminal and/or transit charges, and the Company shall also be entitled to exchange, free of terminal, transit and land line charges, service messages among its wireless stations, but the Company shall not, otherwise than as provided in this Agreement, transmit or receive inland messages unless required by the Commonwealth in cases of interruption to line circuits.

(2) In this Clause—

"Overseas messages" means messages received from, or intended for transmission to—

(a) a ship; or

(b) a place outside Australia; or

(c) commercial or private aircraft (other than aircraft trading or operating exclusively within Australia);

"Service messages" means not only service telegrams as defined in the Regulations under the International Telegraph Convention and in the Regulations under the International Radio Convention, but also includes any messages relating to the general conduct and supervision of the service, and to experimental work carried on by the Company.

17. The Company shall at all times, subject to the conditions of the necessary licence, be permitted to conduct research and experimental work for the further development of wireless and to establish and operate wireless stations and apparatus for the purpose of such research and experimental work, provided that the Company shall take all reasonable precautions to avoid interference with other wireless services.

18. (1) All the stations and services licensed in accordance with this Agreement and the Wireless Telegraphy Act shall be subject to inspection by any officer of the Commonwealth thereto authorised in writing by the Minister for the time being administering the Wireless Telegraphy Act, and the Company shall supply to the Commonwealth such particulars of the traffic as the Commonwealth from time to time requires.

(2) Any information obtained by any authorised officer in pursuance of sub-clause (1) of this Clause shall be used only for the purpose of administration of the Wireless Telegraphy Act, and the Post and Telegraph Act, and this Agreement, or any proceeding relating thereto.

19. In any wireless telephone service licensed by the Commonwealth and established by the Company in accordance with Clause 14 of this Agreement, the Company shall have the same facilities as herein provided for wireless telegraph services, and the Company shall pay the aforesaid terminal and/or transit charges in the case of written messages, and in the case of personal conversation between members of the public the Company shall pay such terminal charges as are fixed by the Commonwealth.

Part 4.—Other Provisions

20. Clause 20 of the Principal Agreement shall apply in like manner in relation to any disagreement arising between the Commonwealth and the Company under this Agreement as it applies in relation to disagreements arising under the Principal Agreement.

21. All rights granted to the Commonwealth or to any broadcasting station, broadcast listener, radio dealer, manufacturer, or newspaper, under Part II. of this Agreement shall cease immediately upon the determination of that Part, and the Company shall thereafter be at liberty to demand royalties from all users of patent rights of the Company and to institute and carry on proceedings to prevent infringement of the patents.

Provided that no demand shall be made or proceedings instituted in respect of any use of the patents which occurs during the currency of Part II. of this Agreement and is in accordance with that Part.

22. Nothing in this Agreement shall be construed to prevent the Company establishing and carrying on any other wireless service under licence from the Commonwealth.

23. The Company agrees that it will not, without the consent of the Commonwealth, appoint to or engage for its service any person who is not a natural born British subject, and that it will use its best endeavours to induce all its present and future officers and employees to become members of the Reserve of the Defence Force.

In witness whereof the parties hereto have executed these presents the day and year first above mentioned.

(Signed on behalf of Commonwealth Government by S. M. BRUCE, and on behalf of Amalgamated Wireless (A/asia) Ltd., by G. MASON ALLARD and E. T. FISK.)

The Commonwealth of Australia

Wireless Telegraphy Act, No. 8 of 1905.

An Act relating to Wireless Telegraphy. (As sented to 18th October, 1905.)

BE it enacted by the King's Most Excellent Majesty, the Senate, and the House of Representatives of the Commonwealth of Australia, as follows:—

1. This Act may be cited as the **Wireless Telegraphy Act,** 1905.

2. In this Act,—

"Australia" includes the territorial waters of the Commonwealth and any territory of the Commonwealth;

"Wireless telegraphy" includes all systems of transmitting and receiving telegraphic messages by means of electricity without a continuous metallic connexion between the transmitter and the receiver.

3. This Act shall not apply to ships belonging to the King's Navy.

4. The Postmaster-General shall have the exclusive privilege of establishing, erecting, maintaining, and using stations and appliances for the purpose of—

(a) transmitting messages by wireless telegraphy within Australia, and receiving messages so transmitted, and
(b) transmitting messages by wireless telegraphy from Australia to any place or ship outside Australia, and
(c) receiving in Australia messages transmitted by wireless telegraphy from any place or ship outside Australia.

5. Licences to establish, erect, maintain, or use stations and appliances for the purpose of transmitting or receiving messages by means of wireless telegraphy may be granted by the Postmaster-General for such terms and on such conditions and on payment of such fees as are prescribed.

6. (1) Except as authorised by or under this Act, no person shall—
(a) establish, erect, maintain or use any station or appliance for the purpose of transmitting or receiving messages by means of wireless telegraphy; or
(b) transmit or receive messages by wireless telegraphy.

Penalty: Five hundred pounds, or imprisonment with or without hard labour for a term not exceeding Five years.

(2) Sub-section (1) of this section shall not, except as prescribed extend to appliances maintained on any ship, arriving from any place beyond Australia, for the purpose of enabling messages to be transmitted from or received on that ship by means of wireless telegraphy but all such appliances shall, while the ship is within Australia—
(a) be subject to the control of the Postmaster-General; and
(b) only be used by his authority or as authorised by the regulations.

Penalty: Five hundred pounds.

7. All appliances erected, maintained, or used in contravention of this Act or the regulations, for the purpose of transmitting or receiving messages by means of wireless telegraphy, shall be forfeited to the King for the use of the Commonwealth.

8. (1) If a justice of the peace is satisfied by information on oath that there is reasonable ground for supposing that any appliance is established, erected, maintained, or used in contravention of this Act or the regulations, for the purpose of transmitting or receiving messages by means of wireless telegraphy he may grant a search warrant to any person.

(2) A search warrant under this section shall authorise the person to whom it is addressed to break and enter any place or ship, where the appliance is or is supposed to be, either by day or by night, and to seize all appliances which appear to him to be used or intended to be used for transmitting or receiving messages by means of wireless telegraphy.

9. (1) Proceedings for any offence against this Act may be instituted in any Court of Summary Jurisdiction, and any person proceeded against under this section may be dealt with summarily or may be committed for trial.

(2) The Court in dealing summarily with any accused person under this section may, if he is found guilty of any offence against this Act, punish him by imprisonment with or without hard labour for any period not exceeding six months or by a penalty not exceeding Fifty pounds.

10. The Governor-General may make regulations, not inconsistent with this Act, prescribing all matters which by this Act are required or permitted to be prescribed or which are necessary or convenient to be prescribed for carrying out or giving effect to this Act.

AMENDMENT No. 33 OF 1915.

An Act to amend the Wireless Telegraphy Act, 1905. (Assented to 6th September, 1915.)

BE it enacted by the King's Most Excellent Majesty, the Senate, and the House of Representatives of the Commonwealth of Australia, as follows:—

1. (1) This Act may be cited as the **Wireless Telegraphy Act,** 1915.

(2) The **Wireless Telegraphy Act,** 1905, as amended by this Act, may be cited as the **Wireless Telegraphy Act,** 1905-1915.

2. Sections four, five and six of the **Wireless Telegraphy Act,** 1905, are amended by omitting the words "The Postmaster-General" and inserting in their stead the words "the Minister for the time being administering the Act."

AMENDMENT No. 4 OF 1919.

An Act to amend Section Two of the Wireless Telegraphy Act, 1905-1915.

BE it enacted by the King's Most Excellent Majesty, the Senate, and the House of Representatives of the Commonwealth of Australia, as follows:—

1. (1) This Act maybe cited as the **Wireless Telegraphy Act,** 1919.

(2) The **Wireless Telegraphy Act,** 1905-1915 as amended by this Act, may be cited as the **Wireless Telegraphy Act,** 1905-1919.

2. Section two of the **Wireless Telegraphy Act,** 1905-1915, is amended by inserting in the definition of "Wireless telegraphy," after the word "telegraphic," the words, "or telephonic."

Commonwealth Wireless Regulations

Under the Wireless Telegraphy Act, 1905-1919

Statutory Rules No. 101 of 1924 have been amended from time to time by No. 123 of 1925, No. 114 of 1926, Nos. 3-24-63-153 of 1927, Nos. 79-129 of 1928, No. 81 of 1929 and No. 113 of 1930, and the following are the existing regulations as applicable to Broadcasting in Australia. Details of regulations governing other wireless stations are available from Government Printer, Canberra, F.C.T., or from the Radio Inspector in any capital city.

Part III.—Broadcasting.

Division I.—Broadcasting Stations.

"45. (1) The Postmaster-General may grant to any applicant a Broadcasting Station Licence.

(2) A Licence shall not be transferred without the approval of the Postmaster-General.

(3) The Postmaster-General shall not recognise any vested interest in the Licence, and compensation shall not be payable to the Licensee on the termination of the Licence.

46. An applicant for a Broadcasting Station Licence shall state in his application the following particulars:—
(a) Name and address of applicant (in the case of a company; (1) the name of the company and the address of the head office thereof; (2) the name and address of the secretary or other person authorised to act on behalf of the company);
(b) Technical qualifications of the applicant or of the persons whom it is proposed will operate the licensed installation (where the applicant does not possess the necessary qualifications and proposes to engage an expert to control the station after the issue of the Licence, this should be stated);
(c) Location of the proposed station;
(d) Type of transmitter and character of modulation proposed;
(e) Proposed normal operating power of transmitter;
(f) Hours of service; and
(g) Class of service to be broadcasted and particulars of average programme.

47. (1) A Broadcasting Station Licence shall be prepared in duplicate, one copy of which shall be retained by the Department and the other shall be issued to the Licensee.

(2) A Licensee shall make his Licence available for inspection by any authorised officer as and when required.

48. (1) A Broadcasting Station Licence may be granted for any period not exceeding three years as the Postmaster-General determines.

(2) The Postmaster-General if he deems it desirable may from time to time renew a Licence for a period not exceeding one year from the date of expiration of the current Licence.

(3) A Licensee who desires a renewal of his Licence shall make application for the renewal thereof at least six months before the date of the expiration of his current licence, except in cases where a licence has been granted or renewed for a period of less than one year, when the application for a renewal shall be made at least one month before the date of expiration of the current licence.

49. A Broadcasting Station Licensee shall commence a satisfactory service in accordance with these regulations within three months from the date of the issue of the Licence or within such further period as the Postmaster-General approves.

50. The licensed installation of a Broadcasting Station shall be equipped, designed and controlled to the satisfaction of the Postmaster-General and shall not be altered without his consent.

51. The power of a Broadcasting Station shall be as approved by the Postmaster-General and shall not be altered without his consent.

52. (1) The frequency (wave length) on which each Broadcasting Station shall operate shall be as determined by the Postmaster-General.

(2) The operating frequency shall be maintained to a constancy to the satisfaction of the Postmaster-General.

(3) For the purpose of the last preceding sub-regulation, the transmitting apparatus shall include such equipment for indicating the accuracy of the operating frequency as the Postmaster-General approves.

53. The location of a Broadcasting Station and the periods of operation thereof shall be subject to the approval of the Postmaster-General.

54. (1) The Postmaster-General reserves the right, during the currency of a Broadcasting Station Licence, to vary the conditions upon which the Licence is granted, especially in regard to the power, location, frequency (wave length) and periods of operation of the licensed installation.

(2) The licensee shall, at his own expense and to the satisfaction of the Postmaster-General, give effect to any such variation.

55. The licensed installation of any Broadcasting Station shall only be operated by such persons as, in the opinion of the Postmaster-General, are competent to operate the installation.

56. The licensed installation of any Broadcasting Station shall, at all reasonable times, be open to inspection by any authorised officer, and every facility shall be given by the Licensee for ascertaining the conditions of the Station.

57. (1) A Broadcasting Station shall be connected by telephone with the public telephone exchange system of the area in which the Station is located.

(2) The Broadcasting Station Licensee shall enter into the usual telephone subscriber's agreement for the establishment of a service.

58. The Postmaster-General may require the licensee of a Broadcasting Station to include, without charge, such items of general interest or utility as the Postmaster-General, from time to time, determines.

Provided however that the requirements of the Postmaster-General shall not be such as to entail a period of occupation of the Station in excess of thirty minutes in each consecutive period of twelve hours.

59. (1) All matter including advertisements to be broadcasted shall be subject to such censorship as the Postmaster-General determines.

(2) The Broadcasting Station Licensee shall, before broadcasting any such matter which is of a controversial nature or likely to cause offence to any section of the community, direct the attention of the Postmaster-General or an authorised officer, to such matter.

60. (1) A Broadcasting Station Licensee may broadcast advertisements.

(2) A Licensee desiring to broadcast advertisements shall publish a tariff of advertising charges, and shall make his advertising service available without discrimination to any person or firm.

61. The Licensee of any Broadcasting Station may, to such extent as the Postmaster-General approves, by agreement with the Licensees of other Stations, relay or broadcast the programmes broadcast by these stations.

62. A Broadcasting Station Licensee shall:—

(a) compile and maintain in a recognised business or commercial form, separate accounts in respect of his broadcasting activities;
(b) make such accounts available for inspection by the Postmaster-General as required;
(c) supply to the Postmaster-General as required duly audited annual balance sheets in detail for the year ending on the thirtieth day of June in each year or on some other date approved by the Postmaster-General; and
(d) keep such records relating to the broadcasting service, as the Postmaster-General, from time to time, directs, and supply copies thereof to the Postmaster-General as required.

63. (1) The programme transmitted from a Broadcasting Station shall, both in rendition and transmission, be to the satisfaction of the Postmaster-General.

(2) The general terms of any announcement, whether complete in themselves or referring to items to be transmitted, shall be to the satisfaction of the Postmaster-General.

(3) Every announcer employed by the Licensee shall be of good education, style and personality, and possessed of clear enunciation, as far as possible free from any characteristic dialect.

64. (1) The licence fee for a Broadcasting Station Licence or any renewal thereof shall be £25 per year or part of a year payable in advance.

(2) This regulation shall be deemed to have come into operation on the first day of November, One thousand nine hundred and twenty-nine.

65. A Broadcasting Station Licensee shall at all times keep the Postmaster-General indemnified against any claim for royalties in respect of any equipment operated under his licence, or against any claims whatsoever arising out of the Licensee's operations.

66. A Broadcasting Station Licensee shall not—

(a) transmit any work or part of a work in which copyright subsists except with the consent of the owner of the copyright; or
(b) send out news or information of any kind published in any newspaper or obtained, collected, collated or co-ordinated by any newspaper, or association of newspapers or any news agency or service except with the full consent in writing, first obtained, of, and upon such payment and conditions as are agreed upon by the licensee and, the newspaper, association of newspapers, news agency or service.

67. (1) A Broadcasting Station Licensee who supplies in advance to the proprietor of any registered newspaper programmes of the items to be broadcasted by his Station shall, on application in writing, supply in advance such programmes on equal terms to the proprietor of any other registered newspaper.

(2) The proprietor of such other newspaper may publish such programmes in any registered newspaper owned by him.

(3) In this regulation "registered newspaper" means a newspaper registered under the Post and Telegraph Act 1901-1923.

68. A person shall not publish any portion of the text of a broadcasted item without the consent of the Broadcasting Station Licensee and the approval of the Postmaster-General.

69. A Broadcasting Station Licensee shall not, without the permission of the Postmaster-General, transmit any message or other communication, the transmission of which would be in contravention of the provisions of the Post and Telegraph Act, 1901-1923 if the licensed installation were a telegraph within the meaning of that Act.

70. Except where any inconsistency exists, nothing in this Part shall affect the generality of the provisions of any other Part of these Regulations.

71. The decision of the Postmaster-General with regard to the interpretation or application of any of the provisions of this Division shall be final.

72. The Postmaster-General may, on such terms and conditions as he thinks fit—

(a) make contracts for the establishment, erection maintenance or use of wireless broadcasting stations or appliances on his behalf; and
(b) for the purpose of using any wireless broadcasting stations or appliances established, erected or maintained by him or on his behalf, make contracts for the provision of programmes by such stations or by such appliances.

73. Any Licence for a Class B Station in force immediately prior to the commencement of this regulation shall be deemed to have been granted under and subject to the provisions of these Regulations.

74. Notwithstanding anything contained in this Division, any Licence for a Class A Station granted under the Regulations in force immediately prior to the commencement of this regulation shall not, on and from the commencement of this regulation, be renewed and those Regulations shall be deemed to apply to such Licence so long as it remains in force.

Division 11.—Broadcast Listeners' Stations

75. A Broadcast Listeners' Licence in accordance with Form 5 in the Schedule to these Regulations may be granted at any Money Order Office on payment of the prescribed fees.

76. (1) For the purpose of the granting of Broadcast Listeners' Licences and the payment of fees therefor, the Commonwealth and the Territories thereof shall be divided into two zones as follows:—

(i) Zone 1 shall include all the territory within an approximate radius of 250 miles from such Broadcasting Stations as the Postmaster-General determines; and
(ii) Zone 2 shall include all the territory of the Commonwealth and the Territories outside Zone 1.

(2) The Postmaster-General may determine the zone within which any Broadcast Listeners' Station is situated.

(3) The Postmaster-General may modify the boundaries of the Zones specified in sub-regulation (1) of this regulation, or establish additional Zones.

77. (1) The fees payable in respect of any Broadcast Listeners' Licence or any renewal thereof shall be as follows:—

(a) For Zone 1, 24/- per annum; and
(b) For Zone 2, 17/6 per annum.

(2) Licence fees shall be paid in advance.

78. Where a Broadcast Listeners' Licence is being granted in respect of receiving equipment which has been used prior to the grant of the Licence, the Licence may be given the date and shall be deemed to have been effective from the date the receiving equipment was first used without a current Licence.

79. A Broadcast Listeners' Licence shall not be transferable from one person to another.

80. (1) The user of receiving equipment, capable of being utilised for the reception of broadcast programmes or other wireless signals, shall be in possession of a current Broadcast Listeners' Licence.

(2) Where a current Broadcast Listeners' Licence is not held in respect of equipment installed or connected up or capable of being connected up for the purpose of receiving broadcast programmes or other wireless signals in any dwelling house, office, shop, premises or place, the occupier of any such dwelling house, office, shop, premises or place shall be guilty of an offence.

(3) It shall be a defence to a prosecution for an offence against the last preceding sub-regulation, if the occupier proves that he was not aware, or could not with reasonable diligence have become aware, of the existence in the dwelling house, office, shop, premises or place of the receiving equipment in question.

81. (1) Receiving equipment shall not, without the consent of the Postmaster-General, or an authorised officer, be used at a place other than that specified in the Broadcast Listeners' Licence.

(2) The Licensee shall notify the Department of any permanent change of address within two weeks of the change.

82. A Broadcast Listeners' Licence shall, at all reasonable times, be available at the address given thereon for inspection by an authorised officer.

83. A Licensee of a Broadcast Listeners' Station shall not divulge, except to an authorised officer or a legal tribunal, the contents of any commercial or defence wireless communications, other than those transmitted by a Broadcasting Station.

84. Any Licensee of a Broadcast Listeners' Station using reaction (back coupling) in such a manner as to cause interference to the reception at any other Station shall be guilty of an offence against these Regulations.

85. A person or firm shall not operate receiving equipment for the purpose of demonstration or test of receivers with the object of promoting the sale of receiving equipment without being in possession of a Broadcast Listeners' Licence.

7. Regulation 109 of the Wireless Telegraphy Regulations is repealed and the following regulation inserted in its stead:—

"109. The fee for an Experimental Licence shall be £1 10s. 0d. per annum."

8. The regulation made on the 22nd December, 1927, under the Wireless Telegraphy Act, 1905-1919 Statutory Rules, 1927, No. 153, is repealed.

STATUTORY RULES

1933. No. 136.

AMENDMENT OF THE WIRELESS TELEGRAPHY REGULATIONS (BLIND PERSONS).

(Statutory Rules 1924, No. 101, as amended to this date.)

Regulation 12 of the Wireless Telegraphy Regulations is amended by adding at the end of sub-regulation (1) the following proviso:—

1. (1) Provided also that a Broadcast Listeners' Licence or any renewal thereof may be granted free of charge to any blind person over the age of sixteen years.

(2) This regulation shall come into operation on the first day of January, 1934.

Patents, Trade Marks and Designs

Unlike land, money, goods or other kinds of property an idea, whether it be what is commonly known as an invention or a musical or literary work, is an intangible thing. When once disclosed it will become common property unless the originator takes the proper legal steps to keep control of it. It is he who must take the necessary steps for obtaining protection and in the case of industrial invention or similar property he must take proceedings under the Patents, Trade Mark or Designs Acts.

Patent Law in Australia is based upon the Statute of Monopolies, which was passed by the English Parliament in 1624, and which declared monopolies in general to be bad but which expressly excepted "new manufactures." This exception was made because it was felt that it would be to the advantage of the State to encourage inventors as invention is a valuable factor in the development of industry. Since 1624 many other Acts have been brought into force but they deal mainly with the machinery for the granting and enforcement of patents, the broad question of whether a grant may be legally made being determined by the original Statute. The phrase "new manufactures" includes any new apparatus, device, machine or process and a grant of Letters Patent for invention gives to the inventor or his legal representatives the sole monopoly to make, use or sell the invention for a term of sixteen years, subject to the payment of annual renewal fees after the fourth year. The holder of the rights has, subject to certain wide limitations, the sole control of the manufacture and sale of the article and at the end of the period, upon the lapsing of the Patent, the Crown obtains the benefit of the invention. The grant of a patent is thus not a matter of right in that the inventor can demand protection, but is a mutual contract made between him and the State and in return for a full and complete disclosure of the invention and the method of carrying it out the State grants to him the monopoly referred to above. There are other requirements and should the inventor not carry out his side of the bargain properly the patent, even after it has been granted, may be declared invalid by any Court which has the necessary jurisdiction.

The fundamental requirements which have to be observed before a Patent can be successfully applied for and maintained are subject matter, novelty, utility and the sufficiency of the description of the invention. As to the first, it is necessary that the invention must be a "manner of manufacture," which is roughly equivalent to saying that it must have a commercial application and be of benefit to the trade. Mere ideas are not patentable unless wrapped up in something which can be applied practically. Thus it happens that a theory or scientific principle is not patentable nor is a book-keeping system, although certain kinds of rulings in books are often necessary for the latter. Summarised what may be patented can be set out as:

(1) New or old methods of applying new principles or new methods of applying old principles;
(2) New contrivances applied to new or old objects or purposes;
(3) New combinations of parts which will produce material objects or a process;
(4) New methods of applying old devices or processes provided that invention is exercised in arriving at the new method;
(5) Improvements on existing combinations, devices or processes and the application of materials or devices to useful purposes.

In all cases invention must be exercised in arriving at the alleged invention.

It is absolutely necessary that the invention be new although the degree of novelty may be slight, which means that the invention must be something more than would be normally carried out by a skilled operator engaged in the particular trade to which the invention relates. Utility is also equally important for it is of no benefit to the State or to the inventor for a patent to be granted for something which is useless.

In making application for a patent the applicant must supply what is known as the specification and this must set out clearly the nature of the invention and the way in which it is to be performed. Sometimes the applicant is tempted not to disclose some features of the process or machine, thereby hoping to retain for himself the benefit of the invention for a longer period than he would by making a full disclosure. This, however, is a highly dangerous proceeding because an omission to describe the invention fully or intentional mis-description would be quite sufficient to render the patent invalid if it should ever be brought into Court.

The main object is to describe the invention in such a manner that an ordinary skilled workman engaged in the same trade can put it into operation and obtain the same result as the inventor could. There is no need, however, to go into such minute detail that those not engaged in the trade could follow it out, but on the other hand, the specification must not need a specialist to understand how it is to be put into practice. Because of the importance of fully and correctly describing the invention it is highly desirable for an intending applicant to seek professional assistance in making his application, although he is not compelled to. There is, of course, additional expense attached to this procedure but such expenditure will undoubtedly pay in the long run.

The application may be made in either of two ways, viz.:

(a) By the filing of a provisional specification to be followed later by the complete specification, or
(b) By the filing of the complete specification in the first instance.

In an application accompanied by a provisional specification the applicant is not required to describe his invention in full detail. It is only necessary that its nature should be outlined so that when, and if, the complete specification is filed the Patent Office Examiners will have no difficulty in identifying that which follows with the invention described in the provisional application. The term of a **provisional application is nine months** and it is usually filed in cases where the inventor has not been able to bring his ideas to their complete form before he finds it necessary to make an application. If during the currency of the provisional protection he should find that it is desirable to abandon the application he may do so without any additional expense. The application dates from the day upon which the first specification is filed, but in the case of a provisional specification the applicant **has no rights whatever** and can take **no steps to prevent infringement.** Obviously a **patent cannot exist** until it is granted and that cannot be until after the complete specification is filed and accepted and the patent issued.

During progress of the application the complete specification, drawings, etc., when filed are examined and if there is nothing in the Patent Records that would prevent the grant the application is accepted. It is then advertised for a period of three months during which any party may, if he can supply sufficient satisfactory evidence, oppose the grant. If no opposition is made or if it is dismissed, the Patent is sealed and the full rights of the patentee commence although they are **retrospective** to the **date of acceptance.** The period of advertisement is to allow anyone who may know of some bar of which the Patent Office is ignorant to come forward. For instance, the applicant may not be the inventor or his legal representative, or the invention may not be new having been put into practice or published in some technical journal, foreign patent specification or otherwise before the date of application.

As to overseas applications, Australia is a member of what is known as the International Convention which, in a few words, means that a local applicant may at any time during the twelve months succeeding the date of his application apply in any other convention country and obtain as the effective date of that patent the date of his Australian patent. This is a very useful arrangement as the detrimental effect of publication of the invention abroad, before the application is made, may be avoided. Conversely, applications made in Australia may be dated back and thus a device originating overseas **may apparently not be the subject of an application** and **yet be adequately protected subsequently.**

TRADE MARKS

From the point of view of the average trader the matter of trade marks which are inseparably wrapped up with goodwill is not to be neglected because although there may not be much importance attached to a trade mark in the early stages of the development of a business or of a new activity of an established concern, in later years the trade done in the goods covered by the mark may reach large proportions and unless the mark has been well chosen in the beginning the goodwill of the business may not acquire its full value. It is, therefore, wise to choose the best available mark right at the start.

The underlying feature of a trade mark is its ability to distinguish the goods of the proprietor from the goods of others engaged in the same line of business and throughout all trade mark law this question of **ability to distinguish** is paramount. Registration, which, by the way, is not compulsory but which is highly desirable, **requires this quality** of a trade mark beyond all others.

A registrable trade mark may consist of a name of a Company, individual or firm put up in a distinctive manner; the signature of the applicant or some predecessor in business; an invented word or words; a word or words having no direct reference to the character or quality of the goods and not being according to its ordinary meaning a surname or a geographical name; or any other distinctive mark such as a label, combination of devices, letters, numbers or monograms which can be fairly held to be distinctive of the goods of the proprietor. It **must not,** however, be **so like any existing mark** on the Register of Trade Marks or any mark used in connection with similar goods as to lead to any possibility of confusion or deception in the minds of the trade or the public.

An invented word or words is possibly the best type of trademark, good examples of this being "Kodak," "Magnavox," "Osram" and such words. This kind of word may in an indirect manner introduce some allusion to the character or quality of the goods but as long as it is not entirely obvious they are acceptable. Ordinary English language words if used as trade marks cannot have any direct reference to the character or quality of the goods and therefore such words as "Best" or "Perfect" are **not** registrable. Otherwise, words such as "Kangaroo," "Cornstalk," "King Dick" are acceptable. Trade Mark law will not allow any word which may fairly describe the goods to be **monopolised** by any maker, nor will it permit a geographical name such as "Sydney" to become the property of any one individual while **surnames** are **also not** registrable trade marks unless they have acquired the necessary ability to distinguish by long and wide use of the mark, "Dunlop" and "Pears" being examples of this type of mark. Certain other of the unregistrable marks may also by reason of long use be acceptable, but it is not wise to choose such a mark for until they had this long use they are difficult to maintain, as being unregistered it is necessary for the proprietor to fully establish his title before he can get any redress at common law and then he must supply evidence of passing off and deception. On the other hand registration immediately supplies prima facie proof of ownership which after seven years becomes conclusive unless the mark was acquired by fraud in the beginning. Furthermore, registration gives a right for infringement proceedings to be taken and mere possession of goods wrongfully marked may be an offence. It is not necessary to prove the passing off.

Registration is not a very difficult matter, but although a selected mark may conform to the definitions of what is registrable laid down in the Trade Marks Act it is desirable that a search be made in the existing records before the application is filed or the mark used so that there can be no risk of conflicting with a mark already on the register. For the purpose of registration all goods are divided into fifty classes and registration is effected in one or more of these according to the goods in respect of which the mark is to be used. Proprietors of trade marks may conduct their own proceedings with the Trade Marks Office, but as in patents it is advisable that skilled professional assistance be obtained, for there are many little points which have to be watched. The period of registration extends for fourteen years, but upon proof being furnished that the mark has been used during its period of registration may be renewed for a further period of fourteen years.

DESIGNS

There is another form of protection which in general principle resembles that given by the Patents Act but which is commonly known as **registration of designs.** According to the Act governing this matter, design means **"an industrial design applicable in any way or by any means to the purpose of the ornamentation of pattern or shape or configuration of an article to any two or more of these purposes."** Putting this in other words, the protection is given to that which appeals to the eye in regard to the shape, configuration, ornamentation or pattern of the article. It does not cover any principle of construction or operation of the device and if it is desired to cover any mechanical principle, process or method of manufacture Letters Patent must be applied for. In radio work cabinets are often the subject of design registrations, but such registrations only cover the outward appearance and do not give any protection for any constructional features there may be in the device. Likewise the external appearance of a switch or a transformer may be registered as a design, but the only way to protect the method of manufacture or the mechanism of the device would be to apply for patent. As in a trade mark the register is divided into classes and registration must be made in one or other of these classes.

For registration purposes **exact** drawings, photographs or samples of the design must be provided. Upon registration the proprietor is given exclusive right to use the design and any manufacturer who infringes or imitates the copyright in a registered design whether knowingly or otherwise may be proceeded against in the appropriate courts. There is, however, an important provision in the Designs Act which is to the effect that each article to which the design is applied must be marked before delivery for sale with the prescribed mark to denote that the design is registered. Failure to mark in this manner renders the maker liable to a penalty of £20 and moreover may cause the proprietor to lose his rights to get damages for infringement. On the other hand any wrongful application of a marking to indicate that the article is registered renders the person so marking liable to a similar penalty. The usual marking is "Registered No. 12345" or some abbreviation as "Reg'd."

The term of registration is five years, but it may be extended for two further periods of five years each.

Transactions of Radio Patents in Australia For 1933

Overseas Companies Dominate the Situation

(Specially Compiled by the Patent Expert of "Radio & Electrical Merchant")

It is probable that never before in the history of the radio industry in Australia has the question of patents and their effects become so important. A year ago very few manufacturers gave much attention to patents (there was no need for it), but in the intervening period most of them have learnt quite a lot and it seems that in future some of them will learn a lot more. A situation has arisen, the outcome of which is difficult to estimate with any accuracy. The only certainty about it is that a lot of time and money will be spent and, in certain instances, wasted, before a satisfactory solution is arrived at, which at the present moment seems a matter of years.

A list is given hereunder of the patent applications which were accepted in Australia during the year 1933. An analysis of this is interesting. For one thing, it shows that technical progress in Australia, at any rate as indicated by patent applications, is negligible for the reason that the great majority of the applications listed have originated overseas. Of the 178 patents mentioned, England was responsible for 43 of the inventions, U.S.A. 76, Germany 31, other overseas countries 5 and Australia 13. These figures hardly bear out the contention so often expressed that Australian manufacturers and laboratories are at least equal to those of other countries in the matter of carrying out investigational work. Another point of interest is that the Marconi Co. and the Telefunken Co. seem to have matters all their own way, if numbers count, no less than 124 of the 178 applications

accepted being in the name of one or other of those concerns. It will also be observed that the great majority of the applications relating to radio circuits are confined to transmission circuits of various sorts, more particularly short wave and ultra short wave. Receivers or even parts of them are comparatively rare and of them ultra short wave apparatus forms a large percentage.

It is abundantly clear from the information that technical progress in Australia could almost entirely be regulated by a few big overseas concerns if these patents measure up to their full face value.

It is obvious to anyone who has had the necessity to go into patent matters with any degree of thoroughness that it is part of the policy of certain companies to protect every advance, large or small, that can be covered. This method of controlling or seeking to control an industry is not entirely peculiar to radio as it is practised in other lines of activity. In its broad aspects there is nothing wrong with it. The underlying idea of granting Letters Patent for Invention is to encourage research and the exercise of inventive ingenuity and any person or concern that carries out investigations that result in an advance in any art or industry is entitled to reap the benefit. There is, however, one aspect of this wholesale applying for and obtaining patents and that is the unnecessary cost which, whatever else may be said to the contrary, is inevitably borne by those who from choice or necessity use some or all of the patents of the concern they are dealing with.

Costs of applications and the upkeep of a patent vary according to the nature of the invention, but they could be safely put down at about £80 to £100 per patent assuming that it runs for its full term of 16 years. This is an average of £5 or £6 per annum which does not seem much, but assuming that there are 2,000 patents in Australia having a more or less great application to radio the industry is loaded with perhaps £12,000 per annum for their initial cost and upkeep to say nothing of what is required by the patentees for a return on their investment whether such investment be cash, research or brains. If, as is extremely probable, a large percentage of the radio inventions are useless from the point of view of incorporation into the every day products of factories or the operation of broadcasting or communication systems those that are of value must seem not only enough for their cost, upkeep and investment value, but also enough to pay for their less valuable comrades. Those who take out the patents may claim that neither they nor anyone else can accurately assess the probable value of any alleged invention. Such an argument may have carried a considerable amount of weight ten or twenty years ago, but radio development has to a large extent passed from the "hit or miss" methods of the old days to the status of a respectable steadily progressing science and such arguments must now lose a lot of value. The bluff aspect of this promiscuous patenting may also have been valuable at one time but it, too, is losing its force. In short, the mania for patenting any and every discovery or seeming advance is neither economically or psychologically sound. Someone must pay for the privilege.

In this patent situation there is one ray of hope. As time goes on more and more patents are expiring and more and more principles are becoming public property. New principles may be and are discovered from time to time, but they grow less. New applications of old principles will also be evolved, but they will be narrower in their scope than their forebears. Thus there must be a time when it will be possible to run a reasonably good service or build a reasonably good receiver without being forced to recognise a multitude of patentees.

RADIO CIRCUITS

MARCONI WIRELESS TELEGRAPH CO. LTD.

No.	Subject.	Country of origin.
5626/32	Ultra High Frequency Receivers	U.S.A.
5658/32	Oscillatory Systems	U.S.A.
5670/32	Receiver	U.S.A.
5761/32	R.F. Distribution System	U.S.A.
5847/32	A.F. Amplifiers (frequency correction)	U.S.A.
5933/32	Potentiometric circuits (keeping voltage constant)	U.S.A.
5934/32	Receiving systems (Avoiding electrical interference)	U.S.A.
5953/32	Alarm Devices for Ships	England
6052/32	Modulation Arrangements	England
6092/32	Directional Radiating Systems	Austria
6093/32	Control System for Amplifiers	U.S.A.
6130/32	Modulated carrier wave transmitting and receiving system	U.S.A.
6361/32	Amplifier (a.v.c. for receivers)	U.S.A.
6362/32	Selective H.F. circuit arrangements	U.S.A.
6436/32	Stabilising H.F. Systems	U.S.A.
6437/32	Instrument shaft control devices	U.S.A.
6611/32	Amplifying Systems (ultra short wave)	England
6696/32	Automatic Gain Control of H.F. Receivers (80-60m)	England
6726/32	Noise reduction in a.v.c. receivers	U.S.A.
6740/32	Avoid distortion on communication systems	U.S.A.
6783/32	Amplifier for sound reproducers frequency compensation with volume control	U.S.A.
6784/32	Piezo-electric coupling devices	U.S.A.
6817/32	Ultra Short Wave Receiver	England
7012/32	Oscillators	U.S.A.
7107/32	H.F. Circuits (stabilising)	England
7123/32	H.F. Oscillators	U.S.A.
7306/32	Oscillators	U.S.A.
7307/32	Oscillators	U.S.A.
7375/32	Aerial Systems	England
7376/32	Keying Systems	England
7449/32	Low Frequency Amplifiers	England
7510/32	Oscillators	U.S.A.
7511/32	Amplifiers	U.S.A.
7512/32	Oscillators	U.S.A.
7580/32	High Frequency Feeders	England
7631/32	Short Wave Receiver	U.S.A.
7632/32	Superheterodyne Receivers	U.S.A.
7633/32	Super-regenerative Receivers	U.S.A.
7696/32	Receivers (A.V.C.)	England
7785/32	Oscillators	England
7786/32	Short Wave Oscillators	England
7808/32	Oscillator (ultra short wave)	U.S.A.
7810/32	Automatic Tuning	U.S.A.

No.	Subject.	Country of origin.
8329/32	Valve Circuits	England
8440/32	High frequency transmitters and receivers	England
8442/32	Oscillation Generators	England
8702/32	Short Wave Systems	England
8780/32	Transmitter	England
8781/32	Oscillation Generators and Amplifiers	England
8933/32	Modulation Systems	England
9026/32	Direction Finding	England
9069/32	Modulated Carrier Systems	U.S.A.
9125/32	Aerial Systems	England
9170/32	Filters	U.S.A.
9171/32	Modulated Carrier Systems	U.S.A.
9336/32	Signal Systems	U.S.A.
9508/32	Frequency Control	U.S.A.
9509/32	Condensers	U.S.A.
9605/32	Frequency Modulation Systems	U.S.A.
9878/32	Amplifiers	England
9919/32	Modulation Systems	U.S.A.
9920/32	Oscillator	U.S.A.
10070/32	Frequency Control	England
10396/32	Amplifiers	England

TELEFUNKEN COMPANY

5669/32	Modulation Circuit Arrangements	Germany
5762/32	Oscillations from gas discharge amplifier valve	Germany
5763/32	Crystal stabilising device	Germany
5844/32	Selective receivers	Germany
5845/32	Holders for piezo-electric crystals	Germany
5930/32	Transmitters, constancy of amplitude of modulation	Germany
6616/32	Signalling systems for navigating or landing aeroplanes in fog	Germany
6903/32	"Beam" receivers	Germany
7124/32	Ultra short wave receivers	Germany
7807/32	Frequency wobbling	Germany
7729/32	Super-regenerative receivers	Germany
8001/32	Feeder systems for ultra short waves	Germany
8962/32	Directional radio systems	Germany
9606/32	Receivers	Germany
10493/32	Frame receiver	Germany

HAZELTINE CORPORATION

6746/32	Peak detector	U.S.A.
6910/32	Feed back circuits	U.S.A.
7573/32	Double band receiver	U.S.A.
8119/32	Superheterodyne receiver	U.S.A.
8545/32	Noise suppressor	U.S.A.
11128/33	Selective circuits	U.S.A.

INTERNATIONAL GENERAL ELECTRIC CORP.

6551/32	Power converting apparatus (d.c. to a.c.)	U.S.A.
8312/32	Automatic steering (radio control)	U.S.A.
9163/32	A.V.C. system	U.S.A.
9387/32	Piezo-electric oscillating generators	U.S.A.
10837/32	Diversity reception	U.S.A.

WESTINGHOUSE BRAKE & SAXBY SIGNAL CO. LTD.

7992/32	Detector (dry metal)	England
7993/32	Detector (copper oxide)	England
7994/32	Receivers	England

THE GENERAL ELECTRIC CO. (ENG.)

No.	Subject.	Country of origin.
7122/32	Signalling apparatus	England
10835/33	Magnetron oscillators	England

STROMBERG-CARLSON (A/SIA) LTD.

10073/32	Muting (Cox, Lindsay & Moore)	N.S.W.
10459/32	Receiver dials (E.J.T. Moore)	N.S.W.

SUNDRY APPLICANTS

No.	Subject	Name	Country of origin
4651/31	Remote control	A. S. McDonald	N.S.W.
5626/32	Signalling system	S.F. Radio Electrique	France
7430/32	Echo Sounding	Marconi Sounding Device Co.	England
7456/32	Modulated signalling systems	S.T.C. (Australasia) Ltd.	France
8006/32	Detector Circuit	J. K. Johnson	U.S.A.
8209/32	Communication System	G. W. Walton	England
8283/32	Low Voltage d.c. receiver	K. A. Isaacs and another	Victoria
9045/32	Amplifiers	T. G. Taylor	N.S.W.
9511/32	Coupling oscillatory circuits	P. P. Eckersley and another	England
9333/32	Secret signalling	J. T. Vessier and others	Holland
10834/32	S. W. Valve generators	E. C. S. Megaw	England
11353/33	Aerial systems	R. Leheup	France

TELEVISION

MARCONI WIRELESS TELEGRAPH CO LTD.

No.	Subject.	Country of origin.
5967/32	Scanning Apparatus	England
6091/32	Scanning Apparatus	England
6277/32	Facsimile Telegraph, etc.	England
6610/32	Scanning Apparatus	England
6725/32	Cathode Ray Television Receiver	U.S.A.
7065/32	Scanning Apparatus	England
7447/32	Scanning Apparatus	England
7448/32	Scanning Apparatus	England
7579/32	Television Synchronising	England
7742/32	Television Synchronising	U.S.A.
7809/32	Television System	U.S.A.
7812/32	Scanning Apparatus	U.S.A.
7813/32	Light Translating	U.S.A.
8082/32	Scanning Apparatus	England
8083/32	Scanning Apparatus	England
8441/32	Television Receiver	England
8546/32	Cathode Ray System	U.S.A.
8547/32	Cathode Ray System	U.S.A.
9068/32	Television Transmission	U.S.A.
9266/32	Television Transmission	U.S.A.
10269/32	Recording Telegraph	England

TELEFUNKEN COMPANY

5479/31	Television Receivers	Germany
5668/32	Light Amplifiers	Germany
6236/32	Cathode Ray system	Germany
6360/32	Television system	Germany
6724/32	Cathode ray system	Germany
7806/32	Television system	Germany
8108/32	Television Receiver	Germany
10346/32	Cathode Ray Receiver	Germany

INTERNATIONAL GENERAL ELECTRIC CO. INC.

9164/32	Television Receiver	U.S.A.
10447/32	Television Transmission	U.S.A.

SUNDRY APPLICANTS

6513/32	Television scanning system—I. L. Maguire	Victoria
7954/32	Television scanning system—I. L. Maguire	Victoria
5163/32	Single carrier system—A. N. Buckley	N.S.W.
7115/32	Scanning apparatus—Von Mihaly	Germany

Miscellaneous

MARCONI WIRELESS TELEGRAPH CO. LTD.

5846/32	Loud Speaker	U.S.A.
6206/32	Glow discharge tube	England
6235/32	Electromagnetic circuit arrangement	U.S.A.
65/32	Microphone	U.S.A.
6961/32	Valve for Ultra Short Waves	England
7064/32	Glow discharge tube	England
7811/32	Cathode ray tubes	U.S.A.
8002/32	Microphones	U.S.A.
8084/32	Television cathode ray tube	England
10204/32	Rectifier control	England

TELEFUNKEN COMPANY

5843/32	Electronic discharge valve	Germany
6010/32	Thermionic Valve	Germany
6532/32	Electrodes for Valves	Germany
7010/32	Valve construction	Germany
7011/32	Fluorescent screens	Germany
7730/32	Cathode ray tube	Germany

INTERNATIONAL GENERAL ELECTRIC CO. INC.

9063/32	Selenium tube	U.S.A.
9388/32	P. E. tube	U.S.A.
10045/32	Photo-electric tube	U.S.A.
10253/32	Photo-electric tubes	U.S.A.

MAGNAVOX (AUST.) LTD.

7774/32	Loud speaker fields	U.S.A.
10176/32	Condenser vent	U.S.A.

SUNDRY APPLICANTS

5706/32	Electrolytic condensers—Ruben Condenser Co.	U.S.A.
6569/32	Electrolytic condensers—A. G. Hydrawerk	Germany
6893/32	Magnetic core materials — Johnson Laboratories Inc.	U.S.A.
7524/32	Diaphragm—J. B. Hawley	U.S.A.
8562/32	Diaphragm—J. B. Hawley	U.S.A.
8894/32	Volume control potentiometer—A. W. Baker	N.S.W.
9273/32	Microphones—Siemens Bros. & Co. Ltd.	England
9294/32	Coil formers—A. W. Baker	N.S.W.
9373/32	Valve sockets—J. E. Smith	N.S.W.
9567/32	Resistor—H. A. Marshall	N.S.W.
10109/32	Dual capacity fixed condensers—A. P. J. Wetless	N.S.W.
10938/32	Cathode ray tube—A. C. Cossor Ltd.	England

SUMMARY

Countries of Origin

	U.S.A.	Eng.	Ger.	Aust.	Others	Total
Radio	50	34	15	5	5	109
Television	11	12	9	3	—	35
Miscellaneous	15	7	7	5	—	34
Totals	76	43	31	13	5	178

Ownership

	Radio	Television	Miscell.	Total
Marconi Co.	64	21	10	95
Telefunken Co.	15	8	6	29
I.G.E.	5	2	4	11
Hazeltine Corp.	6	—	—	6
Sundry	19	4	14	37
Totals	109	35	34	178

Single-Span Tuning

A New Receiver Principle

ALMOST important advance in receiver design has just been achieved by "The Wireless World," England. Features of this new development are: 200—2,000 metres tuning range without gaps or switching; single control tuning without ganging; no matched coils or condensers; no second channel interference or other whistles; variable adjacent channel selectivity and no signal-frequency tuned circuits.

One of the greatest drawbacks associated with present-day receivers is the ganging of the various tuning controls, for such a high degree of accuracy is required for a high standard of performance that components become costly and easily damaged. The initial adjustments, moreover, require to be performed with precision. All these disadvantages are removed at one stroke by this new receiving system. A receiver in which no ganging is required, and yet which has only a single tuning control coupled with an ability to tune over a wave range of 200 to 2,000 metres without necessitating any switching, is the receiver of one's dreams, for it removes once and for all the bugbear of poor switch contacts. The receiver is a superheterodyne, but has no signal-frequency tuned circuits. The oscillator condenser only is varied for tuning, and this is the only tuning control.

To cover a wavelength range of 200-2,000 metres or 1500-150 Kc/s. would require a frequency range of 10—1. With existing arrangements, this would mean a capacity variation ratio of 100—1 calling for a variable condenser with a capacity of some 0.005 mfd.!

If we use an intermediate frequency of 1600 Kc/s., however, the oscillator can cover a much smaller range.

For reception on 1500 Kc/s. the oscillator would work at 3100 Kc/s. and for a station on 150 Kc/s. at 1750 Kc/s. Therefore the oscillator need cover only the band of 3100—1750 Kc/s., and for this capacity change of only 3.14—1 is needed.

It is, in fact, possible to use a short wave type condenser of 160 mmfd. capacity and cover the range with ease.

Complete details of this innovation will be found in the May and subsequent issues of the "Radio Review." Send 1/- Postal Note to Box 3765, G.P.O., Sydney, for extra copies.

Australian License No. 1

(Radio Patents)

(Issued December, 1933).

License No. 1

An agreement made this ..... day of ..... 193 between Australian Radio Technical Services and Patents Company Limited, having its registered office at 47 York Street Sydney in the State of New South Wales (hereinafter called "the Grantor") of the first part, and ..... of ..... (hereinafter called "the Licensee") of the second part ..... Whereas the Australian Radio Technical Services and Patents Company Limited has the right to grant licences to the extent purpose and for the period of this agreement for all patents owned or controlled by Amalgamated Wireless (Australasia) Limited, Standard Telephones and Cables (Australasia) Limited and N. V. Philips Gloeilampenfabrieken but only from the first day of March 1934 with respect to patents owned or controlled by Amalgamated Wireless (Australasia) Limited.

And whereas the licensee claims to be a bona fide manufacturer of wireless broadcast receiving apparatus and/or radio gramophones and as such manufacturer has applied to the Grantor to grant and the Grantor has agreed to grant to the Licensee a licence under the Letters Patent and upon the terms and conditions hereinafter mentioned and in consideration of the royalties herein reserved and assessed upon the basis agreed between the parties as being convenient now it is hereby agreed as follows:—

1. (a) The expression "Broadcast Receivers" when herein used shall mean broadcast receiving apparatus (other than valves and loud speakers) for the reception of speech or music transmitted and intended for simultaneous reception by all listeners as distinct from point to point communication but only for private or domestic use or for the purpose of lectures or demonstrations in any institution of a charitable, educational, philanthropic or religious character (such lectures or demonstrations not being open to the public and not being held for payment) but not otherwise and shall not include such receivers combined with gramophones but shall include sets of component parts.

(b) The expression "Set of component parts" for broadcast receiving apparatus when herein used shall mean a number of component parts which are capable of being assembled so as substantially to constitute a broadcast receiver.

(c) The expression "Radiogramophone" when herein used shall mean a unitary instrument which is designed to incorporate valves (whether or not equipped with valves themselves) and which is designed for the reproduction of sound through an electrically-operated loudspeaker alternatively from (a) apparatus designed for the reception and translation into sound of modulated electrical oscillations broadcast to the public and (b) apparatus (such as a turntable and pick-up) designed for the translation into sound vibrations recorded on a sound record. Such expression does not include valves and does not include any radiogramophones combined with other apparatus dependent thereon either wholly or in part for its operations but does include battery eliminators as hereinafter defined when incorporated in a radiogramophone and any set of component parts which are capable of being assembled to substantially constitute a radiogramophone.

(d) The expression "Battery Eliminator" when herein used shall mean an apparatus which renders unnecessary the use of one or more batteries in the operation of broadcast receiving apparatus or a radiogramophone by facilitating the substitution therefor of electricity mains.

(e) The word "Valve" (or "Valves") when herein used shall be deemed where the context so admits to include inter alia a multiple valve a valve for rectifying electric current and other apparatus used in direct substitution for a valve.

(f) The expression "Multiple Valve" when herein used shall mean a valve designed to operate with more than one cathode-anode stream.

(g) The expression "Place of Public Entertainment" when herein used shall mean a place of public entertainment now existing or which during the subsistence of this Licence may exist and at which entertainment tax is or shall be payable or would be payable but for any statutory exemption granted subsequent to the first day of January, 1934. If during the subsistence of this Licence entertainment tax should be abolished then thereafter the expression shall mean a place of public entertainment now existing or which during the subsistence of this Licence may exist of the character of those places of public entertainment at which at the present time entertaiment tax is in fact payable or would be payable but for any statutory exemption granted subsequent to the first day of January, 1934.

(h) The expression "Private or Domestic Use" as used herein shall be deemed to include also the manufacture and sale of broadcast receiving apparatus and radiogramophones to proprietors of for use in Public Houses Hotels Boarding Houses Restaurants Cafes Tea House and/or small Dance Halls (only). Provided that such are not attached to or do not form part of a theatre or cinema.

(i) The expression "Selling" when herein used shall be deemed to include selling on the so-called hire-purchase system.

2 (a) The Grantor grants and agrees to grant to the Licensee subject to the terms and conditions herein appearing a personal non-exclusive non-assignable licence to use and exercise all or any of the inventions the subject of the Letters Patent applicable to broadcast receiving apparatus and radiogramophones respectively in respect of which and insofar as the Grantor now has or may hereafter during the subsistence of this Licence have power to grant Licences or Sub-Licences for the purposes and on the terms hereof (which Letters Patent are herein collectively called "the said Letters Patent") for the purpose of manufacturing, using, selling or letting on hire within the Commonwealth of Australia and such territories as may from time to time be administered under mandate by the said Commonwealth (a) broadcast receiving apparatus and (b) radiogramophones but in both cases only for private or domestic use or for the purpose of lectures or demonstrations in any institution of a charitable educational philanthropic or religious character (such lectures or demonstrations not being open to the public generally and not being held for payment) and not otherwise. Such Licence shall be deemed to have commenced on the first day of January, 1934, insofar as relates to the patents owned or controlled by Standard Telephones and Cables (Australasia) Limited and N. V. Philips Gloeilampenfabricken respectively and on and from the first day of March, 1934, insofar as relates to the patents owned or controlled by Amalgamated Wireless (A/sia) Limited and shall continue until the thirty-first day of December, 1938, unless previously revoked as hereinafter provided.

(b) The Licensee undertakes that all companies or firms now or hereafter during the subsistence of this Licence directly or indirectly owned or controlled by the Licensee and all Companies or Firms formed by the Licensee during the subsistence of this Licence and directly or indirectly owning or controlling the Licensee shall if engaged in any field of business to which this Licence is applicable forthwith accept licences from the Grantor upon the same terms as this Licence and the Grantor agrees to grant such Licences accordingly. If the Licensee shall become directly or indirectly owned or controlled by a company or firm which does not hold or forthwith obtain a Licence from the Grantor upon the same terms as this Licence the Grantor shall be at liberty to revoke this Licence.

3. (a) Nothing contained herein shall be deemed to license the Licensee to manufacture, sell or let on hire

(a) valves of any kind or
(b) loudspeakers of any kind, or
(c) television receiving apparatus.

(b) Nothing herein contained shall be deemed to license the Licensee to manufacture sell or let on hire any individual component part of broadcast receiving apparatus or a radiogramophone other than in and forming part of broadcast receiving apparatus or a radiogramophone.

(c) The Licence hereby granted shall not authorise the use or exercise of broadcast receiving apparatus or any radiogramophone for any purpose whatsoever other than the purposes herein set forth and in particular shall not authorise the use or exercise of any of the said apparatus by operating the same for revenue-earning purposes. Nor shall this Licence authorise the use or exercise of any of the said apparatus for purposes of receiving, broadcasting or operating any radiogramophone in relation in any manner to the service of any place of public entertainment or of any place in which any business requiring any License from public authority is conducted (except insofar as such use is authorised under the definition of "private and domestic use") or for use with a microphone.

4. The Licensee agrees with the Grantor as follows:—

(a) Not without the previous written consent of the Grantor to export or sell for export or knowingly permit to be exported any broadcast receiving apparatus or radiogramophone.

(b) Not without the previous written consent of the Grantor to sell, let on hire or put into use in the territory for which this Licence is granted any broadcast receiving apparatus or radiogramophones which have not been manufactured in the territory for which this Licence is granted.

(c) From time to time on the request of the Grantor to furnish to the Grantor diagrams and/or samples of all broadcast receiving apparatus and radiogramophones for the time being manufactured, sold or let on hire by the Licensee.

(d) To attach or cause to be attached in a prominent position to all broadcast receiving apparatus and radiogramophones sold or put into use by the Licensee (or in the case of sets of component parts of such apparatus to supply for attachment by the constructor to the assembled apparatus) a plate indicating the number of valves (as hereinbefore defined but subject to the provisos contained in Sub-Clauses (f) (i) and (ii) of this Clause) on which the royalty for such apparatus is payable and bearing the following words: With respect to broadcast receiving apparatus:—

"No..... This instrument was manufactured under a licence granted by Australian Radio Technical Services and Patents Company Limited in respect of patents controlled by it for the reception in the Commonwealth of Australia and such territories as may from time to time be administered under mandate by the said Commonwealth of sound broadcast by wireless but only for private use and not for operation for any public or commercial or revenue-earning purpose. N.B. A Post Office Licence is necessary."

With respect to radiogramophones:—

"No..... This instrument is manufactured under a licence granted by the Australian Radio Technical Services and Patents Company Limited in respect of patents controlled by it for the reception in the Commonwealth of Australia and such territories as may from time to time be administered under mandate by the said Commonwealth of sound broadcast by wireless and for the reproduction within the said territory of sound from records but only for private use and not for operation for any public or commercial or revenue-earning purpose. N.B. A Post Office Licence is necessary.

Such plates shall be obtained only from and shall be supplied by the Grantor and no such plate shall be removed from any apparatus to any other without the previous consent in writing of the Grantor and no apparatus shall be considered as duly franked hereunder unless such plate be attached thereto. In addition if required the Licensee shall mark in accordance with the requirements of the Patent Acts of the Commonwealth of Australia or any amendments thereof made during the subsistence of this Licence all apparatus manufactured sold let on hire or put into use by the Licensee hereunder.

(e) So far as is reasonably practicable to make the conditions of this Licence a condition of every sale or hire binding upon and observable by every purchaser or hirer of any broadcast receiving apparatus or any radiogramophone sold or put into use by the Licensee.

(f) To pay to the Grantor by way of royalty:—

(i) In respect of each and every broadcast receiving apparatus sold let on hire or put into use by the Licensee employing or designed to employ a valve or valves.

(a) in respect of patents owned or controlled by Standard Telephones and Cables (Australasia) Limited and N. V. Philips Gloeilampenfabrieken from the first day of January 1934 up to and including the twenty-eighth day of February, 1934, the sum of one shilling and sixpence (1/6d.) and

(b) on and from the first day of March, 1934, the sum of three shillings and sixpence (3/6d.)

in respect of each and every valve included or intended to be employed herein whether or not such apparatus embodies or utilises or is designed or intended to embody or utilise any invention the subject of any of the said Letters Patent PROVIDED that in the case of multiple valves employed or intended to be employed in such broadcast receiving apparatus each and every cathode-anode stream contained therein shall be deemed to be one valve and the royalty shall be calculated accordingly;

(ii) In respect of each and every radiogramophone sold or let on hire or put into use by the Licensee employing or designed to employ a valve or valves

(a) the sum of three shillings and sixpence (3/6d.) in respect of each and every valve employed or intended to be employed therein and in addition

(b) the sum of three shillings and sixpence (3/6d.) whether or not such radiogramophone embodies or utilises or is designed or intended to embody or utilise any invention the subject of any of the said Letters Patent PROVIDED that in the case of multiple valves employed or intended to be employed in such radiogramophone each and every cathode-anode stream contained therein shall be deemed to be one valve and the royalty shall be calculated accordingly.

PROVIDED that at the end of each year of the term of the Licence granted to any Licensee an account shall be prepared by the Grantor showing the amount of royalties paid by such Licensee during such year under paragraph (1) of this sub-clause and such Licensee shall according to the Licensee's actual output of Broadcast Receivers during such year be entitled to a reduction on the royalties so paid by him calculated on the basis of the difference between the royalties so paid by the Licensee and the rates of royalty set out in the schedule hereto and the amount of such difference which may be payable to such Licensee shall be credited to such Licensee by the Grantor.

PROVIDED ALWAYS that no royalty shall be payable under paragraphs (i) and (ii) of this Sub-Clause (f) in respect of a battery eliminator incorporated in and forming part of a complete broadcast receiver or radiogramophone and PROVIDED ALWAYS that in respect of broadcast receiving apparatus or radiogramophones manufactured or sold by the Licensee which employ any Patent under which the Grantor may become liable to pay a royalty to a third party or share a royalty with a third party the Grantor shall offer to the Licensee and the Licensee may accept the right to the inclusion in this licence of that patent on payment to the Grantor of an additional royalty of such amount as may be required to enable the Grantor out of the total royalties paid by the Licensee both to retain the royalties payable under paragraphs (i) and (ii) of this Sub-Clause (f) and to satisfy the terms of the Licence or Agreement under which royalty is or shall be payable by the Grantor. The Grantor shall if so required in writing by the Licensee furnish the Licensee with proof of the third party's claim to royalty. The Grantor shall upon request of the Licensee and the Licensee shall upon request of the Grantor permit the Grantor to examine free of charge diagrams and/or samples of broadcast receiving apparatus and radiogramophones manufactured or proposed to be manufactured by the Licensee and advise whether such apparatus embodies or utilises any invention the subject of any of the said Letters Patent under which the Grantor may be liable for royalty to a third party as herein mentioned. The Grantor shall inform the Licensee of the amount of any such additional royalty and any such additional royalty shall be shown separately in the returns hereinafter mentioned.

(g) Keep proper and accurate and separate accounts of everything necessary to ensure an accurate return to be made each calendar month in conformity with any of the provisions of this Licence showing separately the royalties payable under each of the paragraphs (i) and (ii) of the last preceding Sub-Clause (f) and to render such accounts within fifteen (15) days of the last day of each calendar month in each year to such person as the Grantor may designate to the Licensee from time to time and to accompany each such account with a remittance in respect of the royalties thereby shown to be due. In the event that the Licensee fails to keep the books of accounts above mentioned in addition to any other rights and remedies the Grantor may have the Licensee agrees to pay to the Grantor the amount of royalty which the Grantor may by notice in writing to the Licensee stipulate as the amount estimated to be due unless the Licensee proves that the royalty due should be some other amount.

(h) The Licensee shall furnish monthly returns certified by the Auditor of the Licensee or by a Statutory Declaration of the proper officer and in the event of any dispute shall permit the Grantors to appoint a Public Accountant to inspect the books and accounts of the Licensees relative to this License.

(i) To pay to the Grantor on the execution hereof for the first yearly period of this Licence and thereafter so long as the Licensee shall continue to manufacture sell let on hire or put into use broadcast receivers and/or radiogramophones in advance each year during the period of this Licence the sum of one hundred and fifty pounds (£150) as minimum royalty for the yearly period, which sum shall in no event be returnable but from the initial minimum royalty payment under this Clause shall be deducted and regarded as full settlement of all claims for past infringement of patent owned or controlled by Standard Telephones and Cables (Australia) Limited, as distinct from any claims under any patents owned or controlled by Amalgamated Wireless (Australasia) Limited or others the sum of ten pounds (£10) for every thousand (1000) broadcast receivers manufactured during one year by the Licensee. For the purpose of computing such number the production of the Licensee for the quarter ending 31st March 1934 will be taken as the basis.

(j) Not at any time during the subsistence hereof to dispute or impeach or to assist others to dispute or impeach the validity of the said Letters Patent.

(k) Not without the previous written consent of the Grantor to sell or let on hire or put into use or permit to be sold let on hire or put into use any broadcast receiving apparatus or any radiogramophone except under the Licensee's own trade mark or trade name or any other trade mark or trade name which may be approved by the Grantors from time to time.

(l) Not to assign transfer mortgage grant sub-licences under or in any manner part with the possession or control of this Licence or any part of it without the previous written consent of the Grantor.

5. During the subsistence of this Licence the Grantor will keep the Licensee fully indemnified against costs and damages arising in connection with all actions proceedings claims and demands which may be made against the Licensee by any third party who seeks to establish or establishes to the satisfaction of a court of competent jurisdiction within the Commonwealth of Australia and such territories as may from time to time be administered under mandate by the said Commonwealth his right to restrain the user and exercise by the Licensee under the Grant contained under this Licence for any of the said Letters Patent on the ground that such user and exercise is an infringement of any legal rights or legal interests of such third party in such Letters Patent PROVIDED ALWAYS that the Grantor is immediately informed of the institution of such proceedings and is given full and complete rights to take over at its own cost and through its own solicitors the defence of such proceedings if it so requests and in that event the Licensee shall assist the Grantor in every reasonable manner but the Grantor shall be at liberty to compromise submit to judgment in abandon discontinue or otherwise dispose of the same as to it may seem expedient.

6. The Grantor may revoke this Licence upon the happening of any of the following events:—

(a) If any royalty return or any royalty shown to be due is not rendered or is unpaid for thirty days (30) after the last day of any proceeding month and remains unrendered or unpaid for seven days after notice in that behalf from the Grantor, or

(b) If there be any breach on the part of the Licensee of any other of the Agreements herein contained and the same be not remedied made good or desisted from within seven (7) days of notice on that behalf from the Grantor; or

(c) If the Licensee shall become bankrupt or compound with his creditors (or being a company) shall go into liquidation whether voluntary or compulsory;

any revocation of this Licence shall be without prejudice to all claims of the Grantor against the Licensee for outstanding royalties or prior breaches of this Licence or otherwise and also without prejudice to the provisions of Clause 7 hereof.

7. (a) The Licensee agrees to grant to the Grantor upon request a non-exclusive non-transferable licence (but with the right to sub-license subsidiary or associated companies) to make use exercise and vend all or any of the inventions the subject of Letters Patent applicable to broadcast receiving apparatus and/or a radiogramophone in respect of which and insofar as the Licensee has or shall herafter have power to grant a license for the purposes of manufacturing using selling or letting on hire within the Commonwealth of Australia and such territories as may from time to time be administered under mandate by the said Commonwealth broadcast receiving apparatus and/or radiogramophones but only for private or domestic use or for the purpose of lectures or demonstrations in any institution of a charitable educational philanthropic or religious character (such lectures or demonstrations not being open to the public generally and not being held for payment) and not otherwise.

(b) If any invention in respect of which any such licence is herein agreed to be granted by the Licensee comes within the scope of the claims of any Letters Patent in respect of which the License is granted or agreed to be granted hereunder by the Grantor then the Grantor shall pay no royalty. If any such invention does not come within the scope as aforesaid then the Grantor shall be entitled to such licence on payment of a royalty at a rate not exceeding the lowest rate paid by any Licensee in respect of the same invention or if there is no other Licensee then at a rate not exceeding five per cent. (5%) of the net selling price of the article manufactured in accordance therewith or (whether or not there is another licensee) not exceeding the rate paid by the Licensee to the Grantor hereunder whichever is the smaller.

(c) Any such licence granted by the Licensees shall continue until the thirty-first day of December 1938 or for such other period as may be agreed upon.

IN WITNESS WHEREOF the parties hereto have duly executed these presents the day and year first hereinbefore written.

No. 1 LICENSE REBATE ARRANGEMENTS

The royalty payable in accordance with the attached No. 1 License is subject to reduction when a manufacturer's output passes a certain limit, which reduction increases progressively as production increases, until the undermentioned minimum average royalty has been attained. Thereafter, payment is continued at the said minimum rates. The details are as follows:—

Valves as defined	Rate per valve as defined excluding Rectifier From 1st Jan., 1934	From 1st March, 1934
4 to 1999	1/6	3/6
2000 „ 3999	1/5½	3/5
4000 „ 5599	1/5	3/4
5600 „ 7199	1/4½	3/3
7200 „ 9999	1/4	3/2
10000 „ 12879	1/3½	3/1
12880 „ 17999	1/3	3/–
18000 „ 23199	1/2½	2/11
23200 „ 35999	1/2	3/10
36000 „ 43999	1/1½	2/9
44000 „ 59999	1/1	2/8
60000 „ 75999	1/0½	2/7
76000 „ 105999	1/–	2/6
106000 „ 135999	11½	2/5
136000 „ 191999	11	2/4
192000 „ 245999	10½	2/3
246000 „ 343999	10	2/2
344000 „ 442799	9½	2/1
442800	9	2/–

PATENT LICENCE AGREEMENT

NEUTRODYNE PTY. LTD.

Issued 1933

This Indenture made the day of 19 Between NEUTRODYNE PROPRIETARY LIMITED whose registered office is situate at 440 Little Collins Street Melbourne in the State of Victoria (hereinafter called "the Licensor" which expression shall be deemed to include its successors and assigns) of the one part and (hereinafter called "the "Licensee") of the other part WHEREAS the Licensor is the beneficial owner in the Commonwealth of Australia of or controls or is entitled to grant licences or sub-licences in respect of certain inventions the subject of Letters Patents hereinafter specified AND WHEREAS the Licensee has applied for and the Licensor has agreed to grant to the Licensee such licence to use the said inventions as is herein contained upon the terms and conditions hereinafter appearing. NOW THIS INDENTURE WITNESSETH AND IT IS HEREBY COVENANTED AND AGREED by and between the parties hereto as follows that is to say:—

1. The Licensor as beneficial owner hereby grants to the Licensee personally licence to manufacture in the Commonwealth of Australia the apparatus hereinafter mentioned under and according to the specifications of the Letters Patents or any of them now belonging to or controlled by the Licensor or in respect of which the Licensor has power to grant licences or sub-licences particulars whereof are set forth in the First Schedule hereto and also of the applications for Patents particulars whereof are set forth in the Second Schedule hereto and to sell or let on hire radio receiving apparatus coming within the scope of the said Letters Patents or within the scope of any further Letters Patents which may hereafter be granted in the Commonwealth of Australia to the Licensor insofar as such patents may appertain to radio receiving apparatus and circuits used for entertainment purposes but not otherwise.

2. In the event of failure by the Licensee to pay all or any of the royalties herein provided for when such royalties become due and payable or to comply with any of the other obligations covenants terms or conditions of this agreement and on the part of the Licensee to be observed or performed or if the Licensee shall become bankrupt or enter into an assignment for the benefit of creditors or go into liquidation then the Licensor shall be at liberty by notice in writing to determine the licence hereby granted and all rights of the Licensee hereunder shall forthwith cease and determine but without prejudice to the remedy of the Licensor to sue for and recover any royalties then due and to the remedy of either party in respect of any previous breach of the covenants or agreements herein contained.

3. The Licensor hereby agrees that subject to the provisions of this Agreement any bona fide purchaser of radio receiving apparatus from the Licensee shall be at liberty to use sell or hire the same.

AND the Licensee hereby further covenants and agrees with the Licensor as follows:—

4. The Licensee will upon the signing of this agreement deposit with the Licensor the sum of
which money shall be retained by the Licensor free of any liability as to payment of interest thereon until such time as this agreement shall be determined as a guarantee that the Licensee shall and will during the continuance of this licence pay to Licensor the said royalties at the times and in the manner herein provided and shall otherwise observe and perform all the covenants conditions and provisions on the part of the Licensee herein contained and the Licensor shall be entitled to apply the whole or any portion of such deposited money in payment or part payment or any moneys which may be payable by the Licensee to the Licensor in the event of default by the Licensee in making such payments.

5. The Licensee undertakes that all companies individuals or firms which are now or may hereafter during the subsistence of this Licence be directly or indirectly owned or controlled by the Licensee and all companies individuals or firms formed by the Licensee during the subsistence of this Licence and directly or indirectly owning or controlling the Licensee who or which shall be engaged in any field of business to which this Licence is applicable shall forthwith accept licences from the Licensor and sign a Licence Agreement with the Licensor upon the same terms as this Licence and the Licensor agrees to grant such Licences accordingly. If the Licensee shall become directly or indirectly owned or controlled by a company individual or firm who or which does not hold or forthwith obtain a Licence from the Licensor upon the same terms as this Licence then the Licensor shall be at liberty to revoke this Licence.

6. The Licensee hereby covenants and agrees that it will not use or cause to be used the word "NEUTRODYNE" in any form or the words "Approved by the Hazeltine Corporation of America" or words of a similar meaning or effect in any manner whatsoever upon or in connection with any radio receiving apparatus made hired or sold or offered for sale by the Licensee under the terms of this licence without the permission in writing of the Licensor first had and obtained.

7. The Licensee will not during the continuance of this licence nor at any time after the determination thereof either directly or indirectly dispute reject or question or cause to be disputed rejected or questioned the validity or otherwise of the said patents or the novelty or utility of the said inventions or assist so to do and the Licensee shall and will use its best endeavours to detect and prevent infringement of the said patents and will give to the Licensor notice of any infringement or suspected infringement or infringements thereof which shall come to the knowledge of the Licensee and shall and will at the expense of the Licensor as to actual disbursements (if any) made or liabilities (if any) incurred assist the Licensor in any proceedings undertaken by the Licensor to repress any such infringement.

8. The Licensee agrees to keep true accurate and separate books of account containing all the information to be given in the statements herein provided for and agrees to permit the Licensor's duly authorised agent who shall be a public accountant to inspect at any time during the usual business hours all books accounts receipts papers and documents in the possession or under the control of the Licensee relating in whole or in part to the manufacture sale hire or use of any radio receiving apparatus under this agreement and to inspect and take an account of all apparatus in stock.

9. The Licensee shall on or before the 30th day of each and every calendar month furnish the Licensor with a written statement specifying exactly the total number of radio receiving apparatus covered by this agreement manufactured or sold or let on hire by the Licensee during the preceding calendar month. Such statement shall show separately each particular type of radio receiving apparatus. The first of such statements shall be rendered not later than the 15th day after the first complete calendar month next following the date of this agreement and shall cover the period from the date of this agreement to the end of the said first complete calendar month. The royalty prescribed herein shall be due and payable on or before the 15th day of each calendar month of each year upon all such radio receiving apparatus manufactured or sold or let on hire by the Licensee during the preceding month or in the case of the first statement the period covered thereby. The said statements shall be prepared by a competent accountant or bookkeeper in the employ of the Licensee and if required by the Licensor the Licensee shall furnish the Licensor with a statutory declaration by such accountant or bookkeeper verifying such statements. The Licensee shall if so required by the Licensor and at the expense of the Licensee furnish the Licensor with statements as herein provided by a Public Accountant who shall also verify such statements by statutory declaration except that if the statements supplied by the Licensee shall be found to be correct then the expense of such investigation shall be borne by the Licensor.

10. The Licensee shall pay the sum of 5/- to the Licensor by way of royalty in respect of each and every Radio Receiving Apparatus manufactured or sold or let on hire which employs or is designed to employ valves, except in respect of a radio receiving apparatus embodying only two valves either with or without the addition of a rectifier for battery elimination purposes when the royalty shall be as follows:—

Two single function valves with or without the addition of a rectifier 1/-

One single function valve and one double function valve either with or without the addition of a rectifier 2/6

Two double function valves either with or without the addition of a rectifier 5/-

11. The term of this agreement shall be years and months from the date hereof unless sooner terminated or extended as herein provided. And this agreement shall if mutually desired by the Licensor and the Licensee continue in force after the said term until three months' notice to terminate the same is given by either party. Such notice shall be signed by either party or its authorised representative and either served personally or posted by registered letter addressed to the last known place of business of the other party.

12. The termination of this agreement either by expiration of time or otherwise shall not release the Licensee from any of its liabilities accruing prior to such termination.

13. The Licensee will not assign transfer or mortgage or otherwise deal or part with the possession or control of this Licence or attempt so to do.

14. The Licence hereby granted is non-exclusive and is personal to the Licensee and the Licensee shall not assign mortgage charge or grant sub-licences in respect of this licence or share the same or any part thereof without the written consent of the Licensor. This licence agreement shall inure to the benefit of the successors and assigns of the Licensor but shall not inure to the benefit of the successors assigns or legal representatives of the Licensee.

15. Each and every radio receiving apparatus manufactured or sold or let on hire by or on behalf of the Licensee under the terms of this Agreement shall have affixed thereto in a readily observable location a plate or label indicating the royalty payable on the particular receiver under Clause 10. Such plate or label shall also properly identify, in accordance with the legal requirements, custom or practice, the letters patent or patents of the Licensor under which same is manufactured and/or sold and/or let on hire. The inscription on such plate or label shall in each case be subject to the expressed approval of the Licensor. The Licensee shall obtain from the Licensor solely such plates and/or labels, and shall pay to the Licensor royalty in respect of each plate and/or label obtained from the Licensor in accordance with the classification under Clause 10, irrespective of whether such plates and/or labels are used for attachment to radio receivers or otherwise. The Licensee agrees that he will not sell or part with the possession of any such radio receiving apparatus unless and until such plate or label is firmly affixed thereon as aforesaid.

16. Every kit of component parts adapted for use in the construction of Radio receivers under the terms of this agreement manufactured sold or let on hire by or on behalf of the Licensee shall have affixed thereto a notice to the effect that it is manufactured and sold under licence of the Neutrodyne Proprietary Limited Patents for use by the ultimate purchaser or hirer in the construction of radio receiving apparatus for his own use and enjoyment and that the purchaser or hirer does not by the purchase or hire thereof acquire any licence whatsoever under the said Patents to use the kit of component parts in the consruction of radio receiving apparatus for sale or hire.

17. All radio receiving sets which may be sold or let on hire by or on behalf of the Licensee under this licence shall be of good material and of good workmanship and in the event of any dispute arising under this clause the same shall be submitted for determination to an engineer or other qualified person to be mutually agreed upon by the parties hereto and in making any such determination such engineer or other qualified person shall be deemed to be acting as an expert and not an arbitrator and the provisions of the Arbitration Act 1928 and any modification thereof shall not apply. If the parties cannot agree upon an expert one shall be appointed and act under the provision of the Arbitration Act 1928 and any modification thereof.

18. Notwithstanding anything herein contained it is expressly covenanted and agreed by and between the parties hereto that should the Licensor enter into and complete any agreement licence or other contract with the Government of the Commonwealth of Australia relating to the use of the inventions protected by the patents referred to in this licence then this licence shall and will as and from the date of the commencement and operation of such agreement licence or contract with or by the said Government be thereupon deemed to be terminated and as of no effect but without prejudice to the right of the Licensor to collect from the Licensee any and all such royalty or royalties or other payments as shall be due and payable to the Licensor by the Licensee at the date of the commencement and operation of any such agreement licence or contract with or by the said Government.

19. In the event of any step being taken by or on behalf of or against the Licensee (if the Licensee is a Company) to place the Licensee in liquidation either compulsorily or voluntarily other than and except a liquidation of the Licensee by reason of it being unable to pay its liabilities as they become due, then the Licensee shall thereupon pay to the Licensor

the sum of £ as a further payment of royalty and as further consideration for the Licence hereby granted. Provided, however, that the Licensor shall not require or enforce payment of the said sum in the event of the purchaser of the assets of the Licensee entering into and executing a License Agreement with the Licensor similar to this Licence Agreement.

20. Wherever the words "radio receiving apparatus" are used throughout this agreement the same include radio apparatus kits and chassis respectively.

FIRST SCHEDULE hereinbefore referred to:

No. 19,999/24 dated 20th February, 1924: "MEANS FOR NEUTRALISING CAPACITY COUPLING."

No. 20,000/24 dated 7th April, 1924: "MEANS FOR ELIMINATING MAGNETIC COUPLING BETWEEN COILS."
No. 23,308/25 dated 27th February, 1925: "WAVE SIGNALLING SYSTEM."
No. 23,802/25 dated 3rd April, 1925: "UNI-CONTROL SIGNALLING SYSTEM."
No. 24,489/25 dated 22nd September, 1924: "METHOD OF AND MEANS FOR ELIMINATING CAPACITIVE COUPLING."
No. 1,947/26 dated 26th May, 1925: "RADIO RECEIVING SYSTEM."
No. 11,420/28 dated 26th September, 1927: "RADIO FREQUENCY AMPLIFIER."
No. 14,290/28 dated 7th July, 1927: "AMPLIFIER VOLUME CONTROL."
No. 15,877/28 dated 25th May, 1928: "WAVE SIGNALLING SYSTEM."
No. 17,417/28 dated 24th September, 1927: "SHIELDING FOR RADIO FREQUENCY AMPLIFIERS."
No. 17,741/29 dated 20th January, 1928: "WHEATSTONE BRIDGE FILTER."
No. 20,801/29 dated 23rd June, 1928: "WAVE SIGNALLING SYSTEM."
No. 21,139/29 dated 14th July, 1928: "ELECTRIC COUPLING SYSTEMS."
No. 22,403/29 dated 22nd September, 1928: "ELECTRIC COUPLING SYSTEMS."
No. 22,403/29 dated 22nd September, 1928: "VOLUME CONTROL FOR RADIO RECEIVERS."
No. 24,740/30 dated 15th February, 1929: COUPLING SYSTEM."
No. 26,701/30 dated 20th June, 1929: RADIO COUPLING SYSTEM."
No. 27,836/30 dated 16th July, 1929: "PUSH-PULL AMPLIFIER."
No. 28,171/30 dated 3rd August, 1929: "HIGH FREQUENCY TRANSFORMER."
No. 28,264/30 dated 17th August, 1929: "PUSH-PULL AMPLIFIER."
No. 28,265/30 dated 17th August, 1929: "THERMIONIC AMPLIFIER."
No. 28,266/30 dated 17th August, 1929: "PUSH-PULL AMPLIFIER."
No. 28,663/30 dated 26th August, 1930: "ELECTRIC COUPLING SYSTEM."
No. 30,645/30 dated 15th February, 1929: " TRANSFORMER."
No. 768/31 dated 30th June, 1929: "RADIO COUPLING SYSTEM."
No. 2987/31 dated 21st July, 1930: "WAVE SIGNALLING SYSTEM."
No. 2988/31 dated 19th July, 1930: "ELECTRIC COUPLING CIRCUIT."
No. 3279/31 dated 19th August, 1930: "ELECTRIC COUPLING CIRCUITS."
No. 3280/31 dated 20th August, 1930: "ELECTRIC COUPLING CIRCUITS."
No. 3303/31 dated 19th August, 1930: "COUPLING SYSTEM."
No. 3358/31 dated 20th August, 1930: "ELECTRIC COUPLING SYSTEMS."
No. 3946/31 dated 10th September, 1930: "ELECTRIC COUPLING CIRCUITS."
No. 4033/31 dated 25th September, 1930: "ELECTRIC COUPLING CIRCUITS."
No. 4932/31 dated 28th November, 1930: "HIGH FREQUENCY TRANSFORMER."
No. 5526/31 filed 24th December, 1931, dated 13th February, 1931: "SUPERHETERODYNE."
No. 6746/32 filed 31st March, 1932, dated 1st April, 1931: "PEAK DETECTOR."
No. 6910/32 filed 28th May, 1931: "FEED BACK CIRCUITS."
No. 7573/32 filed 27th May, 1932, dated 16th July, 1931: "DOUBLE BAND RECEIVER."
No. 7625/32 filed 30th May, 1932, dated 7th July, 1931: "RADIO RECEIVING APPARATUS."
No. 8006/32 filed 27th June, 1932, dated 31st March, 1932: "DETECTOR CIRCUIT."
No. 8119/32 filed 5th July, 1932, dated 13th February, 1931, Divisional application of No. 5526-31: "SUPERHETERODYNE."
No. 8545/32 filed 1st August, 1932, dated 6th April, 1932: "NOISE SUPPRESSOR."

SECOND SCHEDULE hereinbefore referred to:

No. 11128/33 filed 31st January, 1933, claiming date of 1st February, 1932: "SELECTIVE CIRCUITS."
No. 12085/33 filed 5th April, 1933, claiming date of 6th April, 1932: "AUTOMATIC VOLUME CONTROL."
No. 12086 filed 5th April, 1933, claiming date of 9th April, 1932: "OSCILLATORS."
No. 12785 filed 24th May, 1933, claiming date of 25th May, 1933: "RADIO RECEIVERS."
No. 13036/33 filed 13th June, 1933, claiming date of 6th April, 1932: "NOISE SUPPRESSOR."
No. 13139/33 filed 21st June, 1933, claiming date of 22nd June, 1932: "TUNING INDICATOR."
No. 14000/33 filed 19th August, 1933, claiming date of 22nd August, 1932: "TONE CONTROL."

SPECIAL NOTICE

Since this Patent Section was compiled and printed, the position in Australia has clarified and both Neutrodyne and A.R.T.S. & P. patents are available under the A.R.T.S. & P. Licence at no extra cost and as per schedule on Page 77.

Broadcasting Licences in Australia

Current Receiving Licences (Total All Classes) and Ratio to Population.

At end of	N.S.W.		VIC.		Q'LD.		S.A.		W.A.		TAS.		COMMONWEALTH	
	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population
1924.														
July	906	.04	187	.01	23	.003	74	.01			16	.008	1,206	.02
Aug.	6,945	.3	887	.05	160	.02	309	.05	333	.09	54	.02	8,688	.1
Sept.	13,861	.6	1,398	.08	356	.04	537	.1	576	.1	131	.06	16,859	.3
Oct.	16,721	.8	3,080	.2	456	.05	885	.16	784	.2	161	.08	22,087	.4
Nov.	22,442	.9	5,957	.3	533	.06	1,095	.2	1,301	.3	201	.09	31,529	.54
Dec.	26,071	1.1	8,327	.5	633	.07	1,345	.25	1,716	.4	244	.1	38,336	.66
1925.														
Jan.	28,397	1.2	10,975	.6	697	.08	1,579	.27	2,321	.6	305	.14	44,274	.76
Feb.	30,450	1.3	13,953	.8	825	.09	1,874	.34	2,756	.7	365	.17	50,223	.85
Mar.	31,796	1.4	16,459	.9	942	.11	2,198	.4	3,029	.8	429	.19	54,853	.93
Apr.	32,847	1.4	18,036	1.09	1,050	.12	2,507	.46	3,215	.9	478	.2	58,133	.99
May	33,906	1.5	19,383	1.1	1,177	.14	2,855	.5	3,392	.93	518	.23	61,231	1.04
June	34,857	1.54	20,290	1.22	1,267	.15	3,331	.62	3,562	.97	567	.26	63,874	1.08
July	35,504	1.57	21,357	1.28	1,362	.17	4,096	.77	3,679	1.02	607	.28	66,605	1.1
Aug.	37,565	1.6	23,776	1.4	1,704	.2	4,775	.89	3,943	1.09	720	.33	72,483	1.24
Sept.	38,892	1.7	26,232	1.5	2,229	.26	5,259	.97	4,083	1.1	790	.36	77,485	1.31
Oct.	37,203	1.6	28,442	1.7	2,892	.34	5,774	1.07	4,124	1.1	836	.38	79,271	1.34
Nov.	34,744	1.5	31,318	1.8	3,660	.43	6,099	1.1	4,179	1.1	853	.39	80,853	1.37
Dec.	34,911	1.5	33,988	2	4,141	.49	6,985	1.29	4,192	1.15	913	.41	85,130	1 44
1926.														
Jan.	34,108	1.5	38,323	2.2	4,476	.5	8,568	1.01	4,198	1.1	967	.44	90,640	1.5
Feb.	32,444	1.4	45,274	2.7	4,795	.5	9,734	1.7	3,959	1	1,013	.46	97,219	1.6
Mar.	33,188	1.4	49,402	2.9	5,247	.6	10,480	1.9	3,764	1	1,064	.5	103,145	1.7
Apr.	34,100	1.4	53,547	3.1	5,951	.6	11,029	2	3,759	1	1,114	.5	109,500	1.8
May	35,438	1.5	57,700	3.4	6,681	.7	11,624	2.1	3,877	1	1,171	.5	116,491	1.9
June	37,082	1.61	64,587	3.83	8,450	.98	12,657	2.27	4,003	1.07	1,281	.58	128,060	2.14
July	39,206	1.7	70,070	4.1	12,892	1.4	13,764	2.4	4,113	1.1	1,347	.6	141,392	2.3
Aug.	41,929	1.8	77,493	4.6	15,082	1.7	14,631	2.6	4,157	1.1	1,444	.6	154,736	2.5
Sept.	44,962	1.9	83,077	4.9	16,619	1.9	14,904	2.6	4,225	1.1	1,649	.7	165,436	2.7
Oct.	47,127	2.04	89,055	5.28	17,971	2.08	15,252	2.7	4,143	1.1	1,750	.8	175,298	2.9
Nov.	47,879	2.06	95,136	5.6	18,902	2.1	15,136	2.7	4,118	1.1	1,849	.8	183,020	3.02
Dec.	48,858	2.1	97,744	5.8	19,414	2.2	15,165	2.7	4,114	1.09	1,933	.92	187,228	3.09
1927.														
Jan.	50,301	2.2	101,635	5.9	20,082	2.3	15,469	2.7	4,047	1	2,008	.9	193,542	3.2
Feb.	51,154	2.2	104,428	6.1	20,425	2.3	15,773	2.7	4,014	1	2,078	1	197,872	3.2
Mar.	52,528	2.2	106,081	6.2	20,787	2.3	15,807	2.8	3,932	1	2,153	1	201,288	3.3
Apr.	54,561	2.3	108,732	6.3	21,335	2.4	15,738	2.8	3,890	1	2,259	1	206,515	3.4
May	57,251	2.4	113,977	6.6	22,287	2.5	16,061	2.8	3,874	1	2,351	1	215,801	3.5
June	59,880	2.55	118,965	6.95	23,249	2.63	16,791	2.96	3,903	1.03	2,461	1.14	225,249	3.68
July	62,869	2.68	122,443	7.15	23,957	2.71	17,503	3.09	3,922	1.04	2,592	1.20	233,286	3.82
Aug.	65,803	2.78	126,830	7.36	24,235	2.74	17,797	3.13	3,943	1.03	2,730	1.25	241,338	3.93
Sept.	69,212	2.93	130,236	7.56	24,699	2.79	18,329	3.22	3,987	1.04	2,912	1.38	249,375	4.06
Oct.	71,479	3.03	132,871	7.72	24,914	2.81	18,417	3.23	3,932	1.03	3,125	1.87	254,738	4.15
Nov.	72,162	3.04	133,746	7.75	25,203	2.82	18,645	3.27	3,911	1.02	3,343	1.60	257,010	4.17
Dec.	72,854	3.05	134,825	7.80	24,433	2.73	18,792	3.29	3,872	1.00	3,403	1.63	258,179	4.19
1928.														
Jan.	74,323	3.13	135,729	7.86	24,787	2.77	19,126	3.35	3,829	.99	2,510	1.20	260,304	4.22
Feb.	75,212	3.15	136,410	7.86	24,813	2.77	19,388	3.38	3,820	.98	2,720	1.30	262,363	4.23
Mar.	75,869	3.16	136,481	7.83	24,920	2.77	19,452	3.38	3,780	.96	2,838	1.31	263,340	4.22
Apr.	77,010	3.20	136,712	7.84	25,072	2.79	19,605	3.40	3,756	.96	2,912	1.34	265,067	4.25
May	78,698	3.27	136,496	7.84	25,239	2.80	19,969	3.46	3,740	.95	3,036	1.40	267,178	4.28
June	80,197	3.34	137,758	7.91	25,287	2.82	20,319	3.53	3,774	.96	3,172	1.46	270,507	4.33
July	82,872	3.45	139,023	7.98	25,685	2.86	20,736	3.60	3,798	.97	3,327	1.54	275,441	4.42
Aug.	85,196	3.55	141,344	8.11	25,736	2.86	21,088	3.66	3,844	.98	3,480	1.61	280,688	4.50
Sept.	87,622	3.63	142,597	8.15	25,673	2.84	21,305	3.70	3,848	.97	3,645	1.72	284,690	4.54
Oct.	88,783	3.67	141,988	8.12	25,566	2.83	21,514	3.73	3,844	.97	3,855	1.82	285,550	4.56
Nov.	90,177	3.72	143,250	8.19	25,235	2.77	22,019	3.81	3,830	.96	3,946	1.87	288,457	4.59
Dec.	91,709	3.78	141,890	8.11	25,224	2.77	22,120	3.81	3,814	.95	4,117	1.95	288,874	4.59
1929.														
Jan.	92,681	3.83	141,279	8.08	24,761	2.72	22,420	3.88	3,819	.96	4,204	1.99	289,164	4.60
Feb.	94,404	3.87	141,642	8.07	24,543	2.68	22,682	3.93	3,820	.95	4,198	1.99	291,289	4.61
Mar.	95,487	3.92	141,932	8.09	24,642	2.67	22,942	3.97	3,790	.94	4,327	2.05	293,120	4.64
Apr.	96,877	3.97	143,393	8.17	24,627	2.69	23,186	4.01	3,767	.93	4,467	2.12	296,317	4.69
May	98,550	4.04	143,344	8.17	24,681	2.70	23,573	4.09	3,799	.94	4,604	2.17	298,551	4.73
June	101,012	4.13	142,750	8.15	24,744	2.70	24,021	4.15	3,890	.96	4,782	2.21	301,199	4.75
July	102,787	4.20	142,293	8.08	24,856	2.71	24,346	4.20	3,936	.97	4,974	2.30	303,192	4.78
Aug.	104,580	4.28	140,529	7.98	24,910	2.72	24,474	4.23	3,938	.97	5,131	2.37	303,562	4.79
Sept.	105,549	4.29	140,309	7.94	24,218	2.63	24,647	4.25	4,122	1.01	5,311	2.49	304,156	4.78
Oct.	107,489	4.37	144,295	8.16	23,505	2.54	24,737	4.27	4,353	1.06	5,441	2.56	309,820	4.86
Nov.	108,244	4.40	143,466	8.12	23,204	2.50	25,166	4.34	4,658	1.13	5,575	2.62	310,313	4.87
Dec.	107,503	4.37	144,141	8.16	22,449	2.42	25,481	4.38	4,727	1.15	5,680	2.67	309,981	4.86
1930.														
Jan.	108,835	4.41	144,165	8.13	22,388	2.41	25,337	4.37	4,759	1.15	5,590	2.63	311,074	4.86
Feb.	108,780	4.40	142,196	8.02	22,422	2.41	25,140	4.34	4,857	1.17	5,606	2.63	309,001	4.83
Mar.	109,193	4.42	141,853	8.00	22,589	2.43	25,265	4.36	5,023	1.21	5,649	2.66	309,572	4.84
Apr.	109,256	4.41	140,945	7.93	22,476	2.41	25,253	4.35	5,163	1.24	5,668	2.59	308,711	4.81
May	110,682	4.47	141,081	7.94	22,797	2.45	25,448	4.39	5,552	1.33	5,762	2.64	311,322	4.87
June	111,253	4.49	140,072	7.88	23,335	2.51	25,729	4.43	5,755	1.38	6,048	2.76	312,192	4.88
July	115,345	4.65	143,716	8.00	23,628	2.54	27,102	4.67	6,631	1.59	6,582	3.00	323,004	5.03
Aug.	120,673	4.86	147,180	8.25	24,217	2.59	28,227	4.86	7,298	1.25	7,442	3.45	335,037	5.21
Sept.	117,915	4.74	144,925	8.13	24,193	2.57	28,002	4.82	7,547	1.80	7,587	3.52	330,169	5.13
Oct.	118,189	4.75	143,819	8.07	24,214	2.57	28,082	4.83	7,668	1.81	7,655	3.55	329,627	5.12
Nov.	117,885	4.74	142,421	7.99	24,235	2.57	28,266	4.86	7,809	1.86	7,691	3.57	328,307	5.10
Dec.	119,131	4.79	141,687	7.95	24,418	2.59	28,447	4.90	8,030	1.92	7,752	3.59	329,465	5.12

BROADCAST LISTENERS' LICENCES 1931 - 1932 - 1933

At end of	N.S.W.		VIC.		Q'LD.		S.A.		W.A.		TAS.		COMMONWEALTH	
	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population	Licences in force	Ratio to 100 of Population
1931.														
Jan.	118,507	4.78	140,142	7.87	24,297	2.59	28,198	4.87	8,103	1.95	7,755	3.60	326,993	5.08
Feb.	118,720	4.77	138,908	7.79	24,193	2.57	28,407	4.90	8,230	1.97	7,812	3.63	326,270	5.06
Mar.	119,398	4.79	138,784	7.76	24,241	2.57	28,723	4.95	8,388	2.01	7,879	3.58	327,413	5.07
Apr.	120,612	4.82	138,152	7.71	24,542	2.59	29,205	5.02	8,645	2.05	7,978	3.61	329,134	5.08
May	120,642	4.84	137,306	7.64	24,256	2.56	29,729	5.12	8,789	2.10	8,093	3.68	328,815	5.09
June	122,470	4.91	137,005	7.66	24,108	2.55	30,238	5.21	9,075	2.17	8,232	3.74	331,128	5.12
July	122,259	4.88	136,183	7.58	24,320	2.55	30,681	5.26	9,219	2.19	8,256	3.76	330,918	5.10
Aug.	120,583	4.81	133,965	7.44	24,182	2.54	30,449	5.22	9,364	2.23	8,077	3.68	326,620	5.03
Sept.	120,686	4.82	132,563	7.37	24,790	2.58	30,679	5.26	9,621	2.29	8,260	3.77	326,599	5.02
Oct.	122,039	4.87	132,968	7.39	25,550	2.66	31,155	5.34	9,961	2.37	8,506	3.88	330,179	5.08
Nov.	123,372	4.92	133,709	7.44	25,931	2.70	31,600	5.42	10,433	2.48	8,669	3.91	333,714	5.13
Dec.	125,409	5.00	134,173	7.46	26,449	2.76	32,160	5.51	10,800	2.57	8,667	3.96	337,654	5.19
1932.														
Jan.	127,734	5.09	134,523	7.48	26,775	2.79	32,560	5.60	11,046	2.63	8,756	4.00	341,394	5.25
Feb.	130,866	5.20	136,211	7.57	27,341	2.84	33,049	5.66	11,269	2.67	8,819	4.02	347,555	5.33
Mar.	132,861	5.28	135,995	7.56	27,671	2.88	33,757	5.78	11,489	2.73	8,888	4.05	350,661	5.38
Apr.	135,295	5.37	138,388	7.68	28,174	2.92	34,608	5.92	11,841	2.81	9,127	4.09	357,433	5.48
May	138,329	5.49	139,397	7.74	28,656	2.97	35,815	6.12	12,234	2.90	9,341	4.18	363,772	5.56
June	141,745	5.63	139,592	7.75	29,060	3.02	37,227	6.36	12,745	3.02	9,567	4.28	369,936	5.67
July	145,101	5.76	141,032	7.82	29,293	3.04	38,206	6.53	13,292	3.15	9,835	4.40	376,759	5.77
Aug.	148,422	5.88	143,270	7.94	29,784	3.09	39,371	6.78	13,827	3.28	10,113	4.56	384,787	5.88
Sept.	150,415	5.95	145,316	8.05	30,051	3.11	40,178	6.86	14,291	3.39	10,301	4.65	390,552	5.97
Oct.	152,996	6.06	147,652	8.18	30,375	3.14	41,039	7.01	14,950	3.55	10,478	4.73	397,490	6.08
Nov.	157,506	6.23	151,498	8.39	31,534	3.24	42,312	7.22	15,568	3.68	10,846	4.90	409,264	6.25
Dec.	159,972	6.33	156,307	8.66	32,183	3.31	43,362	7.40	16,127	3.79	11,229	5.08	419,180	6.40
1933.														
Jan.	163,139	6.45	158,975	8.81	33,037	3.40	44,594	7.61	16,639	3.94	11,437	5.17	427,821	6.53
Feb.	165,282	6.52	161,244	8.92	33,768	3.46	45,605	7.78	17,136	4.05	11,597	5.24	434,632	6.62
Mar.	169,034	6.65	164,393	9.09	34,613	3.55	46,670	7.90	17,691	4.18	11,978	5.42	444,379	6.77
Apr.	171,403	6.72	164,600	9.09	34,904	3.59	47,547	8.03	18,283	4.32	12,051	5.35	448,788	6.83
May	175,125	6.88	167,682	9.17	35,554	3.65	48,900	8.27	19,453	4.60	12,293	5.56	459,007	7.00
June	178,387	7.00	171,318	9.46	36,314	3.72	50,261	8.49	20,604	4.87	12,593	5.59	469,477	7.14
July	182,312	7.15	176,195	9.73	37,000	3.79	51,484	8.70	21,409	5.08	12,884	5.72	481,374	7.32
Aug.	185,864	7.12	178,721	9.83	38,097	4.03	52,682	9.00	22,599	5.16	13,270	5.83	491,233	7.41
Sept.	189,386	7.26	181,425	9.98	38,894	4.11	53,723	9.18	23,452	5.35	13,461	5.91	500,341	7.55
Oct.	192,966	7.29	183,507	10.08	39,902	4.21	54,532	9.31	23,999	5.47	13,628	5.99	508,534	7.67
Nov.	195,509	7.49	184,749	10.15	40,480	4.29	55,057	9.40	24,707	5.63	13,785	6.06	514,287	7.76
Dec.	197,869	7.56	184,861	10.14	40,918	4.31	55,762	9.51	25,325	5.76	13,893	6.11	518,628	7.81

Broadcast Listeners' Licences in force in areas within 50 miles of principal cities and towns

Quarter Ended 30th June, 1933

New South Wales

Location	Licences	Population	Ratio of Licences to 100 of Population.	
Area within 50 miles of Sydney	135,951	1,461,060	9.24	(1:11)
Remainder of State	42,436	1,087,801	3.90	(1:26)
State Total	178,387	2,548,861	7.00	(1:14)
Area within 50 miles of Albury—				
N.S.W. Sec.	1,699	28,532	5.9	(1:17)
Victorian Sec.	1,474	37,400	3.94	(1:25)
Total	3,173	65,932	4.8	(1:21)
Bathurst	3,216	91,941	3.4	(1:29)
Broken Hill	1,165	23,434	4.9	(1:20)
Canberra	1,327	37,602	3.5	(1:29)
Corowa—				
N.S.W. Sec.	1,828	34,138	5.3	(1:19)
Victorian Sec.	1,747	38,400	4.6	(1:22)
Total	3,575	72,538	4.9	(1:20)
Dubbo	908	34,800	2.6	(1:38)
Goulburn	2,292	53,738	4.2	(1:23)
Grafton	931	34,704	2.7	(1:37)
Gunnedah	1,143	38,650	2.9	(1:34)
Lismore	2,221	82,345	2.7	(1:37)
Mildura—				
N.S.W. Sec.	133	1,733	7.6	(1:13)
Victorian Sec.	1,165	16,100	7.2	(1:14)
Total	1,298	17,833	7.3	(1:14)
Moss Vale	6,161	102,900	5.9	(1:17)
Newcastle	14,038	231,270	6.1	(1:16)
Orange	1,811	64,735	2.8	(1:36)
Swan Hill—				
N.S.W. Sec.	173	4,230	4.1	(1:24)
Victorian Sec.	1,166	23,000	5.0	(1:20)
Total	1,339	27,230	4.9	(1:20)
Wagga	2,563	60,633	4.2	(1:24)
Wangaratta—				
N.S.W. Sec.	1,306	15,870	8.2	(1:12)
Victorian Sec.	3,153	88,500	3.5	(1:28)
Total	4,459	104,370	4.3	(1:24)
Area within 15 miles of Wollongong—				
Inc. Sydney	134,119	1,355,560	9.9	(1:10)
Exc. Sydney	2,684	35,840	7.5	(1:13)

Victoria

Location	Licences	Population	Ratio of Licences to 100 of Population.	
Area within 50 miles of Melbourne	134,906	1,220,000	11.0	(1:9)
Remainder of State	36,412	590,637	6.11	(1:16)
State	171,318	1,810,637	9.46	(1:11)
Area within 50 miles of Albury—				
N.S.W. Sec.	1,699	28,532	5.9	(1:17)
Victorian Sec.	1,474	37,400	3.94	(1:25)
Total	3,173	65,932	4.8	(1:21)
Ballarat	13,178	156,000	8.44	(1:12)
Bendigo	6,159	112,000	5.5	(1:18)
Corowa—				
N.S.W. Sec.	1,828	34,138	5.3	(1:19)
Victorian Sec.	1,747	38,400	4.6	(1:22)
Total	3,575	72,538	4.9	(1:20)
Geelong	136,233	1,178,000	11.6	(1:9)
Hamilton	2,990	54,000	5.5	(1:18)
Mildura—				
Victorian Sec.	1,165	16,100	7.2	(1:14)
N.S.W. Sec.	133	1,733	7.6	(1:13)
Total	1,298	17,833	7.3	(1:14)
Mt. Gambier—				
Victorian Sec.	658	12,800	5.1	(1:20)
S.A. Sec.	766	16,000	4.8	(1:21)
Total	1,424	28,800	4.9	(1:20)
Sale	2,594	45,200	5.7	(1:17)
Swan Hill—				
Victorian Sec.	1,166	23,000	5.0	(1:20)
N.S.W. Sec.	173	4,230	4.1	(1:24)
Total	1,339	27,230	4.9	(1:20)
Wangaratta—				
Victorian Sec.	3,153	88,500	3.5	(1:28)
N.S.W. Sec.	1,306	15,870	8.2	(1:12)
Total	4,459	104,370	4.3	(1:24)
Area within 15 miles of Geelong	4,858	50,000	9.7	(1:10)

Queensland

Location	Licences	Population	Ratio of Licences to 100 of Population.	
Area within 50 miles of Brisbane	25,208	402,745	6.26	(1:16)
Remainder of State	11,106	572,911	1.94	(1:52)
State	36,314	975,656	3.72	(1:27)
Area within 50 miles of Bundaberg	910	40,933	2.22	(1:45)
Cairns	294	23,750	1.23	(1:81)
Mackay	391	20,645	1.89	(1:53)
Rockhampton	1,883	39,800	4.73	(1:21)
Toowoomba	1,841	34,430	5.34	(1:19)
Townsville	648	38,546	1.68	(1:59)
Warwick	849	30,603	2.77	(1:36)

South Australia

Location	Licences	Population	Ratio of Licences to 100 of Population.	
Area within 50 miles of Adelaide	37,659	400,799	9.4	(1:11)
Remainder of State	12,602	191,000	6.6	(1:15)
State	50,261	591,799	8.49	(1:12)
Area within 50 miles of Port Pirie	3,409	45,000	7.6	(1:13)
Mt. Gambier—				
S.A. Sec.	766	16,000	4.8	(1:21)
Victorian Sec.	658	12,800	5.1	(1:20)
Total	1,424	28,800	4.9	(1:20)

Western Australia

Location	Licences	Population	Ratio of Licences to 100 of Population.	
Area within 50 miles of Perth	16,053	234,272	6.85	(1:15)
Remainder of State	4,551	188,920	2.41	(1:41)
State	20,604	423,192	4.87	(1:20)
Area within 50 miles of Albany	307	9,194	3.33	(1:30)
Bunbury	540	26,921	2.00	(1:50)
Collie	733	33,401	2.19	(1:46)
Geraldton	179	7,912	2.26	(1:44)
Kalgoorlie	427	17,710	2.41	(1:42)
Katanning	550	17,313	3.17	(1:31)
Nerredin	392	14,859	2.63	(1:38)
Narrogin	315	19,867	1.58	(1:63)
Northam	576	13,047	4.41	(1:23)

Tasmania

Location	Licences	Population	Ratio of Licences to 100 of Population.	
Area within 50 miles of Hobart	6,746	92,336	7.3	(1:14)
Remainder of State	5,847	132,774	4.4	(1:23)
State	12,593	225,110	5.59	(1:18)
Area within 50 miles of Burnie	2,645	42,040	6.3	(1:16)
Devonport	4,609	77,637	6.0	(1:17)
Launceston	4,202	82,005	5.1	(1:20)
Queenstown	399	13,242	3.0	(1:33)

Important Licence Statistics

The undermentioned analysis of the wireless licences throughout Australia from the Commonwealth Statistician of fresh population data, based on the census taken in June last year.

Attention is also invited to the fact that consequent upon the adoption of the new population figures, the licence density calculations vary somewhat from those shown in previous returns and published in the "Radio Retailer," page 30, September 7th, and on page 85 hereof, thus rendering those figures ineffective for comparison purposes with those published herein.

Quarter Ended, 30th September 1933

New South Wales and Federal Capital

Locality	Licences	Population	Ratio of Licences to 100 of Population	Dwellings
(1)	(2)	(3)	(4)	(5)
Within 50 miles of Sydney	143,005	1,422,673	10.5	42
Remainder of State (inc. F.C.T.)	46,381	1,187,378	3.90	17
State (inc. F.C.T.)	189,386	2,610,051	7.26	31
Within 50 miles of—				
Albury—N.S.W. Section	1,913	30,792	6.21	28
Vic. Section	1,593	38,016	4.19	18
Total	3,506	68,808	5.10	22
Bathurst	3,527	93,390	3.78	16
Broken Hill (exc. S.A.)	1,275	28,257	4.51	18
Canberra (inc. N.S.W.)	1,418	33,586	4.22	18
Corowa—N.S.W. Section	2,078	32,168	6.46	29
Vic. Section	1,885	48,963	3.85	16
Total	3,963	81,131	4.88	21
Dubbo	1,020	31,277	3.26	14
Goulburn	2,483	61,541	4.03	18
Grafton	1,008	42,314	2.38	10
Gunnedah	1,247	47,214	2.64	12
Lismore (ex. Qld.)	2,312	90,680	2.55	12
Moss Vale	6,529	114,179	5.72	25
Newcastle	15,154	242,606	6.25	27
Orange	1,982	79,855	2.48	11
Wagga	2,870	73,086	3.93	18
Wollongong—				
Inc. Sydney	141,089	1,382,440	10.20	44
Exc. Sydney	10,733	147,073	7.30	30

Victoria

Within 50 miles of Melbourne	144,465	1,192,556	12.11	50
Remainder of State	36,960	627,804	5.89	25
State	181,425	1,820,360	9.98	41
Within 50 miles of—				
Ballarat	13,411	161,826	8.29	34
Bendigo	6,254	126,454	4.95	19
Geelong—Inc. Melbourne	144,593	1,148,212	12.59	53
Exc. Melbourne	15,536	156,164	9.95	42
Hamilton	3,071	55,555	5.53	24
Horsham	2,163	44,380	4.87	20
Mildura—Vic. Section	1,350	23,976	5.63	24
N.S.W. Section	200	3,584	5.58	22
Total	1,550	27,560	5.62	24
Sale	2,863	49,869	5.74	24
Swan Hill—Vic. Section	1,489	29,583	5.03	22
N.S.W. Sec.	201	5,490	3.66	16
Total	1,690	35,073	4.82	21
Wangaratta—Vic. Section	3,414	59,151	5.77	24
N.S.W. Sec.	1,482	22,484	6.59	30
Total	4,896	81,635	6.00	26

Queensland

Within 50 miles of Brisbane	27,160	395,924	6.86	29
Remainder of State	11,734	551,865	2.13	9
State	38,894	947,789	4.11	18
Within 50 miles of—				
Cairns	369	48,850	.76	3
Mackay	474	29,065	1.63	7
Maryborough	1,290	53,527	2.41	10
Rockhampton	1,889	47,944	3.94	17
Toowoomba	4,740	123,059	3.85	18
Townsville	806	40,055	2.01	9
Warwick (exc. N.S.W.)	2,857	84,287	3.39	15

South Australia

Within 50 miles of Adelaide	37,834	391,552	9.66	39
Remainder of State (inc. N. Territory)	15,889	194,295	8.18	35
State (inc. N.T.)	53,723	585,847	9.18	38
Within 50 miles of—				
Crystal Brook	4,429	50,128	8.84	38
Port Pirie	3,845	43,330	8.87	39
Mt. Gambier—				
S.A. Section	915	17,181	5.33	22
Vic. Section	661	7,922	8.34	35
Total	1,576	25,103	6.28	26

Western Australia

Within 50 miles of Perth	18,036	236,342	7.63	33
Remainder of State	5,416	202,606	2.67	10
State	23,452	438,948	5.35	22
Within 50 miles of—				
Bunbury	632	33,848	1.87	7
Collie	861	35,470	2.43	9
Geraldton	200	9,984	2.00	9
Kalgoorlie	460	23,257	1.98	8
Katanning	571	14,537	3.93	17
Merredin	478	15,031	3.18	13
Narrogin	323	15,847	2.04	9
Northam (exc. Perth)	650	37,782	1.72	7

Tasmania

Within 50 miles of Hobart	7,153	99,727	7.17	31
Remainder of State	6,308	127,878	4.93	21
State	13,461	227,605	5.91	25
Within 50 miles of—				
Burnie	2,774	48,377	5.73	25
Devonport	5,021	86,597	5.71	25
Launceston	4,591	82,196	5.59	24
Queenstown	421	9,719	4.34	17

LICENCES WITHIN 50 MILES OF FOLLOWING CITIES AND TOWNS FOR QUARTER ENDING DEC. 31, 1933

N.S.W. and Federal Capital Territory

Sydney	149,477	1,422,673	10.50	45
Remainder of State (Inc. F.C.T.)	48,392	1,193,583	4.06	18
State (inc. F.C.T.)	197,869	2,616,256	7.56	33
Albury—N.S.W. Sec.	1,986	30,792	6.45	29
Vic. "	1,652	38,016	4.35	19
Total	3,638	68,808	5.29	23
Bathurst	3,830	93,390	4.10	17
Broken Hill (Exc. S.A.)	1,345	28,257	4.75	19
Canberra (in. N.S.W.)	1,493	33,586	4.44	19
Corowa—N.S.W. Sec.	2,159	32,168	6.71	30
Vic. Sec.	1,891	48,963	3.86	16
Total	4,050	81,131	4.99	21
Dubbo	1,200	31,277	3.83	17
Goulburn	2,582	61,541	4.19	18
Grafton	1,090	42,314	2.57	11
Gunnedah	1,291	47,214	2.73	13
Lismore—N.S.W. Sec.	2,398	90,680	2.64	12
Q'sland Sec.	126	5,812	2.16	9
Total	2,524	96,492	2.62	12
Moss Vale	6,859	114,179	6.01	26
Newcastle	15,549	242,606	6.40	28
Orange	2,247	79,855	2.81	12
Wagga	3,057	73,086	4.18	19
Wollongong Inc. Syd.	147,537	1,382,440	10.67	47
Exc. Syd.	11,238	147,073	7.64	32

Victoria

Melbourne	146,740	1,192,556	12.3	50
Remainder of State	38,121	629,715	6.05	25
State	184,861	1,822,271	10.14	42
Ballarat	13,615	161,826	8.41	34
Bendigo	6,502	126,454	5.14	20
Geelong—Inc. Melb.	147,407	1,148,212	12.83	54
Geelong—Exc. Melb.	15,635	156,164	10.0	42
Hamilton	3,108	55,555	5.6	24
Horsham	2,236	44,380	5.04	21
Mildura—Vic. Sec.	1,425	23,976	5.94	26
Bunbury	703	33,848	2.07	8
Collie	955	35,470	2.69	10
Geraldton	222	9,984	2.22	10
Kalgoorlie	489	23,257	2.10	8
Katanning	632	14,537	4.34	18
Merredin	531	15,031	3.53	15
Narrogin	354	15,847	2.23	10
Northam (except Perth)	714	37,782	1.89	8
Wagin	494	17,767	2.78	12
Mildura—				
N.S.W. Section	185	3,584	5.16	20
Total	1,160	27,560	5.83	24
Sale	2,853	49,869	5.72	23
Swan Hill—				
Vic. Section	1,725	29,583	5.83	25
N.S.W. Section	235	5,490	4.28	19
Total	1,960	35,073	5.58	24
Wangaratta—				
Vic. Section	3,622	59,151	6.12	26
N.S.W. Section	1,562	22,484	6.90	31
Total	5,184	81,635	6.35	27

Queensland

Brisbane	28,271	395,924	7.14	31
Remainder of State	12,647	553,248	2.26	10
State	40,918	949,172	4.31	19
Cairns	460	48,850	.94	4
Mackay	522	29,065	1.79	8
Maryborough	1,388	53,527	2.59	11
Rockhampton	2,286	47,944	4.76	21
Toowoomba	4,938	123,059	4.01	18
Townsville	952	40,055	2.37	11
Warwick (excluding N.S.W.)	2,951	84,287	3.5	16

South Australia

Adelaide	39,758	391,552	10.15	41
Remainder of State (inc. N. Territ.)	16,004	195,059	8.20	35
State (inc. N.T.)	55,762	586,611	9.51	39
Crystal Brook	4,568	50,128	9.11	39
Port Lincoln	557	7,196	7.74	33
Port Pirie	3,939	43,330	9.09	40
Mt. Gambier—				
S.A. Section	878	17,181	5.11	21
Vic. Section	692	7,922	8.73	37
Total	1,570	25,103	6.25	26

Western Australia

Perth	19,360	236,342	8.19	35
Remainder of State	5,965	203,661	2.92	12
State	25,325	440,003	5.76	24

Tasmania

Hobart	7,406	99,727	7.43	32
Remainder of State	6,487	127,649	5.06	22
State	13,893	227,376	6.11	26
Burnie	2,868	48,377	5.92	26
Devonport	5,248	86,597	6.06	26
Launceston	4,776	82,196	5.81	25
Queenstown	447	9,719	4.61	18
Ulverstone	2,521	80,697	3.12	14

Licence Figures By States For 1933

New South Wales

	New Issues.	Renewals.	Cancellations.
January	4,712	8,472	1,545
February	4,476	7,918	2,333
March	4,753	8,502	1,001
April	4,166	8,137	1,797
May	5,069	11,446	1,347
June	5,304	13,477	2,042
July	6,290	15,137	2,365
August	6,450	15,239	2,898
September	5,248	13,245	1,726
October	5,489	11,966	1,849
November	4,858	12,163	2,315
December	4,686	10,632	2,326
	61,441	136,334	23,544

Victoria

	New Issues.	Renewals.	Cancellations.
January	4,054	7,968	1,386
February	4,098	8,142	1,829
Radio Annual—Thirty			
March	3,693	8,495	544
April	3,048	8,613	2,841
May	4,398	11,516	1,316
June	4,811	12,330	1,175
July	6,287	14,841	1,410
August	5,454	14,550	2,928
September	4,684	12,057	1,979
October	4,493	11,538	2,411
November	3,775	11,341	2,533
December	3,843	10,753	3,731
	52,638	132,144	24,083

Queensland

	New Issues.	Renewals.	Cancellations.
January	1,127	1,434	273
February	1,112	1,373	381
March	1,072	1,711	227
April	830	1,552	539
May	1,062	2,216	412
June	1,237	2,873	477
July	1,282	3,123	596
August	1,425	2,864	328
September	1,256	2,492	459
October	1,431	2,253	423
November	1,248	2,828	670
December	958	2,122	520
	14,040	26,811	5,305

South Australia

	New Issues.	Renewals.	Cancellations.
January	1,501	1,888	269
February	1,338	1,798	327
March	1,362	2,213	297
April	1,319	2,356	442
May	1,926	3,264	573
June	1,739	4,042	378
July	1,841	4,499	618
August	1,708	5,943	510
September	1,455	3,324	414
October	1,332	2,815	523
November	1,157	2,844	632
December	1,275	2,807	570
	17,953	37,893	5,353

Western Australia

	New Issues.	Renewals.	Cancellations.
January	618	677	106
February	671	668	74
March	657	676	102
April	757	769	165
May	1,243	1,209	73
June	1,220	1,333	69
July	1,197	1,563	302
August	1,249	1,617	149
September	1,061	1,393	208
October	924	1,341	377
November	886	1,595	178
December	901	1,181	283
	11,384	14,022	2,086

Tasmania

	New Issues.	Renewals.	Cancellations.
January	379	788	171
February	412	319	252
March	486	399	105
April	306	418	233
May	437	584	195
June	475	863	175
July	575	947	284
August	670	1,127	284
September	552	744	361
October	467	689	300
November	456	698	299
December	416	628	308
	5,631	8,204	2,967

Commonwealth

	New Issues.	Renewals.	Cancellations.
January	12,391	21,472	3,750
February	12,023	20,218	2,276
March	12,007	21,996	5,196
April	10,426	21,845	6,017
May	14,135	30,235	3,916
June	14,786	34,918	4,316
July	17,472	40,110	5,575
August	16,956	41,340	7,097
September	14,255	33,255	5,149
October	14,076	30,602	5,883
November	12,380	31,469	6,627
December	12,079	28,177	7,738
	162,986	355,637	63,540

Monthly Licence Figures for 1933

	New Issues.	Renewals.	Cancellations.
January—			
N.S.W.	4,712	8,472	1,545
Victoria	4,054	7,968	1,386
Queensland	1,127	1,434	273
South Australia	1,501	1,888	269
Western Australia	618	677	106
Tasmania	379	788	171
Commonwealth	12,391	21,227	3,750
February—			
N.S.W.	4,476	7,918	2,333
Victoria	4,098	8,142	1,829
Queensland	1,112	1,373	381
South Australia	1,338	1,798	327
Western Australia	671	668	74
Tasmania	412	319	252
Commonwealth	12,023	20,218	2,276
March—			
N.S.W.	4,753	8,502	1,001
Victoria	3,693	8,495	544
Queensland	1,072	1,711	227
South Australia	1,362	2,213	297
Western Australia	657	676	102
Tasmania	486	399	105
Commonwealth	12,007	21,996	5,196
April—			
N.S.W.	4,166	8,137	1,797
Victoria	3,048	8,613	2,841
Queensland	830	1,552	539
South Australia	1,319	2,356	442
Western Australia	757	769	165
Tasmania	306	418	233
Commonwealth	10,426	21,845	6,017
May—			
N.S.W.	5,069	11,446	1,347
Victoria	4,398	11,516	1,316
Queensland	1,062	2,216	412
South Australia	1,926	3,264	573
Western Australia	1,243	1,209	73
Tasmania	437	584	195
Commonwealth	14,135	30,235	3,916
June—			
N.S.W.	5,304	13,477	2,042
Victoria	4,811	12,330	1,175
Queensland	1,237	2,873	477
South Australia	1,739	4,042	378
Western Australia	1,220	1,333	69
Tasmania	475	863	175
Commonwealth	14,786	34,918	4,316
July—			
N.S.W.	6,290	15,137	2,365
Victoria	6,287	14,841	1,410
Queensland	1,282	3,123	596
South Australia	1,841	4,499	618
Western Australia	1,197	1,563	302
Tasmania	575	947	284
Commonwealth	17,472	40,110	5,575
August—			
N.S.W.	6,450	15,239	2,898
Victoria	5,454	14,550	2,928
Queensland	1,425	2,864	328
South Australia	1,708	5,943	510
Western Australia	1,249	1,617	149
Tasmania	670	1,127	284
Commonwealth	16,956	41,340	7,097
September—			
N.S.W.	5,248	13,245	1,726
Victoria	4,684	12,057	1,979
Queensland	1,256	2,492	459
South Australia	1,455	3,324	414
Western Australia	1,061	1,393	208
Tasmania	552	744	361
Commonwealth	14,255	33,255	5,147
October—			
N.S.W.	5,429	11,966	1,849
Victoria	4,493	11,538	2,411
Queensland	1,431	2,253	423
South Australia	1,332	2,815	523
Western Australia	924	1,341	377
Tasmania	467	689	300
Commonwealth	14,076	30,602	5,883
November—			
N.S.W.	4,858	12,163	2,315
Victoria	3,775	11,341	2,533
Queensland	1,248	2,828	670
South Australia	1,157	2,844	632
Western Australia	886	1,595	178
Tasmania	456	698	299
Commonwealth	12,380	31,469	6,627
December—			
N.S.W.	4,686	10,632	2,326
Victoria	3,843	10,753	3,731
Queensland	958	2,122	520
South Australia	1,275	2,807	570
Western Australia	901	1,181	283
Tasmania	416	628	308
Commonwealth	12,079	28,177	7,738

Country-Metropolitan Licence Distribution

The following figures show the quarterly licence figures in the various metropolitan and country areas for each State for 1933

It must be specially noted that the generally accepted boundaries for the metropolitan areas are not exactly in accordance with that as defined by the Commonwealth Statistician, and to assist the radio industry throughout Australia in a proper determination of the various figures, it will be noted that the names of the various municipalities are given here under each State.

Metropolitan Area of Sydney

Including the following Municipalities: Alexandria, Annandale, Ashfield, Auburn, Balmain, Bankstown, Bexley, Botany, Burwood, Canterbury, Concord, Darlington, Drummoyne, Dundas, Eastwood, Enfield, Ermington and Rydalmere, Erskineville, Glebe, Granville, Holroyd (Part), Homebush, Hunters' Hill, Hurstville, Kogarah, Kuring-gai, Lane Cove, Leichhardt, Lidcombe, Manly, Marrickville, Mascot, Mosman, Newtown, Paddington, Parramatta, Petersham, Randwick, Redfern, Rockdale, Ryde, St. Peters, Strathfield, Sydney, Sydney North, Vaucluse, Waterloo, Waverley, Willoughby, Woollahra. In this area, at the census taken 30th June, 1933, there were 1,235,367 persons and a total number of dwellings of 302,382 of which 10,941 were unoccupied and 253 were being built.

NEW SOUTH WALES

		Licences in Force	% of State Total	Ratio of Licences to Pop.
Metropolitan	31/3/33	118,121	70	1:11
	30/6/33	123,939	70	1:11
	30/9/33	130,356	69	1: 9
	31/12/33	136,299	69	1: 9
Country	31/3/33	50,913	30	1:25
	30/6/33	54,448	30	1:24
	30/9/33	59,030	31	1:24
	31/12/33	61,570	31	1:22
State Total	31/3/33	169,034		1:15
	30/6/33	178,387		1:14
	30/9/33	189,386		1:14
	31/12/33	197,869		1:13

Melbourne Metropolitan Area

Including the following Municipalities: Box Hill, Brighton, Brunswick, Camberwell, Caulfield, Chelsea, Coburg, Collingwood, Essendon, Fitzroy, Footscray, Hawthorn, Kew, Malvern, Melbourne, Melbourne South, Mordialloc, Northcote, Oakleigh, Port Melbourne, Prahran, Preston, Richmond, Sandringham, St. Kilda, Williamstown, and Shires of Braybrook (Part) Heidelberg (Part), Moorabbin. In this area there were 992,048 persons, and a total of dwellings 244,645, of which 6,669 were unoccupied and 394 were being built.

VICTORIA

		Licences in Force	% of State Total	Ratio of Licences to Pop.
Metropolitan	31/3/33	116,234	71	1 : 9
	30/6/33	121,299	71	1 : 8
	30/9/33	129,057	71	1 : 8
	31/12/33	131,862	71	1 : 8
Country	31/3/33	48,159	29	1:16
	30/6/33	50,019	29	1:16
	30/9/33	52,368	29	1:16
	31/12/33	52,999	29	1:15
State Total	31/3/33	164,393		1:11
	30/6/33	178,387		1:11
	30/9/33	181,425		1:10
	31/12/33	184,861		1 : 9

Brisbane Metropolitan Area

Including the following State Electoral Districts: Bremer (Part), Brisbane, Brisbane South, Bulimba, Buranda, Enoggera (Part), Fortitude Valley, Hamilton, Ithaca, Kelvin Grove, Kurilpa, Logan (Part), Maree, Merthyr, Nundah, Oxley (Part), Sandgate (Part), Toowong, Windsor, Wynnum (Part). In this area there were 299,782 persons, and a total number of dwellings of 72,141, of which 2,270 were unoccupied and 86 were being built.

QUEENSLAND

		Licences in Force	% of State Total	Ratio of Licences to Pop.
Metropolitan	31/3/33	20,903	60	1:16
	30/6/33	21,974	61	1:15
	30/9/33	23,772	61	1:13
	31/12/33	24,563	60	1:13
Country	31/3/33	13,710	40	1:47
	30/6/33	14,340	39	1:39
	30/9/33	15,122	39	1:43
	31/12/33	16,355	40	1:39
State Total	31/3/33	34,613		1:28
	30/6/33	36,314		1:27
	30/9/33	38,894		1:24
	31/12/33	40,918		1:23

Country - Metropolitan Licence Distribution — (Continued from Page 91).

Adelaide Metropolitan Area

Including the following Corporations: Adelaide, Brighton, Colonel Light Gardens, Glenelg, Henley and Grange, Hindmarsh, Kensington and Norwood, Port Adelaide, St. Peters, Thebarton, Unley, and the following District Councils: Burnside, Campbelltown, Marion, Mitcham, Payneham, Prospect, Torrens West, Walkerville, Woodville, Yatala South. In this area there were 312,629 persons, and a total number of dwellings of 79,678, of which 2,242 were unoccupied and 44 being built.

SOUTH AUSTRALIA

		Licences in Force	% of State Total	Ratio of Licences to Pop.
Metropolitan	31/3/33	30,635	64	1:11
	30/6/33	33,359	66	1:10
	30/9/33	35,585	66	1 : 9
	31/12/33	37,362	67	1 : 8
Country	31/3/33	16,035	36	1:17
	30/6/33	16,902	34	1:16
	30/9/33	18,138	34	1:12
	31/12/33	18,400	33	1:15
State Total	31/3/33	46,670		1:13
	30/6/33	50,261		1:12
	30/9/33	53,723		1:15
	31/12/33	55,762		1:11

Perth Metropolitan Area

Including the following municipalities: Claremont, Cottesloe, Fremantle, Fremantle East, Fremantle North, Guildford, Midland Junction, Perth, Subiaco, and the following Road Board Districts: Bassendean, Bayswater, Belmont Park, Buckland Hill, Canning, Melville, Nedlands, Peppermint Grove, Perth, Perth South, Swan (Part). In this area there were 207,464 persons, and a total number of dwellings of 49,790, of which 1,506 were unoccupied and 176 being built.

WESTERN AUSTRALIA

		Licences in Force	% of State Total	Ratio of Licences to Pop.
Metropolitan	31/3/33	13,336	75	1:16
	30/6/33	15,500	75	1:13
	30/9/33	17,408	75	1:12
	31/12/33	18,704	74	1:11
Country	31/3/33	4,355	25	1:49
	30/6/33	5,104	25	1:42
	30/9/33	6,044	25	1:38
	31/12/33	6,621	26	1:35
State Total	31/3/33	17,691		1:24
	30/6/33	20,604		1:20
	30/9/33	23,452		1:19
	31/12/33	25,325		1:17

Hobart Metropolitan Area

Including the following: Glenoreby, Hobart, Kingborough (Part), Clarence (Part). In this area there were 60,408 persons, and a total number of dwellings of 14,678, of which 495 were unoccupied and 23 being built.

TASMANIA

		Licences in Force	% of State Total	Ratio of Licences to Pop.
Metropolitan	31/3/33	4,610	38	1:13
	30/6/33	4,900	39	1:12
	30/9/33	5,181	38	1:12
	31/12/33	5,354	39	1:11
Country	31/3/33	7,368	62	1:23
	30/6/33	7,693	61	1:21
	30/9/33	8,280	62	1:20
	31/12/33	8,508	61	1:16
State Total	31/3/333	11,978		1:18
	30/6/33	12,593		1:18
	30/9/33	13,461		1:17
	31/12/33	13,862		1:16

COMMONWEALTH

		Licences in Force	% of State Total	Ratio of Licences to Pop.
Metropolitan	31/3/33	303,839	68	1:11
	30/6/33	320,971	68	1:10
	30/9/33	341,359	68	1 : 9
	31/12/33	354,144	68	1 : 9
Country	31/3/33	140,540	32	1:24
	30/6/33	148,506	32	1:23
	30/9/33	158,982	32	1:22
	31/12/33	164,448	32	1:22
Grand Total	31/3/33	444,379		1:15
	30/6/33	469,477		1:14
	30/9/33	500,341		1:13
	31/12/33	518,592		1:13

New Zealand Broadcasting Stations

Call Sign	Licensee and location of station.	Power (output) (watts)	Wavelength Kc/s.	Wavelength Metres	HOURS
2 YA	N.Z. Broadcasting Board, Featherston Street, Wellington.	5000	570	526	Mon., Fri., Sat., 7.30 a.m.—8.30 a.m., 10 a.m.—11 p.m.; Tues., Wed., Thurs., 7.30 a.m.—8.30 a.m., 10 a.m.—10 p.m.; Sun., 9 a.m.—Noon, 1—4.30 p.m., 6—10 p.m.
4 ZP	R. T. Parsons, 155 Layard Street North, Invercargill.	125	620	483.6	Mon. to Fri., 12.30—1.30 p.m., 7—10 p.m.; Sat. 7—10 p.m.; Sun., 11 a.m.—Noon, 6.30—10 p.m.
1 YA	N.Z. Broadcasting Board, Karangahape Road, Auckland.	500	650	461.3	Mon., Thurs., Fri., 7 a.m.—8 a.m., 10 a.m.—10 p.m.; Tues., Wed., Sat., 7 a.m.—8 a.m., 10 a.m.—11 p.m.; Sun., 9 a.m.—Noon, 1—4.30 p.m., 6—10 p.m.
3 YA	N.Z. Broadcasting Board, Gloucester Street, Christchurch.	2500	720	416.4	Operates almost continuously between 10 a.m. to 10 p.m. on week-days, and until 11 p.m. on Tues. and Wed.; 3—11 p.m., Sat.; Sunday, 9—11 a.m., 1—4.30 p.m., 5.30—10 p.m.
2 YB	The North Taranaki Radio Society, Empire Building, King Street, New Plymouth.	100	750	399.8	Mon., 7—10 p.m.; Wed., 6.30—10 p.m.; Sat., 6.30—10.30 p.m.; Sun., 6—10 p.m. (2.30—4.30 Saturdays during football season).
1 ZH	G. S. Anchor, 165 Victoria Street, Hamilton	45	770	389.4	Mon., 8—10 p.m.; Tues., noon—1 p.m., 7.30—10 p.m.; Wed., noon—1 p.m.; Thurs., noon—1 p.m., 8—10 p.m.; Fri., noon—1 p.m., 6—7, 8—10 p.m.
4 YA	N.Z. Broadcasting Board, Stuart Street, Dunedin	500	790	379.5	Operates almost continuously between 10 a.m. and 10 p.m. on week-days, and until 11 p.m.; Mon., Thurs., 3—11 p.m., Sat.; Sunday, 9—11 p.m.; 1—4.30 p.m.; 5.30 to 10 p.m.
2 ZH	C. B. Hansen and Co. Ltd., 59 Latham Street, Napier	65	820	365.6	Mon., Tues., Fri., noon—2 p.m., 7 p.m.—10.30 p.m.; Wed., noon—2 p.m.; 6.30—10.30 p.m.; Thurs., noon—2 p.m.; Sat., 10 a.m.—5 p.m., 7—11 p.m.; Sun., noon—3 p.m., 6.30—10 p.m.
2 YC	N.Z. Broadcasting Board, Featherston Street, Wellington	200	840	356.9	5—6 p.m., 7—10 p.m. (daily except Sunday); Sunday, 7—10 p.m.
1 YX	N.Z. Broadcasting Board, Karangahape Road, Auckland	75	880	340.7	5—6 p.m., 7—10 p.m. (daily except Sunday); Sunday, 7—10 p.m.
2 ZP	E. A. Perry, 128 Queen Street, Wairoa	105	900	333.3	Daily, 7—9 a.m.; Tues., 6—10.30 p.m.; Sun., 8 a.m.—9.30 a.m.
3 ZR	West Coast Radio Society, Bright Street, Cobden, Greymouth	400	940	319	Mon. to Fri., 7—9 a.m., 6 p.m.—10 p.m.; Sat., 7—9 a.m., 3—5 p.m., 6—6.30 p.m., 7—9 p.m.; Sun., noon—1.30 p.m., 5.30—9 p.m.
2 ZF	The Manawatu Radio Club, King Street, Palmerston North	150	960	312.3	Mon, Thurs., Sat., 8—10 p.m.; Wed., 6.15 p.m.—10 p.m.; Fri., 7—9.30 p.m.; Sun., 7—9.30 p.m.
2 ZJ	C. T. C. Hands, 229 Gladstone Road, Gisborne	250	980	303.9	Mon., Fri., Sat., 7—10 p.m.; Tues., Wed, noon.—1.30 p.m.; 7—10 p.m.; Thurs., 7—8 p.m.
4 ZB	Otago Radio Association, 180 Rattray Street, Dunedin	20	1050	285.5	Wed., 6.30—11 p.m.; Thurs., 6—11 p.m.; Sun., 10 a.m.—noon.

N.Z. Broadcasting Stations—(Continued).

Call Sign	Licensee and Location of station.	Power (output) (watts)	Wavelength Kc/s'	Wavelength Metres	HOURS
4 ZM	McCracken and Walls, 17 George Street, Dunedin	30	1050	285.5	Daily except Sun., 10—noon; Mon. to Thurs., 1—2 p.m., 3—5 p.m.; Tues., 6—11 p.m.; Fri., 1—2 p.m.; Sat., 5—9 p.m.; Sun., 2—5 p.m., 6—10 p.m.
4 ZO	Barnett's Radio Supplies, The Octagon, Dunedin	25	1050	285.5	Mon. to Fri., noon—1 p.m., 2—3 p.m., 5—6 p.m., Mon., 8—11 p.m.; Fri., 7—11 p.m.; Sat., noon—1 p.m.
2 ZM	Atwater Kent Radio Service Ltd., 258 Gladstone Road, Gisborne	15	1150	260.9	Mon. to Sat., 7.30 a.m.—10 a.m.; Thurs., 8 p.m. to 10.30 p.m.; Sun., 7 p.m—10 p.m.
2 ZD	W. D. Ansell, 7 Rimu Street, Masterton	5	1170	256.3	Mon. to Sat., 8—10 p.m.; Sunday, 9.30—11 a.m., 8—10 p.m.
1 ZB	La Gloria Gramophones Ltd., 155 Karangahape Road, Auckland	18	1190	252	Mon., 9—10.30 a.m., 7.30—10.30 p.m.; Tues., Wed., Thurs., Fri., Sat., 9 a.m.—10.30 a.m.; Wed., 8—10 p.m.
3 ZC	N.Z. Farmers' Co-op. Assn., 212-226 Cashel Street, Christchurch	250	1200	250	Mon., 10 a.m.—11.30 a.m., noon—2 p.m., 6 p.m.—10 p.m.; Tues., 10—11.30 a.m., 12 noon—2 p.m., 5.30—10 p.m.; Wed., 10—11.30 a.m., 5.30—10 p.m.; Thurs., 10—11.30 a.m., noon—2 p.m., 5.30—10 p.m.; Sat., 10—11.30 a.m., 7—11 p.m.; Sun., 9—10 a.m., 6.30—10 p.m.
4 ZF	Laidlaw and Gray Ltd., 123 George Street, Dunedin	7	1220	245.9	Daily except Sunday, 9—10 a.m., noon—1.30 p.m.; Tues., 7—10 p.m., Wed., 7—11 p.m.; Sun., 5—6 p.m.
4 ZL	Radio Service Ltd., 243 Macandrew Road, Dunedin	100	1220	245.9	Mon. and Thurs., 7—9 a.m., 7.30—11 p.m.; Tues, Wed. and Fri., 7—9 a.m.; Sat., 7—9 a.m., 7—11 p.m.; Sun., 8—10 a.m.
2 ZL	John Holden, 609 Park Road, Hastings	20	1240	241.8	Thurs., 6.30—11 p.m.; Sun., 9.30 a.m. to noon.
1 ZM	W. Rodgers, Massey Road, Manurewa	15	1260	238	Mon., 9—11.30 a.m., 2—5 p.m., 7—10 p.m.; Tues. to Fri., 9—11.30 a.m., 7—9.30 p.m.; Sat., 9 a.m.—2 p.m., 7—9.30 p.m.; Sun., 10 a.m.—3 p.m., 4—6 p.m., 7—10 p.m.; Holidays, 9 a.m.—2 p.m.
4 ZC	John I. Bilton, Lowburn Ferry, Cromwell, Otago.	20	1280	234.2	Mon., noon—1 p.m., 7—9 p.m.; Tues., Wed., noon—1 p.m.; Thurs., noon—1 p.m., 7—10 p.m.; Fri., noon—1 p.m.; Sat., noon—1 p.m., 5.30—7 p.m.; Sun., 11 a.m.—12.30 p.m.
3 ZE	Schaef's Ltd., Mackay Street, Greymouth	50	1300	230.6	Mon., 12.30—1.30 p.m., 4.45—5.45 p.m.; Wed., 12.30—1.30 p.m.; Fri., noon—2 p.m., 4.45—5.45 p.m.; Sat., 9.15—11 p.m.
1 ZJ	Johns Ltd., Chancery Street, Auckland	26	1310	228.9	Tues. and Thurs., noon—2 p.m.; Wed., 7.30—9.30 p.m.
4 ZR	Renton and Clark, Clyde Street, Balclutha	5	1340	224	Thurs., 7—11 p.m.; Fri., 2—3 p.m.; Sun., 10 a.m.—noon; 6—8.30 p.m.

N.Z. Broadcasting Stations—(Continued).

Call Sign	Licensee and location of station.	Power (output) (watts)	Wavelength Kc/s'	Wavelength Metres	HOURS
2 ZR	2ZR Radio Club, Trafalgar Street, Nelson	30	1360	220.5	Mon., Wed., 5—10 p.m.; Tues., Thurs., Fri., 6—10 p.m.; Sat., 2.30—4.30 p.m., 6—10 p.m.; Sun., 10.45 a.m.—1 p.m., 6.15—9.30 p.m.
2 ZO	J. V. Kyle, 50 Waldegrave Street, Palmerston North	200	1400	214.2	Tues., 6.30—10 p.m.; Sun., 10 a.m.—12.30 p.m.
1 ZS	Messrs. Radio Ltd., Cnr. Queen Street and Karangahape Rd., Auckland	50	1420	211.3	Mon. and Wed., 7.30—9 a.m., 2—4 p.m.; 6—7.30 p.m.; Tues., Thurs., Fri., 7.30—9 a.m., 2—4 p.m.; 6—10 p.m.; Sat., 7.30—9 a.m.; 7.30—10 p.m.
3 ZM	W. J. Green and J. Younger, 253 Brougham Street, Christchurch	100	1450	206.8	Mon., Tues., Thurs., 7.30—10 a.m., 5—6 p.m., 7—10 p.m.; Wed., 7.30—10 a.m., 5—6 p.m., 6.45—10 p.m.; Fri., 7.30—10 a.m.; Sat., 7.30 a.m.—2 p.m., 8 p.m. to midnight; Sun., 11 a.m.—2 p.m., 5—6 p.m., 7—10 p.m.

Complete List of A and B Class Stations in Australia

2CO	535.7 metres 560 kilocycles 7500 watts	National Broadcasting Station, Relaying 3LO and 3AR, COROWA
7ZL	517 metres 580 kilocycles 3000 watts	National Broadcasting Station, Studio: Elizabeth Street, HOBART
3AR	492 metres 610 kilocycles 5000 watts	National Broadcasting Station, Studio. 120a Russell Street, MELBOURNE
5CK	472 metres 635 kilocycles 7500 watts	National Broadcasting Station, Relaying 5CL, CRYSTAL BROOK, S.A.
2FC	51 metres 665 kilocycles 5000 watts	National Broadcasting Station, Studio: 96-98 Market Street, SYDNEY
6WF	435 metres 690 kilocycles 5000 watts	National Broadcasting Station, Studio: Hay Street, PERTH
5CL	411 metres 730 kilocycles 5000 watts	National Broadcasting Station, Studio: Hindmarsh Square, ADELAIDE
4QG	395 metres 760 kilocycles 5000 watts	National Broadcasting Station, Studio: c/o State Ins. Buildings, BRISBANE
3LO	375 metres 800 kilocycles 5000 watts	National Broadcasting Station, Studio. 120a Russell Street, MELBOURNE
2BL	351 metres 855 kilocycles 5000 watts	National Broadcasting Station, Studio: 96-98 Market Street, SYDNEY
6PR	341 metres 880 kilocycles 500 watts	Nicholsons Ltd., Studio: 86-90 Barrack Street, PERTH
7HO	337 metres 890 kilocycles 50 watts	Commercial Broadcasters Ltd., Studio: 82 Elizabeth Street, HOBART
3MA	333 metres 900 kilocycles 50 watts	Sunraysia Pty., Ltd., MILDURA
4RK	330 metres 910 kilocycles 2000 watts	National Broadcasting Station, Relaying 4QG ROCKHAMPTON
3UZ	326 metres 930 kilocycles 500 watts	Oliver J. Nilson and Co., Studio: 45 Bourke Street, MELBOURNE
2GB	316 metres 950 kilocycles 3000 watts	Theosophical Broadcasting Stn., Studio: 29 Bligh Street, SYDNEY
5DN	312 metres 960 kilocycles 500 watts	Hume Broadcasters Ltd., Studio: 21 Rundle Street, ADELAIDE
3BO	309 metres 970 kilocycles 200 watts	Amalgamated Wireless (A'asia), Ltd. Studio: Kangaroo Flat, BENDIGO
6BY	306 metres 980 kilocycles 50 watts	Bunbury Broadcasters Ltd., Studio: Bedford Hall, BUNBURY
4GR	300 metres 1000 kilocycles 50 watts	Gold Radio Service, Studio: Ruthven Street, TOOWOOMBA
3HA	297 metres 1010 kilocycles 200 watts	Western Province Radio Co., Studio. 37 Gray Street, HAMILTON
2UE	293 metres 1025 kilocycles 250 watts	Radio House, Studio. 296 Pitt Street, SYDNEY
5PI	288 metres 1041 kilocycles 50 watts	Midlands Broadcasting Services, Studio: Ellen Street, PORT PIRIE
2CA	286 metres 1040 kilocycles 50 watts	A. J. Ryan, KINGSTON, CANBERRA
4MB	283 metres 1060 kilocycles 50 watts	Maryborough Broadcasting Co., Wynne's Station, MARYBOROUGH, Queensland
2KY	280 metres 1070 kilocycles 1500 watts	Trades and Labour Council, Studio. 424 George Street, SYDNEY
3SH	277.8 metres 1080 kilocycles 50 watts	Swan Hill Broadcasting Co., Amble Street, SWAN HILL
7LA	273 metres 1100 kilocycles 200 watts	Findlay and Wills, Broadcasters, 67 Brisbane Street, LAUNCESTON
2HD	270 metres 1100 kilocycles 200 watts	Airsales Broadcasting Co., Bateman's Road, Sandgate, NEWCASTLE
2UW	267 metres 1125 kilocycles 1500 watts	Radio Broadcasting Ltd., Studio: State Shopping Block, Market St. SYDNEY
6ML	264 metres 1135 kilocycles 300 watts	W.A. Broadcasters Ltd., Studio. Lyric House, Murray Street, PERTH
4BC	262 metres 1145 kilocycles 600 watts	J. B. Chandler and Co., Studio: 45 Adelaide Street, BRISBANE
3YB	262 metres 1145 kilocycles 25 watts	Mobile Broadcasting Service, 430 Little Collins Street, MELBOURNE
2WG	260 metres 1155 kilocycles 50 watts	Riverina Broadcasting Co., 16 Fitzmaurice Street, WAGGA, N.S.W.
4TO	256.4 metres 1170 kilocycles 100 watts	Amalgamated Wireless, (A'asia) Ltd., Bell Street, TOWNSVILLE
3DB	254 metres 1180 kilocycles 500 watts	3DB Broadcasting Station Pty., Studio: 36 Flinders Street, MELBOURNE
4MK	252 metres 1190 kilocycles 100 watts	Mackay Broadcasting Service, 64 Nelson Street, MACKAY
5KA	250 metres 1200 kilocycles 300 watts	Sport Radio Broadcasting Co. Ltd., Richard's Bldg., Currie Street, ADELAIDE
2CH	248 metres 1210 kilocycles 1000 watts	Council of Churches, 77 York Street, SYDNEY
2GF	246 metres 1220 kilocycles 50 watts	Grafton Broadcasting Co., Address: A.W.A., 47 York St., Sydney. Station at GRAFTON
6KG	246 metres 1220 kilocycles 100 watts	Goldfields Broadcasters Ltd., 86 Palace Chambers, KALGOORLIE
2NC	241 metres 1245 kilocycles 2000 watts	National Broadcasting Station, Relaying 2FC and 2BL, NEWCASTLE
3WR	238 metres 1260 kilocycles 50 watts	Wangaratta Broadcasting Pty. Ltd., Studio: Reid Street, WANGARATTA
2SM	236.1 metres 1270 kilocycles 1000 watts	Catholic Broadcasting Co., Australia House, Carrington Street, SYDNEY
3TR	234 metres 1280 kilocycles 50 watts	Publicity Pty. Ltd., Raymond Street, SALE
4BK	233 metres 1290 kilocycles 200 watts	Brisbane Broadcasting Co., 47 Charlotte Street, BRISBANE
3BA	230.8 metres 1300 kilocycles 50 watts	Ballarat Broadcasters Pty. Ltd., Cr. Armstrong and Dana Streets, BALLARAT
5AD	229 metres 1310 kilocycles 300 watts	Advertiser Newspaper Ltd., Studio: Weymouth Street, ADELAIDE
2MO	226 metres 1330 kilocycles 250 watts	M. J. Oliver, Marquis Street, GUNNEDAH
4RO	225.56 metres 1330 kilocycles 250 watts	Rockhampton Broadcasting Co., ROCKHAMPTON
2XN	224 metres 1340 kilocycles 50 watts	G. W. Exton, Address: 137 Molesworth Street, LISMORE
3KZ	222 metres 1350 kilocycles 200 watts	3KZ Broadcasting Coy., 64 Elizabeth Street, MELBOURNE
3HS	218.9 metres 1370 kilocycles 50 watts	Wimmera Broadcasting Co., Ltd., 15 Firebrace Street, HORSHAM
4BH	217.3 metres 1380 kilocycles 600 watts	Broadcasters (Aust.) Ltd., 231 Albert Street, BRISBANE
2GN	216 metres 1390 kilocycles 50 watts	Goulburn Broadcasting Co., Studio: Auburn Street, GOULBURN
3GL	214 metres 1400 kilocycles 50 watts	Geelong Broadcasting Pty. Ltd., Studio: National Mutual Buildings, GEELONG
2KO	212 metres 1415 kilocycles 200 watts	Newcastle Broadcasting Co., Studio: Civic Block, NEWCASTLE
3AW	210.5 metres 1425 kilocycles 300 watts	Vogue Broadcasting Co., Ltd., His Majesty's Theatre, Exhibition St., MELBOURNE
2WL	209.06 metres 1435 kilocycles 50 watts	Wollongong Broadcasting Co., Address. 149 Crown Street, WOLLONGONG
7UV	205.5 metres 1460 kilocycles 200 watts	North Western Tasmanian Broadcasters, Ltd., Town Hall Chambers, ULVERSTONE
6IX	204 metres 1470 kilocycles 300 watts	W.A. Broadcasters Ltd., Address: Murray Street, PERTH
2AY	203 metres 1480 kilocycles 50 watts	Amalgamated Wireless (A'asia), Ltd., Studio: 610 Dean Street, ALBURY
3AK	200 metres 1500 kilocycles 50 watts	Akron Broadcasting Service Ltd., 490 Elizabeth Street, MELBOURNE

Beam Wireless—A Great Australian Service

Spanning the gap between Australia and Great Britain is the longest telegraph service in the world, yet the means of communication are invisible, being an unseen track through the intangible ether.

The Beam differs from other forms of wireless communication inasmuch as it concentrates the rays of energy bearing the message in a particular direction, very much in the same way as a searchlight projects a ray. Such a system has the advantage of conserving the power used and not dissipating it in every direction.

The possibilities of a Beam system were investigated early by Mr. E. T. Fisk, Managing Director of Amalgamated Wireless, who, working in collaboration with the Marchese Marconi on the other side of the world, realised the great advantages of such a method. Indeed, it was one of several main objectives towards which Mr. Fisk was directing his scientific and organising ability. Seven years ago the Beam was brought into operation by A.W.A.

To Most Parts of the World

To-day anyone can enter the Beam Offices at Sydney or Melbourne or any Post Office in the Commonwealth and lodge a message via Beam to even the remote places of the earth—to Esthonia or Finland in Europe, Yukon or Alaska in North America, to Porto Rico or San Domingo in the West Indies, Guatemala or Costa Rica in Central America. Day and night messages are being despatched direct by Beam to Great Britain and Canada, whence they are relayed to surrounding countries as required.

It was on April 8th, 1927, that the Beam Wireless Service between Australia and Great Britain was opened for commercial traffic, and on June 16th, 1928, the service from Australia to North America was instituted. The latter service provided not only communication with the New World but also a second link with England and the Continent via the Montreal-London Beam circuit.

Travelling by electrical impulse, the Beam Wireless messages actually bridge the gap between Australia and England in about one-seventh of a second, the messages are usually sent by mechanical means at the rate of about 200 words a minute. The Beam Offices in Sydney and Melbourne are open for traffic day and night.

Automatic Transmissions

The Beam Wireless transmitting centre in Australia is located at Fiskville, about fifty miles north-west of Melbourne, and the receiving centre is at Rockbank, thirty miles from Fiskville. Both stations are connected by special telegraph lines with the Beam Wireless Offices of Amalgamated Wireless at Melbourne and Sydney. At Fiskville there are two transmitters. One is used for sending messages to England and the other transmits to Montreal all messages for North and South America. A great deal of the equipment is in duplicate, some in triplicate, to insure continuity of service under all conditions. Each station is supervised by a technical staff. The transmission of messages originates at the Beam Offices at the heart of Melbourne or Sydney. The telegraph operators at these centres, working with special telegraph lines to the Beam station, automatically cause the transmitters at Fiskville to radiate the messages. Incoming messages from London or Montreal are received at Rockbank and automatically pass on to the telegraph centres at Sydney or Melbourne, where they are recorded on tape.

As the messages are lodged at the Post Offices throughout the Commonwealth or at the Beam Offices they are passed on in a continuous stream to telegraphists who are seated at machines resembling typewriters. Actually these machines are high-speed automatic perforators. As quickly as an expert types, the messages are transcribed by this machine, but instead of recording them in letters of the ordinary alphabet, the machine punches in the form of a series of small perforations on paper tape about half an inch wide, similar to music rolls in player pianos. There is a distinctive series of perforations corresponding to ordinary Morse character to each letter. The rate of transmission is much greater than the rate at which an operator can work a perforating machine, and it is therefore necessary to keep several operators employed punching tape to satisfy the speed of transmission.

The tape after being punched is passed through an automatic transmitter at high speed and the signals are picked up by the Beam receiving station at Skegness, England, or Yamachiche, Canada, and relayed to London and Montreal respectively, where they are recorded by machines.

In addition to the Beam stations, smaller stations or units are provided for collecting the outward traffic and feeding it to the main Beam station, and also for distributing the inward Beam traffic to other States. These smaller units, known as Beam feeder transmitters and Beam feeder receivers, have been installed at practically every Australian capital. Two Beam feeder transmitters are located at Sydney, two at Melbourne and one each at Adelaide, Perth, and Brisbane. These stations are equipped to transmit traffic direct by wireless to the Beam traffic office, Melbourne, whence it is automatically transmitted overseas via the Fiskville transmitting station.

Commercial Broadcasting Stations (B Class)

F.C.T.

2CA

A. J. RYAN BROADCASTERS LTD., Kingston, Canberra. Station location, 1 mile S.E. Canberra P.O. Commenced 14/11/31 . Frequency 1050 k.c., 286m., 50 watts (a.c.). Engineer and Manager, A. J. Ryan. Interstate relays of Parliamentary and notable events. Covers large area of southern N.S.W., and claims to be one of the most efficient country stations on the air. Out to Leeton, up to Forbes, down past Albury and south to Delegate and Eden, all comes within the influence of this well-equipped 2CA station located in the Federal Capital.

New South Wales—Metropolitan

2CH

N.S.W. COUNCIL OF CHURCHES' SERVICE, 77 York Street, Sydney. Station location, Dundas, 9¾ miles N.W. of G.P.O. Commenced 15/2/32. Freq. 1210 k.c., 248m., 1000 watts ae.

Directors, H. R. Stewart, J. T. Taylor and T. A. McNeil. Programmes, Gwen Gibson. Announcers, A. S. Cochrane ("The Hello Man"), Warren H. Penny, Ernest Walsh ("The Good Morning Man"), Donald Scott. Sporting Announcer, Marguerite Herd ("The Fairy Godmother"). Chief Engineer, T. A. E. McNeil.

2GB

THEOSOPHICAL BROADCASTING STATION LTD., 29 Bligh Street, Sydney. Station location, Mosman, 3 miles N.E. of G.P.O. Commenced 25/8/26. Freq. 950 k.c., 316m., 3000 watts d.c.

Executives: Managing Director, A. E. Bennett; Production Manager, Charles H. Cousens; Director of Music, Mr. Gil Dech; Advertising Manager, C. A. Fletcher; Publicity Manager, J. L. Davidge; Chief Eng., L. N. Schultz; Advertising Representatives, C. A. Fletcher, G. A. Saunders, E. M. Stelzer, C. H. Cousens, Miss Etta Field, and H. M. Buxton. Engineers: L. N. Schultz (Chief), E. C. Crouch, C. H. Innes, C. K. Louer, R. Meeks, S. S. Stevens, H. V. Taylor, and H. V. R. Thomas. 2GB Charity Board: Chairman, G. A. Saunders; Secretary, R. E. Bennett. Announcers and Personalities: Lucille Bruntnell interprets "Christopher Robin," A. A. Milne's famous character; Eric Colman, announcer evening sessions, and Sunday afternoon; George Edwards, producer of plays; Frank Grose, "Uncle Frank"; Arthur Hahn, "Bimbo"; Richard Hughes, announcer, baritone soloist, "Cousin Cyril"; Dorothy Jordan, women's radio service; Kathleen Jordan, announcer afternoon tea session; Oscar Lawson, sporting specialist; Jack Lumsdaine, "Radio Rascal," "Father Time," and "Cousin Jack"; Gladys Moncrieff, Australia's most popular soprano, exclusive to 2GB; Harold Morton, psychology session; A. M. Pooley, international affairs; Lindo Taylor, book talks; Miss Muriel Valli, "Auntie Val"; Miss Dorothy Wood, programme director.

Sessions: Afternoon tea, Miss Kathleen Jordan; Anti-vivisection, Mrs. A. L. Green; Astrology, Miss June Marsden; Bluebirds, Miss Muriel Valli ("Auntie Val"); Book Reviews, Lindo Taylor; Breakfast Session, Jack Lumsdaine; Bridge, Mrs. Irene Allan; Children's Sessions, G. A. Saunders ("Uncle George"), Jack Lumsdaine ("Cousin Jack"), Cyril James ("Cousin Cyril"), Lucille Bruntnell ("Christopher Robin"); Community Singing, G. A. Saunders; Drama, George Edwards (Producer), Ellis Price; Happiness Club, Mrs. E. M. Stelzer; International Affairs, A. M. Pooley. Special Sessions Charles H. Cousens (Production Manager): Sport, Oscar Lawson; Music, Gil Dech; Psychology, A. E. Bennett, Harold Morton, Richard Want; Racial Hygiene, Mrs. L. E. Goodisson; Women's Radio Service, Dorothy Jordan (Personal Problems, Cooking, School, Talks); Questions and Answers, L. W. Burt, Harold Morton.

Seven years ago, when 2GB went on the air, the staff numbered four. To-day it numbers over fifty, and it boasts the most efficient engineering, artist, programme, advertising and advance copywriting departments of all the broadcasting stations in the Commonwealth. By the end of 1932 it became necessary to reconstruct the studio system and replace the control equipment. The exclusive services of Gladys Moncrieff in song, of George Edwards in drama, of A. M. Pooley as a speaker, being cases in point. In 1933 also 2GB extended the use of American electrical transcriptions, introducing some novel features and establishing exclusive sources of supply in America. On his visit to U.S.A. (December, 1933-February 1934) Mr. A. E. Bennett (Managing Director) secured new supplies of these features. A 1934 campaign is being made effective, which will give 2GB two more regular studios, totalling five in all, and new equipment in the control room will give depth and perspective to sound production. With wide-range transmission, 2GB's reproduction will persuade the listener that he is listening not to radio but to the artist himself.

2KY

LABOUR COUNCIL OF N.S.W., 424 George Street, Sydney. Commenced 31/10/25. Freq. 1070 k.c., 280m., 1000 watts in the aerial. General Manager, E. R. Voigt; Secretary, J. S. Garden; Studio Manager, H. E. Beaver; Assistant Studio Manager, Harcourt Garden; Chief Engineer, J. Brown. Announcers: Mrs Grey (Women's Session); Messrs H. E. Beaver, Harcourt Garden, C. Angles, E. Gordon, Andy Flanagan, Rion Voigt. Advertising Manager, H. T. Hungerford.

Programmes: Women's Session (Mrs Grey); Children's Session (Uncle Jack and Rion); Community Concerts (H. E. Beaver and Harcourt Garden); Sporting Interviews and Travel Talks, Rion; General Sporting Commentaries, Andy Flanagan; Turf Racing Broadcasts and Commentary, Cyril Angles, Ian Garden and Eric Gordon; Wrestling and Boxing Ringside Descriptions, E. R. Voigt and H. E. Beaver; Social and Economic Talks, J. S. Garden and C. E. Martin, M.Sc.; Musical Sessions, H. Garden and Donald Day.

2SM

CATHOLIC BROADCASTING CO., Australia House, Wynyard Square, Sydney. Stn. Location, Pennant Hills, 11¼ miles N.W. of G.P.O. Commenced 24/12/31. Freq. 1270 k.c., 236m., 1000 watts ae.

Manager, Monsignor Meany; Studio Director, John Dunne. Announcers: John Dunne, John Tuttell, Nora McManus. Engineers: Engineering Section of A.W.A. Advertising: Broadcasting Section of A.W.A. Secretary, Olive Malone.

2UE

RADIO 2UE SYDNEY LTD., 296 Pitt Street, Sydney. M4577. Station location, Lilli Pilli, 14 miles S.S.W. of G.P.O. Commenced 16/1/25. Freq. 1025 k.c., 293m., 1000 watts ae. Managing Director, C. V. Stevenson; Manager and Chief Announcer, Lionel Lunn. Announcing Staff: S. Merideth (Uncle Si), Cecil Agassiz (Aggie), C. Honeyfield (Country Man's Session), Mrs Filmer (Aunty May), Harry Solomons (Racing Announcer), Captain A. C. C. Stevens (Special Readings), S. B. Gravenall (Sport), Arthur Carr (Ambrose), Children's Entertainer, Murray Stevenson (Chief Engineer), Rex Shaw (Musical and Programme Director), Isabelle Grace (Publicity).

Special sessions of Horse Racing, Greyhound Coursing, Wrestling, full description ball-to-ball Cricket Tests, Boxing. 2UE Old Time Dances (fortnightly). Children's Party, Saturday mornings. Minstrel Show, alternate Mondays, Australia Hall.

2UW

COMMONWEALTH BROADCASTING CORPORATION LTD., located in the centre of the City of Sydney, with studios, dual transmitters, and executive offices occupying the seventh floor in the State Theatre Building, 49 Market Street, Sydney. Wavelength 267m., 1125 k.c.

Originally controlled by the well-known music warehousemen, W. H. Paling & Co., Ltd., the station was purchased in 1933 by the Australian Broadcasting Company (Stuart F. Doyle, Sir Ben Fuller and Frank Albert), who formerly provided the national programme services prior to the appointment of the Australian Broadcasting Commission.

Telephones, M6686 (5 lines). Reg. Cable Address, "Twouw." Broadcasting hours, 7 a.m. to midnight.

General Manager, Oswald Anderson; Advertising Sales Manager, F. R. Thompson; Studio Supervisor, Norman Lyons; Programmes, Clifford J. Arnold; Talks and Operas, J. M. Prentice. Announcers: J. M. Prentice, C. J. Arnold, Vernon Sellars, Charles Lawrence, Jack Win, S. E. Baume, Keith Blakeney, Bruce Anderson. Productions, J. J. Donnelly; Dramas and Plays, Mayne Lynton; Publicity and Relays, J. H. Finlayson; Women's Interests, Mrs A. Littlejohn, Myra Dempsey, Dorothea Vautier, Marjorie Skill, Coralie McKellar, Joan Harvey, Enid Lorimer; Auditions, Miss Amy Ostinga; Children's Session, Farmer & Co., with "Gay," Uncle Jack, "The Professor," and "Bob Breezy"; Consulting Engineer, C. Kaupner; Engineers, H. Marshall (Chief), Roy Allen, H. Buzacott and N. Bonnington.

Special Station Features: Cec. Morrison's Dance Band; Operatic Presentations and Foreign Affairs, J. M. Prentice; Musical Novelties, C. J. Arnold; State Theatre Orchestra; Hamilton Webber; Wurlitzer Organ, E. Aarons; Model Aeroplane Association, Norman Lyons; Rosemary Club, Myra Dempsey; Shortwave Radio, R. H. Power; Repertory Movement, Enid Lorimer; Psychology, Joan Harvey; Gardening Sessions, S. H. Hunt; Cricket Talks, Vic. Richardson; Sporting Sessions, Eric Welch, Charles Lawrence, Bruce Anderson.

New South Wales—Country

2AY

Wavelength 203m., 1480 k.c. AMALGAMATED WIRELESS A/ASIA LTD. Manager, Mr. A. E. Lawrence. Power, 50 watts. Time schedule: 5.30 to 10.30 p.m. daily. Station location, Kiewa Street, Albury. 'Phone Albury 261.

2GF

Wavelength, 246m., 1220 k.c. AMALGAMATED WIRELESS A/ASIA LTD. Office location, 13 Prince Street, Grafton. Station on the outskirts of the town. Manager, Mr. C. E. Coldwell-Smith. Assistant, Miss Molly Noonan. Power 50 watts. Time schedule: 1-2 p.m., 5.30-10.30 p.m. every day. Licences have materially increased since this station was erected at Grafton.

2GN

Wavelength 216m., 1390 k.c. AMALGAMATED WIRELESS A/ASIA LTD. Station 'phone 91, Office 111. Station location, River Road, Goulburn, N.S.W. Manager, Lloyd Russell. Transmission Schedule: Mondays to Thursdays, 12.15 to 1.45 p.m., 6.30 to 10 p.m.; Fridays, 12.15 to 1.45 p.m. only; Saturdays, 6.30 to 10 p.m.; Sundays, 7.30 p.m. to 9.30 p.m. This station is understood to be the only station on the air which has a silent night, and this occurs on Friday night, and enables the people in Goulburn districts to compare an evening's entertainment when their local station is not on the air. In consequence, considerable agitation is going on to have the station on the air, even on that night—which proves the popularity of the country "B" class station. Power is 50 watts, and it is a standard A.W.A. transmitter. The Sydney advertising representative is the Broadcasting Department of Amalgamated Wireless, 47 York Street, Sydney; Broadcasting Manager, V. Brooker. Melbourne representative, Amalgamated Wireless Ltd., 162 Queen Street, Melbourne.

2HD

NEWCASTLE. Wavelength 270m., 1110 k.c. AIR-SALES BROADCASTING CO., Civic Centre, Newcastle, N.S.W. Box 123, Newcastle, N.S.W. 'Phone, Waratah 487. Manager, Mr. E. Wood. Engineer, Mr. T. Kitto. Assistant Engineer, R. Oakley. Chief Announcers: Messrs Les. Daley and Andrew Auchterlonie, and Mr. Sid Sheperd. Lady Announcers: Mrs. E. Wood ("Cousin Joy"), Mrs. W. Johnston ("Auntie Maud"), Mrs. R. C. Sparks ("Auntie Betty"). Advertising Manager, Mr. R. C. Sparks. Prominent among the services of this station is the Joy Club and Children's Session, featured daily in both morning and evening. The Joy Club has a membership of about 5,000 children. The Joyster Club, an adult listeners' organisation, has a membership of over 2,000 appreciative listeners, for whom many benefits are obtained, and whose enthusiastic support of 2HD is manifest in various ways. 2HD is readily recognised by national advertisers to be an effective advertis-

T. W. WALL.

L. S. DARLING.

W. M. WOODFULL (Captain).

THE TESTS again from the "Big 5" Chain

TWO years ago "Relays" of programmes and special features between "B" class stations were in the nature of a radio novelty—now they are of daily, or rather nightly, occurrence, but—the pioneer stations which lead the way with the Test Broadcasts in 1930 are still the leaders in this sphere of broadcasting development.

Advertisers—and particularly national advertisers—are well aware of this leadership enjoyed by the Big 5—2UW (Sydney), 3DB (Melbourne), 5AD (Adelaide), 4BC (Brisbane) and 6ML (Perth) and their associate stations in the respective States.

So we find most of the "big things" in radio entrusted to the stations named, any or all of which will be pleased to furnish complete proposals for local or interstate radio publicity in special features sponsored or announcement form.

C. V. GRIMMETT.

A. F. KIPPAX.

W. A. OLDFIELD.

2UW The new 2UW Transmitter which is being installed by A.W.A. and will be in operation in time for the First Cricket Test Match embodies the latest improvements in radio transmission which will enable 2UW to use the greatest power granted to a licensed station.

2UW is the originator of the system of interstate relayed advertising and the first station to use film recordings in general broadcasting programmes.

2UW provides a diversified and entertaining programme every day of the week from 7 a.m. to midnight.

H. I. EBELING.

S. J. McCABE.

Photographs by courtesy of "The Sydney Mail."

D. G. BRADMAN (Vice-Captain).

W. J. O'REILLY.

L. FLEETWOOD-SMITH.

3DB The "Herald" Broadcasting Station has for many years been acknowledged by advertiser and listener alike as Melbourne's leading station.

Ever progressive in transmission and programmes, 3DB pioneered the sponsored session in Australia, and now presents the greatest variety of features in the State, including Saturday and Mid-week race broadcasts by Eric Welch.

A new increase of 50% in its power makes 3DB more dominating than ever.

4BC This station was the beginning of a group of Queensland stations—4BC, 4MB, 4GR, and 4RO—all controlled from 4BC. One of the outstanding features of 4BC activities is the presentation of broadcasts dealing with matters of public interest including all shades of political and religious beliefs.

4BC was the first station to receive and operate under a Commercial licence in the City of Brisbane and during the past three years has made remarkable progress.

5AD This station is unique through the fact that it relays all its night programmes to its Country Branch, 5PI, at Crystal Brook, some 140 miles north of Adelaide. With its unmodulated aerial power of 2000 watts, 5PI is the most powerful Country licensed station in Australia.

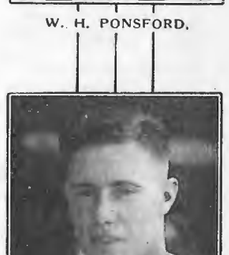
Programmes are all supplied from a library of some 12,000 numbers, many hundreds of which are exclusive to 5AD, since they are direct importations.

5AD handles by far the largest amount of radio advertising in South Australia.

6ML The pioneer Commercial Broadcasting Station of W.A. is the leader in the State of West Australia. Quite recently they secured a second broadcasting licence (6IX) and by having two separate stations in operation, two distinct and different types of programmes can be, and are, simultaneously broadcast nightly.

The popularity with advertisers is attested by the large and increasing volume of advertising which is now handled by both stations.

3DB-2UW-4BC 5AD-6ML



W. H. PONSFORD.

E. H. BROMLEY.

A. G. CHIPPERFIELD.

W. A. BROWN.

B. A. BARNETT.

2HD (Continued)

ing medium in Newcastle districts, and is largely patronised by all who desire to gain the ears of the public in the northern districts of N.S.W. 2HD is on the air early and late. Market reports for the man on the land are broadcast at 5.45 a.m. Early morning sessions daily from 6 a.m. Devotional session at 7 a.m. Joy Club session at 8 a.m., followed by music at 8.30 a.m. At 9.30 a Housewives' Session is conducted by "Auntie Betty," from when the station is continuously on the air until 2 p.m. 9.30 to 11.30 a.m. is devoted to the ladies, and the remaining portion of the time to a midday session of a general nature. The 3 to 4 p.m. and afternoon session, of interest to both men and women, is conducted by "Auntie Maud," and at 5.45 Cousin Joy is on the air with the Joy Club and evening session. This continues until 10.30 p.m. week nights, and 12 midnight on Saturday and Sunday.

This station has recently acquired a new site about seven miles from Newcastle, located at Sandgate. A handsome group of buildings, designed on a Spanish mission style, has been constructed, and profusely decorated. They are crowned by a huge globe illustrating "2HD Telling the World," the whole forming a striking landmark on the Maitland Road, on the way to Brisbane. Floodlights and neon signs make it prominent by night and by day.

2KO

NEWCASTLE BROADCASTING CO. LTD., 57 Hunter Street, Newcastle. Station location, Sandgate, 6½ miles N.W. Newcastle P.O. Commenced 1/8/31. Freq. 1415 k.c., 212m., 200 watts ae.

Manager, Allen Fairhall. Announcers: Harold Pickhover, Alan Fairhall, Stan Heanery (Sporting), Tom Horan (Sporting), Miss Nora Downie (Secretary), N. O. Whale (F.A.I.S., A.F.I.A.).

Special Services: Cheerio Club, Ladies' Session, Sporting, Boxing and Wrestling Descriptions two nights per week. Turf Prospects. Old Time and Jazz Music.

2MO

M. J. OLIVER, Marquis Street, Gunnedah. Station location, ¾ mile W. of P.O. Commenced 16/1/31. Freq. 1320 k.c., 227m., 50 watts aerial. General Manager, L. M. Oliver. Chief Engineer, M. J. Oliver.

2WG

Wavelength 260 metres, 1155 k.c. RIVERINA RADIO BROADCASTING CO. LTD., 164 Fitzmaurice Street, Wagga. 'Phone, Wagga 164. Station 2WG is one of the most up-to-date country broadcasting stations in Australia. It operates on 260 metres with a power of 50 watts in the aerial, but, in keeping with the steady growth of country broadcasting, the station, after a short battle for greater signal strength, will, in the near future, go up to 1500 watts input. An improved transmitter is being erected seven miles out of town. The station will increase its hours on the air, adding to the present early morning, afternoon, and night sessions, a mid-morning, a mid-afternoon, and an evening session. The present stock and market reports will be greatly amplified, a continuous series of agricultural and pastoral talks relating to specific problems in the Riverina. The policy of the station is to foster everything that comes under the title of "Riverina," so it naturally and logically follows that from this station will emanate a great body of Riverina New State propaganda. Senator Hardy, "The Cromwell of the Riverina," is a well-known broadcaster from 2WG. Mr. E. Roberts, B.Sc., is the Managing Director. He took up radio, as a professional, after the Great War, commenced business in Narrandera, and later moved to Wagga. The studios of 2WG are located in perhaps the most spectacular building in Wagga. The actual studios, which are on the first floor, and overlook beautiful Memorial Gardens, on the banks of the Murrumbidgee River, include a large dance hall, which is an acquisition few city stations can boast.

2WL

WOLLONGONG BROADCASTING CO., 149 Crown Street, Wollongong. Station location, ¾ mile N.N.W. of P.O. Freq., 1435 k.c., 209m., 50 watts ae.

Manager and Chief Technician, Russell A. Yeldon; Deputy Engineer, A. R. Hazelton.

2XN

224 metres, 1340 k.c. EXTON'S BROADCASTING SERVICE, 173 Molesworth Street, Lismore, N.S.W. 'Phone, 474-173 Lismore. Telegrams, 2XN. General Manager and Proprietor, George W. Exton. Studio Manager and Chief Announcer, Walter G. A. Exton Advertising Manager, John H. Wittup. Announcers: Walter G. A. Exton, John H. Wittup, Alfred Phillips, Miss Gladys Lulham. Announcers for Children's Session: "Aunty Sadie," Miss Gladys Lulham; "Uncle Eck," Walter G. A. Exton; "Uncle Jack," John H. Wittup; "Yo Yo," Walter G. A. Exton. Times of Sessions: Breakfast Session, 7 a.m. to 8 a.m., conducted alternatively by Walter Exton and Jack Wittup; Housewives' Hour, 2 p.m. to 3 p.m., conducted by Miss Gladys Lulham. Main Evening Session: Monday evening, Announcer, Walter G. A. Exton; Tuesday evening, Announcer, John H. Wittup; Wednesday evening, Announcer, Alfred Phillips; Thursday evening, John H. Wittup, Walter G. A. Exton, Miss Glayds Lulham. Main evening session: Friday evening, Announcer, Alfred Phillips; Saturday evening, Announcer, Walter G. A. Exton, John H. Wittup, Miss Gladys Lulham. The whole of Station 2XN was built by the proprietor, George W. Exton, and is operated by him. The station will be moved and the power increased within the very near future, and moved to a site which has been approved of by the P.M.G. Department. The studio will be moved to the centre of the town of Lismore.

Victorian—Metropolitan

3AK

MELBOURNE BROADCASTERS PTY. LTD., 116 Queen Street, Melbourne, C.1. 'Phone, Cl. 1900. Station location, 8 Yerrin Street Balwyn, E8 (W2100). Commenced 19/11/31. Freq. 1500 k.c., 200m., 50 watts.

Manager, G. F. Palmer. Directors, G. F. Palmer and W. Harrison. Announcers, F. C. Bibby, T. L'Elliott.

In other parts of the world the owner of a receiving set enjoys the privilege of tuning in at any hour of the day or night. This station operates from 11.30 p.m. to

3AK (Continued)

2 a.m., and from 5 a.m. to 7 a.m. daily, and entertains thousands in all sections of the community. Particular care is exercised to ensure 100 per cent. entertainment and experts leave nothing to be desired in the way of broadcasting programmes at this hour from this unique station. World-wide broadcasts are carried out by 3AK during this station's early morning sessions, which, together with the latest of local music, sends the early morning worker off with a song in his heart. At the week-end 3AK provides a midday session on Saturdays and Sundays.

3AW

THE VOGUE BROADCASTING COMPANY PTY. LTD., owned and operated by David Syme and Co. (The "Age"), J. C. Williamson Ltd., and Allan & Co. Pty. Ltd., controlling the Feature Station, Exhibition Street, Melbourne. Station location, 34 chains N.E. Elizabeth Street P.O. Commenced 22/2/32. Freq. 1425 k.c., 210m., 300 watts ae.

With portable transmitting equipment has broadcast an outstanding number of sporting fixtures, notable among these being the Australian Golf Championships, the Head of the River, the Brighton Yachting Championships, and the Melbourne Royal Agricultural Show. The portable transmitting equipment has enabled 3AW to follow every turn of events and give its radio audiences a graphic and minutely detailed account of such items. 3AW is the only "B" class station in Victoria which broadcasts every Metropolitan Race Meeting.

Managing Director, George Sutherland. Manager, Stuart Bridgman. Studio Manager, E. Mason Wood. Sessions: "The Early Birds" (Nicky and Tuppy), breakfast session; Margaret Manning, "Happy Circle" Session; Nancy Lee and the Chums of Chatterbox Corner. Mr. G. B. Thompson (Mike) was Studio Manager of 7LA, Launceston, before joining 3AW staff. Miss Louise Homfrey, with broadcasting experience covering a period of eight years, enjoyed the reputation (while on the staff of 2UW, Sydney) of being the best woman announcer in Australia. Melbourne listeners have been pleased to endorse this opinion. The Continuity Department boasts of a particularly strong team in Mr. Gordon Massey and Miss G. Miller.

Time Schedule: Monday to Friday, 6.30 to 9.30 a.m., 10.45 a.m. to 11 p.m.; Saturday, 6.30 to 9.30 a.m., 10.45 to 11.30 p.m.; Sunday, 10.30 a.m. to 12.30 p.m., 4.30 pm. to 10.30 p.m.

3DB

HERALD BROADCASTING STATION, 36 Flinders Street, Melbourne, C1. 'Phone F2118. Telegraphic address, "Threedb." Commenced 21/2/27. Freq. 1180 k.c., 254m., 400 watts ae.

Manager, David T. Worrall. Programme Director, Charles E. Taylor. Manager of Advertising Services, R. McCowan Russell. Sales Manager, Leslie Mather. Musical Director, Hugh Huxham. Representative, F. Thompson, Pictorial Newspapers, 30 Carrington Street, Sydney.

3KZ

BROADCASTING COMPANY PTY. LTD., Strand 'Phone Cl. 318. Freq. 1350 k.c., 222m., 400 watts. Directors: Mr. Syd Morgan, Managing Director, W. V. Morgan, and M. G. Sloman. Assistant Manager, A. Isaacson. Permanent Announcing Staff: N. Banks, N. E. Balmer, A. Dear, Miss N. Melwit, Miss D. Bush. Engineers: A. Grace (Chief), S. Thurling, E. Barwick. Advertising Director, W. V. Morgan. Programme Department, N. E. Balmer.

Features: Bright programme policy, weekly radio party, special dance programme each evening, dramatic, humorous and novelty presentations, broadcast of leading theatrical orchestras and stage productions, daily talks to housewives, broadcast description of football matches from leading grounds, Test cricket service and a regular weekly review of all branches of sport.

Time Schedule: Monday to Friday, 7 a.m. to 1.45 p.m., 2.30 p.m. to 4.30 p.m., 5.15 p.m. to 11.30 p.m.; Saturday, 7 a.m. to 10.45 a.m., 12.15 p.m. to 1 a.m.; Sunday, 2.30 p.m. to 4.30 p.m., 6 p.m. to 10 p.m.

3MA

SUNRAYSIA BROADCASTERS PTY. LTD., Zimmer's Bldgs., Langtree Avenue, Mildura, Victoria. 'Phone 25. Freq. wavelength 333.1m., 50 watts. Directors: Senator R. D. Elliott, G. S. Baxter, C. D. Lanyon. Manager, J. Young. Announcers: J. Young, Miss G. Salter. Engineer, Mr. M. Folie.

Feature Services: Children's Session, conducted by "Uncle Jim"; Smilers' Club; Benefit and Free Theatre Ticket Club; Diggers' Session conducted every Saturday night between 9 and 10; Garden Session, every Tuesday night at 8.30; Reverie, every Sunday night at 9.45.

Time Schedule: 12.30-1.30 daily, excepting Sundays; 6.30-10.30 Monday and Tuesday; 6.0-10.30 Wednesday; 6.30-10.30 Thursday and Friday; 6.30-11 Saturday; 2-3.30 and 6.30-10 Sunday.

3UZ

THE NILSEN BROADCASTING SERVICE PTY. LTD., 45 Bourke Street, Melbourne, C1. Station location, half mile N.E. Elizabeth Street P.O. Commenced 8/3/25. Freq. 930 k.c., 323m., 600 watts aerial.

Manager, J. S. Larkin. Programme Director, Ernest Trotman. Announcers: J. Lloyd Jones, Frank Jenkin, Alec Dear, Miss Elsie Bradshaw and Miss Anne Harvey. Engineers: L. G. Glew, S. Riches and W. Virgona. Advertising Staff: O. W. Abramowski, G. S. Fawcett. Continuity Writer, J. Gurry.

Daily Time Schedule: 7 a.m.-8.45 a.m., 9 a.m., 2 p.m., 3.30 p.m., 11.30 p.m.; Saturday, 7 a.m.-8.45 a.m., 9 a.m., 12 noon, 6 p.m., 12 midnight; Sunday, 10.30 a.m., 12.30 p.m., 5.45 p.m., 10 p.m.

Victoria—Country

3BA

BALLARAT BROADCASTERS PTY LTD., corner Armstrong and Dana Streets, Ballarat, Victoria. Station location opposite P.O., Sturt Street. Commenced 31/7/30. Freq. 1300 k.c., 231m., 50 watts ae. Managing Director, J. H. Davey. Manager and Station Engineer, Warne A. Wilson. Announcers: Stephen McDonald (Uncle Mac), Miss Lela Lake, Messrs J. H. Davey, A. E. C. Kerr and Pat Corby ("Early Bird"). Operating Engineer, A. E. Kerr.

3BA (Continued)

Special Services: Early Bird Breakfast Session, 7 to 9 a.m. except Sundays; Saturday afternoons, Sporting broadcast, 1.15 to 5.15 p.m., by Eric Welsh.

3BO

BENDIGO. Wavelength 309m., 970 k.c. AMALGAMATED WIRELESS A/SIA LTD. 'Phone, Office 54, Station 26. Studio location, Allen's Walk, Bendigo. Station location, three miles out of Bendigo at Kangaroo Flats. Power, 200 watts.

Manager, Mr. M. A. L. Shepherd. Advertising and Publicity Manager, Mr. Roger Fair. Engineer, F. Pearce. Assistant Announcer, Miss Edna McGladdery. Representatives, Amalgamated Wireless Ltd., Broadcasting Department, 47 York Street, Sydney, and 162 Queen Street, Melbourne. Time Schedule: 11.30 a.m. to 1.30 p.m., and 5.30 p.m. to 10.30 p.m., Monday to Friday; Saturday, 11.30 a.m. to 10.30 p.m.; Sunday, 7 p.m. to 10 p.m.

3GL

GEELONG BROADCASTERS PTY. LTD., National Mutual Bldgs., Moorabool Street, Geelong. Freq. 1400 k.c., 214m., 50 watts ae. Directors, Ramsay B. Cook, A. Leslie Sutton. Manager, J. A. McKenzie. Advertising Manager, Bruce Tart. Announcers: Wilfred Gray, Ian Dickson, Miss Kishere. Engineer, Morris Israel, J. Matthews (Assistant). Time Schedule: Monday and Tuesday, 7.45 a.m. to 9.15 a.m.; Wednesday, 1 p.m. to 2 p.m.; Thursday and Friday, 5.30 p.m. to 10.30 p.m.; Saturday, 7.45 a.m. to 9.15 a.m., 6 p.m. to 11 p.m.; Sunday, 7 p.m. to 10 p.m.

3HA

WESTERN PROVINCE RADIO PTY. LTD., 37 Gray Street, Hamilton. Station Location, four miles N. of P.O. Commenced 24/10/31. Freq. 1010 k.c., 297m., 200 watts ae.

3HS

Wavelength 219 metres, 1370 k.c., 50 watts. WIMMERA BROADCASTING CO. PTY. LTD., 15 Firebrace Street, Horsham, Victoria. 'Phone, Horsham 84. Company Directors. Messrs Senator R. D. Elliott and J. V. S. Ward. Manager and Announcer, A. T. Hopton. Secretary and Assistant, Miss N. Orloff. Time Schedule: Mondays, Wednesdays, Thursdays, 6.30 to 10.30; Tuesdays, Fridays, 6.0 to 10.30; Saturday, 6.30 to 11; Sunday 7 to 10. Special Sessions: Children's Session, Tuesday and Friday, 6 to 6.30, conducted by "Peter Pan." Digger's Session, Saturday, 8 p.m., conducted by "Qui Vive." This station was opened on 11th September, 1933, by the Hon. Archdale Parkhill, M.H.R., from Sydney. From the outset, the station has been very popular in the Wimmera District, and within a radius of fifty miles serves a population of approximately 50,000 people.

3SH

SWAN HILL BROADCASTING CO., Campbell Street, Swan Hill. Station location, half mile S. of P.O. Commenced 29/9/30. Frequency 1080 k.c., 277.6m., 50 watts ae.

3TR

GIPPSLAND PUBLICITY PTY. LTD., Myrtlebank, near Sale. Freq. 1280 k.c., 234m., 250 watts. Managing Director and Chief Anouncer, Mr. Archibald Gilchrist. Miss Gwenyth Gilchrist is "second-voice," assisted by Miss O'Bryan. Assistant Announcer, George Jaguer. Advertising Manager, S. R. McLaren. Station Engineer, Ron. Schmidt. Assistant Engineer, Ken Dalziel.

Station 3TR serves a wide area, from Drouin to Mallacoota. An increase of power to 250 watts in the aerial has been authorised by the P.M.G.'s Department, and, in preparation for this increase the transmitter has been removed to Myrtlebank on the Sale-Maffra Road, four miles air distance from Sale. The new aerial is 120ft high and is on an open plain free from trees and hills. There are two studios at the station building in Sale, one of which is used by concert parties and dance bands. There is an emergency studio at Myrtlebank.

A special feature is made of Children's Sessions, which are controlled by "Uncle Fred." Church Services are broadcast every Sunday night and concert and dance programmes have been relayed from Traralgon, Bairnsdale, Maffra, Newry and Cowwarr. Regular features: Talks on women's interests, cookery, gardening, farming, and international affairs, three news services daily, weather forecasts, serial story daily, travel bureau.

Time Schedule: Monday to Friday, 10.30 a.m. to 1.30 p.m., 6 p.m. to 10.30 p.m.; Saturdays, 10.30 a.m. to 1 p.m., 6 p.m. to 10.30 p.m.; Sundays, 6.30 p.m. to 10.30 p.m.

3WR

WANGARATTA BROADCASTING PTY. LTD., Reid Street, Wangaratta. 'Phone 331, 355. Station location, 200yds. W. of P.O. Commenced 5/1/31. Freq. 1260 k.c., 238m., 50 watts ae. Managing Director, L. J. Hellier. Engineer, G. Steane, A.M.I.R.E. Announcers: Messrs. L. J. Hellier, G. Steane, Mrs. G. Steane, Miss Rita Wilson. Features: Weekly broadcast of relay from 3DB by Eric Welch; Smile Away Club, 1200 members. According to statistics published by "Radio and Electrical Merchant," 3WR has the largest population within fifty miles radius, the highest ratio of licences to population and dwellings of any country station in the Commonwealth. Please note particularly this does not include such places as Ballarat, Geelong or Bendigo, as these are cities, although the last-named could be included, as its figures are much below 3WR.

3YB

MOBILE BROADCASTING SERVICE PTY. LTD., 430 Little Collins Street, Melbourne, C1. 'Phone Cl. 7759. Commenced 13/10/31. Freq. 1060 k.c., 283m., 25 watts ae. Chairman, G. I. Purbrick. Directors, A. N. Rennie, V. M. Dinneny, J. A. Young. Secretary, L. G. Callaway. Station Manager and Announcer, Mr. James Joyce. Office Manager, Mr. V. M Dinneny. Engineer, Mr. A. J. G. Glover. Time Schedule: 6.30 p.m. until 10.30 p.m., week days, and 7 p.m. until 10 p.m. on Sundays. The commercial policy of the Mobile Station is to advocate the purchase of commodities through the local retail outlet and to identify the retailer with the product. 3YB offers a carefully selected programme of recorded music during the week and on Sunday evenings a programme devoid of publicity is given from 7 to 10 p.m. By arrangement with metropolitan stations, relays of items of particular interest are featured, the most recent being the cricket talks by Mr. M. A. Noble that came through Station 3AW. 3YB has become an institution that is known throughout Victoria from Mildura to Bairnsdale, Bairnsdale to Portland, Portland to Kaniva, and Kaniva to Echuca.

Queensland—Metropolitan

4BC

CHANDLER'S BROADCASTING SERVICE, 45 Adelaide Street, Brisbane, Q. Commenced 16/8/30. Freq. 1145 k.c., 262m., 750 watts ae. 'Phone: B 5493.

General Manager, John Beale Chandler. Secretary, William Gordon Duncan, V. F. Mitchell. Manager, Russell F. Roberts. Advertising Manager, J. Arundel Radford. Musical Director, Howard Sleath. Announcers: Rodway C. Gainford ("Uncle Rod"), Norman G. Carter ("Uncle Norm."), Eric Bessemer ("Sunrise Sam"), Mrs. R. L. Reid (Ruth Rutherford), Miss Tone Seymour ("Mary Elizabeth"), Arthur Morley ("Old Timer"), James C. Anderson (Racing Commentator), Eva Howard ("Aunty Eva"), Miss Mervyn Jones (Social Announcer), Dean Casos (Tennis Commentator), Barney Cook (Cricket Commentator), Stan Philips (Sailing and Golf), George Ricketts (Physical Culturist). Guest Announcers: Miss A. Morris (Women's Activities), Miss Freda Bage, M.Sc. (Women's Activities), Dr. Shirley Lane (Mothercraft broadcasts). Engineers: Fred Stevens, Chief Engineer; Frank E. Elliott, Chief Studio Engineer; George B. Sutherland, Assistant Engineer; Patrick Lindsay, Assistant Studio Engineer; E. C. Littler, Chief Technician; Robert Hare, Control Engineer.

Official broadcasting station for: "Telegraph" Newspaper, Queensland Eisteddfod, Queensland Lawn Tennis Association, Queensland Turf Club, Brisbane Amateur Turf Club, Tattersall's Club, Ipswich Amateur Turf Club, Brisbane Rugby League, Queensland Amateur Boxing and Wrestling Union, Social Service League, Regent Theatre, Trocadero Dansant.

Time Schedule: Monday, Tuesday, Thursday and Friday, 6.30 to 9 a.m., 10 to 3.30 p.m., 5.30 to 11 p.m. Wednesday, 6.30 to 9 a.m., 10 to 11 p.m.; Saturday, 6.30 to 9 a.m., 1 to 11 p.m.; Sunday, 10 to 11 a.m., 5.45 to 10 p.m.

4BH

217.3m., 1380 k.c., 600 watts. BROADCASTERS (AUST.) LTD., Grice's Bldg., 90-92 Queen Street, Brisbane. 'Phones B3810, B3935. Telegrams, "Four BH," Brisbane. Station, Bald Hills, Queensland. Operating on 1380 k.c. and power of 600 watts.

Manager, W. Kickson-Adams. Staff: Senior Announcer, "Uncle George"; Early Morning Announcer, John Christopher; Evening Announcer, "Uncle Archie"; Women's Session, "Sally"; Chief Engineer, N. Cruikshanks. Assistant Engineer, C. D. Moran. Studio Players: Miss Joan Adams, "Sally," W. H. Adams, Reginald Mitchell, W. Murray Henderson, Archie Graham and John Christopher. Continuity and Publicity, John Christopher, Miss Joan Hall, and C. D. Moran. Sessions: Early Morning, featuring Breakfast Music; "The Early Worm"; News and Amusements; "Visits to the Future," etc., conducted by John Christopher; 7 a.m. to 9 a.m., Women's Sessions, featuring dressmaking and interior decoration classes, recipe talks, visiting speakers, bright music, etc., conducted by "Sally," from 11 a.m. to 1 p.m. Children's Sessions, 5.30 to 6 p.m., Monday and Thursday, "Uncle Archie," Tuesday, "Uncle George," Wednesday and Friday, John Christopher, Saturday, "Sally"; 6 to 9.30 p.m., Evening presentation, featuring sponsored sessions, late release music and dramatic entertainments, conducted by "Uncle George"; 9.30 to 10.30 (11 p.m. on Saturdays), Studio Vaudeville.

4TO

Wavelength 256.3m., 1170 k.c., 200 watts. TOWNSVILLE (AMALGAMATED WIRELESS A/ASIA LTD.). 'Phone 349. Station location, Flinders Street, Townsville, Queensland. Manager, H. E. Cox. Assistant, H. Derriman. Lady Announcer, Miss E. Gray. This station is one of the very few stations which provide a very effective service in the mandated territories and the northern part of Australia. Important shipping and other information is broadcast, and is greatly appreciated by the residents up north. Mr. Cox is of a dynamic personality, and a very effective Station Manager. This is also one of the few "B" class stations in country areas which is able to produce plays which are effectively appreciated. Time Schedule: Monday to Friday, 12.30-1.30 p.m., 5.30-6.30 p.m., 7.30-10.30 p.m.; Saturday, 12.30 p.m.-6.30 p.m., and 7.30-10.30 p.m.; Sunday, 7.15 p.m.-10 p.m.

4BK

THE COURIER-MAIL STATION, King House, Queen Street, Brisbane, Quensland. Telephone B6610. Wavelength 233m., 1290 k.c. Proprietors, Brisbane Broadcasting Pty. Ltd., Courier-Mail Bldg., corner Queen and Edward Streets, Brisbane, Q. Staff: Manager, Alec Robertson; Chief Engineer, A. L. Dixon; Studio Director, Gordon W. Marsh; Continuity, Ernest Briggs; Programmes, Winifred Haslam. Announcers: Royston Marcus, Hilda Hastie, L.T.C.L., Bert Browne, Neara Sampson. Particular Sessions: Family Breakfast Session, 7.15 a.m.; Barber Shop Session, 7.45 a.m.; Shopping Guide, 9.15 a.m.; Courier-Mail Social Talk, 11.30 a.m.; Courier-Mail Musical Session, 11.45-12.15 p.m.; Children's Session, 5.30 p.m., "Wendy and her children," and "Professor Longlegs" conducting alternate days. Courier-Mail Half Hour, 9.30 p.m.; Courier-Mail News Service, 10 p.m.; Radio Trader's Two Hours, 10-noon Saturdays; Howard's Feature Sessions, 8 p.m., Tuesday and Saturday; One-act Play, 8.30 p.m., Wednesday.

Regular Feature Speakers: Marketing Talks, Mary Gray; Bridge, Laura Ludgate, L.A.B.; Baby Clinics, Miss Axelson; Graphology, Royston Marcus; Tennis, S. P. England; Football, Norman Potter; Bowls, F. Gould; Mission, Rev. Wilfrid Magor; Gardening, Queensland Horticultural Society; Ex-Service, R.S.S.I.L.A., Ex-Imperial.

Special Activities: Exclusive broadcasts of Golden Casket Drawings.

Daily Transmission Times: 7 a.m. to 2 p.m., 3.30 to 11 p.m.; Saturday until midnight; Sunday, 6.30 to 10.30 p.m.

Brief Resume of History: 4BK made its first appearance in October, 1930, and did much pioneering work under the management of the Brisbane Broadcasting Co. Ltd. At the beginning of 1934 it was acquired by the present owners and on February 1st last it went on the air as the Courier-Mail Station. As such it is one of the newspaper interstate chain headed by 3DB, on similar lines to which it is modelled.

Queensland—Country

4GR

GOLD RADIO SERVICE LTD., 43 Adelaide Street, Brisbane (Station at Toowoomba). Station location, 200 yards N.W. of Toowoomba P.O. Commenced 9/8/25. Freq. 1000 k.c., 300m., 50 watts ae.

4MB

MARYBOROUGH BROADCASTING CO. LTD., 43 Adelaide Street, Brisbane (Station at Maryborough). Station location, 1 mile W. of Maryborough P.O. Commenced 16/8/32. Freq. 1060 k.c., 283m., 50 watts.

4MK

MACKAY BROADCASTING SERVICE, 64 Nelson Street, Mackay. Station location, half mile W. of P.O. Commenced 12/1/31. Freq. 1190 k.c., 252m., 100 watts ae.

4RO

ROCKHAMPTON BROADCASTING CO. PTY. LTD., 43 Adelaide Street, Brisbane. (Station at Rockhampton.) Station location, Rockhampton. Commenced 2/7/32. Freq. 1330 k.c., 226m., 50 watts ae.

South Australia—Metropolitan

5AD

ADVERTISER NEWSPAPERS LTD., Waymouth Street, Adelaide. Station location, 6½ chains N. of G.P.O. Commenced 2/8/30. Freq. 1310 k.c., 229m., 300 watts ae.

5DN

312.5m., 960 k.c., 100 watts. HUME BROADCASTERS LTD., 29 Rundle Street, Adelaide. 'Phone Cl. 3847. Names of Manager, etc.: H. R. Pinkerton, General Manager; J. W. Burnard, Assistant Manager; A. J. Carvosso, Secretary; L. B. Carter, B.A., Chief Announcer ("Uncle Nick"); C. Hardman, Announcer ("Uncle Bob"); Mrs. E. Pullman, "Phyliss"; E. J. Hume, Chief Engineer; F. J. Hill, Assistant Engineer; J. J. Hume, Technician; Miss K. Taylor, Cousin "K." Telegraphic Address, "Saverys," Adelaide. Particular Sessions: 7.45 to 9 a.m. daily, Early Morning Shopping Sessions, by "Phyliss," Announcer C. Hardman; 11 a.m. to 12 noon, Happiness Club and Housewives' Sessions, Cousin "K"; 2 to 3 p.m., and 9 to 10 p.m., Savery's Sessions of high quality Orchestral and Vocal Music, Announcers, Mr. L. B. Carter, Mr. Hardman; 5.30 to 6 p.m., Special Young Folk's Session, featuring Happy Street, Tailwaggers' Club, and Children's Stories, Mr. Carter and Cousin "K"; Sundays, 7 to 8.15 p.m., Church Relays; 8.15 to 9.15 p.m., George Edwards and his Players (relayed from Sydney); 9.15 to 10.15 p.m., Church of England broadcast Hour (Mr. Carter). Other Sessions during the week include Sporting, Travel Talks, John Redpath Plays, etc Regular Feature Speakers: Mr. L. B. Carter, Historical, Mr. P. H. Nicholls, Topical; Rev. A. C. Stephens, M.A., Social Service. 5DN was first licensed in 1924 and is therefore the oldest "B" station in South Australia. Originally designed as an experimental station, 5DN became widely known in the early days of broadcasting. Two years ago the transmitter was transferred to its present location in Savery's building, Rundle Street. The power has been more than doubled, new studios and transmitting plant installed. The programmes have been planned so as to co-operate closely with business houses, both locally and interstate.

5KA

SPORT RADIO BROADCASTING CO. LTD., Richards Buildings, Currie Street, Adelaide, S.A. 'Phone C2721. Commenced 25/3/27. Freq. 1200 k.c., 250m., 1000 watts ae. General Manager, Mr. R. Lincoln. Advertising Manager, Mr. John K. Jameson. Engineers, Mr. J. Jack and Mr. K. Armistead. Announcers: Mr. Cyril Freeman, Mr. Arthur Thorn, Mrs. Linda Schneider ("Cousin Dora"), Miss Lillian Hartwig. Early morning, ladies', and mid-evening sessions are arranged to give a bright variety of musical numbers. The lunch hour and evening dinner music recitals are arranged to supply a type of music suitable for those hours of the day. On Monday night a well-known dance band broadcasts from the studio for two hours. Every third Wednesday night a special studio variety concert is arranged. Children's sessions, 8.0 a.m. for 15 minutes; 5.30 to 6 p.m. Health topics and physical exercises, three mornings per week. Racing, tennis, trotting, soccer and football, and instructions in dancing, talks regularly through the season. Sunday night, a special relay from the console of the Wurlitzer Organ of the Regent Theatre, with vocal numbers. Organist, Charles Tuckwell; Tenor, Charles Brockbank. Time Schedule: Week-days, 6.30 a.m. to 8.30 a.m., 10 to 2 p.m., 5.30 to 11 p.m.; Sundays, 10 to 11 a.m., 3 to 4 p.m., 4.45 to 5.45 p.m., 6.30 to 10 p.m. Station 5KA runs two clubs, one for adults known as the Merry-makers' Club, and one for children, known as the Cheerio Club. Membership of these clubs are 3,000 and 4,500 respectively.

South Australia—Country

5PI

MIDLANDS BROADCASTING SERVICES LTD., Ellen Street, Port Pirie. Station location, quarter mile S. of P.O. Commenced 7/1/32. Freq. 1040 k.c., 288m., 50 watts ae.

West Australia—Metropolitan

6IX

Wavelength 204m., 1470 k.c., 300 watts ae. W.A. BROADCASTERS LTD., Lyric House, Murray Street, Perth. Directors: Messrs H. B. Jackson, K.C. (Chairman), F. C. Kingston, C. P. Smith, M. D.'O. Musgrove, H. Greig. Manager, B. Samuel. Advertising Manager, E. C. Churchward. Announcers: Messrs Paul Daly, Ron Gledhill, Bram. Saunders. Engineers: Messrs. N. Parker, N. Greer, J. Tapper, G. Buckeridge.

News services at 7.50, 8.50, 9.50, each evening. Programme units consisting of twenty minutes presentations not interspersed by advertising. Provision is made for the inclusion of advertising in the hourly news services. Saturday, late dance programme till midnight. Sundays, Church Services.

Time Schedule: Monday to Friday, 8.30 a.m. to 11 a.m., 3 p.m. to 5 p.m., 6 p.m. to 11 p.m.; Saturdays, 8.30 a.m. to 12 noon, 6 p.m. to 12 midnight; Sunday, 9.30 a.m. to 12 noon, 1.30 p.m. to 3 p.m., 4.30 p.m. to 6 p.m., 7 p.m. to 10.30 p.m.

The association of the "West Australian" Newspapers with 6IX assures for it an outstanding News Ser-

6IX (Continued)

vice, and the news services broadcast each evening are particularly outstanding. A feature of 6IX's programme policy is the presentation of programme units in twenty minute features, which do not permit of being broken by advertising. Advertisements are inserted between the programme features, and during news services. This policy governs the programme arrangement from 8 till 10 p.m. 6IX commenced transmitting on 27/11/33.

Broadcasting time schedules have been arranged so that 6IX fills in all the blank spots that were existing previously, including Sundays.

6ML

W.A. BROADCASTERS LTD., Lyric House, Murray Street, Perth. Station location, 100yds. S. of G.P.O. Commenced 19/3/30. Freq. 1135 k.c., 264m., 300 watts ae. Directors: H. B. Jackson, K.C. (Chairman), F. C. Kingston, C. P. Smith, M. D.'O. Musgrove, H. Greig. Station Manager, Bryan Samuel. Advertising Manager, E. C. Churchward. Announcers: Eric Donald, Ned Taylor, Misses L. Berryman, E. Dunne. Engineers: Harry T. Simmons, M. Urquhart, G. Butterfield.

Features: Early Morning Session, Children's Session, Sporting Anticipations, Boxing and Wrestling Descriptions, Tennis and Cricket Broadcasts, Morning and Evening News Service, Lotteries Drawings, 6ML Cheerio Club.

Time Schedule: Monday to Friday, 7 to 8.30 a.m., 11 a.m. to 3 p.m., 5 p.m. to 10.30 p.m.; Saturday, 7 to 8.30 a.m., 11 a.m. to 2 p.m., 3 to 5 p.m., 6 to 10.30 p.m.; Sunday, 7 p.m. to 10 p.m.

6ML was the first "B" class station to be erected in Western Australia, and has now been on the air four years. For over two years 6ML has been broadcasting exclusively ringside descriptions of boxing and wrestling contests, which have taken place in Perth; arranged the first interstate relay emanating from W.A., also arranged and conducted the first relay to include all B class stations in W.A.; is a unit of the first commercial network of "B" class stations to be formed in Australia; with its associate stations, 2UW, 3DB, 4BC, and 5AD, provided in W.A. an outstanding Test Score Service during the 1930 Tests.

6PR

NICHOLSONS LTD., 86-90 Barrack Street, Perth. Station location, Applecross, 4¼ miles S.W. of G.P.O. Commenced 14/10/31. Freq. 880 k.c., 341m., 500 watts ae.

Western Australia—Country

6KG

GOLDFIELDS BROADCASTERS LTD., 86 Palace Chambers, Kalgoorlie. Station location, ¼ mile S.W. of P.O. Commenced 16/9/31. Freq. 1220 k.c., 246m., 100 watts ae.

Tasmania—Metropolitan

7HO

COMMERCIAL BROADCASTING PTY. LTD., 82 Elizabeth Street, Hobart, Tasmania. Station location, ¼ mile W. of G.P.O. Commenced 13/8/30. Freq. 890 k.c., 337m., 50 watts ae.

Managing Director, Selwyn H. Findlay (Manager Findlay's Pty. Ltd., Hobart). Chief Announcer and Studio Manager, John Broadbent ("Uncle David"). Assistant Announcer, Tas. Ward. Chief Lady Announcer, Miss K. Major ("Auntie Kath."). Assistant Lady Announcer, Miss B. Broughton. Engineers: Chief, R. S. Hope; Assistant Engineer, W. R. Nicholas. Advertising Manager, T. Rycroft. Advertising Representative, W. Lloyd and Mrs Rycroft. Sporting Session, News Session, Popular Children's Session.

Time Schedule: Breakfast Session, 8 to 9 daily; Housewives' Session, 12 to 1 p.m.; Children's Session, 5.45 to 6.30 p.m.; Dinner Session, 6.30 to 7.30 p.m.; Evening Session, 7.30 to 10.30 p.m.; Midday Session, 1 to 2; Sunday, Evening Concerts and special recordings, 8 to 9.30 p.m.

Tasmania—Country

7LA

FINDLAY & WILLS BROADCASTS PTY. LTD., Findlays' Bldgs., Brisbane Street, Launceston. 'Phone 1486 Launceston. Station location, 2¼ miles S. of P.O. Commenced 13/12/30. Freq. 1100 k.c., 273m., 300 watts ae. Manager, Chief Announcer and Publicity Adviser, John T. Gough ("Uncle Jack"). Directors: Senator J. D. Millen, A. P. Findlay, N. A. Findlay. Secretary, A. E. Garrott, F.C.A. (Aust). Advertising Manager, Studio Director and Announcer, Ed. Davies ("Uncle Ted"). Lady Announcer, Miss L. Nicholls ("Aunt Louise"). Sporting Announcers, M. Anderson and Geoff Martin. Engineer, Val. Sydes. Control Panel Officers, D. Holland and D. Hope.

7UV

NORTHERN TASMANIA BROADCASTERS PTY. LTD., Town Hall Chambers, Ulverstone. Victorian Office, 116 Queen Street, Melbourne. Station location, 2½ miles W. of S. from P.O. Commenced 6/8/32. Freq. 1460 k.c., 205.5m., 300 watts ae. Directors: G. F. Palmer and W. Harrison. Manager, W. Launder-Cridge. Announcers, W. Launder-Cridge, W. Martin and Miss J. Webb. Engineers, W. Martin and W. Launder-Cridge.

Time Schedule: Monday to Friday, 7.30 to 9 a.m., 5.30 to 10.30 p.m.; Saturday, 7.30 to 9 a.m., 12 noon to 2 p.m., 5.30 to 11 p.m.; Sundays, 12 noon to 2 p.m., 5.30 to 10 p.m.

Station 7UV is the only broadcasting station in North Western Tasmania. This station has just recently been acquired by Mr. G. F. Palmer, Managing Director also of Station 3AK, Melbourne. Considerable improvements have been made to the Studio and Transmitter, and with the increased hours of broadcasting is supplying a much needed want in this locality. The Transmitting Station of 7UV, which is situated 2½ miles from Ulverstone, on a very high hill overlooking the ocean, has its programmes conveyed by means of land lines from the studio. This station is a boon to local listeners and a considerable sum has been expended in improving the programmes by supplementing record stocks of the very best and latest in musical releases. 7UV figured prominently in the recent Tasmanian bush fires, and appeals launched by this station brought hundreds of volunteer fire fighters to lend assistance. This station is used by the Prime Minister and his wife (the Rt. Hon. J. A Lyons and Mrs. Lyons) for their New Year addresses to listeners. Many other important public men broadcast items of interest regularly and the views of these speakers have done much to improve the tourist trade to the Island State.

Institution of Radio Engineers (Aust.)

The Institution of Radio Engineers (Aust.) was registered in 1924 under the Companies Act of N.S.W. The Institution did not function actively until 1932, when, by arrangement with the N.S.W. Division of the Wireless Institute of Australia, an amalgamation was effected, and since May of that year the Institution has shown considerable progress.

Objects

The objects for which the Institution is founded are subject to Section 53 of the N.S.W. Companies Act, 1899, and are as follows: To promote the science and practice of radio telegraphy and radio telephony in all its branches and the usefulness and efficiency of persons engaged therein. To raise the character and status and advance the interests of the profession of radio telegraphy and radio telephony and those engaged therein. To increase the confidence of the mercantile and general community in the employment of recognised engineers and technical advisers by admitting to the Institution such persons only as shall have satisfied the Council of the Institution that they have a satisfactory knowledge of both the theory and practice of radio-telegraphy and radio telephony. To promote honourable practice, to repress malpractice and to settle disputed points of practice and to decide all questions of professional usage and etiquette among persons engaged in the profession of radio telegraphy and radio telephony. To collect and circulate statistics and other information relative to radio-telegraphy and radio-telephony in all its branches. To provide for the delivery and holding of lectures, exhibitions, etc. To encourage the study of radio in all its branches and to improve and elevate the general and technical knowledge of persons engaged or about to be engaged in the profession of radio. To conduct examinations, to award prizes, distinctions, certificates, establish scholarships, etc. In general to do all such other lawful things that the Institution may think incidental or conducive to the attainment of the objects of the Institution.

During 1933-34 the following Councillors held office:

President: Mr. E. T. Fisk.

Vice-Presidents: Mr. N. S. Gilmour and Mr. W. Phil. Renshaw.

Hon. Treasurer: Mr. Charles H. Norville.

Hon. Secretary: Mr. Oswald F. Mingay.

Councillors: Messrs. L. P. R. Bean, W. T. S. Crawford, L. A. Hooke, R. J. W. Kennell, A. McDonald, L. N. Schultz, F. W. P. Thom, D. Wyles, J. N. Briton, E. E. Tree, J. D. Olle, T. R. W. Bushby and A. E. Emmelhainz.

Qualifications Committee consisted of Messrs. A. S. McDonald (Chairman), W. T. S. Crawford, F. W. P. Thom and D. Wyles.

Examination Board consisted of Messrs. S. Grime (Chairman), Y. B. F. J. Groeneveld, L. N. Schultz, E. G. Bailey and R. J. W. Kennell.

The standard of examination is taken from the Admiralty Hand Book of Wireless Telegraphy, 1931. The first examination was held in October, 1933.

Papers & Lectures Committee: N. S. Gilmour (Chairman), and C. H. Norville.

Standards Committee: E. J. T. Moore (Chairman), S. M. Grime, C. H. Norville, W. T. S. Crawford.

Since the 1933 Annual General Meeting, which was held in May, 1933, in Sydney, the Institution has progressed in a most satisfactory manner, the most outstanding event being the establishment of the Victorian Division in September, 1933. That Division functions under the N.S.W. Articles of Association, but has its own Chairman and Committee, and conducts its own affairs in keeping with the policy laid down by the Council.

Engineer-Commander Cresswell was elected Chairman; Mr. R. R. Mackay, Hon. Secretary; Mr. Clive Evans, Hon. Treasurer; Vice-Chairmen, Messrs. J. Malone and J. Mulholland; Committee, Messrs. S. Witt, F. J. Henderson, M. Hayes, J. Dobbyn, J. Martin, Captain R. J. Kendall, W. Conry, J. Draffin.

Membership of the Victorian Division as at 31/3/34 consisted of 16 Full Members and 3 Associates. In the direction of other Interstate Divisions, Western Australia is now giving the matter attention, and Queensland is also interested.

The Institution generally added 25 Full Members, 15 Associates and 3 Juniors to the roll, which now totals 1 Fellow, 79 Full Members, 54 Associate Members, 13 Junior Members and 18 Radio Society Members, making a grand total of 164.

During the year the honour of being appointed first Fellow of the Institution was accorded to the President, Mr. E. T. Fisk.

The Qualifications Committee functions and carefully scrutinises and makes fullest enquiries regarding every application before same is passed on to Council for final determination.

Lectures and Papers: During the past year the Institution has been favoured by papers and lectures from Messrs. E. G. Beard, N. V. Hayes, J. N. Briton, T. R. W. Bushby, H. Weir and Dr. D. F. Martyn.

Radio Inductive Interference: The Council has given this matter of radio inductive interference considerable attention and is now exploring ways and means to combat this growing menace to the progress of radio.

Social Functions: During the period under review, three social functions were held, namely, 1933 Annual Dinner, Christmas Meeting Night, and a Welcome Home to the President, Mr. Fisk and a Councillor D. Wyles.

Official Organ: Satisfactory arrangements have been made for the printing of lectures and papers in "Radio Review," and every member receives a copy of this monthly technical publication.

Standards Committee: During the year Council appointed the Standards Committee to co-operate with all other bodies and to investigate and report in respect to proper radio standards. It is now collaborating with the Standards Association of Australia in regard to the proposed new Radio Code.

1934-35 Council of the I.R.E.

At the 1934 Annual General Meeting of the Institution of Radio Engineers held on Wednesday, April 11th, at Science House, Sydney, the following Councillors were declared elected:

Messrs. E. T. Fisk, N. S. Gilmour, W. P. Renshaw, C. H. Norville, L. P. R. Bean, W. T. S. Crawford, L. A. Hooke, A. S. McDonald, L. N. Schultz, F. W. P. Thom, D. Wyles, P. N. Briton, E. E. Tree, S. Colville, T. P. Court and J. Burnett.

Radio Society of Australia

Recognising the need for the fullest development of radio and all its associated arts and sciences; also to encourage the intercourse of those persons interested in such development, the Institution of Radio Engineers (Aust.), being an institution established by radio engineers for the development of all branches of the science, art and industry of radio-electricity and radio communication, decided to form the Radio Society of Australia.

It is appreciated by the radio engineers that there are many persons interested in the development of radio and its associated arts and sciences in all or many phases, and yet who would not necessarily come within the scope of membership of such a technical body as the Institution of Radio Engineers. There are several thousands engaged in radio merchandising and broadcasting. There are also thousands of private citizens keenly interested in the National development of radio and allied arts and sciences. The medical profession is beginning to analyse the radio arts. In fact, the possibilities of the associated radio arts are so widespread and of National importance, to warrant the formation of such a Society.

The organisation and management of the Radio Society will be under the direction of the Institution of Radio Engineers, whose President, Treasurer and Secretary will occupy similar position in the Society.

The Radio Society will be governed by a Board of Trustees, 15 in number, 6 of whom shall be appointed by the Council of the I.R.E., and 6 elected by the members of the Society (the President, Secretary and Treasurer are ex-officio members of the Board).

There shall be two grades of membership: Fellows, and Members. The former shall, as a general principle, be leaders in the art, and the latter, all people interested in the development of radio and associated arts and sciences. The annual subscription for Fellows shall be £2/2/- and Members 10/6.

Society members shall have the right to attend all lectures, demonstrations, etc., conducted by the I.R.E., but shall have no voice or vote in the conduct of the affairs of the I.R.E. Membership of the I.R.E. automatically carries membership of the Radio Society.

Radio Society of Australia

Postal Address:
BOX 3120 P
G.P.O., SYDNEY

Meetings held at Science House, Gloucester and Essex Streets, Sydney.

Under the Auspices of
The Institution of Radio Engineers, Australia

Secretary's Office:
15 CASTLEREAGH ST.
SYDNEY.

PHONE: B 2549

MEMBERSHIP APPLICATION FORM

I,.....

of.....

being interested in the development of radio arts and sciences hereby apply for Membership in the Radio Society of Australia. If accepted I agree to abide by the rules and regulations of the Society, and enclose herewith 10/6 annual subscription fee for current period.

SIGNED:.....19.....

PROPOSER.....of.....

SECONDER.....of.....

I.R.E. President and Officers 1934-5

L. P. R. BEAN
Vice-President

O. F. MINGAY
Hon. Secretary

N. S. GILMOUR
Vice-President

W. PHIL. RENSHAW
Councillor

E. T. FISK
President

R. J. W. KENNELL
Councillor

C. H. NORVILLE
Hon. Treasurer

W. T. S. CRAWFORD
Councillor

L. A. HOOKE
Councillor

I.R.E. Councillors and Officers 1934-5

E. E. TREE
Councillor

A. S. McDONALD
Councillor & Chairman
Qualifications Committee

D. G. WYLES
Councillor

S. V. COLVILLE
Councillor

F. W. P. THOM
Councillor

J. N. BRITON
Councillor

E. J. T. MOORE
Chairman Standards
Committee

S. M. GRIME
Chairman Examination Board

J. K. BURNETT
Councillor

E. G. BAILEY
Examination Board

T. COURT
Councillor

L. N. SCHULTZ
Councillor

The Society of Radio Technicians, Aust.

SYLLABUS AND REGULATIONS COVERING QUALIFICATIONS FOR MEMBERSHIP, GENERAL INFORMATION AND EXAMINATIONS

OFFICERS AND COUNCIL

Patron, H. C. Trenam; President, T. P. Court; Vice-Presidents, E. J. T. Moore, L. N. Schultz, R. Allsop; Hon. Secretary and Treasurer, J. W. Robins, Box 1716, G.P.O., Sydney, Phone YU 1209; Assistant Hon. Treasurer, N. Kellie; Council, D. MacIntyre, G. Mitchell, G. R. Seach, R. Oxford, W. Hardy, A. Tollow, M. Cutts, W. D. Sullivan, H. A. Warby, R. Evans, R. A. Parker, G. H. Wilson; Technical Committee, W. Hardy, J. Duffy, W. Healy, K. Blackwell, R. A. Parker, C. P. Healy, B.E.E.; Technical Editor, T. P. Court; Hon. Auditor, D. G. Bell, A.C.A. (Aust.); Hon. Solicitor, W. R. Nicol.

Objects of the Society

The Society has been established to do all or any of the following things for the purpose of attaining the Objects of the Society and observing and performing whatever may be required by law in order legally to carry out such objects:—

(a) To promote and develop the Science of Radio Technique with respect to Radio Service and set and maintain standards of efficiency for those Professionally occupied in the Service and Maintenance of Radio Broadcast equipment.

(b) To procure the recognition of the Status of the Society by Government, Public, Local and other authorities.

(c) To provide for the regular delivery of Lectures, and for the reading and discussing of communications and papers bearing on Radio Technology or upon subjects relating thereto.

(d) To provide for the holding of Classes of Instruction for the advancement of Technical knowledge and to employ teachers or other persons for these objects.

(e) To keep Members fully informed on Technical developments from time to time and to provide a source of information on all matters of Radio Technique.

(f) To publish Journals, Books, etc., for the dissemination of Technical information.

(g) To co-operate with any Government Department, Public Body or other organisation established for the regulation of safety in the Service and Maintenance of Radio equipment.

(h) To establish and maintain Libraries, Museums and Laboratories for the purpose of the Society.

(i) To acquire Premises for use as Offices, Meeting Rooms, Club Rooms and Laboratory.

MR. H. C. TRENAM, Patron

(j) To encourage research in Radio Technique and investigate and make known details of Technical Development for the benefit of the Society's Members.

(k) To co-operate with, subscribe to, support or affiliate with any Society or Association with similar objects to those of this Society.

(l) To encourage the maintenance of a high standard of Technical Service to the Public and supervise Members' obligations in this regard. To subvent malpractice and if necessary adjudicate on matters concerning Members' obligations and practice.

(m) To do all things necessary to the attainment of the Society's objective and to develop and carry out the Objects of the Society in any part of the Commonwealth of Australia.

Membership

The Society shall consist of:—

1. HONORARY MEMBERS.—(a) An Honorary Members shall be a person who has attained distinction by his work in Radio Technology and/or whom the Society wishes to honour for services rendered to the Society or whose connection therewith would be of benefit to the Society. (b) Honorary Members shall be elected by the Council and every such election shall be announced at the next Ordinary General Meeting of the Society.

2. MEMBERS.—Every candidate for admission or transfer to the class of Members shall be at least twenty-five years of age and shall satisfy the Council: (a) That he has been regularly educated as a Radio Technician, and has been professionally engaged for a period of not less than five years in any of the departments of Radio Technical Service. (b) That he has during such period held a Technical position of responsibility. (c) That he possesses acknowledged Technical qualifications, always provided that such candidate may be required to submit a paper or thesis forming an important contribution to the science of Radio Technique, provided that the Council may waive such requirements upon production by the candidate of satisfactory evidence of competency, or upon such other grounds as the Council may from time to time think fit.

Meetings

1. The Meetings of the Society shall be held at such places and at such times as the Council may appoint and shall be as follows: (a) Ordinary Meetings for Lectures and the reading and discussion of papers on Radio Technology and all kindred subjects. (b) The Annual General Meeting. (c) Special General Meetings of Corporate Members for the purpose of revoking, altering or amending the Rules and Regulations of the Society or any part thereof.

Fees and Subscriptions

(a) The following Annual Subscriptions shall be payable by members of the Society, namely: Members, £3/3/-; Associate Members, £2/2/-; Graduates, 10/6; or such other Annual Subscription or Subscriptions as the Society may from time to time, by Special Resolution, determine.

MR. T. P. COURT, President

MR. J. W. ROBINS, Hon. Sec.

MR. R. ALLSOP, Vice-President

3. ASSOCIATE MEMBERS.—Every candidate for admission or transfer to the class of Associate Members shall be at least twenty-one years of age and shall satisfy the Council: (a) That he has been professionally occupied in any of the departments of Radio Technical Service for not less than two years. (b) That he has held a position of responsibility or performed work of acknowledged importance. (c) That he possesses acknowledged Technical qualifications, always provided that such candidate may be required to pass the Associate Membership Examination, provided always that the Council may waive the requirements of passing such examination upon production by the candidate of satisfactory evidence of competency, or upon such other grounds as the Council may from time to time think fit.

4. GRADUATES.—Every candidate for admission to the class of Graduates shall be between sixteen and twenty-one years of age and must be employed in the Radio Industry and shall satisfy the Council: (a) As to his general education, and (b) That he is studying an approved course of Radio Technical education with the object of qualifying for the Radio Technical profession.

(b) All remittances should be made payable to "The Society of Radio Technicians, Australia," and crossed "Not Negotiable."

Election

Candidates for admission shall be proposed according to grade as provided hereunder: (a) Any person desirous of admission as Member shall be proposed and seconded by two Members. (b) Any person desirous of admission as Associate Member shall be proposed and seconded by two Members or Associate Members or produce suitable references from approved persons connected with the Radio or Electrical Profession. (c) Any person desirous of admission as Graduate shall be proposed and seconded by two Members or Associate Members or produce suitable references from approved persons connected with the Radio or Electrical Profession.

Persons Eligible for Examination

Applications for entrance to the examinations for Associate Membership can be considered from: (a) Graduates. (b) Candidates who have lodged with the Secretary a duly completed Application Form for election as Associate Member.

Application for consideration of a thesis, paper or other written work in lieu of examination can be entertained, with certain exceptions, only from (a) Associate Members. (b) Candidates who have lodged with the Secretary a duly completed Application Form for election as Associate or Member.

Candidates passing the Society's Examination will be awarded an appropriate Certificate.

MR. E. J. T. MOORE
Vice-President

MR. LEN SCHULTZ
Vice-President

Membership Certificates, Abbreviated Titles, and Description of Members

Certificates of Membership are issued to all Candidates, other than Graduates, elected to Membership of the Society and every Candidate admitted as an Associate Member or Member is entitled to use after his name the appropriate initials indicating the class of membership to which they have been elected.

An Honorary Member, Hon. M.S.R.T.; a Member, M.S.R.T.; an Associate Member, A.M.S.R.T.

Badges of Membership

Members and Associate Members of the Society shall be entitled to the use of the Society's Badge only whilst remaining a financial member and on termination of membership shall be required to return to the Society such Badge or Insignia with which he has been issued.

Use of Insignia for Business Purposes

Members and Associates and Firms employing Members and Associate Members may with the consent of the Council, use the Society's Insignia for Publicity Purposes only whilst such Members and Associates are financial members and such Firms employ financial Members or Associate Members of the Society. Always provided that the method of use of such Insignia meets with the approval of the Council.

Educational Classes

Suitable classes of Instruction following a progressive Syllabus shall be available to Graduate Members upon the payment of class fees, details of which may be obtained from the Secretary.

All Graduates applying for and attending these classes shall be required to submit to periodical examination.

Radio Interests Limited

Registered Address—44 Margaret Street, Sydney, N.S.W.
Box 2353M, G.P.O, Sydney.

Radio Interests Limited, registered as a limited liability Company in the State of New South Wales, Australia.

Capital £10,000 in £1 shares.

Directors: R. J. W. Kennell (Chairman), C. Plowman (Vice-Chairman), J. I. Carroll, N. S. Gilmour, A. E. Kaleski, G. C. Beardsmore, A. E. Bennett (all of Sydney). D. E. McLaren (Adelaide), A. G. Healing (Melbourne) and J. B. Chandler (Brisbane).

Manager-Secretary: Reg. J. Burchell.

Telegraphic Address—"INTERRADIO."

MR. R. J. W. KENNELL, Chairman of Directors

PRINCIPAL OBJECTS

(a) To advance and protect the interests and preserve and enforce the rights of all persons or companies engaged in or concerned with wireless telegraphy or telephony or any kind of radio electrical or allied trade or industry or engaged or interested in any business or pursuit relating thereto, whether for commercial, scientific, experimental, personal or other purposes.

(b) To promote and safeguard trade and commerce in and the manufacture supply invention license use of and dealing in every form or apparatus, instrument, article, device, machine or appliance required for, or capable of being used in relation to any trade, business, industry or pursuit mentioned in sub-paragraph (a) hereof or any right or interest therein.

(c) To bring or defend any action, suit, claim or proceeding in any Court or before any tribunal, commission or arbitrator, in which the Directors may consider the Company or any of its members have any interest or purpose direct or indirect and any such action, suit or proceedings, to discontinue, abandon or compromise on such terms as the Directors think fit.

(d) To pay costs of litigation, to indemnify shareholders, to make agreements with any person or corporation affecting the right or interests of shareholders.

(e) To originate, support or oppose legislative and other measures affecting any business or matter within the objects of the Company.

(f) To petition the Parliament or any Government or judicial authority of the Commonwealth of Australia or any State thereof or of the United Kingdom in any matter affecting the Company or any of its members or any business or concern within the objects of the Company.

(g) To establish, form and maintain a library of reference and other works and collection of models, designs, drawings, apparatus and other articles of interest to members.

(h) To investigate the nature and merits of inventions which may seem capable of being used by any of its members; to acquire any patents or licences relating to any such invention with a view to the use thereof by the Company or its members or other persons either gratuitously or upon such terms as may seem expedient.

(i) To take such steps as the Directors think fit either alone or in conjunction with others and either actively or by means of financial or other support in or towards the regulation, control or improvement of customs duties patent or copyright royalties, mode of licensing, tariff distribution, monopoly, taxation or other conditions affecting the rights and interests of the Company or any of its members or any trade, business concern, or matter within the Company's objects.

Radio Retailers Association of N.S.W.

Head Office, Fifth Floor, Australia House, Carrington Street, Sydney.

OBJECTS:

To promote the welfare of members of the Association, and to further their interests by modern scientific methods of co-operation and organisation. To inaugurate and carry out publicity for the popularising of radio by advertising in approved directions and to adopt such other means of publicity as may seem expedient for educating the public to a better knowledge of the advantages, etc., of radio.

To provide a centre of information, instruction and advice on all matters pertaining to the business of members, and generally to do all such other things as are incidental or conducive to the attainment of all the objects of the Association.

President: Ernest E. Tree.

Vice-Presidents: Edward D. Huckell and George L. Oswin.

Committee: Messrs. Cutts, Charlton, Webb, Grills, Wollaston, Oakes, Ferris, Furner and Goldsmith.

Secretary: D. Wilson.
Subscription 10/6 per annum. Entrance fee 5/-.

Australian Federation of Broadcasting Stations

360 COLLINS STREET, MELBOURNE.
Telephone: F 2143 (2 lines).

Office Bearers for 1934.

President: Mr. M. B. Duffy.
Vice-Presidents: Messrs. Thorold Fink and A. E. Bennett.

Executive Committee: An executive committee is comprised of the President, Vice-Presidents and three members of the Council.

Members of Council: Messrs. O. J. Nilsen (3UZ), D. Worrall (3DB), O. Anderson (2UW), E. R. Voigt (2KY), J. B. Chandler (4BC), A. L. Holtze (5AD), A. Stoddard (6PR), W. A. Wilson (3BA), A. Fairhall (2KO).

Name of Secretary: Mr. G. L. Chilvers.

Aims and Objects of the Federation are:—

1. To stimulate popular interest in and support of broadcasting in Australia and to promote and defend the interests of licensed broadcasting stations individually and collectively.
2. To confer with and bring before the proper authorities any matters affecting broadcasting with a view to amelioration or improvement of the conditions.
3. To provide for and be a central medium of useful information available for all members and those associated or affiliated with the Federation and generally for the furtherance and promotion of their interests.

History of the Federation. The Federation was established at a Convention of stations held in Sydney in November, 1930, and at present has a membership of 38 licensed or "B" class broadcasting stations in the various States of the Commonwealth. There are many questions of common interest affecting the licensed stations, e.g., fees for performing right, broadcasting of gramophone records, for the discussion of which the Federation has proved a useful medium both for members and for the outside bodies with whom the negotiations have been conducted. The system of having a number of licensed broadcasting stations in addition to the national stations has been established by the Commonwealth Government for many years, and the licensed stations are recognised as an important section of the broadcasting system. The aim of the stations has been to set a higher standard of quality in broadcasting programmes and it can be fairly claimed that the standard set by the licensed stations has been a considerable factor in inducing the Australian public to take such an intense interest in broadcasting.

Radio Traders' Association of W.A.

(14 Weld Chambers, St. George's Terrace, Perth, W.A.)

The Radio Traders' Association of Western Australia is a section of the W.A. Wholesale Electrical Traders' Association. Headquarters: 14 Weld Chambers, St. George's Terrace, Perth. Tel. B 9201.

Chairman: Mr. Alan Thomson, C/o Thomsons Ltd., Murray Street, Perth.

Committee: Messrs. J. G. Pritchard, J. R. W. Gardam, J. L. Mattinson, F. C. Kingston, F. Beames, C. S. Southcott.

Secretary: Mr. J. O. Smith, L.I.C.A., No. 14 Weld Chambers, Perth.

Obviously the Association is to undertake such work which may be deemed to the mutual interest of members and to the radio trade generally. A summary of the operations of the Association is as follows:—

Adoption of trade discount list. Adoption of rules and by-laws, designed for the maintenance of prices and discounts. Joint advertising and publicity campaign. First Annual Radio-Electrical Exhibition, 1932, whch was most successful, and preliminary arrangements are now being made to hold a similar Exhibition during April of this year.

Date of formation of the Association, August 1929. The Association has always been a very active one, and has undoubtedly been of great benefit to Members, in addition to the Radio Trade in general.

Metal Trades Employers' Association

Head Office: Fourth Floor, 7 Wynyard Street, Sydney. Telephone: B 4052—B 2376.

This Association is formed to encourage and develop metal working, manufacturing and allied industries, and to safeguard the interests of Australian producers. Formed in 1901 by a few of the leading engineering establishments. Covers such industries as the Automotive, Engineering, Electrical Manufacturing, Foundry, Sheet Metal, Stove Making, Structural, Ship Building, Wire-Working etc., and is now the largest association of its type in Australasia. Constitutionally it is a voluntary association of manufacturers and workers of metal and producers of metal and allied products, the promotion of their several and mutual interests, governed by an annually elected Council, which consists of 16 members elected by ballot among the whole of the membership, and a number up to 4 appointive Councillors, all of whom are actively engaged in the industry.

President: J. Heine, Esq.
Vice-Presidents: J. H. Meiklejohn, T. W. Thornley.
Hon. Treasurer: R. J. Burns, Esq.
Council: Messrs. W. Courtney, A. Duly, E. H. Dunnett, G. E. Griffin, E. A. Horner, P. T. Cavanagh, C. Malley, L. R. Muras, T. Malcolm Ritchie, R. J. Saunders, H. L. Spring, C. W. Squires, E. J. Summons, and L. Napier Thomson.
Secretary: W. C. Myhill.
Assistant Secretary: D. M. McDonald.

The Electrical and Radio Association of N.S.W.

The Grace Building, King, York and Clarence Streets, Sydney. M 2531.

Names of Officers, etc.

President: Mr. R. P. Godfrey (Godfrey Ltd.).
Senior Vice-President: Mr. J. Russell Greenwood (Anthony Hordern & Sons Ltd.).
Junior Vice-President: Mr. G. K. Dunbar (Associated General Electric Industries Ltd.).
Honorary Treasurer: Mr. C. Dunn (Noyes Bros (Sydney) Ltd.).
Executive: Messrs. E. P. Bennett (Hecla Electrica (Sydney) Ltd.), P.L. Boswell (Boswell & Co.), A. J. Bradshaw (Manly Municipal Council), A. Grundy (Nock & Kirby Ltd.), E. Hirst (British General Electric Co. Ltd.), C. H. Jensen (Westcott, Hazell & Co. Ltd.), A. E. Kaleski (Lawrence & Hanson Electrical Co. Ltd.), R. J. W. Kennell (New System Telephones Pty. Ltd.), A. E. Pepper (Kempsey Electric Light and Power Co. Ltd.), A. Waddell (Coupland & Waddell).

Sectional Chairman

Section 1. Private Electricity Supply Undertakings: Mr. A. E. Pepper.
Section 2. Public Electricity Supply Undertakings: Mr. A. J. Bradshaw.
Section 3. Overseas Manufacturers: Mr. C. Crome.
Section 4. Australian Manufacturers: Mr. E. P. Bennett.
Section 5. Direct Representatives: Mr. A. E. Kaleski.
Section 6. Indentors: Mr. P. L. Boswell.
Section 7. Merchants: Mr. C. Dunn.
Section 8. Retailers: Mr. J. R. Greenwood.
Section 9. Contractors: Mr. T. P. Johnson.
Section 10. Radio Manufacturers: Mr. R. J. W. Kennell.
Section 11. Radio Direct Representatives: Mr. G. K. Dunbar.
Section 12. Radio Wholesale Houses: Mr. C. H. Jensen.
Section 13. Radio Retailers: Mr. G. Beardsmore.
Section 14. Electrical & Radio Development Association (ERDA): Mr. J. R. Greenwood.

Secretary: Mr. Andrew F. O. Brown.

Aims and Objects

They are:—

1. To promote the trade interests of the members of the Association.
2. To assist and further the interests of producers, suppliers and consumers of electrical energy and of manufacturers, distributors, contractors, purchasers, and users of electrical commodities and appliances, etc.
3. To encourage the use of standardised electrical material.
4. To secure for the persons, firms, companies, or corporations engaged in the manufacture or sale of electrical appliances, or employing electrical workmen, the benefits of the Industrial Arbitration Act, 1912, or any Act or Acts now passed or hereafter to be passed by the Legislature of the State of New South Wales or by the Parliament of the Commonwealth of Australia relating to industrial matters in connection with electrical workmen.
5. To originate and promote improvements in the laws connected with the electrical industry and to support or oppose alterations therein, and to effect improvements in administration in matters connected therewith.
6. To inaugurate and carry out publicity for the popularisation of electricity and electrical appliances and methods by the collection and distribution among members data relating to the electrical industry, and by advertising in approved directions the benefits of the use of electricity and to adopt such other means of publicity as may seem expedient for promoting the objects of the Association and/or educating the public to a better knowledge of the advantages and use of electric energy and appliances.
7. To provide for and be a central medium of useful and/or confidential information available for members of the Association, and generally for the furtherance and promotion of their business interests.
8. To further the objects herein contained or any of them by action directly, indirectly or in co-operation with any other organised body or bodies having objects similar to those of the Association.

Date of Formation, etc.

The Association was formed nearly 25 years ago with the principal object of contesting wage claims then lodged by the Electrical Trades Union of Australia. These claims became the basis of an award which was probably the first electrical award made in the world. In those days and up to within three or four years ago the Association was known as the Electrical Employers' Association of New South Wales.

With the expansion of its services, however, this name was considered too restrictive, and it was changed by omitting the word "employers." Although the Association retains more than an active interest in industrial matters, its sphere of usefulness has been so widened that it caters now for every section of both the electrical and radio industries and only recently it's name was further changed by including the words "and Radio" after "Electrical."

"ERDA"

The Electrical and Radio Development Association

The Grace Building, King, York and Clarence Streets, Sydney. M 2531.

Some of its Services and Activities

The ordinary services and activities of the Association include:—

1. Free advice to members as to their liabilities under Industrial Awards, Federal and State Legislation, or any other matter affecting their interests individually or collectively.

2. Representation on the S.A.A. Wiring Rules Committees, the Electricians, &c. (State) Conciliation Committee, the Municipal, &c., Councils (Electricians) Conciliation Committee, the Electrical Apparatus Safety Board, and other Public Bodies legislating in the Electrical Industry.
3. The encouragement of amicable relations between the many sections of the Electrical and Radio interests and also between employer and employee.
4. Use of accommodation exclusively set apart for members at the rooms of the Association, containing telephone, writing equipment, reference library, local and overseas trade press, daily press, and other conveniences.
5. A copy of the official journal "ERDA," containing authentic and informative articles from reliable sources, posted free, each month.
6. Special and continuous activity towards stabilising and bettering conditions of the Electrical Trade, especially contracting.
7. A better service to the public—at least an implied warranty of standard in the work done by Association members; the maintenance of a high ethical standard in all business and trade relations.

The association is divided into Sections, and each Section looks after its own interests. The executive, that is the principal Committee, comprises one representative from each section, so that it can be said to be truly representative.

The subscription rates vary according to the Section, and it is possible for an electrical contractor or radio trader to be a member of the Association for as little as two guineas per annum, or roughly 10d. per week.

Chairman: Mr. J. Russell Greenwood (Anthony Hordern & Sons Ltd.).

Committee: Messrs. E. P. Bennett (Hecla Electrics (Sydney) Ltd., G. K. Dunbar (Associated General Electric Industries Ltd.), R. P. Godfrey (Godfrey Ltd.), V. H. Mackinney (Philips Lamps (A/asia) Ltd.), D. J. Miles (W. G. Watson & Co. Ltd.), J. N. Tait (British General Electric Co. Ltd.), W. J. Wing (Amalgamated Wireless (A/asia) Ltd.), W. Wright (Standard Telephones Cables (A/asia) Ltd.).

Secretary: Mr. Andrew F. O. Brown.

Aims and Objects, etc.

The Electrical and Radio Development Association or, as it is usually known by its initials, ERDA, is the Development Section of the Electrical and Radio Association of New South Wales and its sole function is the dissemination of publicity and propaganda as to the advantages of electricity and radio.

THE SOUTHERN TASMANIAN RADIO TRADERS' ASSOCIATION.

Tregears' Buildings, Corner of Collins and Argyle Streets, Hobart.

Established October 1932, with the object of stabilising trade in Hobart and Southern Tasmania, particularly by limiting discounts and by creating a friendly feeling amongst those engaged in the Radio Trade.

For a considerable time members met for luncheon weekly and discussed matters of mutual interest and, should complaints be lodged, they were considered by all present and invariably a satisfactory understanding was arrived at. Later it was considered unnecessary to meet so frequently and the meetings resolved themselves into fortnightly luncheons and lately the meetings have not been so regular.

The benefits accruing have been apparent, as a better understanding has been brought about between the Traders without in any way exploiting the public and the result of the elimination of excess discounts has proved entirely satisfactory from every point of view.

Chairman: B. A. McCann (McCann Bros. Pty. Ltd.)

Committee: Messrs. S. H. Findlay (Findlay Pty. Ltd.), C. Goodrick (W. & G. Genders, Pty. Ltd.), P. Medhurst (Medhurst & Sons, Pty. Ltd.), H. M. Bamford (Noyes Bros. (Melb.) Pty. Ltd.), W. Paton (A. C. Paton & Son Pty. Ltd.), C.Oldham (Oldham, Beddome and Meredith Pty. Ltd.), S. Oliver (Oliver and Oliver Pty. Ltd.).

Secretary: F. A. Allen.

The Radio and Telephone Manufacturers' Association

Section of the Chamber of Manufacturers of N.S.W., 26 O'Connell Street, Sydney.

BW 1844. Formed 11th November, 1927.

President: S. M. Grime.
Vice-President: L. P. R. Bean and C. Plowman.
Secretary: P. S. Edwards.

MR. S. M. GRIME
President, Radio & Telephone Manufacturers' Assn.

AIMS AND OBJECTS of the Association are:—

(a) To render the maximum possible service to the trade in which its members are engaged.

(b) To assist the trade in its efforts to secure Tariff protection by co-ordinated effort.

(c) To promote closer relations and cordial co-operation in all branches of the industry.

(d) To advocate knowledge and learning in the science of business.

(e) To co-operate with other organisations in efforts towards economic advancement, standardisation and other activities.

(f) By any means of committees of skilled and experienced men to investigate solutions of the innumerable financial, technical, and commercial problems that confront us.

(g) To focus the general and sectional activities of the Association on the essential problems of the industry.

Plastic Moulding Trade Association of N.S.W.

Section of the Chamber of Manufacturers of N.S.W., 26 O'Connell Street, Sydney, N.S.W. 'Phone, BW 1844. Qualification of Members: Any person, firm or company engaged in any of the following branches:—(a) Moulders, (b) Manufacturers and suppliers of moulding

MR. J. P. TAYLOR
President,
Plastic Moulding Trade Assn. of N.S.W.

powders and materials, (c) Mould makers and moulding plant manufacturers. Objects of Association:—To foster and develop business and welfare of its members. President, J. P. Taylor, Commonwealth Moulding Co., Ltd.; Vice-President, H. C. Walker, Peerless Mfg. Co., Ltd. Executive Committee, George McKenna, O. H. O'Brien (Syd.) and F. Cornelsen, Tool & Engineering Co. Ltd. (one vacancy). Secretary, P. S. Edwards.

Further particulars regarding any trade association will be gladly supplied by the various Secretaries as listed. "The Radio & Electrical Merchant" will be glad to receive reports from all trade associations regarding their activities—Editor, Box 3765, G.P.O., Sydney.

Electrical Federation of Queensland

Radio Traders' Section.

The Electrical Federation of Queensland, is formed for the purpose of promoting the welfare of members of the Federation and to further their interests by modern scientific methods of co-operation and organisation. To assist and further the interests of producers, suppliers and consumers of electrical energy, and of manufacturers, distributors, contractors, purchasers, and users of electrical commodities and appliances, and to promote and facilitate co-operative planning and inventions of various means and methods effective to this end. These are the general aims of such an organisation.

Merchants' Section

Associated General Electric Industries Ltd., Norman Bell & Co. Pty. Ltd., J. R. Blane, J. B. Chandler & Co., Engineering Suply Co. of Aust. Ltd., Intercolonial Boring Co. Ltd., Lawrence and Hanson Electrical Co. Ltd., Noyes Bros. (Sydney) Ltd., W. E. Peterman Siemens (Aust.) Pty. Ltd., Trackson Bros. Ltd., Warburton Franki (B) Ltd., W. T. Henley's Teleg. Works Co. Ltd., Williams Ltd.

Australian Manufacturers Section

Electric Construction Co. of Aust. Ltd.

Radio Traders' Section

National Radio Co., E. V. Hudson Ltd., A. E. Harrold, G. J. Grice Ltd., J. D. S. Morrison, W. O. Barber, J. C. Price, Lawrence & Hanson Electrical Co. Ltd., J. B. Chandler & Co., Associated General Electric Industries Ltd., Noyes Bros. (Sydney) Ltd., Trackson Bros. Ltd.

Council—1933-34.

President: R. F. Galloway, W. T. Henley's Teleg Works Co. Ltd., Elizabeth Street, Brisbane—B 1636.

Vice-President: B. C. Percy, Lawrence & Hanson Electric Co. Ltd., Elizabeth Street, Brisbane—B 1407.

Merchants: L. G. Hinwood, Associated General Elec. Industries Ltd., Adelaide Street, Brisbane—B 2151. J. L. Ferguson Siemens Aust. Pty. Ltd., Charlotte Street, Brisbane—B 2468.

Radio Traders: F. Hoe, E. V. Hudson Ltd., Charlotte Street, Brisbane—B 3733. A. W. Joss, National Radio Co., Wharf Street, Brisbane—B 4289.

Australian Manufacturers: C. G. Faine, Electric Construction Co. of Aust. Ltd., Petrie Bight, Brisbane—B2059.

Treasurer: P. S. Trackson, Trackson Bros. Ltd., Elizabeth Street—B 2804.

Past-President: P. S. Trackson, Trackson Bros. Ltd, Elizabeth Street—B 2804.

Secretary: E. C. Fernandez, 334 Queen Street, Brisbane—B 8626.

The federation is represented on the Electrical Workers' Board by Mr. P. S. Trackson; on the Uniform Wiring Rules Committee by Messrs. P. A. Trackson and R. F. Galloway; on the Group Apprenticeship Committee by Mr. P. S. Trackson and on the Brisbane Chamber of Commerce by Mr. B. C. Percy.

Victorian Radio Association

Head Office and Place of Meeting at Law Court Chambers, 191-195 Queen Street, Melbourne.

The objects of the Association are:—

(a) To promote the welfare of members of the Association and to further their interests by modern scientific methods of co-operation and organisation.

(b) To inaugurate and carry out publicly for the popularisation of radio by advertising in approved directions and to adopt such other means of publicity as may seem expedient for educating the public to a better knowledge of the advantages of radio.

(c) To encourage the standardisation of radio material.

(d) To secure for members the benefits of any Act or Acts now passed or hereafter to be passed by the Legislature of the State of Victoria or by the Parliament of the Commonwealth of Australia relating to industrial or such other matters as may from time to time be determined by the Association in connection with the Radio Industry and in general to do all such other lawful things as are incidental or conducive to the attainment of the objects for the benefit of members generally.

The activities of the Victorian Radio Association are divided up into several sections being:—

(1) Merchants' Section (4) Broadcasting Stations
(2) Manufacturers' Section (5) Associate Members
(3) Retailers' Section

Radio interests in Victoria were originally served by the Electrical Federation of Victoria, the constitution of which then provided for a radio section. In 1928 Radio interests were entirely divorced from Electrical interests and the Federation from that date has operated wholly as an electrical organisation. At the beginning of that year the Wholesale Radio Association (Victoria) was formed and functioned until 1931, when it evolved into the present Victorian Radio Association.

The new organisation is proving very flexible and is able to deal satisfactorily with problems of each section of the Radio Industry as they arise. The association functions principally through its Council which is elected from the various sections, and has already demonstrated its status as representative of the Radio Industry in Victoria in negotiations which have taken place during the last couple of years with various Government bodies, and in particular, with the Federal Legislature where, for example, in the matter of the Australian Broadcasting Commissioner's Bill, certain influence was brought to bear in the Senate which with all due modesty, the

MR. A. BRASH

President of Victorian Radio Association and Chairman Melbourne Radio Exhibition Committee.

Association claims was directly instrumental in having deleted from the bill at least one very objectionable clause: viz., that clause giving the Commission power to engage in trading activities. A reference to Commonwealth Hansard will indicate the extent to which the Association's influence was exerted in this direction.

In like manner the Association materially assisted the Electrical Federation (Victoria) in its efforts which terminated so successfully in securing similar legislation in December, 1933, under whch the Victorian State Power Authority, viz., the State Electricity Commission is in future precluded from trading in Victorian cities in electrical appliances, apparatus etc. This involved the closing down of the Commission's extensive sales premises in Melbourne and elsewhere as indicated.

Radio Shows: The Council of the Victorian Radio Association conducts the Radio Exhibition held in Melbourne every year. The tenth of these annual Shows is being held this year (1934). These Trade functions have all proved successful and are extremely popular with the Trade.

Generally the Association has proved its worth in, at all times, acting as the "watch dog" of the Trade and in protecting members' interests—either by direct or indirect action as circumstances may require.

The Council of the Association comprises:—

The President, Mr. A. F. Brash, the Past President, Mr. J. L. Mulholland, the Vice-President, Mr. K. Nicholls; the Treasurer, Mr. A. S. Duke; and the following representatives of the various sections of the Association:—

Manufacturers' Section: K. G. Healing (Chairman), and D. E. Williams (Vice-Chairman).

Merchants' Section: H. V. Prior (Chairman), and K. Nicholls (Vice-Chairman), and R. Begg.

Retailers' Section: A. F. Brash (Chairman), and G. Sharwood (Vice-Chairman, and E. Williams.

Broadcasting Stations: T. W. Bearup (Chairman), and D. Worrall (Vice-Chairman).

Secretary: A. D. Broad, 191 Queen Street, Melbourne Telephone: Central 6926-7.

Standards Association of Australia

Established under the aegis of the Commonwealth and State Government for the promotion of Standardisation and Simplified Practice. Headquarters, Science House, Gloucester and Essex Streets, Sydney. Tel. B 1714. Telegrams, "AUSTANDARD," Sydney.

The objects for which the Association is established are:—

(a) To prepare and promote the general adoption of standards in connection with engineering structures, materials, matters and things and from time to time to revise, alter and amend the same;
(b) To adopt such measures and take such steps and do all such things as may, in the opinion of the Council, be conducive to the promotion of cordial relations between the Association and persons interested in the objects of the Association.
(c) To co-ordinate the efforts of producers and users for the improvement of engineering materials, processes and methods;
(d) To register in the name of the Association a Mark and to prove and affix or license the affixing of such Mark to certain engineering materials and to enforce and protect the use of such Mark and to oppose any proceedings or applications which may seem calculated directly or indirectly to prejudice the interests of the Association;
(e) To obtain any Royal Charter provisional order incorporation or Act of Parliament to enable the Association to carry its objects or any of them into effect;
(f) To procure the recognition of the Association in any foreign country or place;
(g) To invest the moneys of the Association not immediately required for its purposes in or upon such investments, securities or properties as may be thought fit;
(h) To do all such other things as are incidental and the Association may think conducive to the attainment of the above objects or any of them.

CHAIRMAN: Sir George Julius, B.Sc., B.E., M.I Mech.E., M.I.E.Aust.; VICE-CHAIRMAN: Mr. W. E Wainwright, A.S.A.S.M., M.Aust.I.M.M., M.Am. I.M.M.; CHIEF EXECUTIVE OFFICER: Mr. W. R. Hebblewhite, B.E., A.M.I.E.Aust. The Standard Association was established 1st July, 1929, by amalgamation of the Australian Commonwealth Engineering Standards Association (founded 1922) and the Australian Commonwealth Association of Simplified Practice (founded 1927), has over 500 Committees including over 4,000 technical experts.

Of particular interest to the radio trade is the fact that the Association has an Electrical Committee with a wireless components and accessories Sub-Committee and a Wiring Rules Committee.

The Chairmen of these Committees are: Electrical Committee, Northern Section (Sydney), Mr. H. R. Harper. Wireless Components and Accessories Sub-Committee, Mr. S. Grime. Wiring Rules Committee, Mr. V. J. F. Brain. N.S.W. Sub-Committee, Mr. V. J. F. Brain Victorian Sub-Committee, Mr. A. L. Hargrave. Queensland Sub-Committee, Mr. W. Arundell. South Australian Sub-Committee, Mr. W. Hobba. Tasmanian Sub-Committee, Mr. G. H. Lofts. Western Australian Sub-Committee, Mr. F. C. Edmondson.

Radio Research Board

The Council for Scientific and Industrial Research in Australia undertakes many activities among which is control of the Radio Research Board, which with the co-operation of the Postmaster-General's Dept., various Universities, etc., conducts radio research.

The Board is constituted as follows: Professor J. P. V. Madsen (University of Sydney), (Chairman); Mr. H. P. Brown (Postmaster-General's Department); Electrical-Commander F. G. Cresswell (Department of Defence), and Professor T. H. Laby (University of Melbourne).

It was established primarily to undertake fundamental investigations likely to yield results of value from the point of view of the improvement of the broadcasting and other radio services of Australia. Up to date it has mainly concerned itself with problems in the field of (1) transmission conditions in the ionosphere, and (2) atmospherics.

Secretary: G. Lightfoot, M.A., headquarters, 314 Albert St., East Melbourne, Vic.

The Radio Research Board has issued five reports to date as follows: Report No. 1, Bulletin No. 47, issued 1931; subjects: 1. Corrections to Field Strength Measurements with Loop Antennae, by W. G. Baker, B.Sc., B.E., and L. G. H. Huxley, M.A., D. Phil (Oxon.). 2. A Radio Field Strength Survey Within 100 Miles of Sydney, by W. G. Baker, B.Sc., B.E., and O. O. Pulley, B.Sc., B.E.

Report No. 2, Bulletin No. 59, 1932: 1. The State of Polarization of Sky Waves, by A. L. Green, M.Sc. 2. Height Measurements of the Heaviside Layer in the Early Morning, by A. L. Green, M.Sc.

Report No. 3, Bulletin No. 60, 1932: 1. The Influence of the Earth's Magnetic Field on the Polarization of Sky Waves, by W. G. Baker, B.E., B.Sc., and A. L. Green, M.Sc.

Report No. 4, Bulletin No. 63, Subject: 1. A Preliminary Investigation of Fading in New South Wales, by A. L. Green, M.Sc., and W. G. Baker, B.E., B.Sc.; 2. Studies of Fading in Victoria: A Preliminary Study of Fading on Medium Wave-lengths at Short Distances, by R. O. Cherry, M.Sc., and D. F. Martyn, Ph.D., A.R.C.Sc. 3. Studies of Fading in Victoria: Observations on Distant Stations in which no Ground Wave is received, by R. O. Cherry, M.Sc., Melbourne, 1932.

Radio Research Board, Report No. 5, Bulletin No. 68: Subject: Atmospherics in Australia. 1. by G. H. Munro, M.Sc., A.M.I.E.E., and L. G. H. Huxley, M.A., D. Phil., Melbourne, 1932.

Further particulars concerning the activities of the reports of the Radio Research Board can be obtained from the Secretary, 314 Albert St., East Melbourne, Vic.

Radio Research Board --- Fifth Annual Report

(For the Year Ended 30th June, 1933).

The Radio Research Board is constituted as follows:—Professor J. P. Madsen (University of Sydney), Chairman; Mr. H. P. Brown (Director-General, Postmaster-General's Department); Electrical-Commander F. G. Cresswell (Department of Defence); and Professor T. H. Laby (University of Melbourne).

1. General.

DURING the past year, the work of the Board has been continued on its former lines, the main investigations concerning (i) the reflecting layers of the ionosphere, chiefly from the point of view of fading problems, and (ii) atmospherics.

The original three year arrangement regarding the financing of the Board has now expired, but the two co-operating bodies, namely, the Postmaster-General's Department and the Council for Scientific and Industrial Research, have entered into another agreement to finance the Board's work for a further period of three years as from the 1st July, 1933. The Department will continue to meet three-quarters of the total cost of the Board's operations. This measure of stability to its investigations —so necessary if effective work is to be done—is appreciated by the Board.

Further changes in the staff of the Board have taken place. Mr. R. O. Cherry, M.Sc., resigned as from the beginning of 1933. Two new appointments have recently been made, the appointees being Dr. G. Builder, M.Ss., Ph.D., and Dr. H. C. Webster, M.Sc., Ph.D. Both of these are Australian graduates, the former from the University of Western Australia, and the latter from the Universities of Tasmania and Melbourne. For the last few years, they have been gaining post-graduate experience in Great Britain.

2. Work on Fading and the Ionosphere.

THE completion of the experimental transmitting equipment at the University of Sydney at the end of 1932 has made possible a considerable extension of the Board's investigations of fading and the ionosphere.

In the previous work of the Board carried out at Jervis Bay, it was evident that under the particular conditions that applied, the chief reflecting medium concerned in the return of indirect rays to the earth was a layer at a height of about 110 kms., i.e., the Kennelly-Heaviside Layer. However, definite indications of the effect of the Appleton Layer at a height of about 250 kms., were observed, and it appeared desirable to make further investigations of this reflecting region. For this purpose, a different set of experimental conditions was required.

The opportunity for these observations occurred with the completion of the Sydney University transmitter. Field intensity measurements of a "B" class station located in Sydney and working at a frequency of 1,125 kilocycles per second were used in the selection of a suitable set of conditions for the new Appleton "frequency-change" experiments. As a result of this short survey of both ground and sky wave intensities, it was concluded (i) that the University transmitter should operate at a mean frequency of about 1,500 kilocycles per second; (ii) that a special transmitting aerial should be available, in addition to the normal type, in order to increase the sky wave radiation, i.e., an aerial whose radiator was a horizontal wire one half wavelength long, and (iii) that the existing receiving site at the Military Camp, Liverpool, N.S.W., distant 25 kms. from the sender, was suitable.

Liverpool Tests

PRELIMINARY tests at Liverpool showed that, even at this short distance from the transmitter, sky wave intensities were adequate for the "frequency-change" experiments, and during the latter part of 1932 an extensive programme of ionosphere height measurements was undertaken. Observations were made during the greater part of the night, both in Melbourne where the received signal was due entirely to sky waves, and also at Liverpool where there was also a ground wave present for reference purposes.

The results obtained at the shorter distance showed that the Appleton Layer was more often the reflecting agent than the Kennelly-Heaviside region; thus it was possible to make a much more extensive investigation of the upper layer than had been possible at Jervis Bay, where penetration of the lower layer was only infrequently observed.

The simultaneous observations made in Melbourne, distant 800 kilometres from the sender, have thrown considerable light on the mechanism of inter-state broadcast reception at distances of this order. On those nights when the check measurements at Liverpool indicated that the Kennelly-Heaviside Layer was in operation, the reception in Melbourne was comparatively steady, and the photographic records of the special "frequency-change" tests showed that the received signal was composed of two sky waves of approximately the same amplitude. On other nights, when the Liverpool measurements showed that the upper layer was the chief reflecting agent for sky waves received at short distances, the long distance reception was irregular, variations in signal occurring very frequently; at these times the "frequency-change" tests showed that either two or three sky waves were being received, one of them having a much longer path than the others and being of less intensity.

General Conclusions

ALTHOUGH the records taken during this period have not yet been fully analysed, it is possible to form the general conclusions that:—

(i) In the case of long distance reception, slow fading is caused by interference between, and by changes in amplitude of, two sky waves, each returned to the earth by the Kennelly-Heaviside Layer. Fast fading is ordinarily due to an indirect ray from the Appleton Layer.

(ii) In the case of short distance reception, slow period fading seems always to be due to interference between the ground wave and a sky wave singly-reflected from the Kennelly-Heaviside Layer. Fast fading has been traced, at different times of the night and on various occasions, to (a) the reception of a doubly-reflected wave from the Kennelly-Heaviside Layer in addition to the singly-reflected wave from the same layer, to (b) the singly-reflected wave from the Appleton Layer at times when the main sky ray is that from the Kennelly-Heaviside Layer, and to (c) the doubly-reflected wave from the Appleton Layer at those times when the main sky ray was also from the same layer. There have also been occasions during the sunset period when the origin of fast fading has escaped detection.

Naval Stations' Co-operation

The same field-intensity set which had been used in obtaining data for the operating conditions of the Sydney University transmitter was later converted for measurements at a frequency of 200 kilocycles per second (1,500 metres wavelength) the stations observed being the Naval Board's transmitters VHD and VHJ at Garden Island (Sydney Harbour), and at Flinders Naval Depot, Western Port, Victoria. With this equipment, measurements of ground wave attenuation, night-time severity of fading, intensity of sky wave, and the intensity of atmospherics, have been made in a number of representative localities in south-eastern Australia, both along the coast-line and inland. In consequence, much information regarding the fading of long waves over different types of country and at different distances from the transmitter has been obtained. The results of this work have been published.

Steady progress has been made at Liverpool with the design and operation of apparatus to measure simultaneously all of the properties of downcoming waves, including length of atmospheric path, angle of incidence at the ground, amount of lateral deviation from the direction of propagation of the ground wave, relative intensities of the normally and abnormally polarised components of magnetic force, angular phase difference between these components, and the sense of rotation of the total magnetic force.

Preliminary results already obtained tend to indicate that the amount of lateral deviation for an east to west direction of transmission is small, but tests of the apparatus have not yet reached the stage when a definite announcement can be made as to the accuracy of the measurements. Concurrently with this experimental work, it has been found necessary to prosecute a number of theoretical investigations concerned with the reception of more than one downcoming wave in addition to the ground wave. The results show that care will have to be exercised in the selection of suitable conditions for these experiments.

3. Work on Atmospherics

Equipment.—The use of cathode ray direction-finders for observing the intensities of atmospherics and locating their sources was described in last years' report. This work has been continued in co-operation with the Solar Observatory, Mt. Stromlo, F.C.T., particularly with a view to providing more accurate information on the sources shown on the directional recorder charts.

The recorder—which is located at Mt. Stromlo—previously worked on a wavelength of 30,000 metres, and the aerial system rotated once every quarter of an hour. Owing, however, to the good propagation on this long wavelength, it was found difficult to distinguish on the charts between sources at 500 to 5,000 kms. and those at several thousand kms. The wavelength has therefore been reduced to approximately 10,000 metres where the variation of intensity with distance is greater. It was found also that the speed of rotation was too great to record accurately the sources of cyclone activity to the south. Though these are not very important as regards radio interference, they are of meteorological significance as indicating barometric depressions, generally over the sea. The time of rotation of the aerial system and recording drum has therefore been altered to half an hour. The instrument is now giving reliable and easily interpretable records of all sources distant not more than 2,000 kms. by day and some 5,000 kms. by night.

Observations in W.A.

A similar recorder which was remodelled for the purpose in the workshop of the Natural Philosophy Department of the University of Melbourne has been installed at the Magnetic Observatory at Watheroo, in Western Australia, so that, in future, a much more accurate analysis of the sources in and beyond Northern Australia will be possible.

As mentioned in last year's report, an auxiliary receiver operating a cathode ray tube was used to measure the intensity on 300 metres of atmospherics at the same time as their intensities and directions were observed on 3,000 metres on the cathode ray direction-finder, thus enabling comparison of the intensities on the two wavelengths. Further information was obtained by applying a time-base to this cathode ray tube so as to give an indication of the composition and duration of the atmospherics. Information on the duration of atmospherics was obtained also by photographic registration with an Einthoven galvanometer. A Cambridge Thread Recorder was also found to be useful in recording "noise levels" due to a large number of atmospherics at the same order of intensity.

Results:—The analysis of a year's charts of the recorder was described in last year's report and the general conclusions stated. Since then, a more detailed analysis of the close sources—within 2,000 kms. of Canberra—has been carried out. Only days when cathode ray direction-finder observations were also available were considered, as the latter enabled the locations of the sources to be determined. The region within the range of observation was divided into equal areas, and the sources in each area for the year compared as regards the number, average activity, and average duration. The diurnal and seasonal variations of these factors were also studied.

The main points brought out by the analysis are:—

(i) In general the annual number of sources increases towards the Equator. The topography also affects the number considerably.

(ii) The activity of sources shows a steady increase with approach to the Equator.

(iii) The average duration of sources increases slightly towards the north, but the most noticeable feature is the marked difference between sea and land sources. The average duration for land sources in the area studied is six hours. They occur mainly between noon and 6 p.m. For sea sources, the average is ten hours, and the times of occurrence are distributed much more uniformly over day and night.

(iv) In the north, the land sources are of the tropical type, and are practically confined to the summer months, while in the south they are of the cyclonic type and occur much more evenly throughout the year.

Since this knowledge is available for a considerable part of the continent, it may be utilised to estimate the amount of interference with radio reception, providing the intensity of the resulting interference is known.

The intensities measured in most of the past work have been peak intensities on the cathode ray tube. These have been compared with the deflections for continuous-wave transmissions, and it has been found that, on a broadcast receiver on a wavelength of 300 metres, the peak intensity corresponds to that which would have been produced by a transmitter located at the source of atmospherics radiating a carrier wavepower of the order of 2 kilowatts. It has been found that the peak intensity of an atmospheric is approximately proportional to the wavelength, so that the corresponding power n wavelengths other than 300 metres regarded as a source of interference will vary as the square of the wavelength.

Effect on Broadcasting

This knowledge is of value in assessing the probable degree of interference to broadcast listening, but several steps are necessary before the final stage of application can be reached. Since the laws of propagation of radio waves are reasonably well understood, it is possible to estimate the electrical quantities that will influence listening conditions at the receiving end, but the interpretation of these quantities in terms of the listener's experience when listening to a programme requires the introduction of psychological and other factors.

Preliminary observations on this aspect showed that, for several individual listeners when listening to a programme of classical music, the interference from occasional atmospherics did not become appreciable until the peak intensity of the atmospherics was at least equal to the carrier-wave intensity of the station received.

The above information is of greatest value for close sources, where the direct ray will predominate. At night, however, the indirect or sky ray becomes of importance, as the intensity due to it is of the same order for distances between 300 and 1,000 kms. The atmospherics will then be received from over a great area, and may be in such great numbers as to give what approximate to a continuous "noise level" in a receiver of sufficient sensitivity. For satisfactory reception, the received signal intensity must be considerably in excess of this level. Tests carried out, using a Cambridge Thread Recorder, on a number of ummer nights when some very active sources were being received mainly by the indirect ray, showed that the interference from this cause would be scarcely audible to a listener receiving a programme of music if the carrier-wave field strength of the station was at least 0.5 m.v/m. on a wavelength of approximately 300 metres.

The duration and composition of the individual atmospherics is of importance in determining the degree of interference caused, and some preliminary observations on this aspect have been made by using a time-base on a cathode ray tube, and by photographic registration on an Einthoven galvanometer. These have shown that the average atmospheric from a close source consists of a succession of impulses of varied intensity occurring in rapid succession. The total duration of a single atmospheric varies from less than 0.1 second to 1 second, or even more on occasions. The average duration was of the order of 0.4 seconds for those observed.

Future Work.—Preparations are being made for the transference of part of the equipment to a site in Queensland to carry out a more intensive study of the very active sources which occur there in the summer. The frequency of close sources will also permit of more ready observations of intensities on shorter wavelengths and of the characteristics of atmospherics and the resultant interference. It will also provide a longer observing base for simultaneous direction-finding and a location which will be particularly suitable for the sea area to the east.

4. Publications

The following publications have been issued during the past year as a result of the Board's investigations:—

(a) Publications of the Council for Scientific and Industrial Research.—Bulletin 68: "Radio Research Board: Report No. 5, Atmospherics in Australia—I.," by G. H. Munro, M.Sc., A.M.I.E.E., and L. G. H. Huxley, M.A., D.Phil.

(b) Individual Articles.—(For convenience, summaries of those reports are also included).

1. "A Field-Intensity Set," J. Inst. Eng. Aust., Vol 5, No. 1, January, 1933, by A. L. Green, M.Sc., and H. B. Wood, B.E., B.Sc.

2. "Measurements of Attenuation, Fading and Interference in South-Eastern Australia at 200 kilocycles per Second," J. Inst. Eng. Aust., Vol. 5, No . 6, June, 1933, by G. H. Munro, M.Sc., A.M.I.E.E., and A. L. Green, M.Sc.

The same field-intensity set described above, but converted for use at a wavelength of 1,500 metres, was employed.

3. "The Limiting Polarisation of Downcoming Radio Waves Travelling Obliquely to the Earth's Magnetic Field," by W. G. Baker, B.E., D.Sc., and A. L. Green, M.Sc., accepted for publication in the Proc. Inst. Radio Eng., New York, 5th April, 1933.

1. "The Polarisation of Sky Waves in the Southern Hemisphere," by A. L. Green, M.Sc., transmitted to the Institute of Radio Engineers, New York, for publication in the Proceedings.

Performing Rights

The subject of Performing Rights is of such paramount importance in broadcasting circles, not only in Australia but in all parts of the world, that it was found necessary by the Commonwealth Government to appoint The Hon. Mr. Justice Owen, C.B.E., Royal Commissioner, to enquire and report on the Performing Rights situation, with special reference to its effect on broadcasting.

The report was completed in April, 1933, and covered 58 pages of typewritten matter.

Recommendations

THE following are the recommendations made by the Royal Commission, and upon which subsequent arrangements have been made by the Commercial "B" class broadcasting stations with the various Performing Right Authorities and the record manufacturers, and also between the Australian Broadcasting Commission and the Copyright Owners and Record Manufacturers.

In the following recommendations: "The Australasian Performing Right Association" includes any organisation or society which claims to represent a substantial majority of the owners of copyright in musical works. "Minister" means the Minister responsible for the administration of the Copyright Act. "Musical works" does not include dramatic-musical works and refers to Musical works controlled or claimed to be controlled by the Australasian Performing Right Association or any similar organisation. "Prescribed" means prescribed by regulations. "Record" includes any other mechanical contrivance of a like nature by means of which sounds may be mechanically reproduced.

It is suggested that at first, at any rate, disputes between associations or organisations and not between individuals should be made the subject matter of legislation. The purpose of the Act should be to amend the law relating to Copyright and Patents and for other purposes.

This Commission Recommends that Legislation be Introduced Having the Following Objects:

(1) The establishment of a tribunal to determine disputes arising out of the performance in public of musical works and/or the use of records in public.

It will not be necessary to set up any form of permanent Court. What is needed is some tribunal which can act promptly, without formality, and with as little expense to the parties as possible. The followings outline indicates what is suggested:—

If it appears to the Minister that any dispute has arisen or is likely to arise between—

(a) The Australian Broadcasting Commission or any Board for the time being controlling National broadcasting stations; or

(b) Any Association or Federation substantially representing "B" class or other broadcasting stations; or

(c) Any association substantially representing any other class of users in public of musical works; and

(b) The Australasian Performing Right Association and/or

(b) An association of manufacturers or vendors of records, the Minister shall, failing agreement between the parties, refer such disputes for determination or arbitration to such person as may be prescribed, and such person may determine or settle the terms and conditions under which such musical works or records may be performed or used in public. His decision shall be binding on the parties to such dispute and upon all persons who are or may be entitled to become members of the association party to such dispute.

There should be no costs allowable to either party to the dispute in question and there should be no appeal to any Court from the decision of the tribunal so constituted. The suggested provision as to costs may have the result of indirectly compelling parties to a dispute to come to an agreement rather than await the decision of the tribunal, may eliminate some of the formalities of litigation, and may prevent a wealthy organisation from crushing a poorer association.

The object of legislation should be to encourage parties to make their own agreements and to render the tribunal necessary only in cases of failure to agree.

The person prescribed should include a Justice of the High Court of Australia, a Justice of the Supreme Court of any State, or a Judge of any District or County Court in any State or any person to be nominated by the Minister. It will probably be found that only important disputes will require to be referred to a member of the judiciary.

It may be of advantage if provision were made for intervention by the Attorney-General in the interests of the public.

(2) Providing that it shall be lawful for any person to perform in public a musical work or to use in public a record (the subject of the dispute), provided such person proves that he has paid or has tendered any charge and has complied with or has bona fide offered to comply with any terms and conditions imposed by such tribunal.

(3) Compelling the Australasian Performing Right Association from time to time to file at such place and

in such form and within such time as may be prescribed lists of all musical works in respect of which authority is claimed to issue or grant performing licences or to collect fees and providing that the Australasian Performing Right Association shall not be entitled to collect any fees for licences for the performance of musical works which are not specified in such lists.

The Canadian Copyright Amendment Act 1931, Section 10, affords an example of such a provision.

At first it may be sufficient if the regulations prescribe that these lists should be filed in the Copyright Office at Canberra and in the capital of each State, and that a copy of such lists be obtainable from the Australasian Performing Right Association on payment of the prescribed fee by any association.

(4) Compelling the filing of statements of all fees and charges which the Australasian Performing Right Association proposes from time to time to collect as compensation for the issue or grant of licences for the performance of musical work and providing for revision of these fees and charges.

This provision should not be made applicable to broadcasters, but should be confined to other classes of users of musical works in public. It would be preferable to leave disputes between broadcasters and the Australasian Performing Right Association, failing agreement, to be decided by the tribunal to be constituted.

The filing of these statements of charges, with power to the Minister to revise them, would probably be sufficient to dispose of many of the disputes as to charges which now exist or are likely to arise between the general body of users of musical works in public and the Australasian Performing Right Association, but disputes as to terms and conditions of user may have to be referred to the tribunal constituted.

There should be power reserved to the Minister, after inquiry by such person as he may nominate, or as may be prescribed, to review these statements of charges from time to time, and to prescribe the charges which may be lawfully sued for or collected. Sub-section 2 of section 10 of the Canadian Act 1931 may be a useful guide on these points.

(5) Compelling the filing from time to time of accounts of the receipts and distribution of fees collected by the Australasian Performing Right Association and of accounts of fees received from the association and distributed by its members.

The places at which these should be filed, the times of filing and the form of these accounts should be prescribed by regulation. Probably at first it would be sufficient to prescribe that the accounts should be filed at the Copyright Office in Canberra and the State capitals. The accounts should be open to inspection by the public on payment of a prescribed fee.

(6) Providing that, until the time prescribed for the filing of the original lists of musical works and the statements of charges has expired, the present rights of the Australasian Performing Right Association shall remain unimpaired.

It will necessarily take time to prepare these original lists of works and statements of charges, and, until the Australasian Performing Right Association has had an opportunity of complying with the Act, it would be unfair to the Australasian Performing Right Association to interfere with the rights now held by the Australasian Performing Right Association.

(7) Providing that the Australasian Performing Right Association shall lodge with the Minister within the time and in the form prescribed, security (in, say, the sum of £3,000) to meet claims made upon the Australasian Performing Right Association for costs and other moneys payable by the Australasian Performing Right Association.

(8) Providing a remedy in case of groundless threats of legal proceedings by the Australasian Performing Right Association, adopting, with the necessary modifications, section 91A of the Patents Act 1903-1921.

(9) Providing that a performing fee shall not be payable for the relay of any musical work by a broadcaster if the broadcaster has paid or tendered the performing fee due for the performance by the originating station.

(10) Providing that (except where admission fees are collected or similar charges are made by the user of the receiving apparatus) there shall be no performing right in respect of the re-diffusion of any musical work in public if the broadcaster has been licensed by the owner of copyright to perform the musical work in question.

The re-diffusion referred to would include such forms of re-diffusion as:—

(1) loud-speakers or similar contrivances operated in public establishments such as hotels, cafes, restaurants, boarding-houses, ships, etc., for the entertainment of the clientele;
(2) loud-speakers or similar contrivances used in shops for demonstrating wireless sets; and
(3) loud-speakers or similar contrivances used in other classes of shops.

(11) Providing that there shall be no fee or charge payable for the performance of any musical work in any place for religious, charitable, fraternal or educational purposes if the entire proceeds, after deducting the reasonable cost of presenting the same, are devoted exclusively to religious, charitable, fraternal or educational purposes or for the maintenance of the place where such performance is held.

(12) Providing that there shall be no charge made for any performing right in a musical work where the performance is not directly for private profit.

This would include such cases as hotels, cafes, restaurants, ships, etc., where music is performed for the benefit of the clientele. Opinions may differ as to whether this provision should be inserted in the proposed Act, but, in the opinion of this Commission, the indirect profit arising from such a performance may reasonably be regarded as not being for the private profit of the user. This assumes that profit to the user is essential to the exercise of the right to claim a performing fee.

A similar provision has been included in a Bill introduced into the House of Representatives of the United States of America on the 16th May, 1932, a copy of which was made available to this Commission through the courtesy of the Consul-General for the United States of America.

(13) Providing that there shall be no performing charge or fee for the broadcasting of musical works forming part of religious services.

(14) Determining whether a performing fee can or cannot be lawfully claimed by the manufacturer for the use of a record in public.

It is suggested for the consideration of Parliament that the law should be made clear on this point, and, in the opinion of this Commission, the performing right now claimed by some record manufacturers is unreasonable and, if in law it exists, this right should be abolished.

(15) This Commission further recommends that consideration should be given to the question whether the delegate of the Commonwealth of Australia to the next International Convention to be held at Brussels in 1935 should not be instructed again to press upon the convention the claims and interests of the public in connection with the performance of musical works in public and the advisability of regulating and controlling the activities of such monopolies as the Australasian Performing Right Association and similar societies. It may also be suggested that the International Convention should be urged to recognise the power of Parliament in each country of the union to regulate and control societies such as these, if their activities be detrimental to the public.

The Empire Broadcast of 1933

ON Wednesday, May 24th, 1933, at the Annual Dinner of the Royal Empire Society, held in the Wentworth Hotel, Sydney, a most successful Empire Broadcast, embracing Canada, New Zealand, Australia, Great Britain, was successfully carried out.

This magnificent Broadcast was organised by the N.S.W. Branch, Royal Empire Society, and with the co-operation of the Commonwealth and New Zealand Post Offices, Amalgamated Wireless A/sia Ltd., the Australian Broadcasting Commission, the New Zealand Broadcasting Board, the Canadian Government and Radio Organisations.

The proceedings were broadcast through National stations in all capital cities of Australia, and also in Canada and other parts of the British Empire, through the short wave stations of Amalgamated Wireless, 2ME Sydney and 3ME Melbourne. Speeches from London, Ottawa and New Zealand were transmitted through radio telephone. The music was supplied by the A.B.C. Symphony Orchestra and the combined choirs of the Musical Association of N.S.W., from the Great Hall of Sydney University.

The Chairman of the Royal Empire Society in New Zealand gave the toast to The King asking all citizens of the Empire within range of the broadcast to stand and join in the expression of loyalty to the throne.

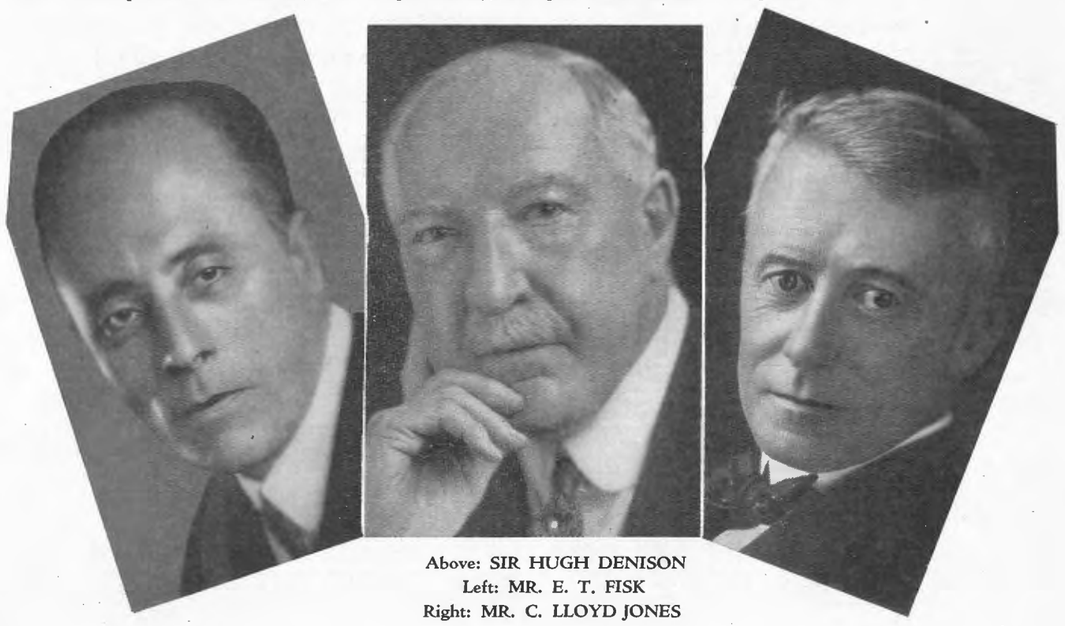
The Chairman of the Royal Empire Society, Sir Hugh Denison, proposed a toast to the Governors-General of Australia and New Zealand, who followed in reply.

The Duke of Connaught, President of the Royal Empire Society, spoke from England. Sir Henry M. W. Gray, President of the Montreal Branch of the Royal Empire Society, also spoke from Canada.

The Australian Postmaster-General, Mr. Archdale-Parkhill, spoke from Sydney, followed by Mr. C. Lloyd Jones, Chairman of the Australian Broadcasting Commission.

Mr. J. H. Whitley, Chairman of the British Broadcasting Commission, spoke from Eng.and, and said that in this Empire Broadcast Service, the B.B.C.'s aims were very similar to the Royal Empire Society.

Sir Josiah Symon, in proposing the toast of "Workers in the Empire's Cause," said: "Mr. Fisk, Mr. C. Lloyd Jones, Mr. Postmaster-General, and the officers of the many broadcasting stations, rival Puck, who boasted he could put a girdle round the earth in 40 minutes. They give us proof to-night, when throughout the Empire, there are millions of listeners, that they are mightier than the press."



Above: SIR HUGH DENISON
Left: MR. E. T. FISK
Right: MR. C. LLOYD JONES

Statistical Summary

Sub-section 1—Population and Vital Statistics

AREA AND POPULATION.

States and Territories	Area Square Miles	Population Census—30th June, 1933 Males	Females	Persons	Population Capital Cities, 30th June, 1933
N.S.W.	309,432	1,318,728	1,282,376	2,601,104	1,235,367
Victoria	87,884	903,399	916,961	1,820,360	992,048
Queensland	670,500	497,394	450,395	947,789	299,782
South Australia	380,070	290,970	290,017	580,987	312,629
West. Australia	975,920	234,000	204,948	438,948	207,464
Tasmania	26,215	115,141	112,464	227,605	60,408
Northern Territory	523,620	3,376	1,484	4,860	—
F.C.T.	940	4,807	4,140	8,947	7,325
Total	2,974,581	3,367,815	3,262,785	6,630,600	3,115,023

ESTIMATED INCREASE OF POPULATION.

Adjusted in accordance with the results of the Census of the 30th June, 1933.

States and Territories	1930	1931	1932	First Nine Months of— 1932	1933
New South Wales	26,683	19,978	25,432	18,620	14,919
Victoria	14,345	10,972	9,821	7,171	8,789
Queensland	14,626	13,011	9,391	9,662	9,832
South Australia	1,500	2,614	2,216	1,337	2,343
West. Australia	4,985	2,086	2,641	2,480	3,591
Tasmania	2,019	3,166	2,143	–1,937	–3,238
Northern Territory	184	–117	–61	94	143
F.C.T.	272	202	–357	–246	793
Total	64,614	51,912	51,226	37,181	37,172

BIRTHS, DEATHS AND MARRIAGES.

Births—Number.

States and Territories	1930	1931	1932	First Nine Months of— 1932	1933
New South Wales	52,128	47,721	44,895	34,257	33,692
Victoria	33,127	30,332	27,464	20,577	21,281
Queensland	18,939	17,833	17,367	13,230	13,133
South Australia	9,984	9,079	8,521	6,447	6,774
West. Australia	9,200	8,549	7,965	6,066	6,044
Tasmania	4,786	4,762	4,491	3,348	3,406
Northern Territory	71	72	79	60	55
F.C.T.	164	161	151	123	106
Total	128,399	118,509	110,933	84,108	84,491

Deaths—Number.

New South Wales	21,235	21,270	21,343	16,260	17,038
Victoria	15,959	17,033	16,805	12,755	13,241
Queensland	7,455	7,525	7,813	5,924	6,462
South Australia	4,851	4,888	4,957	3,714	3,544
West. Australia	3,774	3,681	3,715	2,837	2,872
Tasmania	1,948	2,057	2,022	1,514	1,644
Northern Territory	77	70	73	48	47
F.C.T.	32	36	27	23	21
Total	55,331	56,560	56,755	43,075	44,869

Marriages—Number.

New South Wales	17,383	15,377	17,362	12,847	13,549
Victoria	11,641	10,182	11,747	8,407	9,153
Queensland	6,199	5,951	6,415	4,697	4,766
South Australia	3,312	3,069	3,636	2,691	2,939
West. Australia	3,205	2,741	2,904	2,184	2,465
Tasmania	1,450	1,501	1,505	1,136	1,196
Northern Territory	31	25	22	14	21
F.C.T.	34	36	43	38	40
Total	43,255	38,882	43,634	32,014	34,129

Estimated Population

	1930	December 31st 1931	1932
N.S.W.	2,546,570	2,566,548	2,591,980
Victoria	1,792,689	1,803,661	1,813,482
Queensland	916,938	929,949	939,340
South Aust.	574,499	577,113	579,329
West. Aust.	431,685	433,771	436,412
Tasmania	225,305	228,471	230,614
Northern Territory	4,974	4,857	4,796
F.C.T.	8,719	8,921	8,564
Australia	6,501,379	6,553,291	6,604,517

Principal Crops—Australia

AREA UNDER CROPS.

	1930-31	1931-32	1932-33
Grain—	Acres	Acres	Acres
Wheat	18,164,920	14,741,313	15,741,376
Oats	1,082,101	1,085,489	1,023,401
Maize	293,450	269,448	219,927
Hay	3,323,463	2,634,680	2,881,831
Sugar Cane	311,694	325,737	307,932
Total area under all Crops	25,163,816	21,166,900	21,047,356

Total Production

	1930-31	1931-32	1932-33
Grain—	Bushels	Bushels	Bushels
Wheat	213,594,391	190,612,188	213,445,950
Oats	16,658,058	15,194,680	15,205,609
Maize	8,025,619	7,062,383	4,881,036
	Tons	Tons	Tons
Hay	4,149,661	3,167,459	3,621,978
Sugar Cane	3,688,869	4,213,453	3,703,070
Cane Sugar (*a*)	535,624	603,735	532,594

Wool (as in the Grease) Produced (c)

Season Ended 30th June

	1930	1931	1932
N.S.W. (*a*)	461,852,890	428,752,210	503,275,416
Victoria	160,662,578	146,862,612	159,721,916
Queensland	161,087,873	182,061,407	184,716,462
South Aust.	67,300,881	63,478,524	67,021,312
West. Aust.	72,562,594	76,951,500	77,985,741
Tasmania	14,100,000	14,000,000	13,875,000
Northern Territory	30,000	35,000	35,000
Total	937,596,816	912,141,253	1,006,630,847

(*a*) Including Federal Capital Territory. (*b*) For year ended previous 31st Dec. (*c*) Estimate for 1932-33, 1,028,000,000 lb.

Estimated Value of Production

	1929-30	1930-31	1931-32
	£1,000	£1,000	£1,000
Agricultural	77,109	70,500	74,489
Pastoral	84,563	69,499	61,540
Dairy, Poultry and Bee Farming	49,398	43,067	41,478
Forestry and Fisheries	11,371	8,313	7,703
Mining	17,912	15,856	13,352
Manufacturing (*a*)	149,184	112,966	106,456
Total	389,537	319,701	305,018

(*a*) These amounts differ from those given in the following tables, owing to the inclusion in those tables of certain products which are included in Dairy Farming and Forestry in this table.

Taxation—Commonwealth and State, per Head

	Year Ended 30th June— 1930	1931	1932	1933
Taxation by Commonwealth Govt.—	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Customs & Excise (*a*)	6 10 4	4 7 5	4 7 1	5 0 4
Other (*a*)	2 11 2	c3 8 5	c3 18 4	c3 10 5
Total	9 1 6	7 15 10	8 5 5	8 10 9
Taxn. by State Govts. (*b*)	5 5 9	5 10 8	5 0 7	5 13 9
Total Taxation (*a*)	14 6 11	13 6 3	13 5 9	14 4 3

(*a*) Based on mean population of Commonwealth for each financial year. (*b*) Based on aggregate population of the six States, mean for each financial year. (*c*) Inclusive of Sales Tax, 10s. 9d. per head in 1930-31; £1 5s. 10d. in 1931-32; and £1 8s. 6d. in 1932-33.

MOTOR VEHICLES REGISTERED IN AUSTRALIA.

1931-32.

State	Registrations Motor Cars, &c.	Motor Cycles	Total
New South Wales	184,020	22,741	206,761
Victoria	145,384	22,568	167,952
Queensland	80,926	8,034	88,960
South Australia	49,932	7,860	57,792
Western Australia	40,702	6,700	47,402
Tasmania	13,549	3,661	17,210
North Australia, Central Australia	540	39	579
Federal Capital Territory	1,171	93	1,264
Total	516,224	71,696	587,920

1932/33.

New South Wales*	199,116	23,354	222,470
Victoria	156,163	23,439	179,602
Queensland	81,492	7,725	89,217
South Australia	51,109	8,520	59,629
Western Australia	40,595	5,992	46,587
Tasmania	14,014	3,741	17,755
North Australia	575	39	614
Central Australia	62	4	66
Federal Capital Territory	1,210	82	1,292
Total	544,336	72,896	617,232

*Approximate figures only on account of Annual and Quarterly Registration Certificates.

Savings Banks (a)

AMOUNT ON DEPOSIT.

Date	30/6/30	30/6/31	30/6/32	30/6/33	30/9/33	31/12/33
	£'000	£'000	£'000	£'000	£'000	£'000
N.S.W.	82,465	69,811	71,648	72,308	72,358	72,504
Vic.	69,367	63,243	65,680	67,814	67,839	67,861
Q'land.	23,901	22,354	22,952	23,453	23,604	24,054
S. Aust.	24,012	21,422	21,567	22,515	22,668	22,813
W. Aust.	11,729	10,867	10,218	10,064	9,961	9,978
Tas.	5,699	5,366	5,586	5,865	5,949	5,855
F.C.T.	288	269	275	225	222	224
N. Ter.	49	43	40	38	40	42
Total	217,510	193,375	197,966	202,282	202,641	203,331

Average Per Head of Population (b)

	(i) 1929-30	1930-31	1931-32	1932-33
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
N.S.W.	33 3 8	27 16 11	28 6 10	27 16 0
Vic.	38 18 0	35 3 8	36 7 8	37 5 1
Q'land.	25 7 4	23 5 11	23 11 9	24 14 11
S. Aust.	41 7 2	36 14 2	36 16 0	38 15 1
W. Aust.	28 0 4	25 16 9	24 3 8	22 18 7
Tas.	26 8 10	24 9 9	25 5 4	25 15 4
F.C.T.	32 10 9	31 16 6	32 15 6	25 3 1
N. Ter.	10 5 0	9 5 11	8 19 6	7 18 0
Total	33 15 7	29 14 11	30 4 7	30 10 2
				30 10 3
				30 12 3

(*a*) Includes Commonwealth Savings Bank. (*b*) Averages at end of financial years are based on population at 30th June in the respective years (*i*) Based on population at Census of 30th June, 1933

Taxation—Commonwealth and State

	Year Ended 30th June— 1930	1931	1932	1933
Taxation by Commonwealth Govt.—	£	£	£	£
Customs and Excise	41,774,391	28,295,073	28,405,796	32,992,434
Other	16,413,384	a22,125,033	a25,553,246	a23,153,592
Total	58,187,775	50,420,106	53,959,042	56,146,026
Taxn. by State Govts.	33,823,803	35,759,813	32,748,228	37,325,609
Total Taxation	92,011,578	86,179,919	86,707,270	93,471,635

(*a*) Includes Sales Tax, £3,472,854 in 1930-31; £8,425,067 in 1931-32; and £9,369,275 in 1932-33.

Manufacturing Industries

AVERAGE AMOUNT OF SALARIES AND WAGES PAID PER EMPLOYEE (a)

	1928-29 Males	Females	1930-31 Males	Females	1931-32 Males	Females
N.S.W.	258.68	112.96	244.36	107.56	225.99	98.74
Victoria	241.51	112.94	221.68	102.73	200.27	94.43
Queensland	234.71	95.05	218.64	91.40	204.08	81.61
South Aust.	239.74	102.78	217.40	92.78	191.61	81.21
West. Aust.	247.57	107.01	239.04	100.28	213.43	92.20
Tasmania	217.89	94.92	211.86	85.11	192.28	83.11
Total	247.35	110.63	230.20	102.74	210.26	94.18

(*a*) Exclusive of working proprietors and amounts drawn by them.

Manufacturing Industries

	1929-30	1930-31	1931-32
Number of Establishments	No. 22,700	No. 21,751	No. 21,657
Hands Employed	419,194	338,843	336,658
	£	£	£
Salaries and Wages Paid (*a*)	84,717,033	62,454,859	55,931,818
Value of Plant—Mach., Land and Bldgs.	245,695,920	236,708,306	228,119,701
Value of Materials Used	220,945,187	162,104,646	161,199,245
Value of Production	156,364,432	118,310,123	110,981,830
Value of Output	390,912,373	290,798,564	281,645,785

(*a*) Exclusive of amounts drawn by working proprietors.

MANUFACTURING INDUSTRIES.

Percentage of Each Item of Outlay on Value of Total Output, 1931-32.

Particulars	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tas.	Total
	%	%	%	%	%	%	%
Wages*	19.88	20.83	16.76	19.62	20.88	22.05	19.86
Fuel & Light	3.70	2.90	2.08	3.88	5.04	7.02	3.36
Materials used	55.54	56.60	65.06	60.04	53.79	49.25	57.23
Margin for profits and miscellaneous expenses and charges	20.88	19.67	16.10	16.46	20.29	21.68	19.55
Total output	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Per cent. of Wages on value of Production	48.77	51.44	51.01	54.38	50.72	50.43	50.40

*Exclusive of amounts drawn by working proprietors.

Manufacturing Industries

AVERAGE NUMBER OF MALES AND FEMALES EMPLOYED, 1931-32.

	Males	Females	Masculinity (*a*)
N.S.W.	90,682	35,686	254
Victoria	81,618	46,647	175
Queensland	29,149	6,650	438
South Australia	18,932	4,902	386
West. Australia	10,535	2,857	369
Tasmania	6,999	2,001	350
Total	237,915	98,743	241

(*a*) Number of males per 100 females.

STATISTICS OF BUSINESS CONDITIONS—AUSTRALIA.

Month	Building Permits—Capital Cities and Suburbs: Number of New Buildings and Dwellings	Building Permits—Capital Cities and Suburbs: Value of New Buildings, Dwellings and Alterations and Additions	Bank Clearings, Six Capitals (excluding Treasury Bills Transactions) (*b*)	Bankruptcies (*a*) Australia: Number	Bankruptcies (*a*) Australia: Gross Liabilities	Sterling-dollar Exchange Rates (average of Daily Rates)
1932	Number	£000	£000		£000	$ to £ stg.
January	317	370.0	25,615	155	425	3.430
February	404	337.6	29,737	270	361	3.459
March	371	414.9	25,625	320	774	3.634
April	343	626.8	29,518	266	376	3.752
May	476	427.9	28,581	256	753	3.676
June	408	473.0	27,428	194	715	8.649
July	469	468.0	30,604	161	273	3.552
August	469	498.5	26,892	199	309	3.476
September	565	514.2	27,825	163	263	3.471
October	555	705.6	32,840	140	274	3.399
November	540	502.0	30,399	144	291	3.277
December	442	467.9	32,931	128	206	3.276
1933						
January	422	481.3	27,427	118	139	3.372
February	434	408.0	32,055	188	904	3.422
March	579	552.7	29,503	325	817	3.436
April	444	568.8	29,388	230	600	3.587
May	551	799.7	30,649	200	452	3.933
June	613	883.4	29,997	187	434	4.141
July	535	745.2	32,042	166	445	4.643
August	524	829.2	26,197	194	293	4.503
September	552	749.7	29,925	193	279	4.660
October	566	888.2	33,337	137	319	4.672
November	—	—	35,844	170	556	5.137
December	—	—	37,079	—	—	5.115

(*a*) Sequestrations, Compositions and Deeds of Arrangement. (*b*) Average for four or five weekly periods ending the last Monday in each month.

Statistics of Business Conditions—Australia—*Continued.*

Month	Retail Price Index Numbers, Food and Groceries, Six Capitals	Retail Price Index Numbers, Food, Groceries and Rent (all Houses), Six Capitals	Wholesale Price Index Numbers (all groups), Melbourne	Wool Prices: Brokers' Realisation Price, Greasy Wool, all Centres (*a*)	Wool Prices: Greasy Merino-Standard Average, Sydney (*b*)	Wheat-shippers' Price, f.o.r. Williams-town	Price of Butter (export parity)	Price of Gold (export parity)
1932	Year 1928 =1000	Year 1928 =1000	Year 1928 =1000	Pence per lb.	Pence per lb.	Pence per bushel	Shillings per cwt.	£A per oz.
January	823		789	8.86	8.9	37.13	109	7.431
February	838	815	809	9.46	8.7	37.88	115	7.388
March	834		802	8.48	7.9	36.81	117	7.043
April	833		799	7.48	7.5	36.94	116	6.806
May	821	806	786	6.48	7.4	37.75	106	6.964
June	813		776	5.92	7.3	36.25	108	6.997
July	809		780	5.96	8.0	36.25	112	7.159
August	804	793	790	8.04	8.5	38.88	112	7.315
September	799		804	8.87	9.1	40.00	117	7.323
October	794		783	8.54	8.5	37.19	110	7.492
November	772	774	771	8.53	8.2	35.44	98	7.760
December	767		763	8.43	8.4	32.81	92	7.761
1933								
January	754		750	9.25	8.6	32.75	87	7.560
February	749	760	742	8.80	8.0	31.89	80	7.450
March	740		744	8.47	7.8	31.63	77	7.425
April	753		758	8.36	7.9	33.06	70	7.446
May	758	763	785	8.76	8.8	36.19	82	7.615
June	768		803	9.83	10.0	36.88	84	7.548
July	763		812	8.04	11.4	40.06	86	7.653
August	776	770	817	12.45	11.6	38.31	98	7.758
September	776		826	13.55	13.1	35.56	114	8.107
October	773		806	13.53	12.8	30.19	109	8.119
November	758	769	789	15.92	14.5	30.75	88	7.946
December	778		801	16.47	14.9	29.63	73	7.792

(*a*) Average prices realised for all greasy wool of whatever type or quality marketed during the month.
(*b*) Compiled by the New South Wales Government Statistician.

BASIC WEEKLY WAGE RATES FIXED BY COMMONWEALTH COURT OF CONCILIATION AND ARBITRATION FOR EACH CAPITAL CITY.

Capital.	1st November, 1933 (*a*). "Harvester" Equivalent Plus adjusted "Powers' 3s."	1st November, 1933 (*a*). Weekly Rate after 10 per cent. Reduction	1st February, 1934 (*a*). "Harvester" Equivalent Plus adjusted "Powers' 3s."	1st February, 1934 (*a*). Weekly Rate after 10 per cent. Reduction
	s. d.	s. d.	s. d.	s. d.
Sydney	74 4	66 11	74 4	66 11
Melbourne	69 10	62 10	70 4	63 4
Brisbane	65 11	59 4	65 11	59 4
Adelaide	66 3	59 7	66 10	60 2
Perth	66 11	60 3	65 10	59 3
Hobart	71 0	63 11	72 0	64 10
Weighted Average—Six Capitals	70 4	63 4	70 10	63 9

(*a*) "D" Series Indexes—Commonwealth Arbitration Court's Award of 5th May, 1933.

BASIC WEEKLY WAGE RATES FIXED BY STATE INDUSTRIAL TRIBUNALS.

State	Basic Wage: Males	Basic Wage: Females	Date of Operation	Family Unit (for Male Rate)
	£ s. d.	£ s. d.		
N.S.W.	(*a*) 3 6 6	1 16 0	1/11/33	Man, wife and child
Victoria	(*b*)	(*b*)	(*b*)	(*b*)
Queensland	3 14 0	1 19 0	1/7/31	Man, wife, and three children
South Aust.	(*d*) 3 3 0	(*e*) 1 11 6	—	" " "
West. Aust.	(*f*) 3 9 3	1 17 5	(*g*) 3/8/33	(*c*)
Tasmania	(*b*)	(*b*)	(*b*)	(*b*)

(*a*) Plus child allowances. (*b*) None declared, but follow Federal rates to a large extent. (*c*) Although the family unit is not specifically defined in the legislation of this State, the tribunal appointed to determine the basic wage has adopted the unit of man, wife and two children. (*d*) Judgment dated 17th August, 1931. (*e*) Judgment dated 4th December, 1931. (*f*) Metropolitan area. Basic wage for Goldfields areas and other portions of State, exclusive of the S.W. Land Division—males, £3 17s. 6d.; females, £2 1s. 10d.; Agricultural Areas and S.W. Land Division—males, £3 9s. 6d.; females, £1 17s. 6d. Under the provisions of the "Financial Emergency Act," the Court of Arbitration made orders, on the application of employers in a number of industries and callings, reducing the basic wage rate by 18, 20 or 22½ per cent. of 87s. per week, the basic wage rate on the 30th June, 1930, according to total salary received (*g*) Date declared.

Basis of calculating Customs Charges

Value of Imports

The value of goods imported from countries beyond Australia represents the amount on which duty is payable or would be payable if the duty were ad valorem. Section 154 (1) of the Customs Act, 1901-30 provides that "when any duty is imposed according to value, the value for duty shall be the sum of the following:—

(a) (i) the actual money price paid or to be paid for the goods by the Australian importer plus any special deduction; or
(ii) The current domestic value of the goods, whichever is the higher.

(b) All charges payable or ordinarily payable for placing the goods free on board at the port of export; and

(c) ten per centum of the amounts specified under paragraphs (a) and (b) of this sub-section."

"Current domestic value" is defined as "the amount for which the seller of the goods to the purchaser in Australia is selling or would be prepared to sell for cash, at the date of exportation of these goods, the same quantity of identically similar goods to any and every purchaser in the country of export for consumption in that country."

Imports are recorded in British currency values.

Imports of Radio Apparatus

TWELVE MONTHS ENDED 30th JUNE, 1933.

	Battery Eliminators	Battery Chargers	Parts N.E.I.	Wireless Receivers
	£	£	£	£
New South Wales	218	42	25,371	1,445
Victoria	238	22	11,293	742
Queensland	—	—	88	—
S. Australia	36	—	273	76
W. Australia	—	—	879	7
Tasmania	—	—	13	—
Australia	492	64	37,917	2,270

Imports of Radio Apparatus

SIX MONTHS ENDING DECEMBER, 1933.

New South Wales

	Battery Eliminators	Parts N.E.I.	Wireless Receivers	Total
	£	£	£	£
July	207	1,074	117	1,398
August	9	1,136	110	1,255
September	173	1,048	400	1,621
October	161	1,587	265	2,013
November	193	3,563	195	3,951
December	44	1,744	273	2,061

Victoria

July	14	266	102	382
August	17	227	98	342
September	12	916	240	1,168
October	127	715	149	991
November	422	1,044	387	1,853
December	41	442	369	852

Queensland

July	60	2	203	265
August	—	133	1	134
September	—	12	32	44
October	—	77	2	79
November	11	5	13	29
December	—	57	36	93

South Australia

July	—	51	4	55
August	—	37	8	45
September	170	114	11	295
October	2	68	57	127
November	—	—	42	42
December	34	31	110	175

Western Australia

July	—	60	—	60
August	—	134	—	134
September	—	21	—	21
October	2	129	—	131
November	—	36	—	36
December	—	50	15	65

Tasmania

October	—	6	—	6

Australia

July	281	1,453	426	2,160
August	26	1,667	217	1,910
September	355	2,111	683	3,149
October	292	2,582	473	1,347
November	626	4,648	637	5,911
December	119	2,324	803	3,246

Australian Tariff Schedule Effective December 4th, 1933

In the following Schedules the first duty is British preference tariff and the second general tariff. In addition to the rates of import duty shown hereunder primage duty is payable on goods covered by certain items as follows:—

Tariff Items.	Primary Duty. British Preferential Tariff.	General Tariff.
Item No. 180 (E)	5%	10%
„ „ 180 (G) (1) and (3)	5%	10%
„ „ 180 (1)	5%	10%
„ „ 181 (A) (2)	10%	10%
„ „ 404	Free	4%
„ „ 404A	„	4%
„ „ 415A	„	4%

The import duty on goods admissible at the British Preferential Tariff Rate under Tariff Items Nos. 180 (E), 180 (G) (1) and (3) and 180 (1) is subject to a deduction in accordance with the Customs Tariff (Exchange Adjustment) Act, 1933, and in this connection the extract embodying Section 5 of that Act is as follows:—

5. The duties of Customs (other than primage duty and duty imposed by the Customs Tariff (Industries Preservation) Act 1921-1922 or any Act amending or in substitution for that Act) which would, but for the provision of this Act, be payable on goods to which protective duties apply and which are admissible under the British Preferential Tariff and which are entered for home consumption on or after the fifth day of October, One thousand nine hundred and thirty-three, shall be varied in accordance with the following provisions:—

(a) Whenever at the date of exportation of any such goods Australian currency is depreciated to the extent of not less than sixteen and two-thirds per centum in relation to the currency of the British country from which those goods are imported, a deduction from the amount of duty payable on those goods in accordance with any law of the Commonwealth for the time being in force imposing Duties of Customs (other than primage duty and duty imposed by the Customs Tariff (Industries Preservation) Act 1921-1922 or any Act amending or in substitution for that Act) or in accordance with Customs tariff proposals shall be made of—
  (i) one-fourth of that amount of duty; or
  (ii) twelve and one-half per centum of the value for duty, whichever is the less; and

(b) Whenever at the date of exportation of any such goods Australian currency is depreciated to the extent of not less than eleven and one-ninth per centum and less than sixteen and two-thirds per centum in relation to the currency of the British country from which those goods are imported, a deduction from the amount of duty payable on those goods in accordance with any law of the Commonwealth for the time being in force imposing Duties of Customs other than primage duty and duty imposed by the Customs Tariff (Industries Preservation) Act 1921-1922 or any Act amending or in substitution for that Act) or in accordance with Customs Tariff proposals shall be made of—
  (i) One-eighth of that amount of duty; or
  (ii) six and one-quarter per centum of the value for duty whichever is the less.

180 (G) Storage Batteries and parts thereof, viz.:—

(i) Storage batteries for wireless receiving sets, whether imported separately or incorporated in or forming part of a wireless receiving set.
ad. val. 50 per cent. 70 per cent.

(3) Composition parts including containers for storage batteries for wireless receiving sets.

180 (1) Dry Batteries and Dry Cells of all descriptions whether imported separately or incorporated in any article or appliance—

(1) Up to and including 1 lb. in weight ..... each 4d. and 6d.

(11) Over 1lb. in weight per lb. 7d. and 10d.

181 (a) Electrical Articles and Materials. (Valves) **viz.:—**

(2) Valves for wireless telegraphy and telephony including rectifying valves ..... each 2s. 3d. and 3s. 6d.
or ad. val. 20 per cent. 40 per cent whichever rate returns the higher duty.

Division XVI.—Miscellaneous.

404. Materials and Minor Articles, of a class or kind not commercially produced or manufactured in Australia, for use in the manufacture of goods within the Commonwealth, as prescribed by Departmental By-laws including the following:—

Ad. val. Free and 15 per cent

Resistance alloys in the form of wire, bars, rods, sheets or strips.	For use in the manufacture of all kinds of electrical apparatus and appliances.
Porcelain insulating beads of sizes less than ¾ inch diameter x ¾ inch long over all measurements.	
Cotton covered copper wire finer than 30 gauge (I.S.W.G.)	
Fixed electrolytic condensers.	
Insulating tubes except:	
Tubular cotton covered braiding or sleeving.	
Bakelised paper.	
Porcelain.	
Hard rubber.	

Metal rectifying elements for the manufacture of battery eliminators for wireless receiving sets.

Speaker units for the manufacture of magnetic type loud speakers.

Permanent magnets for the manufacture of loud speakers.

Battery cables (not including terminals) consisting of several flexible cords contained in one braided cover	For the manufacture of wireless receiving sets.
Woven antenna, i.e., aerial tape without terminals.	
Cotton covered loop antenna wire for inside aerials.	

Record changing devices imported unassembled, excluding pick-ups 12 inch turntables and motors, for use in the manufacture of combined radio gramophone sets.

Plain aluminium sheets for all purposes.

404A. Materials and Minor Articles, of a class or kind not commercially produced or manufactured in Australia or the United Kingdom, for use in the manufacture of goods within the Commonwealth, as prescribed by Departmental By-laws. Free and Free.

415A (2) Insulating boards of a quality or kind which the Minister of Customs is satisfied is not being made in Australia.

180 (E) Wireless Receivers, Parts thereof, and Accessories therefor, viz.:—

1. **Chargers,** Battery, .4 ampere to 1 ampere, both inclusive, each 7/—10/-.

2. **Chargers,** Battery, exceeding 1 ampere and up to and including 3 amperes, each 21/—30/-.

3. **Choke Coils,** suitable for use in connection with battery eliminating devices, each 5/—10/-.

4. **Condensers, Fixed Mica,** each 5d.—6d.

5. **Condensers, Variable,** of capacities exceeding .0001 microfarad, but not exceeding .001 microfarad—with gang or drum control—per each Condenser contained therein, 1/6—3/-; without gang or drum control, each 1/6—3/-.

6. **Condensers, Variable, Midget,** of .0001 microfarad capacity or less, each 1/—1/6.

7. **Dials, Vernier,** each 10d.—1/3.

8. **Dials, n.e.i.,** each 1½d.—2d.

9. **Eliminators,** "A" Battery, each 35/—50/-.

10. **Eliminators,** "B" Battery, each 27/6—40/-.

11. **Eliminators,** "BC" and "ABC" Battery, Power Packs, and similar devices, whether imported separately or incorporated in a wireless receiving set, each 40/—60/-.

12. **Resistances, Fixed,** having a resistance value of 2 megohms and over, each 4½d.—6d.

13. **Headphones,** each 2/6—4/-.

14. **Jacks, Phone and Loudspeaker,** each 4d.—6d.

15. **Knobs,** each 1½d.—2d.

16. **Lightning Arresters,** each 4d.—6d.

17. **Loudspeakers and Parts thereof:—**
  (a) Loudspeakers, including transformers, each 10/—12/6.
  (b) Parts of loudspeakers imported other than in complete loudspeakers, viz.:—
    (1) Field Coils, each 2/—3/-.
    (2) Field Coil Cores, each 9d.—1/3.
    (3) Field Coil Housing, each 1/—1/6.
    (4) Cones with or without voice coils, each 1/3—1/9.
    (5) Cone Housings, each 1/9—2/3.
    (6) N.E.I., other than transformers ad. val., 35 per cent.—55 per cent.

Provided, however, that in the case of combinations of any of the above-mentioned parts duty shall be payable on such combinations as though the parts were imported separately.

18. **Plugs, Phone and Loudspeaker,** each 3d.—4½d.

19. **Rheostats, Potentiometers and Variable Resistance,** each 6d.—8d.

20. **Sockets, Valve,** each 3d.—4½d.

21. **Transformers, Audio and Radio,** each 1/9—2/6.

22. **Transformers, Power,** each 10/—15/-.

23. **Power Transformers and Choke Coils,** combined, each 15/—25/-.

Or as to all the goods covered by paragraphs 1 to 23 of sub-item (E), with the exception of the goods covered by clause 6 of sub-paragraph (b) of paragraph 17, the following rates, if same return a higher duty, viz.: ad. val., 35 per cent.—55 per cent.

24. **Parts, n.e.i.,** of wireless receivers, other than cabinets, ad. val., 35 per cent.—55 per cent.

25. **Wireless Receiving Sets** wholly assembled, partly assembled or unassembled, excluding cabinets, valves, loudspeakers, headphones, batteries, or any device for eliminating batteries:—

Per valve socket, excluding sockets for valves forming part of any battery eliminating device, 12/6—25/-; or ad. val., 35 per cent.—55 per cent., whichever rate returns the higher duty.

Provided, (1) in the absence of valve sockets, the sets shall be charged duty at the above rates on the basis of the number of valves for which they are constructed or designed. (2) In the instance of sets constructed or adapted for use with multiple purpose valves, the sets shall be charged duty equal to that payable on sets having an equal number of unit stages using unit function valves.

26. **Wireless Receiving Sets and Gramophones combined,** excluding cabinets, valves, loudspeakers, headphones, batteries, or any device for eliminating batteries, each 20/—25/-; and in addition per valve socket excluding sockets for valves forming part of any battery eliminating device, 12/6—25/-, or as an alternative the cumulative fixed rates provided above ad. val., 35 per cent.—55 per cent., whichever rate returns the higher duty.

Provided—(1) In the absence of valve sockets the combined sets shall be charged duty at the above rates on the basis of the number of valves for which they are constructed or designed. (2) In the instance of combined sets constructed or adapted for use with multiple purpose valves, the combined sets shall be charged duty equal to that payable on combined sets having an equal number of unit stages using unit function valves.

Copper braid.	For use in electrical apparatus and appliances.
Uncovered Copper Cable.	
Insulating paper, under security.	

Cotton covered flat laid cords with terminals affixed thereto, for use in radio head sets.

Standard signal generators.	Being instruments for testing radio equipment.
Beat frequency and low frequency oscillators.	

Carbon being amorphous carbon or consisting principally of amorphous carbon which has been subjected to no other process of manufacture than the formation into plain blocks or plain rods.

Carbon being synthetic graphite or consisting principally of synthetic graphite which has been subjected to no other process of manufacture than the formation into plain blocks or plain rods.

Radio Valve Importations

July, 1932, to June, 1933

Imports into Australia of Valves for Wireless Telegraphy or Telephony during the Twelve Months ended 30th June, 1933.

NEW SOUTH WALES

	U.K.	Canada	Holland	U.S.A.	TOTAL
Quantity	88,126	4,540	256,949	701,604	1,051,219
Value	£37,907	£822	£87,404	£140,595	£266,728

VICTORIA

Quantity	9,985	1,650	2,881	269,634	284,350
Value	£5,384	£259	£2,718	£45,496	£53,857

QUEENSLAND

Quantity	501		1	13,370	13,872
Value	£1,679		£4	£2,911	£4,584

SOUTH AUSTRALIA

Quantity	169		7	8,966	9,142
Value	£611		£273	£1,901	£2,785

WESTERN AUSTRALIA

Quantity	1,542		23	8,155	9,720
Value	£776		£162	£1,971	£2,909

TASMANIA

Quantity	18		5		23
Value	£116		£35		£151

AUSTRALIA

Quantity	100,341	6,190	259,866	1,001,729	1,368,126
Value	£46,473	£1,081	£90,596	£192,874	£331,024

Imported to Australia from Austria, 26 valves: value, £11; from Germany, 250 valves: value £439; from Sweden, 44 valves: value £26; re-imported to Australia, 24 valves: value £45.

RADIO VALVE IMPORTATIONS, JULY TO DECEMBER, 1933

NEW SOUTH WALES

	U.K.	Canada	Holland	U.S.A.	TOTAL
Quantity—					
July	1,764	2,780	4,170	41,810	50,522
August.	1,445	4,750	6,238	61,510	73,952
Sept.	1,585	11,400	2,258	61,601	76,844
October	2,710		623	58,742	62,076
Nov.	3,339	1,253	157	72,012	76,765
Dec.	11,251		1,012	41,331	53,619
Value—					
July	£1,639	£2,780	£4,170	£41,810	£50,522
August	£1,561	£861	£1,540	£6,758	£10,722
Sept.	£429	£1,849	£660	£8,215	£11,153
October	£806		£221	£5,882	£6,909
Nov.	£983	£293	£276	£8,707	£10,266
Dec.	£3,787		£277	£5,094	£9,167

VICTORIA

Quantity—					
July	561	1,100	55	16,606	18,322
August	438		13	13,979	14,430
Sept.	224	2,100	4	32,404	34,732
October	151			19,772	19,923
Nov.	325		7	14,119	14,451
Dec.	207		2	23,322	23,532
Value—					
July	£906	£196	£922	£1,936	£3,760
August	£1,221		£34	£1,600	£2,855
Sept.	£543	£444	£52	£3,372	£4,411
October	£41			£1,934	£1,975
Nov.	£253		£106	£1,499	£1,858
Dec.	£280		£80	£2,402	£2,864

QUEENSLAND

	U.K.	Canada	Holland	U.S.A.	TOTAL
Quantity—					
July	355				355
August	410			262	672
Sept.	111			506	617
October				5	5
Nov.	18			932	950
Dec.	27		1	112	140
Value—					
July	£685				£685
August	£1,187			£39	£1,226
Sept.	£228			£51	£279
October				£1	£1
Nov.	£187			£100	£287
Dec.	£377		£67	£13	£457

SOUTH AUSTRALIA

Quantity—				
July	2	4	24	30
August	68		68	136
Sept.	5		116	121
Oct.	26		772	798
Nov.	3	10	30	43
Dec.	16		240	256
Value—				
July	£3	£16	£19	£38
August	£427		£18	£445
Sept.	£8		£14	£22
October	£18		£77	£95
Nov.	£36	£165	£9	£210
Dec.	£234		£36	£270

WESTERN AUSTRALIA

Quantity—				
July	24	6	500	530
August	108		2	110
Sept.	6	15	200	221
October	32	7	75	114
Nov.	305			305
Dec.	16	4		20
Value—				
July	£4	£57	£83	£144
August	£298		£3	£301
Sept.	£10	£207	£18	£235
October	£35	£21	£10	£66
Nov.	£63			£63
Dec.	£84	£27		£111

AUSTRALIA

Quantity—					
July	2,706	3,880	4,235	58,940	69,761
August	2,470	4,750	6,251	75,821	89,301
Sept.	1,931	13,500	2,277	94,827	12,535
October	2,919		630	79,366	82,915
Nov.	3,990	1,253	174	87,093	92,514
Dec.	11,517		1,019	65,005	77,548
Value—					
July	£3,237	£696	£2,061	£7,120	£13,114
August	£4,781	£861	£1,574	£8,418	£15,636
Sept.	£1,218	£2,293	£919	£11,670	£16,100
October	£900		£42	£7,904	£906
Nov.	£1,522	£293	£547	£10,315	£12,684
Dec.	£4,862		£451	£7,545	£12,861

Imported from Italy to N.S.W., November, 48 valves: value £28; from Germany to N.S.W., October, 25 valves: vlaue £11; imported from Germany to S.A., October, 48 valves: value £25; imported to Tasmania from Canada, 1 valve: value £87.

Electric Supply Systems throughout Australia

The Town or District is given first, then voltage and frequency, followed by number of consumers (abbreviated Con.), area population (abbreviated Pln.), and number of houses in area (abbreviated Hs.) if available. The owners or suppliers to the various districts are not shown, as generally the radio industry is chiefly interested in the voltage and frequency and possible business with all-electric or battery sets. This list has been compiled at great trouble and cost, and should be the most up-to-date list available. No responsibility is accepted for any errors or omissions as in some cases the supply authority failed to supply the information.

A

ABERDARE, N.S.W., 240v. 50c. Con. 620.
ABERDEEN, N.S.W., 240v. D.C. Con. 107.
ABERMAIN, N.S.W., 240v. 50c.
ABERNETHY, N.S.W., 240v. 50c.
ADAMSTOWN, N.S.W., 240v. 50c.
ADELAIDE, S.A., 200v. 50c. Con. 77,228, Pln. 377,400.
ADELONG, N.S.W., 240v. 50c. Con. 100. Pln. 700.
ALBANY, W.A., 220v. D.C.
ALBURY, N.S.W., 240v. 50c. Con. 2550. Pln. 12,000.
ALDGATE, S.A., 200v. 50c. Con. 110.
ALEXANDRA, Vic., 230v. 50c. Con. 202. Pln. 850.
ALLANSFORD, Vic., 230v. 50c. Con. 35. Pln. 296.
ALTONA, Vic., 230v. 50c. Con. 253. Pln. 2,000.
ALVIE, Vic., 230v. 50c. Con. 70. Pln. 150.
AMBLESIDE, S.A., 200v. 50c. Con. 67. Pln. 685.
ANGASTON, S.A., 200v., 50c.
ANTHILL PONDS, Tas., 240v. 50c.
APPLECROSS, W.A., 250v. 40c.
ARARAT, Vic., 230v. 50c. Con. 750. Pln. 5,200.
ARDMONA, Vic., 230v. 50c.
ARDROSSAN, S.A., 220v. D.C.
ARIAH PARK, N.S.W., 240v. D.C. Con. 115, Pln. 500. Hs. 150.
ARMADALE, W.A., 250v. 40c.
ARMIDALE, N.S.W., 240v. 50c. Con. 1,410. Pln. 7,000. Hs. 1,547.
ASHTON, S.A., 200v. 50c.
ATHERTON, Qld., 240v. 50c. Con. 256. Pln. 1,500.
AUBURN, S.A., 240v. 50c.
AVALON, N.S.W., 240v. 50c.
AVOCA, Vic., 230v. D.C. Con. 170, Pln. 800.
AVOCA, Tas., 240v. 50c. Con. 50. Pln. 231.
AVONDALE, N.S.W., 240v. 50c.
AYR, Qld., 220v. D.C. Con. 220.

B

BACCHUS MARSH, Vic., 230v. 50c. Con. 345. Pln. 1,450.
BAGDAD, Tas., 240v. 50c. Con. 60.
BAIRNSDALE, Vic., 230v. 50c. Con. 833. Pln. 4,000.
BALAKLAVA, S.A., 200v. 50c. Con. 313. Pln. 2,170.
BALGOWNIE, N.S.W., 240v. 50c.
BALHANNA, S.A., 240v. A.C.
BALLAN, Vic., 230v. 50c. Con. 109. Pln. 450.
BALLARAT, Vic., 220v. D.C. Con. 4,500. Pln. 40,000. 230v. 50c.
BALLINA, N.S.W., 240v. 50c. Con. 1,000. Pln. 10,000.
BALMAIN, N.S.W., 240v. 50c.
BALRANALD, N.S.W., 240v. D.C. Con. 200. Pln. 1,100. Hs. 220.
BANGALOW, N.S.W., 240v 50c. Con. 170. Pln. 700. Hs. 200.
BANKSTOWN, N.S.W., 240v. 50c. Con. 5,300. Pln. 2,700.
BARCALDINE, Qld., 240v. D.C. Con. 250, Pln. 2,000.
BARGO, N.S.W., 80v. D.C. Con. 12. Pln. 60. Hs. 16.
BARMEDMAN, N.S.W., 240v. 50c. Con. 60. Pln. 700. Hs. 100.
BARHAM, N.S.W., 230v. 50c.
BARNAWARTHA, Vic., 230v. 50c. Con. 24. Pln. 240.
BARRABA, N.S.W., 240v. D.C. Con. 250. Pln. 1,400. Hs. 350.
BARWON HEADS, Vic., 230v. 50c. Con. 161. Pln. 600.
BASKETT RANGE, S.A., 200v. 50c.
BASSENDEAN, W.A., 250v. 40c. Con. 980. Pln. 5,000.
BATHURST, N.S.W., 240v. 50c. Con. 1,768. Pln. 11,000. Hs. 2,000.
BATLOW, N.S.W., 240v. 50c. Con. 60. Pln. 400. Hs. 75.
BAULKHAM HILLS, N.S.W., 240v. 50c. Con. 460.
BAYSWATER, Vic., 230v. 50c. Con. 84. Pln. 450.
BAYSWATER, W.A., 250v. 40c.
BEACONSFIELD, Tas., 240v. 50c. Con. 220. Pln. 1,110.
BEACONSFIELD, Vic., 230v. 50c. Con. 25. Pln. 150.
BEADON POINT, W.A., 220v. D.C.
BEAUDESERT, Qld., 240v. D.C. Con. 170.
BEAUFORT, Vic., 230v. 50c. Con. 200, Pln. 1,400.
BEAUTY POINT, Tas., 240v. 50c. Con. 46.
BEEAC, VIC., 230v. 50c. Con. 195. Pln. 300.
BEECHWORTH, Vic., 240v. 50c. Con. 300, Pln. 2,600.
BEGA, N.S.W., 240v. 50c. Con. 350. Pln. 2,200. Hs. 420.
BELAIR, S.A., 200v. 50c.
BELGRAVE, Vic., 230v. 50c. Con. 507. Pln. 1,800.
BELLAMBI, N.S.W., 240v. 50c.
BELLBIRD, N.S.W., 240v. 50c.
BELLINGEN, N.S.W., 240v. 50c. Con. 200. Pln. 1,300. Hs. 250.
BELMONT, N.S.W., 240v. 50c.
BENA, Vic., 230v. 50c. Con. 134, Pln. 180.
BENALLA, Vic., 230v. 50c. Con. 725. Pln. 4,000.
BENCUBBIN, W.A., 220v. D.C.
BENDIGO, Vic., 230v. 50c. 220v. D.C. Con. 5,253. Pln. 35,000.
BERRI, S.A., 230v. D.C.
BERRIGAN, N.S.W., 240v. 50c. Con. 148. Pln. 950. Hs. 210.
BERRY, N.S.W., 240v. 50c. Con. 261. Pln. 975. Hs. 300.
BERWICK, Vic., 230v. 50c. Con. 91. Pln. 650.
BEULAH, Vic., 230v. D.C. Con. 254. Pln. 550.
BEVERLEY, W.A., 220v. D.C.
BEXLEY, N.S.W., 240v. 50c.
BINALONG, N.S.W., 240v. 50c.
BINGARA, N.S.W., 240v. D.C.
BIRCHIP, Vic., 230v. D.C. Con. 220. Pln. 1,031.
BIREGURRA, Vic., 230v. 50c. Con. 82. Pln. 400.
BISHOPBOURNE, Tas., 240v. 50c. Con. 36.
BLACKALL, Qld., 240v. D.C. Con. 255. Pln. 1,500.
BLACKALLS, N.S.W., 240v. 50c.
BLACKHEATH, N.S.W., 240v. 50c. Con. 650. Pln. 2,500. Hs. 700.
BLACKTOWN, N.S.W., 240v. 50c. Con. 1,329. Pln. 7,500. Hs. 3,000.
BLACKWALL, N.S.W., 240v. 50c.
BLACKWOOD, S.A., 200v. 50c.
BLAYNEY, N.S.W., 240v. 50c. Con. 350. Pln. 2,200. Hs. 440.
BLYTH, S.A., 200v. 50c. Con. 58.
BOAT HARBOUR, Tas., 240v. 50c.
BOGGABRI, N.S.W., 230v. 50c. Con. 116. Pln. 1,250.
BOLWANA, N.S.W. (See West Maitland).
BOMADERRY, N.S.W., 240v. 50c.

BOMBALA, N.S.W., 240v. 50c.
BOMBO, N.S.W., 240v. 50c.
BOOKER BAY, N.S.W., 240v. 50c.
BOOLAROO, N.S.W., 240v. D.C.
BOOLARRA, Vic., 230v. 50c. Con. 52. Pln. 685.
BOOLONG, N.S.W., 240v. 50c.
BOONAH, Qld., 220v. D.C.
BOOROWA, N.S.W., 240v. 50c.
BOORT, Vic., 230v. D.C. Con. 231. Pln. 750.
BORDERTOWN, S.A., 240v. 50c.
BORONIA, Vic., 230v. 50c. Con. 53. Pln. 700.
BOSTOCK CREEK, Vic., 230v. 50c. Con. 24. Pln. 50.
BOTANY, N.S.W., 240v. 50c.
BOTHWELL, Tas., 240v. 50c. Con. 135. Pln. 450.
BOULDER, W.A. (see Kalgoorlie).
BOWEN, Qld., 240v. 50c. Pln. 3,000.
BOWNING, N.S.W., 240v. 50c. Con. 19. Pln. 360.
BOWRAL, N.S.W., 240v. 50c. Con. 820. Pln. 3,000. Hs. 750.
BOWRAVILLE, N.S.W., 240v. 50c.
BOWTHORNE, N.S.W., (see West Maitland).
BOX HILL, Vic., 230v. 50c. Con. 5,500. Pln. 13,400.
BOYA, W.A., 250v. 40c.
BRACKNELL, Tas., 240v. 50c. Con. 52.
BRAESIDE, Vic., 230v. 50c.
BRANXTON, N.S.W. (see Greta).
BREWARRINA, N.S.W., 240v. D.C.
BRIAR HILL, Vic., 230v. 50c. Con. 44. Pln. 200.
BRICKENDON, Tas., 240v. 50c.
BRIDGETOWN, W.A., 220v. D.C. Con. 210. Pln. 1,200.
BRIDGEWATER, S.A., 200v. 50c. Con. 88. Pln. 360.
BRIDGEWATER, Tas., 240v. 50c. Con. 50. Pln. 280.
BRIGHT, Vic., 230v. 50c. Pln. 650.
BRIGHTON, Tas., 240v., 50c.
BRIGHTON, Vic., 200v., 50c.
BRINKWORTH, S.A., 200v., 50c. Con. 56.
BRISBANE, Qld., 240v. 50c. Con. 40,405. Pln. 220,000.
BROADFORD, Vic., 230v. D.C. Con. 200. Pln. 1,000.
BROKEN HILL, N.S.W., 110v. 100c. Con. 3,200. Pln. 26,000. Hs. 7,000.
BROOKTON, W.A., 220v. D.C.
BROOKVALE, N.S.W., 240v. 50c.
BROOME, W.A., 220v. D.C.
BRUCE ROCK, W.A., 220v. D.C. Con. 130.
BRUNGLE, N.S.W., 240v. 50c. Con. 14. Pln. 80.
BRUNSWICK, W.A., 220v. D.C.
BRUNSWICK, Vic., 230v. 50c. Con. 13,092. Pln. 56,200.
BRUNSWICK HEADS, N.S.W., 240v., 50c. Con. 60. Hs. 80.
BRUTHEN, Vic., 230v. 50c. Con. 88. Pln. 580.
BULLI, N.S.W., 240v. 50c. Con. 3,100.
BUNBURY, W.A., 220v. D.C. Con. 1,140.
BUNDABERG, Qld., 240v. D.C. Con. 1,600. Pln. 10,000.
BUNDANOON, N.S.W., 240v. 50c. Con. 300. Pln. 1,000. Hs. 350.
BUNYIP, Vic., 230v. 50c. Con. 56, Pln. 600.
BURNIE, Tas., 240v. 50c. Con. 1,100. Pln. 4,230.
BURRA, S.A., 240v. 50c.
BURRADOO, N.S.W., 240v. 50c.
BURRAWA, N.S.W., 240v. 50c.
BURRAWANG, N.S.W. (see Bundanoon).
BUSSELTON, W.A., 220v. D.C.
BUTE, S.A., 240v. D.C. Con. 83.
BYFORD, W.A., 250v. 40c.
BYRON BAY, N.S.W., 240v. 50c. Con. 310. Pln. 1,800. Hs. 350.

C

CABRAMATTA, N.S.W., 240v. 50c.
CAIRNS DISTRICT, Qld., 240v. 50c. Con. 2,500, Pln. 10,000.
CALTOWIE, S.A., 200v. 50c. Con. 59.
CAMBERWELL, Vic., 200v. 50c.
CAMBRIDGE, Tas., 240v. 50c. Con. 64.
CAMDEN, N.S.W., 240v. 50c. Con. 250. Pln. 1,100. Hs. 360.
CAMPANIA, Tas., 240v. 50c. Con. 70.
CAMPBELLTOWN, N.S.W., 240v. 50c. Con. 370. Pln. 2,000. Hs. 400.
CAMPBELLTOWN, Tas., 240v. 50c. Con. 170. Pln. 650.
CAMPERDOWN, Vic., 230v. 50c. Con. 622. Pln. 3,500.
CANBERRA, F.C.T., 240v. 50c. Con. 1,500. Pln. 8,000.
CANLEY VALE, N.S.W. (Included in Cabramatta).
CANNINGTON, W.A., 250v. 40c.
CANOWINDRA, N.S.W., 240v. D.C. Con. 350. Pln. 2,000.
CARDIFF, N.S.W., 240v. 50c.
CARDUP, W.A., 250v. 40c.
CARLINGFORD, N.S.W. (see Dundas).
CARNAMAGH, W.A., 220v., D.C.
CARNARVON, W.A., 220v. D.C. Con. 160. Pln. 750.
CARRATHOOL, N.S.W., 240v. 50c.
CARRINGTON, N.S.W., 240v. 50c.
CARUM, Vic., 240v. 50c. Con. 1,600. Pln. 7,000.
CARY'S GULLY, S.A., 240v. 50c.
CASINO, N.S.W., 240v. 50c. Con. 760. Pln. 4,500.
CASTERTON, Vic., 230v. D.C. Con. 265. Pln. 1,900.
CASTLE FORBES BAY, Tas., 240v. 50c. Con. 30.
CASTLEMAINE, Vic., 230v. 50c. Con. 750. Pln. 5,650.
CAULFIELD, Vic., 200v. 50c.
CAVERSHAM, W.A., 250v. 40c.
CEDUNDA, S.A., 220v. D.C.
CENTRAL ILLAWARRA, 240v. 50c.
CESSNOCK, N.S.W., 240v. 50c. Con. 5,000. Pln. 20,000. Hs. 4,258.
CHAIN OF PONDS, S.A., 200v. 50c. Con. 22. Pln. 150.
CHARLESTOWN, N.S.W., 240v. 50c.
CHARLESTOWN, S.A., 240v. 50c.
CHARLEVILLE, Qld., 240v. D.C., Con. 450. Pln. 3,500.
CHARLTON, Vic., 230v. D.C. Con. 350. Pln. 1,215.
CHELTENHAM, Vic., 200v. 50c.
CHILDERS, Qld., 220v. D.C. Con. 220. Pln. 2,000.
CHILTERN, Vic., 230v. 50c. Con. 112. Pln. 1,500.
CIRCULAR HEAD, Tas., 240v. 50c. Con. 358.
CLARE, S.A., 230v. 50c.
CLAREMONT, W.A., 250v. 40c.
CLARENCE RIVER COUNTY COUNCIL, N.S.W., 240v. 50c. Con. 3,608.
CLAREVILLE, N.S.W., 240v. 50c.
CLAYTON, Vic., 230v. 50c. Con. 71. Pln. 250.
CLEVE, S.A., 220v. D.C.
COBAR, N.S.W., 240v. D.C.
COBDEN, Vic., 230v. 50c. Con. 182. Pln. 650.
COBRAM, Vic., 230v. D.C. Con. 143. Pln. 850.
COBURG, Vic., 230v. 50c. Con. 9,279. Pln. 40,200.
COFF'S HARBOUR, N.S.W., 240v. D.C.
COHUNA, Vic., 230v. D.C. Con. 210.
COLAC, Vic., 230v. 50c. Con. 1,192. Pln. 4,950.
COLERAINE, Vic, 230v. D.C. Con. 174. Pln. 900.
COLLAROY, N.S.W., 240v. 50c.
COLLIE, W.A., 250v. D.C.
COLLINGWOOD, Vic., 230v. 50c.
CONARA, Tas., 240v. 50c.
CONDOBOLIN, N.S.W., 240v. 50c.
COOEE, Tas., 240v. 50c. Con. 50.
COOLAMON, N.S.W., 230v. 50c. Con. 224. Pln. 2,000. Hs. 230.
COOLANGATTA, Qld., 240v. 50c. Con. 800. Pln. 3,000.
COOMA, N.S.W., 240v. D.C.
COONABARABRAN, N.S.W., 240v. 50c. Con. 200. Pln. 3,000.
COONAMBLE, N.S.W., 240v. 50c.
COOROW, W.A., 220v. D.C.
COOTAMUNDRA, N.S.W., 240v. 50c.
COPMANHURST, N.S.W., 240v. 50c.
CORAKI, N.S.W., 240v. 50c. Con. 180. Pln. 1,200. Hs. 250.
CORNWALL, Tas., 240v. 50c. Con. 40.
COROMANDEL VALLEY, S.A., 200v. 50c. Con. 56.
COROROOKE, Vic., 230v. 50c. Con. 106. Pln. 150.
COROWA, N.S.W., 240v. 50c. Con. 490. Pln. 2,500.
CORRIGIN, W.A., 220v. D.C. Con. 80.
CORRIMAL, N.S.W., 240v. 50c.
CORINDHAP, Vic., 220v. 50c.
COTTESLOE, W.A., 250v. 40c. Con. 3,000.
COTTESLOE BEACH, W.A., 250v. 40c. Con. 3,000.
COUTTS CROSSING, N.S.W., 240v. 50c.
COWELL, S.A., 220v. D.C.
COWRA, N.S.W., 240v. 50c. Con. 820. Pln. 4,000. Hs. 1,000.
COWWARR, Vic., 230v. 50c. Con. 68. Pln. 200.
CRAFERS, S.A., 200v. 50c. Con. 709.
CRANBOURNE, Vic., 230v. 50c. Con. 74. Pln. 300.
CRESSY, Tas., 240v. 50c. Con. 60.

CRIB POINT, Vic., 230v. 50c. Con. 100. Pln. 150.
CROOKWELL, N.S.W., 240v. D.C.
CROYDON, Vic., 230v. 50c. Con. 485. Pln. 1,800.
CRYSTAL BROOK, S.A., 240v. 50c.
CUE, W.A., 220v. D.C.
CULCAIRN, N.S.W., 240v. D.C.
CURRAMULKA, S.A., 110v. D.C.
CULLEN BULLEN, Tas., 240v. 50c. Con. 60. Pln. 500.
CUNDERDIN, W.A., 220v. D.C.
CUNNAMULLA, Qld., 240v. D.C. Con. 160.
CYGNET, Tas., 240v. 50c. Con. 305. Pln. 1,000.

D

DALBY, Qld., 220v., D.C. Pln. 2,300.
DALWALLINU, W.A., 220v. D.C.
DANDENONG, Vic., 230v. 50c. Con. 1,189. Pln. 5,700.
DARBY'S FALLS, N.S.W., 240v. 50c. Con. 20. Pln. 200.
DARLINGTON, W.A., 250v. 40c.
DARNUM, Vic., 230v. 50c. Con. 50. Pln. 100.
DARWIN, North A., 230v. D.C.
DAVENPORT, S.A., 230v. D.C. Con. 130. Pln. 1,114.
DAYLESFORD, Vic., 230v. D.C. Con. 495. Pln. 3,200.
DEER PARK, Vic., 230v. 50c. Con. 13. Pln. 100.
DEE WHY, N.S.W., 240v. 50c.
DELORAINE, Tas., 240v. 50c. Con. 296.
DENILIQUIN, N.S.W., 240v. 50c.
DENNINGTON, Vic., 230v. 50c. Pln. 310.
DERWENT VALLEY, Tas., 240v. 50c. Con. 492. Pln. 4.277.
DEVONPORT, Tas., 240v. 50c. Con. 1,350. Pln. 5,530.
DIAMOND CREEK, Vic., 230v. 50c. Con. 66. Pln. 100.
DIGGER'S REST, Vic., 230v. 50c. Con. 19. Pln. 50.
DIMBOOLA, Vic., 230v. D.C. Con. 494. Pln. 1,500.
DINGLEY, Vic., 230v. 50c. Con. 28. Pln. 100.
DON, Tas., 240v. 50c. Con. 70.
DONALD, Vic., 230v. D.C., Con. 400 Pln. 1.800.
DONCASTER, Vic.. 200v. 50c. Con. 350. Pln. 1,800.
DONNYBROOK, W.A., 220v. D.C.
DOOKIE, Vic., 230v. 50c.
DORA CREEK, N.S.W., 240v. 50c.
DORRIGO, N.S.W., 240v. 50c.
DOVER, Tas., 240v. 50c. Con. 100.
DOWERIN, W.A., 220v. D.C. Con. 68. Pln. 380.
DROMANA, Vic., 230v. 50c. Con. 152. Pln. 350.
DROMEDARY, Tas., 240v. 50c. Con. 40.
DROUIN, Vic., 230v. 50c. Con. 175. Pln. 850.
DRYSDALE, Vic., 230v. 50c. Con. 69. Pln. 800.
DUBBO, N.S.W., 240v. 50c. Con. 2,111. Pln. 8,000. Hs. 1,842.
DUDLEY, N.S.W., 240v. 50c.
DUMBLEYUNG, W.A., 220v. D.C. Con. 73. Pln. 250.
DUNDAS, N.S.W., 240v. 50c. Con. 1,360. Pln. 5,800. Hs. 1,650.
DUNGOG, N.S.W., 240v. D.C.
DUNOLLY, Vic., 230v. 50c. Con. 105. Pln. 580.
DYSART, Tas., 240v. 50c.

E

EAGLEHAWK, Vic., 230v. D.C. Con. 630. Pln. 4,719.
EASTWOOD, N.S.W. (see Dundas). 240v. 50c.
EAST GRETA, N.S.W., 240v. 50c.
EAST MAITLAND, N.S.W. (see West Maitland).
ECHUCA, Vic., 230v. 50c. Con. 748. Pln. 4,032.
EDEN HILLS, S.A., 200v. 50c.
EDENHOPE, Vic., 230v. D.C. Pln. 400.
EDITHBURCH, S.A., 200v. D.C. Con. 70.
ELECTRONA, Tas., 240v. 50c.
ELLIOTT, Tas., 240v. 50c. Con. 42.
ELMORE, Vic., 230v. D.C. Con. 162. Pln. 700.
ELTHAM, Vic., 230v. 50c. Con. 106. Pln. 700.
EPPING, N.S.W. (see Dundas).
ERINA SHIRE, N.S.W., 240v. 50c. Con. 1.588. Pln. 4.375.
ERMINGTON, N.S.W. (see Dundas). 240v. 50c.
ESSENDON, Vic., 230v. 50c.
ESPERANCE, Tas., 240v. 50c. Con. 467.
ESPERANCE, W.A., 220v. D.C.
ESTELVILLE, N.S.W., 240v. 50c.
ETTALONG, N.S.W., 240v. 50c.
EUDUNDA, S.A., 240v. 50c.
EUROA, Vic., 230v. D.C. Con. 398. Pln. 2.300.
EVANDALE, Tas., 240v. 50c. Con. 112. Pln. 540.
EVELYN, Vic. (see Silvan).
EXETER, N.S.W. (see Bundanoon).
EXTON, Tas., 240v. 50c. Con. 36.

F

FAIRFIELD, N.S.W., 240v. 50c. Con. 1,740. Pln. 8,000. Hs. 1,850.
FAIRY MEADOW, N.S.W., 240v. 50c.
FASSIFERN, N.S.W., 240v. 50c.
FERN HILL, N.S.W., 240v. 50c.
FERNTREE GULLY, Vic., 230v. 50c. Con. 182. Pln. 1,200.
FERNY CREEK, Vic., 230v. 50c. Con. 22. Pln. 50.
FINGAL, Tas., 240v. 50c. Con. 102. Pln. 1,250.
FITZROY, Vic., 230v. 50c.
FLEMINGTON, Vic., 240v. 50c.
FLOWERDALE, Tas., 240v. 50c.
FOOTSCRAY, Vic., 230v. 50c. Con. 10,900. Pln. 51,800.
FORBES, N.S.W., 240v. 50c. Con. 650. Pln. 6,000. Hs. 1,200.
FOREST, Tas., 240v. 50c.
FORREST, W.A., 220v. D.C.
FORTH, Tas., 240v. 50c. Con. 106.
FORSTER, N.S.W., 240v. 50c.
FOSTER, Vic., 230v. 50c. Pln. 650.
FRANKLIN, Tas.. 240v. 50c. Con. 178. Pln. 860.
FRANKSTON, Vic., 230v. 50c. Con. 1,242. Pln. 3,000.
FREELING, S.A., 200v., 50c. Con. 120. Pln. 1,000.
FREMANTLE, W.A., 250v. 40c. Con. 6,100. Pln. 38.000.
FOROS, S.A., 200v. 50c. Con. 4.

G

GALONG, N.S.W., 240v. 50c. Con. 51. Pln. 450.
GARFIELD, Vic., 230v. 50v. Con. 55. Pln. 200.
GAWLER, S.A., 200v. 50c. Con. 1.046. Pln. 2,320.
GAWLER, Tas., 240v. 50c. Con. 36.
GAWLER RIVER, S.A., 200v. 50c. Con. 70.
GAYNDAH, Qld., 240v. D.C. Con. 100.
GEELONG, Vic., 230v. 50c. Con. 9,118. Pln. 29,700.
GEEVESTON, Tas., 240v. 50c. Con. 340. Pln. 1,430.
GEORGETOWN, S.A., 200v. 50c. Con. 46.
GERALDTON, W.A., 220v. D.C. Con. 1,050. Pln. 5,000.
GERRINGONG, N.S.W., 240v. 50c. Pln. 500.
GILGANDRA, N.S.W., 240v. D.C. Con. 300. Pln. 2,700. Hs. 440.
GIRRAWEEN, N.S.W., 240v. 50c.
GISBORNE, Vic., 230v. 50c. Con. 107. Pln. 600.
GLADSTONE, Qld., 240v. D.C.
GLADSTONE, S.A., 200v. 50c. Con. 211.
GLEN EWIN, S.A., 200v. 50c.
GLEN GARRY, Vic., 230v. 50c. Con. 18. Pln. 120.
GLEN HUON, Tas., 240v. 50c. Con. 120.
GLEN INNES, N.S.W., 240v. 50c. Con. 880. Pln. 5,000. Hs. 1,300.
GLENORA, Tas., 240v. 50c. Con. 40.
GLEN WAVERLEY, Vic., 230v. 50c. Con. 32. Pln. 350.
GLOUCESTER, N.S.W., 240v. 50c.
GNOWANGERUP, W.A., 220v. D.C.
GOOLWA, S.A., 240v. 50c.
GOOMALLING, S.A., 220v. D.C.
GOONDIWINDI, Old., 240v. D.C. Con. 240. Pln. 1,600.
GOOSEBERRY HILL, W.A., 250v. 40c.
GORDON, Tas.. 240v. 50c. Con. 40.
GORMANSTONE, Tas., 235v. 50c. Con. 150. Pln. 1,000.
GOROKE, Vic., 230v. D.C. Pln. 200.
GOSFORD, N.S.W., 240v. 50c.
GOSNELLS, W.A., 250v. 40c.
GOULBURN CITY, N.S.W., 240v. D.C. Con. 4,461. Pln. 16.000. Hs. 3,800.
GOULBURN, N.S.W. (Outer City), 240v. 50c.
GRAFTON, N.S.W., 240v. 50c.
GRANTON, Tas., 240v. 50c.
GRANVILLE, N.S.W. (see Parramatta).
GREENMOUNT, W.A., 250v. 40c.
GREENOCK, S.A., 200v. 50c. Con. 32. Pln. 430.
GREEN PONDS, Tas.. 240v. 50c. Con. 112. Pln. 600.
GREENSBOROUGH, Vic., 230v. 50c. Con. 210. Pln. 930.
GRENFELL, N.S.W., 230v. 50c.
GRETA, N.S.W., 240v. 50c. Con. 390.Pln. 2,600. Hs. 500.
GRETNA, Tas., 240v. 50c. Con. 30.
GRIFFITH, N.S.W. (Irrigation Com.). 240v. 50c.
GROVE, Tas., 240v. 50c.
GUILDFORD, W.A., 240v. 50c.
GULGONG, N.S.W., 240v. 50c. Con. 200. Pln. 2,000. Hs. 580.

GUMERACHA, S.A., 200v. 50c. Con. 55. Pln. 550.
GUNDAGAI, N.S.W., 240v. 50c.
GUNDURIMBA, N.S.W., 240v. 50c.
GUNNEDAH, N.S.W., 240v. D.C. Con. 520. Pln. 3,000. Hs. 750.
GUNNING, N.S.W., 240v. D.C.
GUYRA, N.S.W., 240v. 50c. Con. 156. Pln. 1,200. Hs. 200.
GYMPIE, Qld., 250v. D.C., Con. 750. Pln. 9,000.

H

HACKHAM, S.A., 200v. 50c. Con. 18.
HAGLEY, Tas., 240v. 50c. Con. 30.
HALBURY, S.A., 200v. 50c. Con. 7.
HAITON, N.S.W. (see West Maitland).
HAMILTON, Vic., 230v. D.C. Con. 1,008. Pln. 5,098.
HAMILTON, N.S.W., 240v. 50c.
HAMILTON, S.A., 240v. 50c.
HAMLEY BRIDGE, S.A., 200v. 50c. Con. 129.
HAMPTON, S.A., 240v. 50c.
HARBORD, N.S.W., 240v. 50c.
HARRIS PARK, N.S.W., 240v. 50c.
HARVEY, W.A., 220v. D.C.
HARWOOD, N.S.W., 240v. 50c.
HASTINGS, Vic., 230v. 50c. Con. 72. Pln. 488.
HAWTHORN, Vic., 200v. 50c.
HAY, N.S.W., 240v. 50c. Con. 405. Pln. 3,000. Hs. 600.
HAYES, Tas., 240v. 50c.
HEALESVILLE, Vic., 230v. 50c. Con. 471. Pln. 2,400.
HEATHCOTE, Vic., 230v. D.C. Con. 235. Pln. 1,200.
HEDDON GRETA, N.S.W., 240v. 50c.
HEIDELBURG, Vic., 230v. 50c. Con. 6,044. Pln. 25,500.
HELENSBURGH, N.S.W., 240v. 50c. Con. 125.
HENTY, N.S.W., 240v. D.C.
HEPBURN, Vic., 230v. 50c. Con. 132. Pln. 200.
HEXHAM, N.S.W., 240v. 50c.
HEYFIELD, Vic., 230v. 50c. Con. 128. Pln. 700.
HIGHERCOMBE, S.A., 200v. 50c. Con. 63.
HILLSTON, N.S.W., 240v. 50c. Con. 150. Pln. 1,000.
HOBART, Tas., 240v. 50c. Con. 14,500. Pln. 58,789.
HOLBROOK, N.S.W., 240v. D.C. Con. 200 Pln. 1,000. Hs. 289.
HOLMESVILLE, N.S.W., 240v. 50c.
HOLROYD, N.S.W., 240v. 50c. Con. 3,200. Pln. 14,000.
HOME HILL, Qld., 240v. 50c. Con. 360. Pln 3,000.
HOPETOUN, Vic., 230v. D.C. Con. 135. Pln. 800.
HORNSBY, N.S.W., 240v. 50c. Con. 4,215. Pln. 20,000.
HORSHAM, Vic., 230v. D.C. Con. 1,029. Pln. 5,129.
HOUGHTON, S.A., 200v. 50c. Pln. 150.
HUGHENDEN, Qld., 240v. D.C. Con. 180. Pln. 1,500.
HUON, Tas., 240v. 50c. Con. 793.
HUONVILLE, Tas., 240v. 50c. Con. 120.
HURSTVILLE, N.S.W., 240v. 50c.

I

INGLEBURN, N.S.W., 240v. 50c.
INGLEWOOD, S.A., 200v. 50c. Con. 12.
INGLEWOOD, Vic., 230v. D.C. Con. 180. Pln. 1,100.
INNISFAIL, Qld., 240v. 50c.
INVERELL, N.S.W., 240v. 50c. Con. 760. Pln. 5,000.
INVERLOCH, Vic., 110v. D.C. Con. 12. Pln. 120.
IPSWICH, Qld., 240v. 50c. Con. 4,030. Pln. 20,000.
IRISHTOWN, Tas., 240v. 50c. Con. 30.
IRON KNOB, S.A., 230v. 50c.

J

JAMBUNNA, Vic., 230v. 50c. Con. 35. Pln. 400.
JAMESTOWN, S.A., 200v. 50c. Con. 379.
JASPERS BRUSH, N.S.W., 240v. 50c.
JEPARIT, Vic., 230v. D.C. Con. 225. Pln. 800.
JERICHO, Tas., 240v. 50c.
JERILDERIE, N.S.W., 240v. 50c. Con. 120. Pln. 720.
JUDBURY, Tas., 240v. 50c. Con. 26.
JUGIONG, N.S.W., 240v. 50c. Con. 21. Pln. 150.
JUNEE, N.S.W., 240v. 50c.

K

KADINA, S.A., 220v. D.C.
KALAMUNDA, W.A., 250v. 40c. Con. 1,900.
KALGOORLIE, W.A., 220v. D.C. Con. 600. Pln. 5,000.
KALIMNA, Vic. 230v. 50c.
KALLISTA, Vic., 230v. 50c. Con. 34. Pln. 150.
KANDOS, N.S.W., 240v. 50c. Con. 320. Pln. 2,500.
KANGAROO FLAT, Vic., 230v. 50c. Con. 60. Pln. 835.
KANIVA, Vic., 230v. 50c. Con. 135. Pln. 550.
KAPUNDA, S.A., 200v. 50c. Con. 271. Pln. 1,660.
KATANNING, W.A., 220v. D.C. Con. 600. Pln. 3,000.
KATOOMBA, N.S.W., 240v. 50c. Con. 2,000. Pln. 12,000. Hs. 2,500.
KEARSLEY, N.S.W. 240v. 50c.
KEIRAVILLE, N.S.W., 240v. 50c.
KELLERBERRIN, W.A., 220v. D.C.
KELMSCOTT, W.A., 250v. 40c.
KEMPSEY, N.S.W., 240v. D.C. Con. 800. Pln. 5,000. Hs. 1,200.
KEMPTON, Tas., 240v. 50c. Con. 80. Pln. 363.
KENTISH, Tas., 240v. 50c. Con. 319.
KENWICK, W.A., 250v. 40c.
KERANG, Vic., 230v. D.C. Con. 550. Pln. 2,750.
KERSLEY, N.S.W. (see West Maitland).
KETTERING, Tas., 240v. 50c. Con. 46.
KEW, Vic., 200v. 50c.
KIAMA, N.S.W., 240v. 50c. Con. 371, Pln. 1,200. Hs. 500.
KILMORE, Vic., 230v. D.C. Con. 180. Pln. 900
KILSYTH, Vic., 230v. 50c. Con. 33. Pln. 150.
KINGAROY, Qld., 240v. D.C. Con. 120. Pln. 2,000.
KINGBOROUGH, Tas., 240v. 50c. Con. 607.
KINGSTON, Tas., 230v. 50c. Con. 260. Pln. 1,050.
KITCHENER, N.S.W., 240v. 50c.
KOGARAH, N.S.W., 240v. 50c.
KOJONUP, W.A., 110v. D.C. Con. 60.
KOLORA, Vic., 230v. 50c. Con. 92.
KONGWAK, Vic., 230v. 50c. Con. 48. Pln. 80.
KONDININ, W.A., 220v. D.C.
KOOLUNGA, S.A., 110v. D.C.
KOONDROOK, Vic., 230v. 50c. Con. 60. Pln. 400.
KOORDA, W.A., 220v. D.C.
KOO-WEE-RUP, Vic., 230v. 50c. Con. 70. Pln. 500.
KOROIT, Vic., 230v. 50c. Con. 235. Pln. 2,000.
KORONGVILLE, Vic., 230v. 50c. Con. 186. Pln. 500.
KORUMBURRA, Vic., 230v. 50c. Con. 565. Pln. 3,000.
KULIN, W.A., 220v. D.C.
KUNONOPPIN, W.A., 220v. D.C.
KURRI KURRI, N.S.W., 240v. 50c. Con. 1,000.
KYABRAM, Vic., 230v. 50c. Con. 388. Pln. 1,700.
KYNETON, Vic., 230v. 50c. Con. 649. Pln. 3,195.
KYOGLE, N.S.W., 240v. D.C.

L

LAKE BOGA, Vic., 230v. 50c. Pln. 300.
LAKE CARGELLICO, 240v. 50c.
LAKE GRACE, W.A., 220v. D.C.
LAKE MACQUARIE, N.S.W., 240v. 50c.
LAKES ENTRANCE, Vic., 230v. 50c. Con. 148. Pln. 900.
LAMBTON, N.S.W., 240v. 50c.
LAMEROO, S.A., 230v. D.C.
LANCEFIELD, Vic., 230v. 50c. Con. 95. Pln. 600.
LARA, Vic., 230v. 50c.
LARPENT, Vic., 230v. 50c. Con. 50.
LATROBE, Tas., 240v. 50c. Con. 279. Pln. 1,660.
LAUNCESTON, Tas., 240v. 50c. Con. 8,240. Pln. 31,700.
LAURA, S.A., 230v. D.C.
LAWSON, N.S.W., 240v. 50c.
LEASINGHAM, S.A., 200v. 50c.
LEETON, N.S.W. (Irrigation Com.), 240v. 50c.
LEONGATHA, Vic., 230v. 50c. Con. 433. Pln. 1,700.
LEONARA, W.A., 220v. D.C.
LEVEN, Tas., 240v. 50c. Con. 615.
LILYDALE, Vic., 230v. 50c. Con. 275. Pln. 1,800.
LISMORE, N.S.W., 240v. 50c. Con. 1,856. Pln. 12,000. Hs. 2,600
LITHGOW, N.S.W., 240v. 50c. Con. 2,500. Pln. 1,700. Hs. 3,500.
LITTLEHAMPTON, S.A., 200v. 50c. Con. 54. Pln. 355.
LIVERPOOL, N.S.W., 240v. 50c. Con. 860. Pln. 7,000. Hs. 1,400.
LOCH, Vic., 230v. 50c. Con. 67. Pln. 136.
LOCKHART, N.S.W., 240v. D.C. Con. 200. Pln. 900. Hs. 230.
LONGFORD, Tas., 240v. 50c. Con. 412. Pln. 1,156.
LONGLEY, Tas., 240v. 50c.
LONGREACH, Qld., 240v. D.C. Con. 530. Pln. 5,000.
LONGWARRY, Vic., 230v. 50c. Con. 43. Pln. 300.

LORN, N.S.W. (see West Maitland).
LOWER FERNTREE GULLY, Vic., 230v. 50c.
LORNE, Vic., 230v. D.C. Con. 120. Pln. 250.
LOWER LONGLEY, Tas., 240v. 50c. Con. 30.
LOWER PLENTY, Vic., 230v. 50c. Con. 27. Pln. 50.
LOXTON, S.A., 220v. D.C.
LUCASTON, Tas., 240v. 50c.
LYMINGTON, Tas., 240c. 50c.
LYNDOCH, S.A., 200v. Con. 48.

M

MACEDON, Vic., 230v. 50c. Con. 191. Pln. 250.
MACKAY, Qld., 240v. 50c. Con. 650. Pln. 7,000.
MACKSVILLE, N.S.W., 240v. 50c.
MACLEAN, N.S.W., 240v. 50c.
MACQUARIE PLAINS, Tas., 240v. 50c. Con. 50.
MADDINGTON, W.A., 250v. 40c.
MAFFRA, Vic., 230v. 50c. Con. 488. Pln. 2,000.
MAITLAND, S.A., 230v. D.C.
MALLALA, S.A., 200v. 50c. Con. 71. Pln. 365.
MALVERN, Vic., 200v. 50c.
MANILLA, N.S.W., 240v. 50c.
MANJIMUP, W.A., 230v. D.C. Con. 183. Pln. 600.
MANLY, N.S.W., 240v. 50c. Con. 6,860. Pln. 24,000.
MANLY VALE, N.S.W., 240v. 50c.
MANNUM, S.A., 230v. 50c.
MARGATE, Tas., 240v. 50c. Con. 60.
MARRABEEL, S.A., 240v. 50c.
MARULAN, N.S.W., 240v. 50c.
MARYBOROUGH, Qld., 240v. 50c. Con. 1,500. Pln. 12.000
MARYBOROUGH, Vic., 230v. 50c. Con. 1,130. Pln. 5,175.
MAYFIELD, N.S.W. (see West Maitland).
McLAREN FLAT, S.A., 200v. 50c. Con. 35.
McLAREN VALE, S.A., 200v. 50c. Con. 99.
MECKERING, W.A., 220v. D.C. Con. 65. Pln. 500.
MEDLOW BATH, N.S.W. (see Blackheath).
MEEKATHARRA, W.A., 220v. D.C. Con. 145. Pln. 500
MELBOURNE CITY, Vic., 230v. 50c. Con. 25,462. Pln. 102,000.
MELTON MOWBRAY, Tas., 240v. 50c.
MENTONE, Vic., 200v. 50c.
MERBEIN, Vic., 230v. 50c. Con. 150.
MEREWETHER, N.S.W., 240v. 50c.
MERREDIN, W.A., 220v. D.C. Con. 200.
MERRIGUM, Vic., 230v. 50c. Con. 55. Pln. 200.
MERRYLANDS, N.S.W., 240v. 50c.
MIDDLE SWAN, W.A., 250v. 40c.
MIDDLETON, Tas., 240v. 50c.
MIDLAND JUNCTION, W.A., 250v. 40c.
MILDURA, Vic., 230v. D.C. Con. 1,200. Pln. 6,000.
MILLER'S FOREST, N.S.W., 240v. 50c.
MILLICENT, S.A., 240v. D.C.
MILTON, N.S.W., 110v. D.C.
MINGENEW, W.A., 110v. D.C.
MINLATON, S.A., 230v. D.C.
MINTARO, S.A., 230v. D.C.
MINYIP, Vic., 230v. D.C. Con. 165. Pln. 700.
MIRBOO NORTH, Vic., 230v. 50c. Con. 127. Pln. 600.
MITTAGONG, N.S.W., 240v. 50c. Con. 431. Pln. 2,000.
MOAMA, N.S.W., 240v. 50c. Con. 60. Pln. 500. Hs. 120.
MOANA, S.A., 200v. 50c. Con. 4.
MOE, Vic., 230v. 50c. Con. 174. Pln. 400.
MOLONG, N.S.W., 240v. 50c.
MONA VALE, N.S.W., 240v. 50c.
MONEGEETA, Vic., 230v. 50c. Con. 11. Pln. 50.
MONTMORENCY, Vic., 230v. 50c. Con. 41. Pln. 400.
MONTROSE, Vic., 230v. 50c. Con. 67. Pln. 100.
MOONTA, S.A., 230v. D.C.
MOORABBIN, Vic., 200v. D.C.
MOOROOPNA, Vic., 230v. 50c. Con. 215. Pln. 1,500.
MOOROODUC, Vic., 230v. 50c. Con. 3. Pln. 20.
MORDIALLOC, Vic., 200v. 50c.
MOREE, N.S.W., 240v. 50c. Con. 640. Pln. 4,000. Hs. 723.
MORGAN, S.A., 220v. D.C.
MORISSET, N.S.W., 240v. 50c.
MORNINGTON, Vic., 230v. 50c. Con. 610. Pln. 2,100.
MOROWA, W.A., 220v. D.C.
MORPETH, N.S.W. (see West Maitland).
MORPETH VALE, S.A., 200v. 50c. Con. 34.
MORTLAKE, Vic., 230v. 50c. Con. 240. Pln. 1,000.
MORUYA, N.S.W., 240v. 50c. Con. 100. Pln. 1,100. Hs. 210.
MORWELL, Vic., 230v. 50c. Con. 289. Pln. 1,365.
MOSS VALE, N.S.W., 240v. 50c.
MOUNT BARKER, S.A., 200v. 50c. Con. 247. Pln. 2,180.
MOUNT BARKER, W.A., 220v. D.C. Con. 75.
MOUNT GAMBIER, S.A., 230v. D.C.
MOUNT KEIRA, N.S.W., 240v. 50c.
MOUNT LOFTY, S.A., 200v. 50c. Pln. 305.
MOUNT MAGNET, W.A., 110v. D.C.
MOUNT NICHOLAS, Tas., 240v. 50c.
MOUNT PLEASANT, S.A., 200v. 50c. Con. 55.
MOUNT PLEASANT, N.S.W., 240v. 50c.
MOUNT TORRENS, S.A., 240v. 50c.
MUDGEE, N.S.W., 240v. 50c. Con. 750. Pln. 4,500. Hs. 1,000.
MULBRING, N.S.W., 240v. 50c.
MULGRAVE, Vic., 230v. 50c. Con. 103. Pln. 350.
MULLEWA, W.A., 220v. D.C.
MULLUMBIMBY, N.S.W., 240v. 50c. Con. 280. Pln. 1,400. Hs. 325.
MUNDARING, W.A., 220v. D.C.
MURCHISON, Vic., 230v. 50c. Con. 100. Pln. 600.
MURGON, Qld., 240v. 50c. Con. 160.
MURRAY BRIDGE, S.A., 230v. D.C. Con. 650. Pln. 3,700.
MURRAYVILLE, Vic., 230v. 50c. Con. 80. Pln. 400.
MURRUMBIDGEE IRRIGATION AREAS, 240v. 50c. Con. 2.700. Pln. 18.000. Hs. 4.000.
MURRUMBURRAH, N.S.W., 240v. 50c.
MURRURUNDI, N.S.W., 230v. 50c. Con. 206. Pln. 1,300. Hs. 240.
MURTOA, Vic., 230v. D.C. Con. 296. Pln. 1,140. Hs. 825.
MURWILLUMBAH, N.S.W., 240v. 50c. Con. 900. Pln. 5.000.
MUSWELLBROOK, N.S.W., 240v. 50c. Con. 600. Pln. 3,000. Hs. 800.
MYLOR, S.A., 200v. 50c. Con. 32.

N

NAGAMBIE, Vic., 230v. D.C. Con. 150. Pln. 750.
NAIRNE, S.A., 200v. 50c. Con. 71.
NALANGAIL, Vic., 230v. 50c. Con. 61. Pln. 100.
NAMBOUR, Qld., 240v. 50c.
NAMBUCCA, N.S.W., 240v. 50c.
NANNUP, W.A., 220v. D.C.
NARACOORTE, S.A., 220v. D.C.
NAREMBEEN, W.A., 220v. D.C. Con. 50.
NARRABEEN, N.S.W., 240v. 50c.
NARRABRI, N.S.W., 240v. D.C.
NARRANDERA, N.S.W., 240v. 50c.
NARRE WARREN, Vic., 230v. 50c. Con. 13. Pln. 100.
NARROGIN, W.A., 220v. D.C. Con. 730. Pln. 2,500.
NARROMINE, N.S.W., 240v. 50c. Con. 258. Pln. 1,600. Hs 425.
NATHALIE, Vic., 230v. D.C. Con. 171. Pln. 860.
NATIMUK, Vic., 230v. 50c. Con. 105. Pln. 559.
NEATH, N.S.W., 240v. 50c.
NERRIM, Vic., 235v. 50c. Pln. 300.
NEWCASTLE & DISTRICT, N.S.W., 240v. 50c. Con. 29.010 Pln. 149.035. Hs. 34,409.
NEW GISBORNE, Vic., 230v. 50c.
NEW LAMBTON, N.S.W., 240v. 50c.
NEWPORT, N.S.W., 240v. 50c.
NEW NORFOLK, Tas., 240v. 50c. Con. 669. Pln. 1,920.
NEWRY, Vic., 230v. 50c. Con. 30. Pln. 300.
NHILL, Vic., 230v. D.C. Con. 400. Pln. 1,700.
NICHOLLS RIVULET, Tas., 240v. 50c. Con. 30.
NILMA, Vic., 230v. 50c. Con. 23. Pln. 100.
NYMBOIDA, N.S.W., 240v. 50c.
NOARLUNGA, S.A., 200v. 50c. Con. 38.
NOBLE PARK, Vic., 230v. 50c. Con. 61. Pln. 120.
NORTHAM, W.A., 220v. D.C. Con. 1,000. Pln. 5,000.
NORTHAMPTON, W.A., 220v. D.C. Con. 90. Pln. 500.
NORTHCOTE, Vic., 230v. 50c. Con. 10.380. Pln. 41,500.
NORTH FREMANTLE, W.A., 250v. 40c. Con. 800. Pln. 4,500.
NORTH ILLAWARRA, N.S.W., 240v. 50c. Con. 1.652. Pln. 8.000. Hs. 1,660.
NORTH PARRAMATTA, N.S.W. (see Dundas).

NORTH MANLY, N.S.W., 240v. 50c.
NORTH SUMMIT, S.A., 200v. 50c. Con. 141.
NORTH WOLLONGONG, N.S.W., 240v. 50c.
NOWRA, N.S.W., 240v. 50c. Con. 546. Pln. 3,000. Hs. 650.
NUMURKAH, Vic., 230v. D.C. Con. 329. Pln. 1,350.
NURIOOTPA, S.A., 200v. 50c. Con. 162. Pln. 2,475.
NYAH, Vic., 230v. 50c. Con. 40. Pln. 600.
NYNGAN, N.S.W., 240v. D.C.

O

OAKBANK, S.A., 240v. 50c.
OAKLEIGH, Vic., 200v. 50c.
OATLANDS, Tas., 240v. 50c. Con. 170. Pln. 760.
OCEAN BEACH, N.S.W., 240v. 50c.
OCEAN GROVE, Vic., 230v. 50c. Con. 37. Pln. 50.
OFFICER, Vic., 230v. 50c. Con. 5. Pln. 50.
OLINDA, Vic., 230v. 50c. Con. 73. Pln. 250.
OMEO, Vic., 230v. 50c.
ORANGE, N.S.W., 240v. 50c. Con. 2,534. Pln. 12,000. Hs. 2,650.
ORANGE GROVE, N.S.W., 240v. 50c.
ORARA, N.S.W., 240v. 50c.
ORBOST, Vic., 230v. D.C. Con. 320. Pln. 2,000.
ORRORoo, S.A., 240v. D.C.
OUYEN, Vic., 230v. D.C. Con. 160. Pln. 950.
OWEN, S.A., 200v. 50c. Con. 54. Pln. 795.
OYSTER COVE, Tas., 240v. 50c.

P

PAKENHAM, Vic., 230v. 50c. Con. 83. Pln. 400.
PALM BEACH, N.S.W., 240v. 50c.
PAMBULA, 240v. D.C.
PARACOMBE, S.A., 200v. 50c.
PARKES, N.S.W., 240v. 50c. Con. 955. Pln. 5,800. Hs. 1,100.
PARRAMATTA, N.S.W., 240v. 50c. Con. 6,400. Pln. 38,000. Hs. 7,600.
PARATTAH, Tas., 240v. 50c. Con. 50. Pln. 210.
PARA-WIRRA, S.A., 200v. 50c.
PATERSON, N.S.W. (see West Maitland).
PATONGA, N.S.W., 240v. 50c. Hs. 100.
PATRICK'S PLAINS, N.S.W. (see Singleton).
PAXTON, N.S.W., 240v. 50c.
PEAK HILL, N.S.W., 240v. 50c. Con. 202. Pln. 1,200. Hs. 230.
PELAW MAIN, N.S.W., 240v. 50c.
PENDLE HILL, N.S.W., 240v. 50c.
PENGUIN, Tas., 240v. 50c. Con. 150. Pln. 670.
PEMOLA, S.A., 220v. 50c.
PENRITH, N.S.W., 240v. 50c. Con. 750. Pln. 5,000. Hs. 1,000.
PENWORTHAM, S.A., 240v. 50c.
PEPPERMINT GROVE, W.A., 250v. 40c.
PERTH, Tas., 240v. 50c.
PERTH, W.A., 250v. 40c. Con. 30,770. Pln. 137,000.
PETERBOROUGH, S.A., 230v. D.C.
PHEGAN'S BAY, N.S.W., 240v. 50c. Hs. 70.
PHILIP ISLAND, Vic., 230v. 50c. Con. 50. Pln. 1,000.
PIALBA, Qld., 240v. 50c.
PICCADILLY, S.A., 200v. 50c.
PICTON, N.S.W., 240v. 50c.
PINNAROO, S.A., 230v. 50c.
PINGELLY, W.A., 220v. D.C. Con. 140.
PINJARRA, W.A., 220v. D.C.
PLENTY, Tas., 240v. 50c.
POINT LONSDALE, Vic., 230v. 50c. Con. 116. Pln. 700.
POMBORNEIT, Vic., 230v. 50c. Con. 21. Pln. 50.
PONTVILLE, Tas., 240v. 50c.
POOWONG, Vic., 230v. 50c. Con. 43. Pln. 100.
PORTARLINGTON, Vic., 230v. 50c. Con. 119. Pln. 600.
PORT AUGUSTA, S.A., 220v. D.C.
PORT AUGUSTA WEST, S.A., 220v. D.C.
PORT BROUGHTON, S.A., 230v. 50c.
PORT ELLIOT, S.A., 200v. 50c. Con. 57.
PORT FAIRY, Vic., 230v. 50c. Con. 276. Pln. 2,000.
PORT HUON, Tas., 240v. 50c.
PORTLAND, N.S.W., 240v. 50c. Con. 500. Pln. 5,000.
PORTLAND, Vic., 230v. 50c. Pln. 2,700.
PORT KEMBLA, N.S.W., 240v. 50c.
PORT LINCOLN, S.A., 220v. 50c.
PORT MACQUARIE, N.S.W., 230v. 50c.
PORT McDONALD, S.A., 220v. D.C.
PORT MELBOURNE, Vic., 230v. 50c. Con. 2,700. Pln. 13,100.
PORT NOARLUNGA, S.A., 200v. 50c. Con. 104.
PORT PIRIE, S.A., 230v. 50c. Con. 2,400.
PORTSEA, Vic., 230v. 50c. Con. 106. Pln. 150.
PORT STEVENS, N.S.W. (see West Maitland).
PORT VICTORIA, S.A., 220v. D.C.
PORT VINCENT, S.A., 220v. D.C.
PRAHRAN, Vic., 200v. 50c.
PRESTON, Vic., 230v. 50c. Con. 7,500. Pln. 29,200.
PROSERPINE, Qld., 240v. 50c. Con. 160.
PYRAMID HILL, Vic., 230v. 50c. Con. 90. Pln. 475.

Q

QUAIRADING, W.A., 220v. D.C.
QUAMBATOOK, Vic., 230v. D.C. Con. 104. Pln. 500.
QUEANBEYAN, N.S.W., 240v. 50c. Con. 1,000. Pln. 3,500. Hs. 1800.
QUEENSCLIFFE, Vic., 230v. 50c. Con. 458. Pln. 1,900.
QUEEN'S PARK, W.A., 250v. 40c.
QUEENSTONE, Tas., 220v. 50c. Con. 600. Pln. 3,470.
QUIRINDI, N.S.W., 240v. 50c.
QUORN, S.A., 230v. D.C.

R

RAILTON, Tas., 240v. 50c. Con. 106. Pln. 460.
RAINBOW, Vic., 230v. D.C. Con. 149. Pln. 900.
RANELAGH, Tas., 240v. 50c.
RAYMOND TERRACE, N.S.W., 240v. 50c.
RAYWORTH, N.S.W. (see West Maitland).
READ TOWN, N.S.W., 240v. 50c.
REDCLIFFE, Qld., 240v. 50c.
RED HILL, S.A., 230v. D.C.
RENMARK, S.A., 230v. D.C.
REYNELLA, S.A., 200v. 50c. Con. 76. Pln. 380.
RHYNIE, S.A., 240v. 50c.
RICHMOND, N.S.W., 240v. 50c.
RICHMOND, Vic., 230v. 50c.
RICHMOND, Tas., 240v. 50c. Con. 145. Pln. 675.
RIDDELL, Vic., 230v. 50c. Con. 22. Pln. 350.
RINGWOOD, Vic., 230v. 50c. Con. 626. Pln. 3,000.
RIVERTON, S.A., 240v. 50c.
ROBE, S.A., 230v. 50c.
ROBERTSON, N.S.W. (see Bundanoon).
ROCHESTER, Vic., 230v. D.C. Con. 372. Pln. 1,487.
ROCKDALE, N.S.W., 240v. 50c.
ROCKHAMPTON, Qld., 240v. 50c. Con. 4,430. Pln. 25,000.
ROCKINGHAM, W.A., 110v. D.C.
ROMA, Qld., 220v. D.C. Con. 600. Pln. 3,000.
ROMSEY, Vic., 230v. 50c. Con. 93. Pln. 600.
ROOKWOOD, Tas., 240v. 50c. Con. 30.
ROSEBERY, Tas., 240v. 50c. Con. 98. Pln. 540.
ROSEBUD, Vic., 230v. 50c. Con. 164. Pln. 200.
ROSEDALE, Vic., 230v. 50c. Con. 71. Pln. 520.
ROSEWORTHY, S.A., 200v. 50c. Con. 30.
ROSS, Tas., 240v. 50c. Con. 95. Pln. 506.
ROTTNEST, W.A., 220v. D.C. Con. 52.
RUBY, Vic., 230v. 50c. Con. 7. Pln. 50.
RUPANYUP, Vic., 230v. D.C. Con. 125. Pln. 700.
RUSHWORTH, Vic., 230v. D.C. Con. 275. Pln. 1,200.
RUTHERFORD, N.S.W. (see West Maitland).
RUTHERGLEN, Vic., 230v. 50c. Con. 261. Pln. 1,160.
RYE, Vic., 230v. 50c. Con. 30. Pln. 50.
RYLSTONE, N.S.W., 240v. 50c. Con. 120. Pln. 800.

S

SADDLEWORTH, S.A., 240v. 50c.
SALE, Vic., 230v. 50c. Con. 823. Pln. 4,000.
SALISBURY, S.A., 200v. 50c. Con. 831. Pln. 3,971.
SANDFLY, Tas., 240v. 50c.
SANDRINGHAM, Vic., 200v. 50c.
SASSAFRAS, Tas., 240v. 50c.
SASSAFRAS AREA, Vic., 230v. 50c. Con. 125. Pln. 500.
SCONE, N.S.W., 240v. D.C.
SCOTTSDALE, Tas., 240v. 50c. Con. 250. Pln. 1,480.
SEA LAKE, Vic., 230v. D.C. Con. 175. Pln. 600.
SEVEN HILLS, S.A., 240v. 50c.
SELMOUR, Vic., 230v. 50c. Con. 450. Pln. 2,525.
SHEFFIELD, Tas., 240v. 50c. Con. 350. Pln. 1,030.
SHELLHARBOUR, N.S.W., 240v. 50c.

SHEPPARTON, Vic., 230v. 50c. Con. 1,160. Pln. 6,000.
SHERBROOKE, Vic., 230v. 50c. Con. 31. Pln. 100.
SILVAN LINE & EVELYN, Vic., 230v. 50c. Con. 45. Pln. 650.
SINGLETON, N.S.W., 240v. 50c. Con. 1,090. Pln. 5,000. Hs. 1,500.
SMITHFIELD, S.A., 200v. 50c. Con. 22.
SMITHTON, Tas., 240v. 50c. Con. 150.
SNOWTOWN, S.A., 220v. D.C.
SNUG, Tas., 240v. 50c.
SOMERSET, Tas., 240v. 50c.
SOMERVILLE, Vic., 230v. 50c. Con. 58. Pln. 200.
SORELL, Tas., 240v. 50c. Con. 93. Pln. 428.
SORRENTO, Vic., 230v. 50c. Con. 294. Pln. 500.
SOUTHERN CROSS, W.A., 220v. D.C. Con. 119. Pln. 350.
SOUTH GRAFTON, N.S.W., 240v. 50c.
SOUTH GUILDFORD, W.A., 250v. 40c.
SOUTH MELBOURNE, Vic., 230v. 50c.
SOUTH PERTH, W.A., 250v. 40c. Con. 2,020. Pln. 5,000.
SOUTHPORT, Qld., 240v. 50c. Con. 1,100. Pln. 5,000.
SPEAR'S POINT, N.S.W., 240v. 50c.
SPION KOP, N.S.W., 240v. 50c.
SPREYTON, Tas., 240v. 50c.
SPRINGHURST, Vic., 230v. 50c. Con. 28. Pln. 100.
SPRINGHEAD, S.A., 110v. 50c.
SPRINGTON, S.A., 110v. D.C.
STANFORD MERTHYR, N.S.W., 240v. 50c.
STANLEY, Tas., 240v. 50c. Con. 145. Pln. 790.
STANTHORPE, Qld., 240v. 50c. Con. 425. Pln. 2,500.
STAWELL, Vic., 230v. 50c. Con. 595. Pln. 5,000.
ST. ALBANS, Vic., 230v. 50c. Con. 60. Pln. 600.
ST. ARNAUD, Vic., 230v. 50c. Con. 434. Pln. 3,500.
ST. GEORGE COUNTY COUNCIL, N.S.W., 240v. 50c. Con. 26,300. Pln. 130,000. Hs. 26,000.
ST. GEORGE, Qld., 230v. D.C. Con. 75. Pln. 800.
ST. KILDA, Vic., 200v. 50c.
ST. MARY'S, N.S.W., 240v. 15c. Con. 130. Pln. 2,000. Hs. 800.
STIRLING, S.A., 200v. 50c.
STOCKINBINGAL, N.S.W., 240v. 50c. Con. 60. Pln. 450.
STOCKTON, N.S.W., 240v. 50c.
STRATFORD, Vic., 230v. 50c. Con. 100. Pln. 800.
STRATHALBYN, S.A., 220v. D.C.
STREAKY BAY, S.A., 220v. D.C.
SUBIACO, W.A., 250v. 40c. Con. 4,000. Pln. 18,000.
SUMMERLEAS, Tas., 240v. 50c.
SUMMERTOWN, S.A., 200v. 50c.
SUNBURY, Vic., 230v. 50c. Con. 190. Pln. 2,000.
SUNSHINE, Vic., 230v. 50c.
SUTHERLAND, N.S.W., 240v. 50c. Con. 3,400. Pln. 13,000. Hs. 5,300.
SWAN HILL, Vic., 230v. 60c. Con. 550. Pln. 3,031.
SWAN REACH, Vic., 230v. 50c.
SWANSEA, N.S.W., 240v. 50c.
SWAN VIEW, W.A., 240/480v. D.C.
SYDNEY, CITY, N.S.W., 240/480v. D.C.
SYDNEY, METROPOLITAN, N.S.W., 240v. 50c. Con. 269,681. Pln. 866,032. Hs. 236,357.
SYMMONS PLAINS, Tas., 240v. 50c.

T

TABLE CAPE, Tas., 240v. 50c. Con. 515.
TAILEM BEND, S.A., 220v. D.C.
TALLY HO, Vic., 230v. 50c.
TALUNGA, S.A., 200v. 50c.
TAMMIN, W.A., 220v. D.C.
TAMBELLUP, W.A., 220v. D.C.
TAMWORTH, N.S.W., 240v. 50c. Con. 3,000. Pln. 12,000. Hs. 2,430.
TANUNDA, S.A., 220v. D.C.
TAREE, N.S.W., 240v. D.C.
TARRAWANNA, N.S.W., 240v. 50c.
TARRO, N.S.W., 240v. 50c. Con. 8. Pln. 110.
TATURA, Vic., 230v. 50c. Con. 258. Pln. 1,300.
TEA TREE, Tas., 240v. 50c.
TEA TREE GULLY, S.A., 200v. 50c. Con. 55. Pln. 1,015.
TELARAH, N.S.W. (see West Maitland).
TELOPEA, N.S.W. (see Dundas).
TEMORA, N.S.W., 240v. 50c. Con. 708. Pln. 3,800. Hs. 800.
TEMPLERS, S.A., 200v. 50c.
TENAMBIT, N.S.W. (see West Maitland).
TENTERFIELD, N.S.W., 240v. 50c. Con. 430. Pln. 2,800.
TERALBA, N.S.W., 240v. 50c.
TERANG, Vic., 230v. 50c. Con. 472. Pln. 2,255.
TERANIA, N.S.W., 240v. 50c.
TERRIGAL, N.S.W. (Erina Shire), 240v. 50c.
THARGOMINDAH, Qld., 220v. D.C. Con. 100. Pln. 300.
THE ENTRANCE, N.S.W. (Erina Shire), 240v. 50c.
THE ROCK, N.S.W., 240v. D.C.
THEODORE, Qld., 240v. D.C. Con. 23. Pln. 150.
THOMASTOWN, Vic., 230v. 50c. Con. 4.
THRONTON, Vic., 230v. 50c. Con. 42. Pln. 150.
THRONTON, N.S.W., 240v. 50c.
THREE SPRINGS, W.A., 220v. D.C.
TINAMBA, Vic., 230v. 50c. Con. 25. Pln. 50.
TINTENBAR, N.S.W., 240v. 50c.
TOCUMWAL, N.S.W., 240v. 50c. Con. 145. Pln. 1,200.
TONGALA, Vic., 230v. 50c. Con. 88. Pln. 250.
TOODYAY, W.A., 220v. D.C.
TOOGOOLAWAH, Qld., 240v. 50c.
TOOMBUL, Qld., 240v. 50c.
TOONGABBIE, N.S.W., 240v. 50c.
TOONGABBIE, Vic., 230v. 50c. Con. 13. Pln. 150.
TOORA, Vic., 230v. 50c. Con. 170. Pln. 350.
TOOWOOMBA, Qld., 240v. D.C. Con. 5,000. Pln. 26,000.
TORONTO, N.S.W., 240v. 50c.
TORQUAY, Vic., 230v. 50c. Con. 131.
TOWNSVILLE, Qld., 240v. 50c. Con. 4,120. Pln. 30,000.
TRAFALGAR, Vic., 230v. 50c. Con. 238. Pln. 700.
TRANGIE, N.S.W., 240v. 50c. Con. 90. Pln. 600. Hs 150.
TRARALGON, Vic., 230v. 50c. Con. 524. Pln. 2,300.
TREMONT, Vic., 230v. 50c. Con. 61. Pln. 200.
TRENTHAM, Vic., 230v. 50c. Con. 120. Pln. 750.
TULLY, Qld., 240v. 50c. Con. 207. Pln. 3,500.
TUMBARUMBA, N.S.W., 240v. 50c.
TUMBY BAY, S.A., 220v. D.C.
TUMUT, N.S.W., 240v. 50c. Con. 370. Pln. 2,100. Hs. 580.
TUNBRIDGE, Tas., 240v. 50c.
TUNCURRY, N.S.W., 240v. 50c.
TWEED HEADS, N.S.W., 240v. 50c.
TWEED VALE, S.A., 240v. 50c.
TWO WELLS, S.A., 200v. 50c. Con. 33.
TYAB, Vic., 230v. 50c. Con. 25. Pln. 50.
TYERS, Vic., 230v. 50c. Con. 49. Pln. 250.
TYNONG, Vic., 230v. 50c. Con. 20. Pln. 50.

U

ULMARRA, N.S.W., 240v. 50c.
ULTIMA, Vic., 230v. 50c. Con. 30. Pln. 250.
ULVERSTONE, Tas., 240v. 50c. Con. 580. Pln. 2,850.
UNDAYLER, S.A., 240v. 50c.
UPPER MACEDON, Vic., 230v. 50c.
UPWEY, Vic., 230v. 50c. Con. 151. Pln. 200.
URAIDLA, S.A., 200v. 50c.
URALLA, N.S.W., 240v. D.C.

V

VICTOR HARBOUR, S.A., 240v. 50c.
VIOLET TOWN, Vic., 230v. 50c. Con. 114. Pln. 600.
VIRGINIA, S.A., 200v. 50c. Con. 15.

W

WAGGA WAGGA, N.S.W., 240v. 50c.
WAGIN, W.A., 220v. D.C. Con. 300. Pln. 1,200.
WAHGUNYAH, Vic., 200v. 50c. Con. 69. Pln. 500.
WAIKERIE, S.A., 240v. 50c. Con. 182. Pln. 500.
WALCHA, N.S.W., 240v. D.C.
WALGETT, N.S.W., 240v. D.C.
WALLACIA, N.S.W., 110v. D.C.
WALLAROO, S.A., 240v. A.C.
WALLA WALLA, N.S.W., 240v. D.C. Con. 155. Pln. 600.
WALLENDBEEN, N.S.W., 240v. 50c. Con. 40. Pln. 300.
WALLERAWANG, N.S.W., 240v. 50c.
WALLSEND, N.S.W., 240v. 50c.
WANGARATTA, Vic., 230v. 50c. Con. 879. Pln. 4,300.
WARATAH, N.S.W., 240v. 50c.

WARBURTON, Vic., 230v. D.C. Con. 140. Pln. 1,000.
WARIALDA, N.S.W., 240v. D.C.
WARRACKNABEAL, Vic., 230v. 50c. Con. 350. Pln. 2,875.
WARRAGUL, Vic., 230v. 50c. Con. 525. Pln. 1914.
WARREN, N.S.W., 240v. 50c.
WARRINGAH, N.S.W., 240v. 50c. Con. 4,600. Pln. 15,000. Hs. 4,982.
WARRION, Vic., 230v. 50c. Con. 10. Pln. 100.
WARRNAMBOOL, Vic., 230v. 50c. Con. 1,472. Pln. 8,000.
WARWICK, Qld., 220v. D.C. Con. 950. Pln. 7,000.
WASLEYS, S.A., 200v. 50c. Con. 37. Pln. 340.
WATERLOO, Tas., 240v. 50c.
WATERVALE, S.A., 230v. 50c.
WATTLE GROVE, W.A., 250v. 40c.
WATTLE GROVE, Tas., 240v. 50c.
WAUCHOPE, N.S.W., 240v. 50c.
WEDDERNBURN, Vic., 230v. 50c. Con. 186. Pln. 1,000.
WEE WAA, N.S.W., 240v. 50c. Pln. 700.
WELLINGTON, N.S.W., 240v. 50c. Con. 691. Pln. 4,000. Hs. 900.
WELSHPOOL, W.A., 250v. 40c.
WENTWORTHVILLE, N.S.W., 240v. 50c.
WERRIBIE, Vic., 230v. 50c. Con. 451. Pln. 1,700.
WERRIS CREEK, N.S.W., 240v. 50c.
WESTBURY, Tas., 240v. 50c. Con. 326.
WESTERN JUNCTION, Tas., 240v. 50c.
WEST MAITLAND, N.S.W., 240v. 50c. Con. 3,700. Pln. 25,000. Hs. 4,500.
WESTMEAD, N.S.W., 240v. 50c.
WESTON, N.S.W., 240v. D.C. Con. 320.
WEST WALLSEND, N.S.W., 240v. 50c.
WEST WYALONG, N.S.W., 240v. D.C.
WHITTON, N.S.W., 240v. 50c. Con. 38. Pln. 150. Hs. 50.
WHYALLA, S.A., 231v. 50c.
WICKEPIN, W.A., 220v. D.C.
WICKHAM, N.S.W., 240v. 50c.
WILLASTON, S.A., 200v. 50c.
WILLIAMSFORD, Tas., 230v. 50c. (see Rosebery, Tas.).
WILLIAMSTOWN, Vic., 230v. 50c. Con. 6,200. Pln. 20,200.
WILLUNGA, S.A., 200v. 50c. Con. 71.
WILMINGTON, S.A., 220v. D.C.
WILUNA, W.A., 250v. 40c.
WINCHELSEA, Vic., 230v. 50c. Con. 101. Pln. 705.
WINDSOR, N.S.W., 240v. 50c. Con. 400. Pln. 2,500. Hs. 550
WINGHAM, N.S.W., 240v. 50c. Con. 300. Pln 1,500 Hs. 327.
WINTON, Qld., 240v. D.C. Con. 260. Pln. 1,750.
WIVENHOE, Tas., 240v. 50c.
WODONGA, Vic., 230v. D.C. Con. 216. Pln. 2,300.
WOLLONGONG, N.S.W., 240v. 50c. Con. 3,000. Pln. 15,000. Hs. 3,000.
WONGAN HILLS, W.A., 220v. D.C.
WONTHAGGI, Vic., 240v. 50c. Con. 1,294. Pln. 6,000.
WOODBRIDGE, Tas., 240v. 50c.
WOODBURN SHIRES, N.S.W., 240v. 50c.
WOODBURY, N.S.W., 240v. 50c.
WOODBURY, Tas., 240v. 50c.
WOODEND, Vic., 230v. 50c. Con. 213. Pln. 1,000.
WOODSIDE, S.A., 240v. 50c.
WOODVILLE, N.S.W. (see West Maitland).
WOOLMERS, Tas., 240v. 50c.
WOOL WOOL, Vic., 230v. 50c. Pln. 50.
WOORALOO, W.A., 220v. D.C.
WOY WOY BAY, N.S.W., 240v. 50c.
WOY WOY SHIRE, N.S.W., 240v. 50c. Con. 750. Pln. 4,000. Hs. 1,570.
WYALCATCHEM, W.A., 220v. D.C.
WYCHEPROOF, Vic., 230v. D.C. Con. 160. Pln. 800.
WYNDHAM, W.A., 220v. D.C.
WYNYARD, Tas., 240v. 50c. Con. 460. Pln. 1,730.
WYONG, N.S.W., 240v. 50c.

Y

YACKA, S.A., 200v. 50c. Con. 45.
YALGOO, W.A., 220v. D.C.
YALINGUP, W.A., 220v. D.C.
YALLOURN, Vic., 230v. 50c.
YALUMBA, S.A., 200v. 50c.
YANCO, N.S.W., 240v. 50c.
YANKALILLA, S.A., 240v. 50c.
YARRAGON, Vic., 230v. 50c. Con. 79. Pln. 400.
YARRAM, Vic., 230v. 50c. Con. 250. Pln. 1,200.
YARRAWONGA, Vic., 230v. D.C. Con. 349. Pln. 1,650.
YASS, N.S.W., 240v. 50c. Con. 488. Pln. 3,000. Hs. 630.
YEA, Vic., 230v. 50c. Con. 70. Pln. 950.
YENDA, N.S.W. (Irrigation Com.), 240v. 50c.
YINNAR, Vic., 230v. 50c. Con. 37. Pln. 685.
YALLA, Tas., 240v. 50c. Con. 66.
YORK, W.A., 220v. D.C.
YORKETOWN, S.A., 220v. D.C.
YOUNG, N.S.W., 240v. 50c. Con. 781. Pln. 5,000.

Z

ZEEHAN, Tas., 240v. 50c. Con. 200. Pln. 1,320.

Fundamentals of Electricity as Applied to Radio Servicing

While most people connected with the radio trade, even though not engaged on the technical side, have a fair general idea as to the meaning and usage of common radio and electrical terms, it will be just as well (so as to fix ideas easily and definitely when the remainder of this section is being digested) to briefly set down the fundamentals on which all technical knowledge is founded.

Electric pressure measured in volts is analogous to the water pressure tending to force water out through a tap. As we can cut off the water with a tap so we can cut off the flow of electricity with a switch, providing that both are effective and do not leak.

Electric current is measured in amperes, which expresses the amount or quantity flowing per second. A thousand milliamperes (abbreviated m.A) are equivalent to one amp. The resistance of a circuit is exactly what its name implies, the opposition offered by a circuit to the passage of a current. This opposition wastes a certain quantity of electrical energy which is converted into heat and light. Power is the amount of electrical energy used **per second,** or the rate of consumption. The ohm is defined as the resistance of a circuit through which a pressure of one volt will force a current of one ampere and the power dissipated in this circuit is taken as unity or one watt.

Ohm's Law

In the formulae below

E = Voltage
I = Current in amps.
R = Resistance in ohms.
W = Power in watts.

Ohm's law may be stated as three formulae although actually all three mean exactly the same thing:

$$I = E/R \qquad (1)$$
$$E = IR \qquad (2)$$
$$R = E/I \qquad (3)$$

The power dissipated may be obtained from the following:

$$W = EI \ (4) \text{ or } I^2R \ (5) \text{ or } E^2/R \ (6)$$

Resistor Replacements

Suppose we have to replace a voltage dropping resistor for the plate supply of the oscillator tube of a superhet that we are called in to service. The power pack voltage on measurement proves to be 320, the oscillator tube is a 56 and no grid bias is provided. The recommended plate voltage for a 56 as an oscillator is 90 and the plate current at zero grid bias is 11.2 m.A. This means that the resistor has to drop the plate voltage from 320 to 90, i.e., by 230 volts.

With a voltage drop **across the resistor** of 230 volts and a current of 11.2 m.A. flowing, the required resistance is found to be $\frac{230}{.0112}$ or 20,600 ohms. The power dissipated is $230 \times .0112$ or 2.6 watts. A 20,000 ohm resistor to dissipate a little over $2\frac{1}{2}$ watts thus fills the position nicely.

Accuracy

Suppose, however, that a case occurs in which it is necessary to replace a resistor which must for some reason be quite accurate but is an odd size. One example where trouble is continually occurring suggests itself in the direct coupled type of set, particularly those of the first vintage when resistors were not so reliable as to-day. Suppose that we want a 2,350 ohm resistor to carry 15 m.A. While it is quite easy to order a special resistor, this takes time, so that it is often a far better proposition to insert two resistors in series, in this case one 2,000 ohms and one of 350 ohm. We can most conveniently calculate the power rating for the resistors from the formula.

$$W = I^2 R \qquad (5)$$

not forgetting to divide the milliamps by 1,000 to put I in amps. This gives us 4.5 watts for the 2,000 ohm resistor. While the total resistance of a number of resistors in series is given simply (as above) by adding the respective resistances; the case of a number in parallel or in a complicated network is not so simple. If two equal resistors are connected in parallel, the resulting overall or effective resistance is half that of each taken separately; if three, then one third and so on (See Fig. 1).

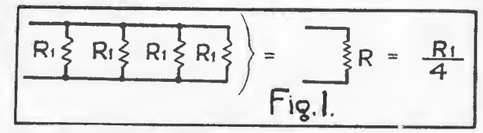


Fig. 1.

Resistors in Parallel

In general if there are n resistors each of resistance R,

$$\text{Effective Resistance} = \frac{R}{n} \qquad (7)$$

Each resistor will carry an equal share of the total current flowing into the bank of resistors. If the individual resistances are not equal but are of values R_1 and R_2 (Fig. 2) then the effective resistance R is given by

$$R = \frac{R_1 R_2}{R_1 + R_2} \qquad (8)$$

If we put $R_1 = R_2$ this boils down to $\frac{R_1}{2}$ On the other hand if we have more than two resistors R is given by

$$R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots} \qquad (9)$$

Unequal resistors carry unequal currents. In the case of two, each current is directly proportional to the

value of the other resistor. Referring to Fig. 2.

$$I_1 = I \frac{R_2}{R_1 + R_2} \qquad (10)$$

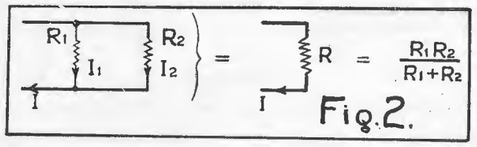


Fig.2.

Safe Current

Suppose we have a 5,000 ohm 10 m.A. and a 3,000 ohm 15 m.A resistor in parallel to give 1875 ohms for a D.C. amplifier. What total current will this combination then pass without burning up? Reversing formula (10) we have.

$$I_1 = I \frac{R_1 + R_2}{R_2} \qquad (11)$$

and we find that the total current which flows when the maximum rated current 10 m.A. I_1, is flowing in the 5,000 ohm resistor, is given by

$$I = 10 \times \frac{8000}{3000} = 26.6 \text{ m.A.}$$

When I_2 is its maximum or 15 m.A. then

$$I = 15 \times \frac{8000}{5000} = 24 \text{ m.A.}$$

It is thus not safe to exceed the lower of these two figures, 24 m.A. The combination given above is an efficient one since each resistor is carrying practically its maximum rated current 10 m.A. I_1, is flowing in the 24 m.A., of course). If we had used a 25 m.A. resistor for one, the combination would be inefficient and more expensive.

Screen Voltage Supply

Another case which often crops up is the calculation of the correct resistance to drop the pack voltage for the screens of s.g. valves. Referring to Fig. 3 one of the usual methods of supplying screen voltage is shown. First let us fix a suitable value for the bleed current IB flowing through R_1. If we choose a value of 20,000 ohms for R_1, and since there is a drop across R_1 equal to the screen voltage of 100, then the current flowing through R_1 is 5 m.A.

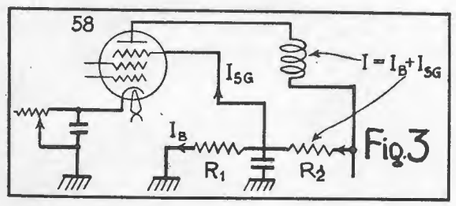


Fig.3

The screen current of a '58 is 3.0 m.A., so that the current flowing through R_2 is equal to the sum of these two or 8.0 m.A. If the pack voltage is 300 (on load) this necessitates a drop of 200 volts across R_2. Substituting these values in formula (3), R_2 is found to be 25,000 ohms. If we want to supply several tubes the calculations are similar but a larger bleed current is desirable, for as the volume control in the cathode leads of the variable mu tubes is turned down, the screen current will diminish and consequently the voltage across R_1 increases. This is, however, counteracted to some extent by the fact that the cathode becomes more positive with respect to chassis and the increase in actual screen volts (from cathode to screen) is lessened.

Voltage Dividers

The design of the voltage divider shown in Fig. 4 is illustrated in the table below. The procedure follows that given above. A bleed current of 10 m.A. through R_1 is our initial assumption.

Section	Current (m.A.)	Voltage Drop	Resistance (Ohms)
R_1	10	100	10,000
R_2	14	150	10,700
R_3	24.2	70	2,900
Total	—	320	23,600

A 25,000 ohm divider set at 10,600, 11,300 and 3,100 would be suitable. It is however, usually more convenient to adjust voltage dividers after installation in a set, measurements being taken with a high resistance voltmeter.

Alternating Currents

An alternating current is one which periodically changes its direction by passing from a maximum in one direction to a maximum in the other direction and back

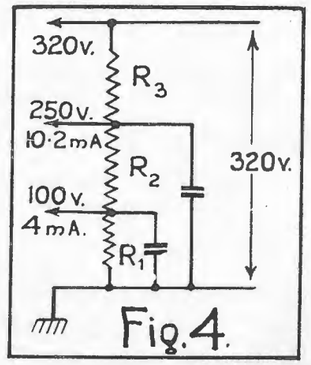


Fig.4.

again. This process completes one cycle and the frequency of an alternating current is the number of cycles occurring per second. The simplest or sinoidal form of alternating current is shown in Fig. 1 in the form of a sine wave, and is obtained from the rotating radius OP, one revolution or 360° corresponding to one cycle. All A.C. currents are not sinoidal, many having a very distorted wave form. It is, however, always possible to express any periodic waveform as the sum of a fundamental sine wave and a number of harmonic or multiple frequency sine waves.

Output valves are rated to give so many watts output with a certain percentage of harmonics present, these harmonics having been generated by the imperfect action of the valve as an amplifier e.g., a 59 will deliver 3.0 watts, allowing 7% total harmonic distortion.

All the formulae and examples given above on D.C. flowing through resistors apply equally well to the passage of A.C., provided that the resistors are non-inductive. However, all circuits contain at least a

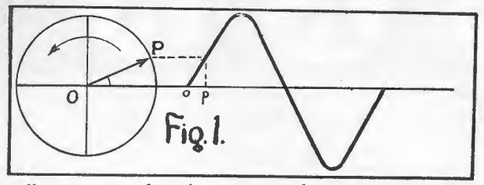


Fig. 1.

small amount of inductance and capacity, and thus Ohm's Law has to be modified by substituting for the resistance R an analogous quantity known as the impedance and denoted by Z. Ohm's law for A.C. states that

$$I = E/Z \qquad (12)$$
$$E = ZI \qquad (13)$$
$$Z = E/I \qquad (14)$$

Inductance

Inductance is the property of a circuit which tends to retard the building up of a current when an E.M.F. is established and to retard the decay of an already existing current if the E.M.F. is removed. Thus in the flow of A.C. through an inductance the current will always **lag** behind the voltage by an amount (the phase difference) which is equal to a quarter cycle or 90° for a pure inductance and is less than 90° when resistance is

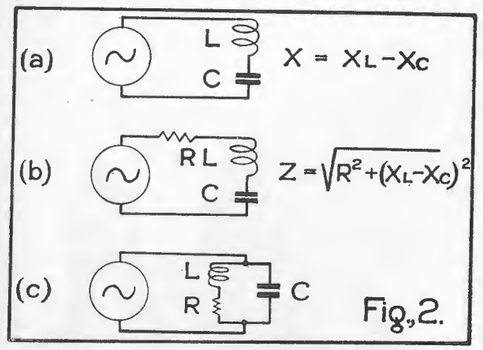


Fig. 2.

present. Suppose that we wish to determine whether a certain filter choke has an inductance of 30 or 50 henries. This may be done by measuring the current which passes when a known A.C. voltage is applied across the choke. The reactance X_L in ohms of an inductance is given by

$$X_L = 2\pi fL \qquad (15)$$

L being in henries.

The impedance Z in ohms is given by

$$Z = \sqrt{R^2 + X_L^2} \qquad (16)$$

where R is the resistance in ohms of the choke. If R is less than 1000 ohms it may be neglected in comparison with X. If the choke is placed across the 240 volt 50 cycle mains its inductance will be

$$L = \frac{.76}{I} \qquad (17)$$

I being the current read on a 0-100 A.C. milliammeter. A 30 henry choke should pass 25 m.A. and a 50 henry choke 15 m.A.

Capacity

Capacity is the property of a circuit which tends to retard the building up of a voltage across a circuit due to a current which suddenly commences to flow. For this reason the current through a capacity will always **lead** the voltage by 90° for a pure capacity or by some angle less than 90° when resistance is present. The reactance X_c in ohms of a condenser is given by

$$X_c = \frac{10^6}{2\pi fC} \qquad (18)$$

C is in microfarads and 10^6 represents 1,000,000. A 1 mfd. condenser has a reactance of 3,200 ohms at 50 cycles, so if connected across the 240 volt mains a current of 75 m.A. will flow. This provides a ready means of testing unknown paper condensers provided they are able to withstand 240 V. A.C.

It is due to these properties of inductance and capacity—namely, that they cause voltage and current to get out of step, that Ohm's law cannot be applied directly to alternating current calculations.

Suppose we strike a short wave T.R.F. set in which the plate lead from the R.F. valve has been shielded by earthed copper braid to prevent interaction where it passes near a grid lead (this would only occur in a badly designed set). See Fig. 3. The owner complains of poor sensitivity, particularly on the lower wavebands.

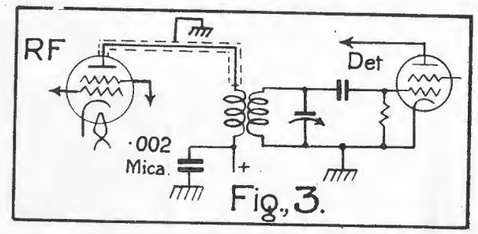


Fig., 3.

The capacity between lead and braid is of the order of 30 mmfd. At a frequency of 15,000 k.c. (20 metres) this has a reactance of 350 ohms and provides quite an effective bypass for the R.F. A cure would be to

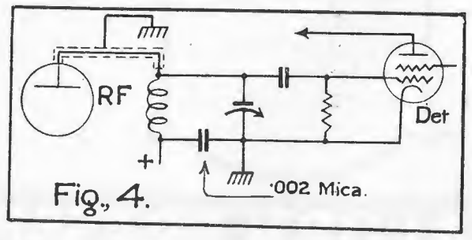


Fig., 4.

change to the circuit of Fig. 4 in which the stray capacities really become portion of the tuning condenser. The internal plate to screen capacity of the R.F. valve also acts in somewhat the same fashion.

Resonance

Resonance occurs in a tuned circuit when $X_c = X_L$ (see equations 15 and 18). The resonant frequency of a circuit is given by

$$f = \frac{159}{\sqrt{LC}} \text{ kilocycles} \qquad (19)$$

L being in microhenries and C in microfarads.

The impedance of the series tuned circuit in Fig. 2 (b) decreases as resonance is approached and at resonance is equal to the R.F. resistance of the coil on the broadcast band and for ordinary commercial tuning coils this is of the order of 7 to 20 ohms, being several times the D.C. resistance. The impedance of the parallel tuned circuits in Fig. 2 (c) increases as resonance is approached and at resonance is equal to L/RC ohms, L being in microhenries and C in microfarads. A low resistance is thus desirable for the highest gain. The wavelength at which a circuit resonates is given by

$$\gamma = 1885 \times \sqrt{LC} \text{ metres} \qquad (20)$$

L being in microhenries and C in microfarads.

Bibliography

Those wishing to further their knowledge of A.C. circuits and their properties will do well to refer to Ghirardi "Radio Physics Course" 1932 ch. 11 and Kemp "The Alternating Current Circuit" ch. I.-IV. in paraticular. The question of resolving a waveform into a sinusoidal wave and its harmonics is dealt with in Piddock "A Treatise on Electricity," and Carslaw "Fourier Series."

Principles and Use of Measuring Instruments

All the meters met with in ordinary radio practice depend upon magnetic effects for their movement and indication of the electrical quantity being measured. Let us then recapitulate our fundamental magnetic laws before proceeding to a consideration of the meters themselves.

MAGNETIC FUNDAMENTALS

A PERMANENT magnet is considered as having a certain number of lines of **magnetic force** passing from the **north** pole to the south pole through the surrounding medium. The magnetic circuit is completed by the lines of force within the body of the magnet running from the south pole back to the north. This is illustrated in Fig. 1 (a). If we now replace the permanent magnet by a coil of wire through which an electric current is flowing an exactly similar magnetic field is produced as shown in Fig. 1 (b).

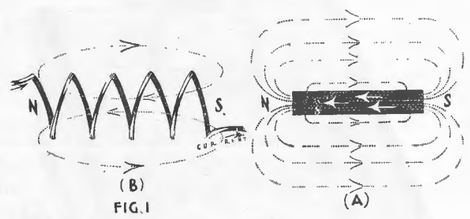


FIG.1

Magnetic field strength **(H)** is defined by the number of lines of force passing through an area of either one square centimetre or one square inch **when the medium is air.**

In any medium other than air the lines of force are known as lines of induction and are denoted by the symbol B (for **flux density).** In air B is equal to H but in other mediums (notably ferrous metals) this is not so. In **ferro-magnetic** materials the permeability μ, which is the ratio of B to H, has a value of several thousand. It should be noted that usually μ is not a constant, but decreases for large values of H. A typical B-H curve for iron is shown in Fig. 2. Starting from zero values of B and H the magnetization follows the dark curve until saturation occurs when the flux density does not increase greatly, if at all, for further increases in H. When H is reduced from this large value to zero the magnetization comes back along the upper branch of the **hysteresis loop,** shown more lightly than the main

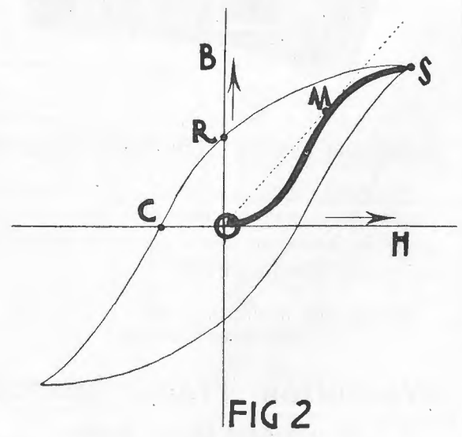


FIG 2

B-H curve in Fig. 2. Thus even when the magnetizing force is removed entirely there remains a certain amount of residual magnetism which is known as the **retentivity.**

This value of B is given by the point R in Fig. 2. The **coercivity,** given by the point C, is the negative value of H required to just reduce the magnetization to zero after the iron has been saturated. The **maximum permeability** occurs at the point M where the ratio of B to H is greatest. The magnetic properties of various common irons and steels are given in the table below.

Material	Coercivity	Retentivity	Maximum Permeability
Electrolytic Iron	2.83	11,400	1,850
Annealed	0.36	10,800	14,400
Annealed electrical iron in sheets	1.30	9,400	3,270
Cast Steel	1.51	10,600	3,550
Annealed	0.37	11,000	14,800
Steel Hardened	52.4	7,500	110
Cast Iron	11.4	5,100	240
Annealed	4.6	5,350	600
Tungsten magnet steel	64.0	9,600	105
Chrome magnet steel ..	64.0	9,000	94
Cobalt steel (15 per cent.)	192.0	8,000	—

Magnetic Circuits

THE magnetic reluctance of a circuit, around which pass ilnes of force, is analogous to resistance in an electrical circuit. Reluctance is inversely proportional to the permeability and as most magnetic circuits contain an **air gap** (or a gap filled by a material such as brass or copper which has a permeability of about one), the reluctance of this air gap is great in comparison with that of the iron comprising the rest of the circuit. In fact the iron can be regarded as merely a convenient means of transferring the magnetization produced by a coil, to the point (the air gap) where it is desired to make use of it. A certain amount of leakage naturally takes place, but by suitable design (short iron paths, etc.), this can be reduced to a few per cent.

The reluctance of an air gap is given by

$$R = \frac{L}{A} \qquad (21)$$

where L is the length of the air gap and A the area. **These dimensions must all be in centimetres.** To obtain the reluctance of a mass of iron divide by the appropriate value of μ taken from the B-H curve. As in electrical circuits the reluctance of two reluctances in series is given by addition. Equations (7), (8) and (9) also apply for reluctances in parallel.

Let us design the field magnet of a dynamic speaker. See Fig. 3. A desirable flux density (B) in the gap in which the coil moves is 8,000 lines per square cm. Assume its mean area as 2 sq. inches or 12.9 sq. cms.; and that its width is 3-16 inch., i.e., L = 0.48 cm. Then the reluctance of the gap is

$$R = \frac{0.48}{12.9} = 0.037 \text{ oersteds}$$

The flux density is 8,000 lines per sq. cm. and the area 12.9 sq. cm. The total flux is thus

$$\Phi = 8{,}000 \times 12.9 = 115{,}200 \text{ lines.}$$

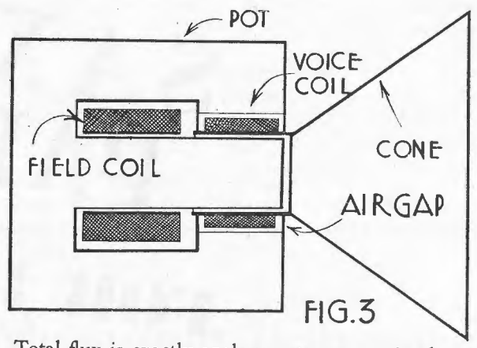


FIG.3

Total flux is exactly analogous to current in electrical circuits.

So magneto-motive force = $R\Phi$

The magneto-motive force of a coil is 0.4π NI.

So $$NI = \frac{R\Phi}{0.4\pi} = \frac{R\Phi}{1.257} = 3390$$

With a total current of 90 m.A. flowing through the field coil, we would thus need a winding of $\frac{3390}{.09}$ or approximately 37,000 turns.

Instrument Movements

IF a coil carrying an electric current is placed in a magnetic field it will tend to place itself axially along the field. See Fig. 4. This is the principle of the moving coil or D'Arsonval movement used almost

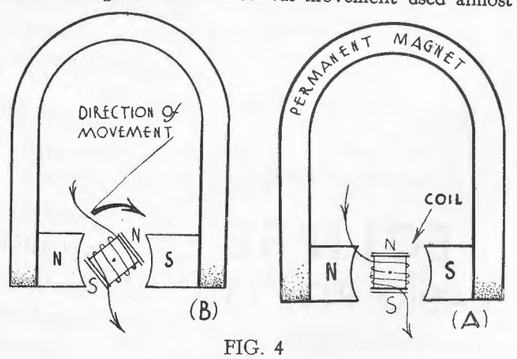


FIG. 4

exclusively for D.C. meters. The construction is as shown in Fig. 5. A permanent magnet (M) usually of tungsten steel is employed, fitted with soft iron pole pieces (P). The coil (W) is wound over a soft iron core (C) to decrease the length of air gap and provide a uniform radial field. Current is led to and from the coil by the hair springs as shown. The coil is wound on a light rectangular aluminium form which serves to make the instrument "dead-beat" by reason of its dissipation of energy as eddy currents so long as the pointer is moving over the scale.

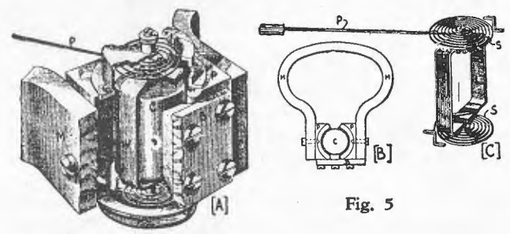


Fig. 5

It follows that by suitable arrangements of shunts or series resistors any moving coil instrument can be made to read any desired value of amperes or volts and the scale directly calibrated for these ranges. The scale of a moving coil D.C. movement is open, i.e., all the divisions are equal. This is not the case with the moving iron type of instrument in which a light iron vane attached to the pointer is drawn into a solenoid which carries the current. High reading ammeters can be constructed by using a heavy coil of relatively few turns. A voltmeter of this type is usually constructed by adding a layer of resistance wire to the coil in order to provide the necessary multiplier. Moving iron instruments are used extensively for A.C. measurements.

Various Types

THE dynamometer type is a moving coil instrument with a field consisting of a second coil in series with the moving coil. The field is thus reversed by the current flowing and the instrument reads r.m.s. or effective values. It can also be used for D.C. measurements. This type of meter is not so sensitive as the permanent magnet, requiring a greater current for full scale deflection. Care should be taken to keep the instrument away from any external magnetic fields, which will negative the accuracy of the meter. Meters can be made astatic, by using pairs of fixed and moving elements the combination being practically unaffected by any ordinary value of external field.

Thermocouple meters use a moving coil D.C. instrument to measure the minute voltage induced in a thermocouple attached to a heater through which the A.C. is passing. Copper and constantan are commonly employed for the couple because of their high thermoelectric power (about 45 V. per degree Cent.). The heater may be constantan or other high resistance alloy. All sensitive couples are evacuated. This type of meter is suitable for high frequencies, having displaced the old hot-wire ammeter, which depended on the stretch of a wire for its indications.

Rectifier type meters utilise a small rectifier and a sensitive D.C. movement. Copper-Oxide rectifiers are usually employed, and are described in full below. An ordinary crystal rectifier (galena, carborundum, etc.) may be used where only comparative readings are needed. With these, however, calibration is almost sure to alter and, further, is dependent on waveform because of the curved characteristic of such a crystal rectifier.

Electrostatic voltmeters depend for their movement on the electrostatic attraction between a moving vane, usually in the shape of a figure of eight and two or four quadrants. The attraction is proportional to the square of the potential and is balanced by a hairspring. On D.C. no current is used and only a small amount on A.C. as the capacity is usually of the order of 10 $\mu\mu$fd.

Valve Voltmeter

THE valve voltmeter employing a triode as a rectifier is superior to diode or ordinary rectifiers. The grid bias in the simple type shown in Fig. 6 (a) is adjusted practically to cut off so that above a certain small value the relation between plate current and input r.m.s. voltage is practically linear. Very little power is drawn from the circuit under measurement by this type of voltmeter. The initial zero current reading may be suppressed by the circuit shown in Fig. 6 (b). Here with S open P_g is adjusted to give the same plate current

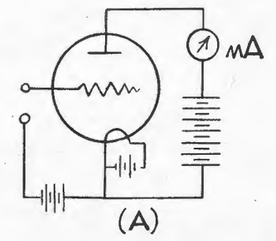


Fig. 6a.

as at calibration. Close S and adjust P_p so that the plate current meter reads zero. The input resistance R_g may be as high as 10 megohms. The valve voltmeter can be made to serve as an ammeter by measuring the voltage drop across a definite resistance. The sensitivity of a valve voltmeter may be increased by the addition of one or two amplifying stages calibrated by means of an attenuator.

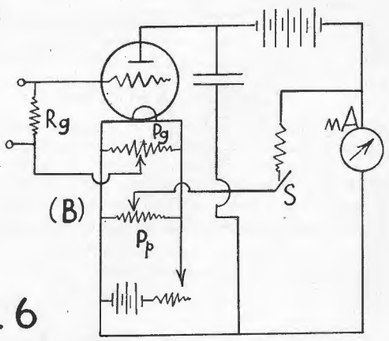


FIG. 6

Ohmmeters consist usually of a low reading milliammeter in series with a resistance and a battery. The unknown resistance is connected in series with this hook-up. A variable shunt is connected across the meter to

adjust the meter reading to full scale when the terminals are shorted. (See Fig. 7). The useful range of the instrument is from zero to about 20 times the series resistor S.

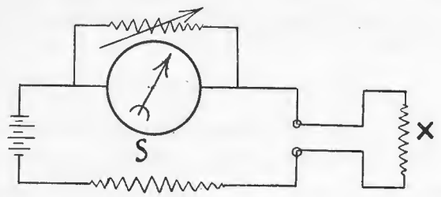


FIG. 7

Half scale reading denotes that the external resistance is equal to S. The general formula is

$$X = S\,\frac{(i_{max} - i)}{i}$$

Where X = Unknown resistance.
S = Internal series resistance.
i_{max} = Full scale reading with terminals shorted.

i = Reading with X in circuit.

Suitable values for an ohmmeter reading to 100,000 ohms are: milliameter full scale reading 1 m.A., battery 4.5 volts, internal resistance 4,000 ohms., shunt minimum less than 200 ohms. and maximum 2,500 ohms., assuming a meter resistance of 27 ohms. If this is not so the shunt resistances will vary in proportion.

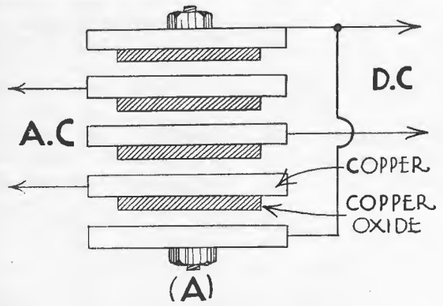


FIG. 8a

Meters having two moving coils at right angles together with a field coil may be used for measuring capacity, power factor and frequency directly. At radio frequencies use is made of calibrated inductance and capacity (i.e. a calibrated tuned circuit) usually connected to a valve oscillator, to measure frequency.

Copper Oxide Rectifier Meters

IN this type of meter use is made of a bridge rectifier circuit with a low-resistance D.C. movement connected directly across its terminals. This is shown in Fig. 8. It is important that the resistance connected across the D.C. terminals of the bridge should be low, as the apparent resistance of the set-up to A.C. current is directly dependent on this resistance in the D.C. side. If this becomes high (e.g. an open circuit) a large A.C. voltage drop will be caused across the bridge, perhaps sufficient to destroy it and certainly enough to upset its calibration.

For this reason it is desirable when using a meter separate from the rectifier unit, to provide a switch to automatically short circuit the D.C. side of the bridge when the meter is removed. A double circuit jack con-

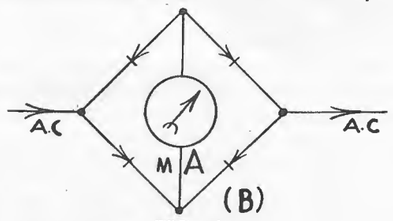


FIG. 8b

veniently does this. Alternatively we may open circuit the A.C. side of the rectifier as a safeguard.

Westinghouse metal rectifiers are available in ranges of 1, 5 and 10 m.A. (D.C. movement) and for voltage drops (D.C.) not exceeding 500 m.V. To make full use of the accuracy obtainable by the combination of such a bridge with a high class moving coil instrument facilities should be available for accurate calibration on A.C. It is possible, however, to provide an approximate calibration from D.C. methods, or even by relying on the existing D.C. calibration of the meter, and using a multiplying factor.

The effective or r.m.s. value of an A.C. wave is $1/\sqrt{2}$ or 0.707 of the peak value. However, the average value is given by $2/\pi$, 0.636 of the peak value. The ratio between these two values or 1.11, is known as the form factor of the A.C. wave. Since a D.C. moving coil meter is an integrating instrument with a linear law, its indication is proportional to the average value of the current passing through it. For this reason the D.C. scale reading has to be multiplied by a factor of 1.11 to obtain the A.C. current passing.

Allowance for Errors

IT is to be noted that due to losses in the rectifier, the calibration is not exactly linear but as the error only affects the first 1/1000 of the scale it can be neglected. The only case in which it is important is in low reading (less than 10 v.) voltmeters. In voltmeters of higher ranges than this the scale can be assumed to be quite linear but that the zero and 0.5 volt readings are identical.

This means, in effect, that all milliameters, ammeters and high reading voltmeters can be calibrated by a single reading against some accurate standard, or against D.C. instruments with two readings on reversed polarity. In the case of low reading voltmeters, however, it will be necessary to draw a complete calibration curve, particularly over the first half of the scale. Six or seven points along the scale will suffice for a good calibration.

In any calibration with A.C. the waveform of the applied voltage should be as nearly as possible sinusoidal. If this is not so the form factor will differ from 1.11 and the meter will read inaccurately on other waveforms. The meter errors for various amounts of harmonic distortion are given below. Note that where an error is negative (i.e. instrument reads low) it is necessary to add the appropriate correction. Alternatively a new form factor is given.

Harmonic.	Percentage Present.	Phase Displacement.	Meter Error.	Form Factor.
2nd	10%	0°	—0.5	1.115
2nd	20%	0°	—2.0	1.13
3rd	10%	0°	+2.7	1.08
3rd	20%	0°	+4.4	1.06
3rd	30%	0°	+5.0	1.055
3rd	20%	180°	—9.2	1.21

Temperature coefficients for milliameters vary from 0.005 to 0.015% per degree Centigrade, the error being such as to make the instrument read low at increased temperatures. The unit should be calibrated at a temperature near its ultimate or normal ambient temperature. Voltmeter temperature errors except in low reading voltmeters are negligible above the first fifth of the scale reading. Even in low reading units the error is negligible near full scale readings. At small scale deflections the error is positive, a 300 volt set-up reading (say) 0.04% high per degree Cent., at a scale reading of 25 volts. At a reading of 200 volts the temperature coefficient may be zero.

Frequency errors are small and due solely to the self-capacity of the rectifier providing a shunt across the A.C. terminals and causing the meter to read low at high frequencies. At 5,000 cycles we may expect an error of 1%. Finally the whole arrangement provides a cheap and robust method of obtaining a sensitive movement for either D.C. or A.C. operation.

DEALERS RADIO SERVICE

Servicing Broadcast Receivers

This section of the Annual aims rather at covering the broad principles of radio servicing than at dealing with any particular models of commercial receivers. However, the principles dealt with here, together with the experience gained in practice, will provide the mental equipment necessary for the servicing of practically any receiver. It has been said that radio servicing is just common sense, and, given the necessary ground work, this is undoubtedly so. Below will be described a system of trouble shooting with the minimum of tools and apparatus.

THE following is intended rather for the radio dealer who is naturally called upon at times to service faulty receivers, than for the regular serviceman who is either efficient, or will gain his efficiency through some College or in the hard school of experience. On the other hand it is quite possible that some little points in the following would be of value even to the most experienced serviceman.

It cannot be stressed too highly that haphazard methods of circuit testing will not pay in the long run. Once in a while the hit or miss man makes a hit, but as a rule this kind of guessing wastes an enormous amount of time. The systematic worker can solve any problem, no matter how difficult, because he eliminates one possibility after another until he has definitely located the fault.

At the same time it is possible to become the slave of a system whereby just as much time is wasted as by haphazard testing of components. Do not measure the numerous point to point resistances until the general symptoms, obtained visually and with the aid of voltage checks have localised the trouble into some portion of the receiver. As always, common sense is the only reliable guide in receiver servicing and backed by a reasonable amount of experience and a proper understanding of the how and why of receivers, we have the makings of a very fine serviceman.

Diagnosis of the Trouble

THE service engineer is really a radio doctor. The symptoms of the case must be obtained from the owner of the set, and these often give a direct lead as to the nature of the fault. If, however, such immediate diagnosis is impossible, systematic testing must be resorted to, although, knowing the symptoms, the area over which tests have to be made can often be very considerably reduced.

We may divide all testing into two classes, the one by means of instruments, the other visual and aural. A judicious combination of the two is necessary. As a rule, the first thing we consider is audible symptoms, e.g., no speech or music from the loud speaker. Following this we consider the visual symptoms, e.g., the valves may not light. Following these preliminary tests which may or may not definitely indicate the trouble, but which will certainly narrow it down to some portion of the receiver, we must test by means of instruments, e.g., we test the voltage from plate to chassis of the power valve.

Considering first the audible symptoms we may divide these into various sections:—

(1) No speech or music; set dead.
(2) Volume weak on all stations.
(3) Volume weak only on distant stations.

Servicing Broadcast Receivers—(Continued).

(4) Noise: crackles, buzzes, etc.
(5) Noise: whistles, howls, etc.
(6) Hum.
(7) Distortion.
(8) Lack of selectivity.
(9) Intermittent operation.

Considering each of these headings in more detail we can rapidly narrow our field of search.

(1) No Speech or Music; Set Dead.

EVEN though no station may be audible the familiar background noise, if present, indicates that at least the speaker is O.K. and the last valve drawing plate current. No sound at all indicates no plate current for the last valve, trouble in the speaker coupling transformer or choke, or in the speaker itself. If the glow from the filaments is not visible check the "A" supply.

In an A.C. receiver examine the 240 volt line for voltage and if O.K. check the secondaries of the power transformer. Sockets may be at fault, causing intermittent contacts. The same applies to speaker and 240 volt plugs. Check also the aerial connection. Disconnecting the aerial and rubbing it on the aerial terminal should cause an enormous rattle in the speaker with the volume full on. If this is so and the set will still not bring in stations check the aerial for a short to ground, both at the lightning arrestor and at its connection to the set.

A rough test for the plate circuit of each valve consists of taking each valve out of its socket for an instant with the receiver in operation. As each valve is removed and replaced there should be a snap or click from the speaker. Starting from the output stage and working back towards the antenna the sound will become weaker and weaker. If one valve can be removed and replaced without causing any sound in the speaker, the trouble lies in the plate circuit of that valve or the grid circuit of the following stage. The next step is to test for plate voltage in that stage. Check also for voltage from plate to cathode with the valve out. Voltage from plate to chassis but no voltage from plate to cathode indicates an open in the bias (cathode) circuit. If O.K., make sure that the valve is making contact and has not lost its emission. All these measurements can, of course, be taken directly with an analyser. Resistance coupled detector may not show plate voltage unless a high resistance (moving coil, 1000 ohms/volt) voltmeter is used.

IF all the plate circuits seem O.K., test the various grid circuits. In most receivers it is possible to reach a grid terminal or some wire connected thereto. With the receiver on, this point should be touched with the finger or with the tip of a screwdriver. If O.K., there should be a click from the speaker. Placing the finger on the grid cap of a screen grid detector with the grid clip removed will produce an ear-splitting howl if everything is in order between the detector grid and the speaker. Failure to obtain a click from the grid circuit denotes a grounded grid circuit. An open grid circuit will still allow the click and can be located by a continuity test using an ohmmeter, or by a voltmeter with one lead hooked to the plus "B" and the negative free to explore all points which are connected to the chassis, either directly or through a coil secondary, I.F. or R.F.

This is one use of a voltmeter for exploring points which should be at chassis potential. Alternatively in exploring with a voltmeter, as distinct from measuring the potential of definite points we hook the negative lead to the frame and explore with the positive lead. The continuity of R.F. and I.F. primaries, decoupling resistors, R.F. chokes, the voltage divider, etc. can be quickly checked in this manner. Zero reading after a decoupling resistor may also indicate shorted bypass condensers. Insulated picks on the voltmeter leads are extremely handy. Always allow plenty of length when making up a pair of meter leads. Five feet is necessary at times; use at least four feet lengths, and two distinctive colours. An A.C. (dynamometer type) voltmeter is useful as it permits tests on high voltage secondaries and 240 volt lines. While not so satisfactory as a high resistance meter for D.C. measurements, it will check most voltages O.K.

Testing for shorts in coils etc. which have already a low resistance is harder, really requiring an accurate ohmmeter. Average resistances for components are as follows:—

R.F. Tuning Coils .... 3–4 Ohms.
460 Kc. I.F. Coils .... 25–30 Ohms.
175 Kc. I.F. Coils .... 80–130 Ohms.

In superhets, if everything tests O.K., but no signals are to be heard the oscillator is not functioning. Check all oscillator coils for corrosion, shorted turns, partial opens. Check also the mica in the oscillator trimmer for dirt, etc. Try a new padder. A new oscillator valve may be needed.

(2) Volume Weak On All Stations

THIS may be due in the case of a new set to an unfavourable location but since all modern sets are so sensitive this is extremely unlikely except in country districts. In the case of sets which have previously operated satisfactorily see if the valves light to their correct brilliancy, if not check the line voltage or A battery, as the case may be. The next check is on the valves by means of an analyser or checker. If unavailable try new valves (or ones which are known to be good) in each socket. Check aerial connection for continuity and corrosion.

The field or voice coils in the speaker may be partially or completely shorted. Check through all plate, screen and bias voltages. Any of these being incorrect may cause loss of volume. If plate voltage is low throughout and line voltage O.K. try a new rectifier. Otherwise there is some abnormal current drawn due to a short which is causing the voltage drop, check both sides of the high voltage winding. The detector and output stages can be checked by feeding a pick-up or an audio signal into the detector grid, or into the pick-up

Servicing Broadcast Receivers—(Continued).

terminals. Experience will indicate the gain to be expected. The I.F. and R.F. stages can be checked properly, only by use of a modulated oscillator and output meter or valve voltmeter of some type. If these are not available it is still possible to feed an I.F. signal to the grid of the various valves, by using the first portion of a similar superhet. as a signal generator. Trouble is likely here, though, due to slight differences in intermediate frequency between the two sets. At best the device is a makeshift.

In sets using a combined mixer-oscillator check all these points, try a new valve and if still no signal test all the associated bypass condensers and the bias resistor. Try a new oscillator coil. Resolder all coil and condenser leads. Try bonding the oscillator gang rotor straight to chassis. Try a new oscillator coil. The easiest way to check condensers etc. for this sort of fault is to (temporarily) insert a new unit.

WITH regard to the 2A7 and 6A7 valves, lowering the screen voltage to less than 100 may start the valve oscillating again. As the triode section of these valves is inefficient even small stray losses in the oscillator coils or condensers will be sufficient to stop oscillation.

In T.R.F. receivers a check may be had by placing the aerial on the plate pin of each R.F. socket in turn. Any stage failing to give a reasonable gain is obviously at fault. One of the most common faults will be bad lining of the gang, I.F.'s or padder due to some expert friend having had a look at the set. The remedy is obvious but again a modulated oscillator is almost a necessity, being really indispensable for lining I.F. transformers.

Another common fault is an open circuit in the secondary of either an audio or radio frequency (including intermediate) transformer. Again the biasing resistor in the cathode circuit of one valve may be open or burnt out.

(3) Volume Weak Only On Distant Stations

In the case of a new receiver the whole bugbear may have been over-confident sales talk. Where this is not so the owner may not know how to operate his set. A more likely cause is a poor aerial-earth system or a defective valve in R.F. or detector sockets. Again incorrect lining causes much annoyance of this kind. Line voltage may not be quite up to what it should be and in battery sets the A or B voltages may have dropped somewhat. Make sure that the volume control is not at fault and allowing only a certain amount of sensitivity. Screen voltages may be too low. This cuts sensitivity. Particularly check the second detector plate and screen voltages. In A.V.C. sets the muting or delay device may be functioning incorrectly, the delay voltage being too high. This can be checked by disconnecting the A.V.C. bias lead and temporarily connecting the cathodes of the 58's to chassis through a bypassed resistor, value 250 ohms divided by the number of controlled valves.

(4) Noise: Crackles, Buzzes, Etc.

THIS type of interference may originate either within the set or outside. External power interference is treated separately in the section on Inductive Interference Elimination and can usually be recognised by a decrease in volume when the aerial is disconnected or the regular and sudden manner of starting and stopping. Another receiver will bring in the same interference.

Where the trouble lies within the set itself the most common cause is a loose or dirty connection, and can be checked by shaking or tapping the receiver. The joint in question can often be located by tapping various leads with a pencil while the set is in operation. Check also for loose sockets or loose connections in the valve bases. Even though soldered joints may look perfect the original flux may have caused corrosion. Every joint, terminal, screwed connection socket and clip is to be regarded as an object of suspicion. If the noise occurs when the set is tuned, check the gang for dirty contacts or dirt between the plates which may be cleared up with a pipe cleaner. The volume control may need replacing. Finally any of the resistors and bypass condensers may have partial shorts. In particular **the detector plate coupling resistor is a frequent source of trouble.** Voltage dividers often wear or cut. Check also the coupling condenser to the grid of the audio stage and the audio transformers if used.

A regular clicking noise (motor-boating) indicates an open grid circuit or defective grid leak.

The question of noise in auto-radios is dealt with in the special section devoted to those receivers.

(5) Noise: Whistles, Howls, Etc.

PRIMARILY these may be divided into two classes (i) of variable pitch as the tuning dial is turned, (ii) of constant pitch. Those in class (1) occur obviously in the R.F. portion of the receiver. In T.R.F. receivers it may take the form of a whistle in passing over each station. If this is so one of the R.F. stages is oscillating.

In neutrodynes the balancing condensers require realigning. Other old types not using screen grid valves employ suppressors which are merely resistances of up to 100 ohms in the grid lead of each valve. These may be shorted or the resistance may have become too low. Check also for a high resistance between the gang rotor assembly and frame by temporarily shorting to earth with a piece of wire. If this is so the contacts need cleaning and possibly the gang frame needs bonding to a point in the chassis. This is true for any type of set employing a tuned R.F. stage. A detector grid leak of too high a resistance will also cause this effect.

In the case of superhets, the grid leak of the oscillator may be of too high a value or even open-circuited. Usually this type of howl becomes worse at the high frequency end of the band. Again the intermediates may be oscillating with a frequency near to the intermediate signal frequency when queer heterodynes will be heard. To check if this is so place one finger lightly on the I.F. grip cap so that a strong signal can still be

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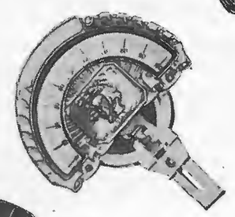

The "BEAM"
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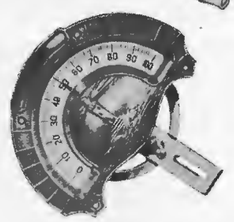

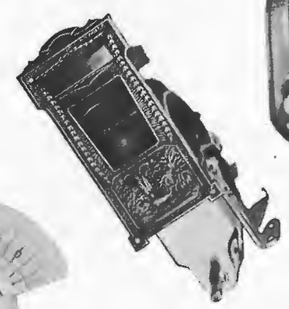

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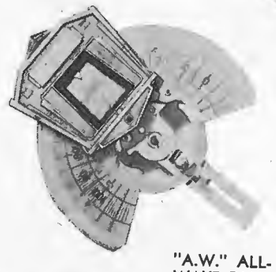

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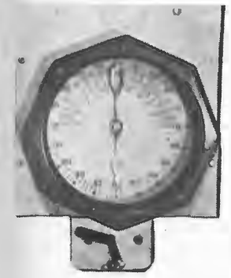
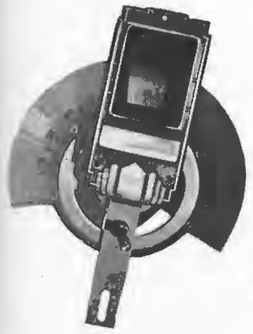


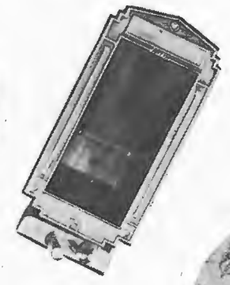
"AVON"
Full Vision, Fixed Light, Wedge Drive.

"GOTHIC"
Full Vision—Travelling Light, Wedge Drive.

"LION"
Full Vision—Travelling Light, Wedge Drive.



The "BEDFORD"
With Broadcast Scale. Wedge Drive, Travelling Light.



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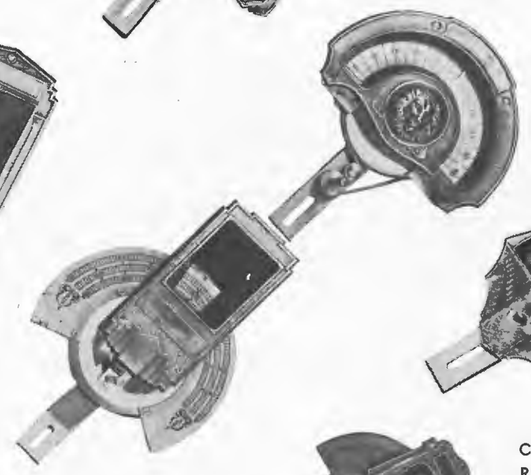

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Servicing Broadcast Receivers—(Continued).

heard. If the oscillation persists it is occurring in the first detector. The first detector when used as a combined mixer—oscillator will sometimes oscillate at I.F. but rarely at signal frequency. This can be checked by placing a finger (carefully because of high voltage) on the plate pin of the valve. Such oscillation trouble can be cured by more effective bypassing, running a common earth lead of heavy copper wire for all R.F. and I.F. chassis returns, including cathode and screen bypasses. Make sure that valve and coil cans are making proper contact with the frame. Sometimes it will be necessary to lower screen voltages or to decouple screen or plate leads with a 10-20,000 ohm resistor and a .1 or .5 mfd. condenser. Check also the volume control for the controlled-bias valves.

IF the grid leak of the oscillator valve is of too high a value this will cause a continuous high-pitched whistle, particularly at the bottom end of the dial. In T.R.F. receivers defective R.F. chokes, open or disconnected bypass condensers in plate, screen or control grid-cathode circuits will cause oscillation. In battery sets, particularly, try lowering the filament voltage. It is, of course, undesirable to use a filament voltage much lower than the rated.

Low-pitched howls, squawking or motor-boating are caused by feed back in the audio section. Quite often this is caused by defects in the power supply system. Bypass condensers open circuited are one obvious fault. An open grid resistor in the output stage or open circuits in audio transformer secondaries can cause very annoying interference particularly if intermittent. In battery sets check both "B" and "C" batteries for low voltage and consequent high resistance. These faults allow feedback from plate and grid of the output stage to the detector and first audio stages. An open grid circuit in the R.F. or I.F. section can also cause motor-boating due to blocking of the grid and consequent sudden discharge.

(6) Hum

IN battery receivers this is obviously a case of induced hum from nearby power lines. Check the aerial to see whether it runs parallel or close to power lines, particularly high tension lines. If this is so shift the location of the aerial. Make sure that the lead-in is not passing near to conduit placed in the walls. Check the conduit for its connection to earth. Check also the receiver earth for high resistance and remove it from any possible connection with the lighting or telephone earth. These remarks apply also to hum induced in an A.C. receiver.

Where there is a trickle charger connected to the accumulator the rectifier may need renewing or the battery may be at fault by reason of corroded terminals, no acid, badly corroded or sulphated plates. Where an eliminator is used check this for open filter condensers, shorted choke or an open on one side of the high voltage secondary.

Where the "death trap" type of eliminator using only a bell ringing transformer is used check for a short or partial short in the condenser between receiver and earth, at the same time reversing the 240 volt plug. Any instrument of this type should definitely be replaced.

In A.C. receivers check for the following points: open circuited filter condenser; shorted power choke; defective rectifier; open on one side of power transfomer; open circuited bypass units, particularly in the audio section; disconnected or high resistance ground; static shield in power transformer (usually the bare flex lead if visible) not connected to ground; dry electrolytics; low plate voltage on detector; open circuit on grid of any valve; short from cathode to heater of any valve; defective centre-tap resistor; pentode bias resistor; and check also the aerial-earth system as described above.

If the hum can be heard with the speaker disconnected (be careful to remove also the pentode as otherwise the screen will become red hot) it is being caused by loose laminations in the power transformer or filter choke, or by the iron cases in which they are sometimes enclosed. Incorrect location of audio transformers or filter chokes (in the field of the power transformer) will cause these components to pick up hum either from the transformer or the A.C. wiring. An open or high resistance grid circuit (e.g. the grid-leak detector) will pick up hum in the same way. In some receivers hum may be reduced by grounding one side or a centre tap from the heater circuits. Do not do this where the same winding supplies a directly heated valve.

(7) Distortion

IT is, of course, necessary to be sure that the receiver was capable of good quality output in the first place. Old valves, particularly in the audio end, will cause distortion when their emission falls off and at the same time a decrease in volume will be noticeable. In a push-pull stage the two valves should have reasonably equal mutual conductances as indicated by the "goodness" test in a valve checker. Using a set analyser the plate currents should be equal. Something may have happened to upset the plate, grid, screen, or filament voltages. Plate voltages too low, screen too low (or sometimes too high), biases too high or too low and filament voltages too low will cause considerable loss of tonal qualities. An excessive amount of hum will cause distortion of the low notes. Check the field coil for shorts. Check also the voice coil and transformer. Make sure that the moving portion of the speaker is not rubbing anywhere and thus causing a rattle.

At times, an excessive amount of feedback while not enough to cause motor-boating will impair the tone. Check the large electrolytic (25 mfd.) across the output bias by hooking an additional temporary unit in place. First check the bias resistor for increased resistance or open circuit.

Make sure that the condensers and resistors comprising the tone control are not open or shorted and that they have maintained their initial value. Open or defective bypass condensers will cause harshness of tone. Open or partly open grid circuits will also cause distortion. Check the coupling condenser from detector to pentode grid for breakdown. This will possibly be indicated by positive bias on the pentode and excessive plate current.

Servicing Broadcast Receivers—(Continued).

(8) Lack of Selectivity

NORMALLY the selectivity of a receiver will depend on the design and the aerial-earth circuit used with it. A smaller or better located aerial will usually help in increasing the selectivity. If the trimmers on the tuning condenser gang have become unbalanced this is sure to cause a loss of selectivity. Check also the possibility of high resistance contacts in the tuned circuits, mainly caused by poor connections to the chassis from the gang or coils. Make sure that no shorted turns occur on any of the coils. A scratch on the enamel winding is quite sufficient to short several turns. A shorted turn on the primary (untuned) may not cause much loss of volume but it will certainly broaden the tuning. Check the soldered joints on the secondary coil itself for a high resistance contact.

Cross talk or cross modulation is due to the modulation from a strong nearby station impressing itself on the grid currents of the various R.F. and I.F. valves when the receiver is tuned to another station. The strong station will impress itself on the other carrier as modulation due to the detection characteristics of the valve in that stage. Usually this occurs in the first stage and may be due either to direct pick-up on an overlong grid lead or insufficient selectivity between the aerial and the grid of this first valve.

In T.R.F. receivers the substitution of 35's in place of the older 24's in the R.F. sockets will help matters. In both R.F. and superhets, shortening the aerial, decreasing the aerial coupling, shortening the grid lead in the first stage in particular, or, as a last resort, shielding this lead will improve matters.

OCCASIONALLY the owner of the set is at fault by his incorrect use of the tuning knob, when he employs this as a volume control by detuning. In this case selectivity naturally suffers and also the background noise is brought up. If however, the trouble is in the original design of the receiver nothing much can be done except by cutting down the length of aerial, decreasing the size of the aerial coupling coil and a general overhaul to try and increase the gain to make up for the consquent loss in volume. Wave traps are somewhat ineffective, except in certain special cases. They should be made up from a good coil (an ordinary aerial coil will serve) and an air dielectric condenser, not one of the padder type. The wave trap should be connected by inserting the primary in the aerial lead. It desired place a small (.0001 or less) condenser from earth to the point where antenna connects the wavetrap. Alternatively a .0001 condenser may be inserted in the aerial lead as a quick method of reducing the effective length of the aerial.

(9) Intermittent Operation

In this case of fading on distant stations, this is an evil which cannot be avoided. Even with A.V.C. we get the converse effect of background noise rising and falling. Distortion due to fading cannot be avoided. Where signals from local stations also fade in and out look for fluctuating line voltage, run-down batteries, intermittent heater circuits either in valve, socket, wiring or transformer. This can be checked by watching the valves. Check also the aerial for partial shorts on to foliage, guttering etc. This type of trouble should be distinguished from intermittent operation where the set goes completely dead at intervals.

The main cause of this second type of intermittent operation is a loose contact, usually, by the natural perversity of circumstances, tucked away where we least expect to find it. Any wire-wound resistor (including the voltage divider) is a potential source of trouble, breaking contact as it warms and coming together again on cooling or bumping. Suspect also the valve sockets and any moving parts or rubbing contacts on switches. The volume control is one obvious place to look. Suspect all wound units such as voice coils, field coils, transformer (A.F., I.F. and R.F.) primaries, particularly those which are carrying current. In superhets try a new oscillator valve and check all oscillator circuit values, voltages and joints. Apart from this the only thing to do is to wait until the set stops playing and then employ the normal service procedure outlined above for symptoms occurring. By judicious tapping and poking with a pencil or pliers it may be possible to locate the faulty unit straight away.

SERVICE HINTS

The following hints have been written after a review of problems encountered in actual servicing. They are not to be followed as the royal road to successful servicing but rather as short cuts in the cases to which they are applicable. As in all servicing, sound judgment and common-sense is the necessary foundation on which to build.

Flux may be melted with an iron from dirty contact surfaces, while grease may be removed by alcohol or benzine.

In old sets, **carbon resistors** which run at all warm should be replaced by the wire-wound type of correct rating.

The **tuning meter** is usually in the plate circuit of the controlled valves. If inoperative it can be shorted pending repair or replacement.

In T.R.F. sets **oscillation** is sometimes caused by bad contact from rotor to frame or gang condenser frame to chassis. If necessary after cleaning, solder a wire to each rotor spring and bond these direct to chassis, near the coils.

The **centre tap** on filament windings is often beneficially replaced by a C.T. resistor.

A.V.C. superhets. If volume drops or increases suddenly and at random, suspect the bypasses from R.F. or I.F. cathodes.

Particularly near the sea or in damp locations **corrosion** can cause weak volume and crackling noises. Suspect coils, R.F. circuits, intermediate and audio transformers. In the primaries of these where current is flowing corrosion often occurs at the soldered junction of the fine wire.

Noisy volume controls. Clean winding, contact springs and/or contact arm with benzine or preferably alcohol (pure).

In packs with choke input filters a 1 mfd. condenser from 280 filament to transformer centre tap or ground often **reduces hum** and increases output.

In some old T.R.F. sets suppressor resistances are fitted to the grid of each valve to **prevent oscillation.** Decreasing these resistances will increase selectivity providing oscillation troubles are not encountered. Start with the first stage.

Weak volume and a point of maximum volume in the middle of the control, suspect the aerial coil and connections, if the volume control itself is O.K.

Low-frequency end of band dead—suspect shorted condenser plates, oscillator, coil, trimmer and padder, or defective oscillator valve where one is used separately.

Hum and reduced B voltage. Shorted C bias or C.T. resistor in output stage (using 45, 47 etc.)

Motor-boating. Make sure of the connection between suppressor and cathode of the 58 I.F. valves.

Rattling sound in speaker. Suspect loose voice coil winding. This may be cured in some cases by dipping coil assembly in thin shellac, one or two coats.

Bad tone, weak volume and positive bias on first audio valve. Shorted coupling condenser from detector plate.

Noisy wiping contacts should be cleansed and pigtailed.

Seccotine etc. will **repair speaker cones** if damaged by a screw-driver.

Oscillation is sometimes caused by gassy 35's which will read O.K. in a checker.

Fading is sometimes due to defective local distance switch.

Lack of volume. Valves and voltages check O.K. Shorted or partially shorted trimmers in R.F. or I.F. stages.

Crackling as condenser turns. Dust or metallic accumulation between plates. Remove by pipe cleaner. If very hard wash with benzine or alcohol. Try putting condenser across the output of a 500 volt pack in series with two small 240 volt lamps to guard against shorts, while cleaning.

Superhets (particularly using separate oscillator valve). **Gradual fade-out** due to overloading this valve. Reduce heater or plate voltages as necessary.

Intermittent reception. Defective chokes in R.F. plate leads.

Noisy, motor-boating. Defective by-pass condensers, particularly R.F. and I.F.

Fading, faltering of signals, sometimes inselectivity. Defective coupling condenser in preselector (band-pass) tuning unit.

Slipping dial cables—smear with resin.

Hum—corroded connections in filter systems.

Oscillation (where R.F. stage used). Bond gang frame to chassis.

Hum—Check bypass on detector screen. Increase if necessary.

Intermittent operation—check speaker plug and socket. Then all valve bases and sockets going back from output stage.

Intermittent noise (especially when set is jarred). Loose valve or coil cans, or corrosion.

Noisy Bradleyometers. Apply vaseline.

Oscillation. Fit pigtails to condensers. These should be cased in spaghetti. Thin rubber-covered hookup wire. Intermittent shorts and noisy. Case all high voltage leads with spaghetti or replace with fry wire. Also leads passing alongside metal points and edges.

Intermittent noise and reception; check bonding to chassis of braid covering leads.

Speaker rattle, especially at high volume. Voice coil out of centre.

Weak, distorted and hum. Field coil shorted.

Loss of volume in old sets. If voltages and valves check O.K., try gang condenser for misalignment due to wear.

Loss of volume and poor tone. Check bias resistor in output stage.

Superhets, refusing to oscillate. Dirty trimmer on gang. Fluff in condenser. Poor coil contacts. Dirt in padder.

Howl during warming up when first switched on. Try another valve in detector socket.

Hum—Check pick-up connections and switch (if any) for poor contacts and shorts.

Thin tone—overbias on output stage.

Distortion and hum. Badly matched push pull valves

Low volume—check screen voltages.

2A7—refusal to oscillate. Try lowering screen voltage.

Intermittent operation A.V.C. sets—check resistor and condenser in rectified control-voltage filter.

Poor tone—Examine speaker cone for fracture.

Low volume—Tune to strong local, remove detector and replace quickly. If O.K. for some seconds, detector screen is open.

Radio-gramophones—**Shorts** may be caused by gramophone needles.

Direct coupled amplifiers—Replace carbon resistors with wire-wound. If **amplifier dead** 45 filament is grounded or shorted by-pass condenser. Try C.T. resistors in place of filament winding C.T.'s.

Auto Radio; **Low output from eliminator.** Check vibrator contacts and adjustment.

1933 Ford etc. Replace carbon brush in coil by 40,000 ohm resistor carbon ground or filed to same dimensions for a handy suppressor. Clean off **all** the paint.

Vibration loosening connections. Mount with several large felt washers to each bolt, well tightened and lock-nutted.

All wavers—**noise on S.W. bands**—Any make and break or moving contact between metal surfaces even if not portion of a circuit. Suspect all soldered joints. Also any metal rubbing on metal around house or grounds, e.g., galvanised iron roof and clotheslines, gutterings, etc.

It does no harm to **touch up the polish** on the cabinet after a repair job.

Oscillation of receiver while using the analyzer. Touch a finger on the grid cap of the valve in the tester.

Air cell batteries—The fumes from these will cause corrosion. Place the battery away from the receiver.

Noisy house wiring—In testing to locate such noises, plug a radiator or jug drawing as many amps. as safety permits, and watch a line voltmeter connected across it for spontaneous variations occurring at the same time as the crackle in the radio.

Metallic coated valves—Do not allow cans etc., to touch the coating as this shorts out the bias.

The Aerial System

THE importance of an efficient aerial and earth system is often overlooked when installing a set. By attention to small details it is nearly always possible to improve the aerial system and decrease the ratio of noise to signal level. The main essentials of an efficient aerial are **height, good insulation** and a location clear of all nearby obstructions—particularly iron roofs and gutterings, structural steel formations, telephone and power wires and even trees. This applies not only to the aerial itself but also to the lead-in. In running the lead-in be careful not to parallel any concealed conduits, etc., in the walls or roof of the building.

Further the lead-in should be run to the receiver by as direct a route as possible. Remember also to keep it well clear of the building—a distance of one foot will be sufficient. The earth lead should also be as short as possible and connected by a good ground clamp to a waterpipe near where it enters the ground. Do **not** use a gas pipe, as the red lead and packing at the joints usually constitute quite a high resistance. Where water piping is not readily available, an inch pipe should be driven several feet into moist ground. Alternatively solder a stout copper wire to a kerosene tin and bury the tin, well below the surface. If necessary a short pipe should be driven into the ground at this point so that the earth may be kept moist.

How Long?

WITH the highly sensitive receiver of to-day the aerial should be as short as is compatible with the reception of the most distant station required. In country districts where interstation interference is negligible the antenna may be made considerably longer to give increased sensitivity for daylight reception. The flat top in this case may be made up to one hundred feet long. Longer spans than this will not give very much gain in sensitivity.

In city and suburban locations the flat top should be restricted to twenty or thirty feet; although fifty feet is O.K. if far enough from all transmitters.

For the aerial itself, insulated wire should be used, either enamel or rubber and braid covered. The lead-in should be made in one piece with the flat top by passing through the insulator, fastening and continuing down. It is desirable to use at least three insulators of the small egg type. It is also preferable to use an insulated earth wire to prevent intermittent contact with any metallic objects and consequent irritating crackles from the speaker. This applies particularly to all-wavers. In fact any two metallic objects or wires rubbing together will produce bad noises when listening on the short waves.

(Continued on next page).

Aerial System—(Continued).

Lightning Arrestors

AN **efficient** lightning arrestor should be installed, meaning one with close contacts which will not move together or apart and will not be bridged over by a deposit of dust. A lighting arrestor provides a definite safeguard against the possibility of a surge from a nearby flash burning out the aerial coil. It is, of course, of no avail in the case of a direct hit but contrary to popular opinion an aerial presents no hazard in this respect. A lightning arrestor is particularly valuable in open locations or in the country where the energy radiated from a nearby flash is not so quickly dissipated by inducing surges in power and telephone wires and metal structures.

Do **not** use an existing earth to which power or telephone systems are already connected. Apart from the possibility of introducing hum and electrical noises this practice can be definitely dangerous under certain conditions. In some locations, most particularly in the city where the lead-in may have to run adjacent to lift control wiring, telephone cables, etc., a shielded lead-in with the shield earthed will provide a measure of relief. Special lead-in cables and matching transformers for coupling the aerial to the set are available. Alternatively use a twisted flex for the lead-in, one wire serving as the lead-in and the other as screen, being connected to earth at the lower end and left open at the top. (See Section on Interference Elimination and also on Auto Radio for further information on these points.) Shielding the lead-in causes a big drop in signal strength and its benefits are doubtful in many cases.

Calculation and use of Shunts and Multipliers

It is to be observed that all indicating meters having only two connections to the external circuit are fundamentally current measuring instruments. The current flowing through the meter is the prime reason for the deflection of the indicator. (Figs. 1 and 2).

However, we may calibrate the meter scale so that the needle deflection will accurately read ohms, volts, microfarads, etc., or any one of the electrical factors which if varied would create a change in current flow provided the other characteristics of the circuit would remain constant.

Let us consider a D.C. milliammeter (O–1) which gives full scale deflection when 1 milliampere flows through the meter. We desire to use this meter as a multirange voltmeter having scales (0–10) (0–100) (0–500) and (0–1000) volts respectively. The resistance of many such meters in commercial use ranges from 20 to 50 ohms. In the extreme case considering a meter of 50 ohms resistance the voltage drop across the meter at full scale current would be, according to Ohm's Law, 50 x .001 or 0.05 volts.

Referring to figure 1 we see that the meter can be used as a 0–10 voltmeter if a resistance or multiplier is connected in series with it.

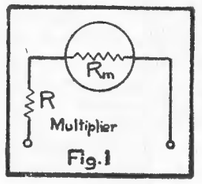


Fig.1

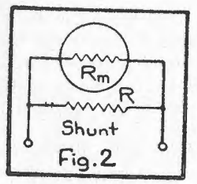


Fig.2

The value of this resistance is such that practically the whole of the voltage drop will occur across it. If a voltage drop of more than 1/20 volt is impressed across the meter it will go off scale and probably be damaged. Further this small drop of 1/20 volt can be quite neglected in calculations for the requisite resistance as it is negligible in comparison with the total voltage. Thus the resistance must be of such value that if 1 milliampere of current (which is full scale deflection of the meter) flows through it the voltage across the resistance will be 10 volts.

If a 0–10 milliammeter was used in place of the 0–1 the multipliers in each case would of course be only 1/10 of their respective values in the previous example. This would also apply to the scale multiples. However, the 10 mil meter would consume appreciable current in itself and may in certain circuits introduce a considerable error particularly where the resistance of the multiplier is not considerably higher than the system to which it is connected. Moreover, the regulation of the voltage supply system may be seriously affected when it is called upon to supply an additional 10 milliamperes to operate the voltmeter which would perhaps introduce a large error.

This emphasises the importance of a high resistance voltmeter; in the first example the resistance was 1000 ohms per volt while in the second instance it was only 100 ohms per volt. For the proper degree of accuracy in radio work a voltmeter having a resistance of 1000 ohms per volt will be quite suitable.

To use the 0–1 milliammeter as a higher scale milliameter, it is necessary to provide a shunt as in Figure 2. In this case it is essential to know accurately the resistance of the meter. Assume that it has a resistance of 27 ohms and that we want to have a scale reading of (0–10) (0–50) (0–100) (0–500) milliamperes.

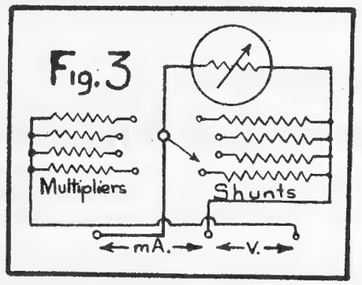
Referring to Figure 2 it is evident that to use the meter for 0–10 mA. measurements the meter would carry 1/10 of the total current and the shunt 9/10 or the shunt resistance would be 1/9 of the meter resistance. If the meter resistance was 27 ohms the shunt resistance would be 3 ohms: correspondingly the shunt resistance for use as an 0–50 milliammeter 1/49 x 27

= .551 ohms. For 0–100 and 0–500 scales the shunt resistance must be 0.2727 ohms and 0.0541 ohms respectively.

The general formula is

$$R = \frac{Rm \times Im}{I - Im}$$

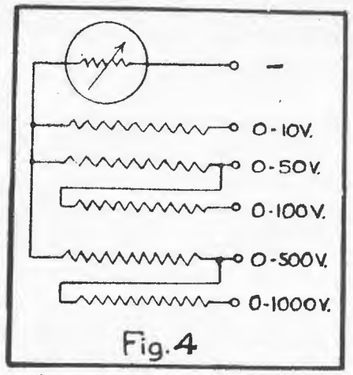
where R = resistance of shunt in ohms.
Rm = resistance of meter in ohms.
Im = full scale current for meter.
I = full scale current for new calibration.



By having a multiple switch as shown in Figure 3, one meter can be used as a voltmeter or milliammeter at any desired range. The accompanying chart shows the resistance of the shunt or multiplier as the case may be.

It should be noted that each of the multipliers must be of large enough capacity to carry 1mA. without unduly heating and thus changing in value.

The circuit is also shown in Figure 4 of a multi range voltmeter in which the multipliers are not separate units but are made up by addition. This helps to get away from the cost of a 1 meg. 1mA. resistor.



Shunt and Multiplier Values
27 Ohm (0–1) Milliammeter.

Scale	Use as.	Resistance in Ohms of Multiplier or Shunt.		Multiply Old scale by
0–10	Voltmeter	10,000	M	10
0–50	,,	50,000	M	50
0–100	,,	100,000	M	100
0–250	,,	250,000	M	250
0–500	,,	500,000	M	500
0–1000	,,	1,000,000	M	1000
0–10	Milliammeter	3	S	10
0–50	,,	0.551	S	50
0–100	,,	0.272	S	100
0–500	,,	0.0541	S	500
	35 Ohm (0–1.5)	Milliammeter.		
0–15	Voltmeter	10,000	M	10
0–150	,,	100,000	M	100
0–750	,,	500,000	M	500
0–15	Milliammeter	3.89	S	10
0–75	,,	0.714	S	50
0–150	,,	0.354	S	100
0–750	,,	0.0701	S	500

R.F. Resistance

The resistance of a given wire is greater for high frequencies than for D.C. This increase in resistance is rather a complex function of $d\sqrt{f}$.

Where d = Diam. of wire in inches.
f = Frequency in kilocycles.

For a 1% increase in resistance

$$d\sqrt{f} = 14$$

For a 10% increase in resistance

$$d\sqrt{f} = 25$$

These figures apply to annealed copper wires and do **not** include the apparent resistance due to dielectric losses in coil formers, and losses due to shielding.

Some slight understanding of the reason for this increase in resistance as the frequency becomes higher may be gleaned from the following. A D.C. current flowing along a wire will distribute itself evenly over the cross-section of the wire. At radio frequencies, however, the current tends to concentrate on the outside of the wire so that the effective cross-section of the wire is reduced and its apparent resistance increased. This is known as the skin effect. For this reason it is desirable to use insulated (enamelled) wire for the aerial to prevent corrosion occurring and forming a high resistance surface along which the minute R.F. currents will have to flow.

Skin effect is due to the rapidly alternating magnetic field set up by the current. This not only surrounds the wire but passes through it. If we consider the wire as a large number of thin filaments or conductors placed together (in parallel), we visualise a magnetic field from each tiny filament. Those in the centre are cut by the fields from all those on the outside, but on the outside are cut by only a few of the fields. As reactance depends on the strength of the field cutting the conductor, the reactance of the internal filaments is higher than that of filaments near the skin and consequently less current will flow in the inside of the wire. At a wavelength of 30 metres (10,000 k.c.) the current penetration is limited to practically one thousandth of an inch. For this reason copper tubing and flat copper strip is made use of in winding transmitting inductances, in order to reduce apparent resistance for a given section of wire.

Installation of Auto Radios

WHILE this section might well be styled "Operation Difficulties of Auto Radios," it must be remembered that until a receiver is operating satisfactorily, with sufficient volume and freedom from noise, the installation cannot be considered complete Hence our troubles are really Installation Difficulties.

After a satisfactory installation job has been completed very few troubles distinct from normal set servicing problems will occur. Of course we may be called on to a job where ignition coil or suppressor breakdown has started to cause interference; where a garage man has disturbed or wrecked bonding or bypass leads. where battery terminals have become corroded; where the vibrator unit has stoppd vibrating; or some similar trouble. These however are usually easy to detect and for the moment our remarks will concern the installation and subsequent necessary work to complete a satisfactory job.

With car radios, we may divide the problem into two main sections:—

(i) Obtaining sufficient sensitivity.
(ii) When (i) is accomplished, the reduction of ignition and similar interference to a reasonable level.

Bench Tests

Requirement (i) usually governs the installation of the aerial system. Provided that a set tests O.K. on the bench powered by a 6 volt battery, and, if necessary, a B eliminator there should be no difficulty in obtaining the requisite sensitivity in the final installation. It is, however, advisable to test out the receiver on the bench before placing it in the car. This gives us a chance to do any necessary lining up and to make any changes in the voltage which may be needed. An old type of B eliminator is handy for these tests. Alternately we may use the "B" power unit supplied with the set, thus checking the whole of the electrical set-up at the one operation. As far as the set itself is concerned follow the ordinary receiver practice as outlined elsewhere.

Testing "B" Supply Units

IN testing "B" power units a 10 watt 240 volt metal filament lamp will do very well as a load. It will draw from 30 to 35 MA. from the average unit rated at 180 volts and 30 MA. Such units should be checked for current consumption from the battery and if excessive go over the following points. Vibrators, dirty and sticking contacts, vibrator too tightly screwed up, moving arm loose, transformer core of too great a gap, shorted turns in transformer, short or partial short on high-voltage D.C. side, defective rectifier valve (look for breakdown from cathode to heater or indications of gas). It is important that the correct polarity be observed in connecting vibration units. Built-up units usually have the negative lead connected to the case. Check this, however. Where the positive terminal of the car battery is earthed it will be necessary to change the leads within the vibrator unit, earthing the positive lead. For convenient reference a table is given elsewhere in this section for the more common makes (later models) of cars encountered. In the case of dynamotor units, as the field is almost invariably shunt connected, the polarity does not matter particularly, unless some special device is attached needing a definite polarity. In rotating units make sure that the armature is free to turn. Grit or dust may have become located in the bearings or between the rotor and field magnet poles. Make sure that the bearings are lubricated. Do not use any other lubricant than specified by the manufacturers as damage may result to the machine. Ball bearings do not require lubrication and are the most satisfactory in every way. Otherwise graphite, graphite-grease or a similar compound is the most widely used in such small machines.

Dynamotor Units

Make sure that the commutator is clean and the mica separating strips are "under-cut," or below the surface level of the copper segments as copper wears more quickly than mica, and check the brushes for sparking during operation. If this occurs (as is likely on excessive input current) make sure that there is no short on either the high voltage commutator or the filter system. The input current is dependent entirely on the speed of the unit. If this falls due to excessive demand on the high voltage end or excessive friction in the bearings or brushes, then the input current will go up above normal. Brushes too heavy on the commutator or too loose and consequently badly pitted will cause extra input to be drawn.

The dynamotor unit is the more dependable but the vibrator type seems to have the advantage so far as efficiency and low consumption goes.

Location of Receiver

THE usual location seems to be at the left hand side of the car, immediately below the dash with the remote control tuning cables brought over to the control unit mounted on the right hand side of the steering column. In this manner it is possible to place the receiver out of the way without interfering with the leg room of the front seat passenger. The tuning control is handy for the driver to operate when driving "solo." If we place the tuning control on the left hand side of the steering column the passenger can operate it without any great inconvenience to him (or her) self and the driver. It is, however, much more inconvenient for the driver unless he is left handed, and it is much harder to see from the driving position.

Power supply units of the vibrator type if not built in with the receiver may be mounted alongside but away from the antenna connection. Dynamotors are usually slung from the frame by small brackets either below the footboards or near the engine and should be enclosed by a protective casing.

Loud speakers are built in and either of the small 6 volt field coil or of the permanent magnet dynamic type. There is little to choose between either although from the standpoint of standing up to long continued rough usage the electro-dynamic type would be superior. This is balanced out to some extent by the extra current necessary to provide the magnetic field.

Installation of Auto Radio—(Continued).

Installation

As in every job installation becomes progressively simpler with each job successfully completed. Perhaps we should say quicker rather than simpler, except in car-models which have been attended to previously. Each make and model of car presents different and puzzling problems. The following is an attempt to clear up the auto radioman's difficulties by a logical attack on the whole problem. In addition a number of "Auto Radio Hints" will be found elsewhere.

Familiarity with the under-dash lay-outs of the various models and makes of cars is the only real requirement. Manufacturer's instructions for mechanical installation are usually complete and the service man experiences little difficulty in this regard.

Engine interference may be apparent and may come from a multitude of sources. Promiscuous attempts to eliminate it by bypasses, grounds, etc., without a thorough understanding of the many possible sources of interference and a well formulated plan of attack, serve only to waste time and temper. A systematic segregation of the many possible sources and elimination of these, one by one, is the logical method of tackling the problem.

As a start, let us list the more common sources of interference:—

(a) High Tension Interference

Interference from the surge of current in the high tension distribution system (spark plugs, spark plug leads, main distributor lead, distributor rotor).

1. Directly radiated into the chassis itself.
2. Radiated into the low tension (6 volt) wires and thence into the set by the battery leads from same.

(b) Low Tension Interference

Interference caused by arcing at the distributor breaker points and the feed back of this surge into the set via the 6 volt battery circuit.

1. May be radiated directly into the receiver.
2. May be fed along the 6 volt battery system into the set.

(c) Generator Interference

Arcing of the brushes of the generator, or at the commutator, feeding through the 6 volt system of the car to the set.

This type of interference is easily recognised by the fact that it is in the form of a note of definite pitch, increasing uniformly with the speed of the car.

(d) Miscellaneous

Other types of interference are not as frequently met with, such as brake drum interference caused by the brake lining dragging on the drums. This is apparent even when the engine is turned off and the car coasting. It usually ceases when the brakes are applied. Corona discharge from the fan belt might also be mentioned.

Systematic Elimination Necessary

(a) The first step is the placing of suppressors on the spark plugs. Service men generally have only a vague idea as to the operation of the suppressor. A spark discharge in an inductive circuit such as the secondary of the ignition coil is of an oscillatory nature. That is, during the period of each spark at the plug points, a high frequency oscillation is set up in the ignition circuit of that plug. The degree of decay of this oscillation is determined mainly by the value of pure resistance in the circuit. As the resistance is increased, the damping of the oscillation is increased until a critical resistance is reached when the damping effect is so great that the oscillation is suppressed before only a few reversals have occurred.

The familiar types of plug suppressors are merely a sturdy resistor of about 20,000 ohms, which value is well above the critical resistance value for car ignition circuits. Thus the surge in the ignition wiring is highly damped and no interference is experienced in the radio chassis. It is also necessary to suppress, in the same manner, the spark occurring at the distributor points by another suppressor of the same type. It must be remembered, however, that this does not eliminate interference from open sparks that might occur through defective ignition wiring.

All open sparks in the ignition circuit must be cured. Every service man is familiar with the clips which are attached to the ends of the leads feeding the plugs, and also feeding the distributor from the coil. These make contact through a small point in the side which pierces the rubber insulation and contacts the stranded copper inside. It is important that the rubber cable be stripped and the wire brought through a hole in the end of the clip and soldered. If the clip does not make proper contact, a small spark occurs, which although not affecting the ignition of the car, interferes with the radio.

Ignition Circuit Continuity

After this is done, continuity of the whole ignition circuit should be checked. High tension terminal on the coil to ground should read approximately 5,000 ohms. If it reads open it indicates an open in the secondary of the coil and an arc inside the coil. In this case, the coil must be replaced. From the rotating contact in the top inside of the distributor cap to ground should read about 5,000 ohms to ground. Each point on the inside of the distributor cap should show full continuity to the tip of its corresponding spark plug.

Each suppressor should show approximately 20,000 ohms continuity. It may be found necessary to eliminate the clip on the top of the suppressor entirely and strip the ignition wire, and attach the wire direct to the terminal on top of the suppressor with a lug. If the car does not perform so well after installing suppressors, the spark gaps on the plugs should be set up from the usual 25-30 thousand to 18-20 thousands. Only a negligible difference in performance will be noticed then.

Clean Plug Insulators

The porcelain on the spark plugs should be cleaned—also the cap on the distributor—to eliminate possibilities of arcing from the high tension leads to ground.

In cars where the coil is located under the dash of the car, in close proximity to the receiver chassis, the ignition lead from this coil to distributor should be well shielded. The shield can be made by slipping over a length of standard shielding, which when stretched, will fit the loom snugly. Without the loom there is a possibility of an arc from the lead to the shield which will only accentuate the interference. The loom also protects the lead when the hot iron is applied to solder the shield to ground.

Care must be exercised in placing the shield. It must be far enough from the ends of the lead to prevent arcing to the shield, and taped so the shield will not slide down with the vibration of the car. Even with the coil in the engine

Installation of Auto Radio—(Continued).

compartment, it may be found necessary to shield this hot lead. The same shield flattened out serves excellently to bond the shield to ground at both ends.

An excellent method of checking whether or not the source of interference is the high tension system, is to race the engine and pull the ignition lead from its socket in the coil. If the noise ceases while the engine coasts to a stop, we know our source is the ignition circuit from the coil to the plugs.

As pointed out above, high tension interference may be directly radiated into the chassis and aerial or may be radiated into the 6 volt wiring, which must be well isolated from the high tension leads. Most important of these is the 6 volt wire leading from the coil to the distributor, which usually is in the same tubing or in close proximity to the high tension lead from coil to distributor. This must be removed and isolated, and in some cases shielded.

High Tension Interference

All possibility of high tension leads arcing over to low tension leads must be eliminated. In many coils, particularly of the cheaper service type—a corona discharge will occur between the base of the bakelite high tension terminal, and the low tension terminals on either side of it, and in many cases an actual arc. This can best be checked by turning off all lights in the garage and watching the engine and coil while the engine and radio are both operating. There should be no spark between the nipple and the terminals to one side. The insulation can be well checked by racing the engine and pulling the high tension lead from the coil. While the engine is coasting to a stop a defective coil will show a very noticeable sparking at the high tension terminal, a good coil will show just a slight corona.

In cars where the engine is mounted on rubber pads, or in any way isolated from the chassis proper, the block should be well grounded to chassis with a heavy flexible strip similar to those used for ground connection on storage battery.

Low Tension Interference

This is the most difficult type of interference to eliminate. It is caused by the breaker points arcing and feeding back through the 6 volt system to the receiver, and also radiating through the antennae.

The first step towards eliminating this is the installation of a bypass condenser of .2 mfd. or greater capacity on the primary terminal of the coil, which runs to the ammeter and battery through the ignition lock, connecting the other end of the condenser firmly to the frame of the car. This should be standard equipment in any installation regardless of noise, as deterioration of the distributor breaker points with time will develop noise after installation is made. Often improvement is noticed by reversing the leads to the coil, i.e., the distributor lead and the battery lead.

As low tension interference may feed directly into the set or radiate into the antennae through the dome light wires, it is wise to remove the dome light wire where it connects to the ammeter and ground it temporarily to eliminate antennae radiation. If this eliminates the interference, the dome light wiring is proven the source of trouble.

Lead Must Be Short!

The low tension leads from ammeter or ignition lock to coil and from coil to distributor should be shortened as much as possible. It must be kept in mind that the lead from the coil to the distributor is the greatest source of interference. The battery lead from the coil is well protected by the coil primary as a choke and the by-pass condenser to ground on the primary coil terminal.

The distributor lead should be made as short as possible and, in many cases, shielded particularly when the coil is located under the dash. The same lead should be as far removed from high tension leads as possible.

In many cases, this lead is in the form of an ignition lock, which means that this hot lead is brought to a lock under the dash, through a cable that is very ineffective shielding.

The type of steel used in the cable eliminates bonding and soldering, and the wire in the cable itself must be shielded. Usually the cable can be removed at the distributor, the lock removed at the dash, the centre wire removed, shielded and reassembled.

For an example, in the Hudson 8 the ignition lock breaks both the ammeter lead to the coil and the distributor lead through the cable. The cable attaches to the distributor, leaving a small lug from the cable at the distributor end for the distributor condenser to attach to. A heavy lead from this lug to the distributor terminal on the car will short out the ignition lock. The lead from the distributor terminal to the lock should be removed at the same time. It would be wise though to remove the lock cable entirely by removing the distributor contact plate assembly and undoing the two bolts that hold the lock cable to the underside of the distributor contact plate, and attaching two wires to these bolts, one to attach to the condenser mounted on the distributor, and another to the distributor terminal on the coil, the latter wire to be shielded.

Replace the distributor assembly and ground the lock cable terminal. The ignition lock will still control the ignition circuit through the battery lead to the coil.

Localise All Trouble

Separation of the low tension type of interference and high tension interference can be done by operating the radio from a separate battery, while the dome light is removed and grounded. If the interference ceases it can be laid to low tension feed back through the battery leads. If it remains the same, it is more likely to be high tension radiation.

It is inadvisable to operate the radio from a single lead to the ammeter as the pick-up through the network of low tension wiring is greatly increased.

A separate lead, shielded, should be run direct to the storage battery or starter button terminal. The low impedance path to ground thus reduces interference pick up.

Other by-passes of .2 mfd. or more, installed on the following points to ground may prove helpful—ammeter, cigar lighters, electric windshield wipers, petrol gauge, heater, fan, stop light, switch, etc. Also try bonding to the metal dash the following —choke, starter, spark control, speedometer cable, petrol gauge, etc.

It will be noticed that by-passes installed on the ammeter, etc., will have varying effect depending on where it is grounded. It may be grounded to metal dash, engine block, radio chassis, antennae shield, etc., and all possible grounds should be tried.

Installation of Auto Radio—(Continued).

The possibility of radiation of low tension interference from the mass of wiring usually under the dash can be determined by operating the engine by a separate storage battery temporarily located near the coil. Run a short wire from the coil to a lug of the battery and ground the other lug. If the noise is reduced we can look for trouble in the 6 volt wiring under the dash, and by-pass accordingly. High tension radiation and low tension pick-up of high tension radiation, and low tension radiation conditions all remain the same in this case.

Generator Interference

This is the easiest to locate and to eliminate. It has a characteristic note which varies in pitch with the speed of the engine. Also, if when the engine is racing, the ignition is switched off, the generator interference (if any) will remain until the engine drops to such a speed that the ammeter ceases to show charge, and will drop in pitch with the drop in speed of the engine. It is eliminated by placing a by-pass condenser of .25 mfd., preferably greater, from the generator side of the cut-out to the frame of the generator.

Miscellaneous Interference

A type of interference present when all other interference is eliminated, is of a periodic nature and not necessarily synchronised with the explosion of the cylinders. It sounds like a building-up and periodic discharge. The most likely source is defective ignition wiring causing periodic arcs to ground or to shields. The shield on the high tension distributor lead should be checked in this case. The whole wiring system should be checked in darkness for periodic arcs—particularly in the neighbourhood of the high tension terminal on the coil.

Occasionally static discharge from the fan belt to the pulley will be noticed. This will be visible in darkness. It can be eliminated by removing the belt and running the engine without it as a check. If this eliminates the trouble, the fan should be given a new light treatment of graphite, which will usually clear it up. It is advisable in some cases to add a good quality molded by-pass condenser of about .002 mfd. capacity across the breaker points in parallel with the standard condenser, which acts as a better R.F. by-pass. This should be installed, if possible, within the distributor case itself and with as short leads a possible.

Other sources of interference, such as brake drum static, apparent when the engine is turned off and the car coasting may be noticed. This may be cured with an extremely light application of graphite to the brake drum.

Aerial System

Antennae installations may be roughly classified as follows:—

(a) Cars with aerial and lead-in already installed.
(b) Cars with wire netting used as roof support, and is not grounded to frame of the car. Lead-in must be installed.
(c) Cars with wire netting used as roof support but wire is grounded to frame of car.
(d) Cars with no wire or any netting which may be used as an aerial.

Let us analyse these classifications in detail:

(a) Under this classification service men hope rather than know that no work must be done to the aerial. Continuity of the aerial and lead-in to ground must be checked. If a 200-volt—1,000 ohm per volt meter is connected in series with the lead-in wire, car frame, and 180 volts of B battery, the meter should indicate not more than 2 volts, even when the roof is damp.

The lead-in must be shielded from the antenna post of the receiver and the shield grounded to the chassis to within at least 8-10 inches of the antenna. The shield must also be grounded well to the frame of the car at the antenna end. Very few car manufacturers including aerials in their cars provide a shielded lead-in, but this should be added in every installation.

Dome Light

Considerable interference can be had from the dome light wiring. This should be checked by removing the dome light wire from the ammeter to which it is usually attached, removing it from under the dash and temporarily grounding it to the car frame. If interference is reduced, the dome light wires are proven to be too close to the aerial screen. Reconnect the lead to the ammeter and try by-passing this terminal to ground with a by-pass condenser of .2 mfd. capacity or greater. If this does not remove the dome light interference try by-passing the dome light at the switch usually found on the side of the car.

If dome light interference still persists, either the top must be removed and the dome light wires re-arranged to run at least three inches away from all screening, or a separate switch installed on the dash to control these lights. This is at the option of the customer. The latter method is obviously the cheapest.

Often the lead-in provided by the car manufacturer, if of any great length, such as older models of the Cadillac V-16, reduces the signal strength materially through its high loss characteristics. It must be changed to a more suitable type. The best that can be recommended can be made from ordinary electrician's loom, covered with some ¼in. shield. Signal attenuation is reduced to a negligible value with a high shielding efficiency.

In lead-ins of great length, impedance matching coils such as used in several of the lead-in sets now on the market will improve signal strength and reduce interferenc pick-up.

(b) In this case, one corner of the head lining of the car should be removed—the corner which will give the shortest lead to the set aerial post. Screen should be checked for grounds, and the lead-in installed as mentioned above.

(c) When the screen in the car is grounded, there is only one alternative, and that is to re-insulate the screen. It is not possible to avoid this by installing a new copper screen—because of the shielding action the grounded screen above this will have.

The screen should be insulated for aerial use by cutting it about 1½in. from the side frame of the top all around the car. Then another cut 2 to 3in. from the first cut is made. This completely isolates the centre section in such a manner that it is from 2 to 3in. away from the remaining grounded section. A six inch wide path should also be cut from the side of the frame to the dome light to allow the light wires to reach the light and yet not interfere with the screen. So that the screen still serves its original purpose of top support, the three inch space is laced with a strong flexible cord or string, back and forth between the cut sections or screen. Care should be taken that the screen is cut where it passes between the top material and the cross bars.

The head lining should not be replaced until the engine interference is eliminated. This allows shielding of the dome light to be done. The wires should be shielded to a point at least six inches from the screening and the shield grounded both to the car frame and the dome light frame.

Installation of Auto Radio—(Continued).

By-Passing Tricks

In some cases by-passing the dome light wires at the ammeter end and the dome light end will not prove effective but by-passing at some other point in the length.

A by-pass of .2 mfd. will suffice and this must have as short leads as possible. As mentioned above—a well shielded lead-in soldered to the wire netting aerial should be used.

(d) When a complete aerial is to be installed, a copper screening of 16 mesh or more should be used. It should be as large as possible without being closer than 3in. from all grounded metal parts. In large cars it will be found unnecessary to carry the screen any further back than the dome light. It should, however, be from 9 to 12 square feet in area for maximum results.

If purchased in a length of 36 inch screening, the side edges will be seamed, but the ends should be solderd to stop fraying and improve the continuity of the screen.

In installing, the screen is tacked to the bottom of the rear bow first, with small carpet tacks. It should also be tacked up to the front side of the bow, then stretched over to the bottom of the next bow. If just tacked to the bottom of the bows or top supports, it will not permit the cotton strips which hold the head lining to the bows, to be tacked in place. It will be only necessary to tack the screen to the side of each bow to which is to be fastened a head lining strip, which is usually every second bow.

The same precautions apply to this antenna as to the wire netting type as regards dome light shielding and bypassing, and isolating the copper screen at least three inches from the dome light assembly and wires.

In roadsters, touring cars or convertible coupes, the antenna offers a different problem. A screen, unless nicely arranged in material the same texture and colour as the top material, offers an objectionable appearance. Usually the most convenient antenna is the plate type used under the running boards. A suggested construction would be two strips of copper screening wrapped and sewed in waterproof material, such as leatherette. A margin of leatherette at each end allows the strips to be attached to the underside of the running boards. The ends of the strips should be joined by a connecting wire. It may be necessary to shield the connecting wire and possibly bypass the tail light or stop light wire if they pass near the screen strips. By using two strips, 4 to 6 square feet of antenna can be had. A well grounded shielded lead-in must be used.

We will find that even a small roof antenna such as in a coupe, will be more satisfactory than a running board antenna. It is only where practical considerations will not permit of the former the latter type is used.

In all checks for engine interference, it is advisable to eliminate pickup of outside interference by spreading a copper screen over the top of the car and temporarily grounding this to the car frame. Excessive noise, or exceptional signal reception will often affect the A.V.C. of the receiver to such an extent that the sensitivity is reduced and engine interference under estimated.

Car Battery Connections

The following list shows the polarity of the chassis connection in most American makes of cars.

A (—) Grounded	A (+) Grounded
Buick	Auburn
Chevrolet	Cadillac
Durant	Chrysler
Essex	De Soto
Hudson	Dodge
Nash	Ford
Oldsmobile	Hupmobile
Pontiac	La Salle
Reo	Marmon
Stutz	Nash (Twin Ignition)
Willys	Packard
	Rockne
	Studebaker

In the case of English cars the following makes have the negative terminals of the battery earthed:

Armstrong	Morris	Talbot
Austin	Riley	Triumph
Hillman	Rover	Wolseley
Humber		

The Singer has the positive terminal earthed.

Auto Radio Hints

Earth Leads

Since the chassis of a car is built up from steel sections these offer quite a high impedance to R.F., and any R.F. currents flowing in the frame may build up quite high voltages. One particular case is R.F. currents due to primary make and break flowing in the return circuit from where the coil is earthed to the frame to the point where the battery is earthed to the frame. This sometimes makes it necessary to take the six volt return connection from the receiver direct to the battery, using a shielded cable. Otherwise a choke in the return lead from the coil (bypassed if necessary) may cut out the interference. A coil from a generator cut-out makes a satisfactory choke.

Brake Interference

Brake interference is caused by the brake linings rubbing on the brake drums and consequent discharge of the static electricity generated. The cures are as follows:—

(1) Readjusting the brakes.

(2) Bonding the brake rods or the trunnion levers operating the brakes, to the frame or the axle with flexible bands or leads.

(3) By application of a small quantity of graphite mixed with lining dressing. Too much graphite will cause the brakes to slip. Only a very small quantity is needed.

Bonding

Bond the instrument panel to the bulkhead at each end.

Bond aprons at top of car body to bulkhead using shield of lead-in as a convenient earthed lead.

In cars having rubber mounted engines make sure that both the engine block and the return side of the battery are grounded directly to the frame by a heavy strip.

In tourers, ground the metalwork of the hood.

Bond choke and other controls running to the dash, direct to bulkhead.

In testing, .5 or 1mfd. condensers with leads and clips will be found very handy as also will heavy flexible leads with large clips on either end.

Non-Electrical Interference

Non-electrical units are sometimes sources of noise in audio radio receivers. Among these are the fan belt and brakes as already mentioned, the gear box and differential or any two rubbing contacts such as metal hoodwork and the steel bodywork in a tourer. Such noises are unusual and can be checked by turning off the ignition. The fabric universal used in some cars is another point where such interference may be generated.

Aerials

A more efficient aerial system can be had by using an aerial-counterpoise system entirely isolated from the frame of the car. This comprises a normal netting antenna in the hood and a running board antenna, both explained in the main section on installation. The lead-ins are run to a suitable point remote from any likely source of interference and thence to the receiver by a twisted pair. Ordinary flex is O.K. and shielding is not usually necessary.

The necessary charge in the receiver is to make the aerial coil completely floating, i.e., disconnected from frame at its bottom end, which is then run to the counterpoise. More pick-up is given by this system and as shielding of the double lead-in is usually unnecessary, less loss in the transmission of the energy from the aerial proper to the set. This also helps to reduce interference due to R.F. eddy currents in the chassis of the car itself.

Magneto Suppressors

These should be of a higher value (about 50,000 ohms) than for coil ignition and fitted to each ignition lead. It is of course impossible to fit a single suppressor, analogous to the normal single suppressor used at the distributor in the case of a coil. At the same time magneto-ignition systems are usually easier than the equivalent coil ignition systems in their interference problems. For a start there is no L.T. circuit connected to the battery.

Vibrator Interference

Where interference is coming from the vibrator contacts sparking, clean and if ineffective shunt them with .25 mfd. condensers.

Generator Charging Rate

If it is desired to increase the charging rate of the car generator to compensate for the additional current drawn by the radio receiver, this may be done quite simply. On looking at the generator it will be found to be equipped with three brushes, one of which is movable. This movable brush is connected to the field coil and taps off a variable voltage for the field excitation. By advancing this brush the excitation may be increased and the generator voltage and hence the charging rate increased. By loosening the screw holding this third brush in position we can adjust it until a suitable increase in the charging rate is obtained. This would amount to two or three amps increase at normal running speed. The screw holding the third brush is usually placed in an accessible position even if the brush itself cannot be readily got at, and is frequently in the form of a ring tightening on a round surface after the manner of an earthing clip.

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All-Wave Section

Before dealing with any receivers it might not be amiss to include a few words on the subject of short-wave reception, dealing particularly with what results may and may not be expected. It is, no doubt, a fact that with very simple equipment it is possible to receive foreign broadcasting stations. At the same time it is also very true and frequently overlooked that the short waves are very adversely affected by certain astronomical and meteorological conditions which are not so apparent in their effects on broadcast frequency reception.

In addition we have to deal with the phenomenon of skip distance which is in itself an exceedingly complicated one, being closely allied with that of fading. The disturbance emitted from a short wave transmitting aerial can be divided arbitrarily into two components, the ground wave and the sky wave. It is the ground wave from which reception is obtained up to short distances. On the broadcast frequencies the ground wave can be received at far greater distances than on the short waves, for as the frequency of transmission is increased the ground wave is correspondingly more absorbed. In the case of a longer wave the sky wave is reflected and refracted or bent back from what is known as the **Heaviside** layer (consisting, it is believed, of a cloud of ionised gas particles which is continually varying in height and density) reaching the earth again before the ground wave has died out. As, however, the frequency is increased, a point comes where the ground wave dies out before the sky wave is reflected back to earth. It should be noted that only those waves that strike the layer at a very small angle are reflected; those which meet the layer at a large angle or practically at right angles pass on and are absorbed. Thus any receiver located near the edge of the skip region will experience a great deal of fading on the transmission due to the spontaneous variation of the reflecting medium, which has a very large effect on those waves meeting the layer near the "critical" angle where reflection and refraction cease.

Inconsistent Service.

Exceedingly complicated effects are introduced at very great distances where several reflections may have occurred. In point to point services it is possible to partially control the effects of skip and fading by using directional aerials, which can also be made to determine the angle at which the wave strikes the **Heaviside** layer. Even so, conditions which are favourable for reception one day may be totally different the next. However, it is often reasonable to state that such and such a station (Paris for example, near 19 metres) can be heard at such and such a time regularly (e.g., in this case 10 p.m. Sydney time).

The trend of short wave commercial development in 1934 is undoubtedly toward the all-wave receiver, providing the thrill of real DX hunting in addition to the ordinary broadcast entertainment by the mere turning of a wave band knob.

Converters.

The converter is a short wave superheterodyne unit comprising an oscillator and detector, and in some cases a stage of I.F. amplification, designed to operate with an intermediate frequency in the broadcast band. Its output is thus a modulated signal of broadcast frequency and is fed into an ordinary broadcast receiver for further amplification at this intermediate frequency.

The short wave converter is disappearing largely from notice. These units are of two types: (a) self powered by an incorporated pack and rectifier, and (b) powered from the main broadcast receiver. They can be operated into any type of receiver, but at least two I.F. stages or their equivalent are necessary for satisfactory operation. This means that if no I.F. stage is provided in the converter itself (typical of type (b)), the broadcast receiver must incorporate at least two stages of R.F., or, if a superheterodyne, two stages of I.F. amplification are very desirable.

Where an initial stage of I.F. is provided in the converter itself (typical of class (a)) this requirement is not so stringent.

I.F. Channel.

The incorporation of an I.F. stage in the converter itself definitely fixes the intermediate frequency to which it is necessary to tune the broadcast receiver. This has the disadvantage that local interference may be troublesome.

For example:—Close to 2FC a channel of 650 Kc may pick up interference, since 2FC is on 665 Kc. In a converter where there is no tuned circuit or I.F. transformer, fixing the channel the broadcast receiver may be tuned to any convenient channel. In fact it is often handy to adjust the dial of the main set when very fine tuning is required.

Converters almost invariably use separate tuning controls for first detector and oscillator circuits. This is not a great disadvantage, as the first detector tuning is very broad.

T.R.F. Receivers.

The most usual arrangement of a receiver of this kind comprises one tuned R.F. stage and a regenerative detector followed by one or two stages of audio. Apart from troubles in the audio end the majority of difficulties encountered concern smoothness of reaction control and

oscillation of the R.F. stage, can usually be cleaned up by proper decoupling and the insertion of R.F. chokes in the positive supply leads. Any bypasses intended to prevent stray R.F. currents in the pack or audio circuits should be of the moulded mica type and not tubular condensers. A value of .001 or .002 is satisfactory. Honey comb R.F. chokes appear to be satisfactory. Regenerative receivers should be worked just below the oscillation point for the reception of phone signals. One advantage of such receivers not possessed by the converter and all wave receiver is their ability to receive morse code signals and to locate the weaker phone stations by heterodyning their carrier waves. Plug-in coils should be coated with some dope or varnish so as to preserve the same tuning position on the dials, even after long or rough handling of coils. Clear duco makes quite an efficient job.

The troubles which beset short wave receivers are essentially the same as with the broadcast receiver. The only additional problem of any great interest here is the extraordinary capacity of a short wave receiver for picking up any inductive interference which may be present in any neighbourhood. In particular this is exemplified by the fact that it is quite possible to receive a noise from the ignition system of a car as far as 100 yards away. Loose guy wires, clothes lines or metal down-haul wires knocking against each other or other metal objects will create an annoying noise in a short wave receiver, particularly noticeable on windy days. The remedy is to bond such metal objects together or securely stay them so that intermittent contact is impossible. The same remarks apply to any intermittent connection present in the house wiring system.

List of Stations.

It should not be thought that all the stations listed in the following comprehensive list will always be audible in Sydney. It is only during periods of good conditions that it will be possible to hear the majority of them, and during the periods of bad conditions which are bound to occur it is sometimes impossible to hear with good strength more than three or four stations transmitting speech. Of course, it must be remembered that morse and beam stations will always be audible. During the middle of the day when no short wave broadcasting is audible the beam stations provide a very effective method of testing the sensitivity of a short wave receiver or converter. In addition to the stations listed, numerous amateur phone stations in Australia and New Zealand can be heard between 75 and 85 metres (4000-3500 K.C.) at night, particularly in the winter months. In addition on some evenings and during the week-ends amateur phones may be heard on the so-called 40 metre band (41-42.8 metres, 7300-7000 K.C.). The third popular amateur band runs from 20.83 to 21.43 metres (14,400-14,000 K.C.), but is mainly used for morse code work.

SKIP DISTANCE AND RANGE TABLE

(for frequencies between 3,500 k.c. and 20,000 k.c.)

Frequency (K.C.)	Wave length (metres)	Range of Ground Wave (miles)	Skip Distance (miles)				Max. Reliable Range (miles).			
			Summer		Winter.		Summer.		Winter.	
			Day	Night	Day	Night	Day	Night	Day	Night
3,500— 4,000	85 —75	60	—	—	—	—	250	1,500	400	4,500
4,000— 5,500	75 —54	55	—	—	—	—	300	4,000	500	7,000
5,500— 6,150	54 —48.8	50	50	50	50	60	450	5,000	650	8,000
6,150— 7,000	48.8—42.8	45	75	150	90	250	600	6,500	800	8,000
7,000— 8,200	42.8—36.6	40	120	250	150	400	700	7,500	1,000	8,000
8,200— 8,900	36.6—33.7	40	160	370	200	570	800	8,000	1,300	8,000
8,900—11,000	33.7—27.3	40	220	530	280	740	1,000	8,000	1,800	8,000
11,000—12,825	27.3—23.4	35	350	850	420	1,150	1,500	8,000	2,900	
12,825—15,000	23.4—20	30	400	1,100	500		2,000		3,800	
15,000—20,000	20 —15	25	580		700		3,000		5,600	
				Not reflected.		Not reflected.		Not reflected.		Not useful.

The above table is obtained from average figures. For night range assume the greater part of the path to be in darkness. Many discrepancies will be found in practice due to seasonal changes, local weather conditions, transmitting antennae, etc. At times signals may be received within the skip distance after travelling right around the world.

WORLD TIME CHART

Hawaiian Islands	U.S.A. Pacific S.T.	U.S.A. Mountain S.T.	U.S.A. Central S.T.	U.S.A. New York, Washington E.S.T.	Halifax, Buenos Aires	Rio de Janiero, Brazil	London, Paris, Madrid	G.M.T. or G.C.T.	Sweden, Germany, Switzerland, Italy	Petrograd, Constantinople, Capetown	Bagdad, Persia	India	Borneo, Java, Dutch E.I.	P.I., China, Western Australia	Tokyo	Adelaide, South Aust.	Sydney, Melbourne, Eastern Aust.	New Zealand	Samoa
1.30	4.00	5.00	6.00	7.00	8.00	9.00	Midn.	0000	1.00	2.00	3.00	5.00	6.00	8.00	9.00	9.30	10.00	11.30	Noon
2.30	5.00	6.00	7.00	8.00	9.00	10.00	1.00	0100	2.00	3.00	4.00	6.00	7.00	9.00	10.00	10.30	11.00	12.30	1.00
3.30	6.00	7.00	8.00	9.00	10.00	11.00	2.00	0200	3.00	4.00	5.00	7.00	8.00	10.00	11.00	11.30	Noon	1.30	2.00
4.30	7.00	8.00	9.00	10.00	11.00	Midn.	3.00	0300	4.00	5.00	6.00	8.00	9.00	11.00	Noon	12.30	1.00	2.30	3.00
5.30	8.00	9.00	10.00	11.00	Midn.	1.00	4.00	0400	5.00	6.00	7.00	9.00	10.00	Noon	1.00	1.30	2.00	3.30	4.00
6.30	9.00	10.00	11.00	Midn.	1.00	2.00	5.00	0500	6.00	7.00	8.00	10.00	11.00	1.00	2.00	2.30	3.00	4.30	5.00
7.30	10.00	11.00	Midn.	1.00	2.00	3.00	6.00	0600	7.00	8.00	9.00	11.00	Noon	2.00	3.00	3.30	4.00	5.30	6.00
8.30	11.00	Midn.	1.00	2.00	3.00	4.00	7.00	0700	8.00	9.00	10.00	Noon	1.00	3.00	4.00	4.30	5.00	6.30	7.00
9.30	Midn.	1.00	2.00	3.00	4.00	5.00	8.00	0800	9.00	10.00	11.00	Midn.	1.00	4.00	5.00	5.30	6.00	7.30	8.00
10.30	1.00	2.00	3.00	4.00	5.00	6.00	9.00	0900	10.00	11.00	Noon	1.00	2.00	5.00	6.00	6.30	7.00	8.30	9.00
11.30	2.00	3.00	4.00	5.00	6.00	7.00	10.00	1000	11.00	Noon	1.00	3.00	4.00	6.00	7.00	7.30	8.00	9.30	10.00
12.30	3.00	4.00	5.00	6.00	7.00	8.00	11.00	1100	Noon	1.00	2.00	4.00	5.00	7.00	8.00	8.30	9.00	10.30	11.00
1.30	4.00	5.00	6.00	7.00	8.00	9.00	Noon	1200	1.00	2.00	3.00	5.00	6.00	8.00	9.00	9.30	10.00	11.30	Midn
2.30	5.00	6.00	7.00	8.00	9.00	10.00	1.00	1300	2.00	3.00	4.00	6.00	7.00	9.00	10.00	10.30	11.00	12.30	1.00
3.30	6.00	7.00	8.00	9.00	10.00	11.00	2.00	1400	3.00	4.00	5.00	7.00	8.00	10.00	11.00	11.30	Midn.	1.30	2.00
4.30	7.00	8.00	9.00	10.00	11.00	Noon	3.00	1500	4.00	5.00	6.00	8.00	9.00	11.00	Midn.	12.30	1.00	2.30	3.00
5.30	8.00	9.00	10.00	11.00	Noon	1.00	4.00	1600	5.00	6.00	7.00	9.00	10.00	Midn.	1.00	1.30	2.00	3.30	4.00
6.30	9.00	10.00	11.00	Noon	1.00	2.00	5.00	1700	6.00	7.00	8.00	10.00	11.00	1.00	2.00	2.30	3.00	4.30	5.00
7.30	10.00	11.00	Noon	1.00	2.00	3.00	6.00	1800	7.00	8.00	9.00	11.00	Midn.	2.00	3.00	3.30	4.00	5.30	6.00
8.30	11.00	Noon	1.00	2.00	3.00	4.00	7.00	1900	8.00	9.00	10.00	Midn.	1.00	3.00	4.00	4.30	5.00	6.30	7.00
9.30	Noon	1.00	2.00	3.00	4.00	5.00	8.00	2000	9.00	10.00	11.00	1.00	2.00	4.00	5.00	5.30	6.00	7.30	8.00
10.30	1.00	2.00	3.00	4.00	5.00	6.00	9.00	2100	10.00	11.00	Midn.	1.00	2.00	5.00	6.00	6.30	7.00	8.30	9.00
11.30	2.00	3.00	4.00	5.00	6.00	7.00	10.00	2200	11.00	Midn.	1.00	3.00	4.00	6.00	7.00	7.30	8.00	9.30	10.00
12.30	3.00	4.00	5.00	6.00	7.00	8.00	11.00	2300	Midn.	1.00	2.00	4.00	5.00	7.00	8.00	8.30	9.00	10.30	11.00

NOTE.—Crossing the midnight line from dark to light area and vice versa:—Crossing from LEFT to RIGHT indicates following day.
Crossing from RIGHT to LEFT indicates preceding day.

E.g.—Wednesday 2 p.m. in Sydney is Tuesday 11 p.m. in New York. Wednesday 11 p.m. in Sydney is Wednesday 2.30 a.m. in Honolulu. Wednesday 11 p.m. in Sydney is Thursday 12.30 a.m. in Auckland. Wednesday 11 p.m. in Sydney is Wednesday 2.30 a.m. in Honolulu.

Principal Short-Wave Stations of the World

Following is a list of short-wave phone and broadcasting stations. Many of these will not be audible at the given times except for periods of freak conditions or only in certain seasons of the year. Conversely there are normally reliable stations which are inaudible at certain times due to these same freak conditions and seasonal variations.

First set of figures is the Wavelength in metres, second set of figures is the frequency in Kilocycles, then the call sign, followed by the location of the Station, Service and Transmitting Times under the 24 hour clock system. **(All times given as Sydney Mean Time.)**

13.92, 21.540, W8XK, Saxonburg, Pa., Phone 2200-0500.
13.97, 21.470, GSH, Empire Broadcasting.
14.59, 20,560, PMB, Malabar, Bandoeng, Phone to PCK; 1810, 1940.
15.50, 19,355, FTM, Paris, Phone to LSG; 0100-0500.
15.60, 19,220, WNC, Lawrenceville, Phone to England; 2300-0700.
15.90, 18,890, ZSS, Klipheuval, Sth. Af., Phone to GAA; 1800-2300.
16.11, 18,620, GBU, Rugby, Eng., Phone to WMI; 2100-0500.
16.32, 18,382, FRS, Saigon, Indo-China, Phone; 0400-0600.
16.35 18350, ZLW, Wellington, N.Z., Phone VK2ME, irregular.
16.38, 18,310, GBS, Rugby, Eng., Phone to WND; 2100-0500.
16.53, 18,145, PMC, Tjimindi Bandoeng, Java, Phone to PCV; 1810-0020.
16.81, 17,850, PLF, Malabar, Bandoeng, Phone
16.82, 17,795, PCV, Kootwijk, Holland, Phone to Java; 2100-2400.
16.86, 17,790, GSG, Empire Broadcasting Zone 2.
16.87, 17,780, W3XAL, Bound Brook, N.J., Broadcast; 2200-0600.
16.88, 17,775, PHI, Huizen, Holland, Broadcast;
16.9, 17,750, HSP, Bangkok (Siam), Sun. and Tues.
17.02, 17,630, PMW, Malabar, Bandoeng, Broadcast.
17.24, 17,400, J1AA, Tokyo, Phone to Australia.
18.37, 16,330, VLK-VK2ME, Sydney, Broadcast; 1800-2100.
18.40, 16,305, PCL, Kootwijk, Holland, Phone to Bandoeng.
18.59, 16,140, GBX, Rugby, Phone to VK2ME; 0700-1400.
18.68, 16,060, NSS, Annapolis, Md.; 0255-0300.
18.71, 16,030, KKP, Kauhuku, Hawaii, Phone to KWO; 0500-1000.
19.04, 15,760, J1AA, Tokyo, Tests up to; 0100.
19.53, 15,355, KWU, Dixon, Calif., Phone to Hawaii; 0500-1000.
19.53, 15,355, KWO, Dixon, Calif., Phone to Hawaii; 0500-1000.
19.55, 15,340, W2XAD, Schenectady, N.Y., Broadcast; 0600-0900.
19.61, 15,300, OXO-OXZ, Copenhagen, Broadcast.
19.61, 15,300 ....., Tandjong Priok, Batavia, Broadcast.
19.68, 15,245, FYA, Radio Colonial, Pontoise, France, Broadcast; 2,200-0100.
19.72, 15,210, W8XK, Saxonburg, Pa., Broadcast; 2130-0700.
19.74, 15,200, DJB, Koenigswusterhausen, Ger., Broadcast; 2300-0830.
19.74, 15,200, J1AA, Tokyo, Japan, Broadcast, irregular.
19.81, 15,140, GSF, Empire Broadcasting.
19.84, 15,120, HVJ, Vatican City, Broadcast; 2000-2015.
20.00, 15,000, TI4NRH, Heredia, Costa Rica, Sat., Sun., Mon., 0200-0300.
20.00, 15,000, CM6XJ, Central Tuinucu, Cuba, Broadcast, irregular
20.50, 14,630, XDA, Mexico City, Broadcast; 0530-0600.
20.80, 14,425, VD , Suva, Phone.
20.95, 14,310, G2NM, Sonning-on-Thames, England, Broadcast; 0430.
21.52, 13.940, YO1, Bucharest, Broadcast;
22.68, 13,230, ..., S.S. Conteraggo, Phone, sometimes broadcast; 2100-2300.
23.06, 13,010, FZG, Saigon, French Indo-China, Broadcast.
23.35, 12,850, W2XO, Schenectady, N.Y., Broadcast; 0000-0600.
23.35, 12,850, W9XL, Anoka, Minn., Broadcast.
24.40, 12,295, ZLT, Wellington, N.Z., Phone to VK2ME; 1800-2300.
24.40, 12,295, PLM, Bandoeng, Java, Phone VK2ME; 2100.
24.46, 12,265, PLM, Bandoeng, Java, Phone; 2245.
24.69, 12,150, GBS, Rugby, Transatlantic phone to Deal, N.J., WND; 0500-1000.
24.89, 12,045, NSS, Annapolis, Md., 1255 (time signal).
25.00, 12000, FZG, Saigon, Indo-China, 0500-0505 (time signal)
25.01, 11,993, PK6KZ, Makassar, Celebes, Broadcast.
25.20, 11,905, FYA, Paris, Broadcast; 0400-0600, daily, 0130-0430.
25.25, 11,880, W8XK, Saxonburg, Pa., Broadcast; 0700-1300, daily.
25.27, 11,870, VUC, Calcutta, India, Broadcast;
25.28, 11,865, GSE, Empire Broadcasting, Zone 2.
25.34, 11,840, W2XE, Jamaica, Broadcast; 2230-1700, daily, 2300 Sun., 1500 Mon.
25.34, 11,840, W9XAA, Chicago, Relays WCFL; 2200-2300, 0400-0500, 0700-0830, 0900-1030.
25.40, 11,810, 2RO, Rome, Broadcast; Approx. 0215-0930.
25.42, 11,801, UOR3, Vienna, Broadcast; 2100-2400, Wed., Thur.
25.53, 11,750, G5SW, Chelmsford, Eng., Broadcast; Mon., Fri., 2145-2230,0330-0910, Sat., 2200-2300, Sun., 0330-0910.
25.53, 11,750, GSD, Empire Broadcasting Zone 1.
25.57, 11,730, PHI, Eindhoven (Holland).
25.60, 11,720, VE9JR, Winnipeg, Man. Can., Broadcast; 0030 daily.
25.62, 11,712, HKN, Medellin, Colombia, Broadcast.
25.63, 11,705, FYA, Paris, Broadcast daily, 0630.
25.64, 11,700, YV4BV, Valencia, Venezuela, Broadcast.
26.46, 11.340, DAN, Norddeich, Ger., Time Signal 2200 and 1000.
27.00, 11,111, XFD, Mexico City, Mexico, Broadcast.
27.17, 11,000, ZLW, Wellington, N.Z., Tests 1800-2300.
27.80, 10,800, GVP, Rugby, Phone to VLK, J1AA, 1200 and 2100.
27.94, 10,755, CT1BO, Lisbon, Broadcast.
28.22, 10,630, PLR, Bandoeng, Java, Phone to Holland and France; week days from 2200.
28.50, 10,525, VLK-VK2ME, Sydney, Phone to GBX; 1600-2200.
28.52, 10,520, VK2FC, Sydney, Broadcast.
28.77, 10,425, UIG, Medan, Sumatra, Phone to Java and VLK; 1800-2300.

28.87, 10,390, GBX, Rugby, Eng., Phone.
28.99, 10,350, LSX, Buenos Aires, Broadcast daily; 0630.
29.97, 10,013, CM2LA, Havana, Cuba, Broadcast.
30.40, 9,860, EAQ, Madrid, Broadcast; 1730-1900 daily; Sat., 1300-1500.
30.68, 9,772, EAM, Madrid, Broadcast.
30.74, 9,760, VLK, Sydney, Phone to Java; 1900-2300.
31.00, 9,672, T14NRH, Heredia, Costa R., Broadcast; daily except Mon.; 1200-1300.
31.10, 9,640, HS2PJ, Bangkok, Siam, Mon.
31.21, 9,616, VQ7LO, Nairobi, Kenya, Broadcast.
31.25, 9,600, CT1AA, Lisbon, Broadcast; 0700-1000, Fri., Sat.
31.28, 9,590, W3XAU, Byberry, Pa., Relays WCAU; daily.
31.28, 9,590, VK2ME, Sydney, Broadcast; Sun., 1500-1700, 1930-2330, Mon., 0430-0630.
31.28, 9,590, PCJ, Hilversum, Holland, Broadcast.
31.29, 9,585, GSC, Empire Broadcasting, Zone 3.
31.32, 9,580, HBL, Prangins, Switz., Sun. 0800-0845.
31.35, 9,570, WIXAZ, Springfield, Mass., Broadcast, 0630-1430.
31.35, 9,570, SRI, Poznan, Poland, Broadcast; Wed. 0445-0745, Fri. 0430-1100.
31.38, 9,560, DJA, Koenigswusterhausen, Ger., Broadcast; daily 0800.
31.40, 9,555, VE9DR, Drummondville, Can., Broadcast.
31.48, 9,530, W2XAF, Schenectady, N.Y., Broadcast; 0800-1400.
31.54, 9,510, GSB, Empire Broadcasting, Zones 4-5.
31.51, 9,510, OXY, Skamleback, Denmark, Broadcast; 0500-0930.
31.51, 9,520, ..., Tandjong Priok, Batavia, Broadcast.
31.55, 9,510, VK3ME, Melbourne, Broadcast; Wed. 2000-2130, Sat. 2000-2200.
31.58, 9,500, HSP2, Bangkok, Siam, Broadcast; 0000-0200.
31.58, 9,500, PRBA, Rio de Janeiro, Broadcast; between 0900 and 1130.
31.62, 9,488, OXO-OXZ, Copenhagen, Broadcast.
31.63, 9,485, PLW, Bandoeng, Phone to Australia; 1800-2300, irregular.
31.72, 9,460, ..., Buenos Aires, Broadcast.
31.86, 9,415, PLV, Bandoeng, Phone to Australia, Sumatra; 1900-2300.
31.88, 9,410, PLE, Bandoeng, Broadcast.
31.98, 9,380, CMAP, Los Andes, Chile, Broadcast.
32.00, 9,388, CT3AQ, Funchall, Madeira, Broadcast; Wed. Fri. 0700-0930, Mon. 0130-0300.
32.02, 9,369, VK3LO, Melbourne, Broadcast.
32.05, 9,360, CM2MK, Havana, Cuba, Broadcast.
32.22, 9,310, GBC, Rugby, Phone 0530-0800.
32.50, 9,230, FL, Eiffel Tower, Time Signal: 1956 and 0756. 0800.
32.50, 9.230, FL, Eiffel Tower, Time Signal; 1956 and 0756.
32.61, 9,200, GBS, Rugby, Transatlantic phone.
32.76, 9,130, HB9OC, Berne, Switz., Broadcast; 0600-0830.
32.88, 9,125, HAT, Szekesbehervar, Hungary, Broadcast.
33.00, 9,091, XDA, Mexico City, Broadcast.
33.26, 9,020, GCS, Rugby, Phone to WND; 0900-2100.
33.50, 8.955, TGX, Guatemala City, Guat., Broadcast; Sun. 1300-1500.
33.71, 8,900, ZLT, Wellington, N.Z., Phone to VLK; 1600-2400.
33.82, 8,870, NPO, Cavite (Manilla), P.I., Time Signal; 1255-1300.
34.68, 8,650, VE9BY, London, Canada, Broadcast; Tu. 0600-0700, irregular.
35.01, 8,570, RW15, Khabarovsk, Siberia, Broadcast.
37.03, 8,100, J1AA, Tokyo, Japan, Tests; 2000-2300.
37.33, 8,936, CNR, Rabat, Morocco, Mon. 0700.
38.02, 7,890, VPD, Suva, Fiji, Phone.
38.02, 7.890, PK2AG, Samarang, Java, Broadcast.
38.52, 7,790, HBP, Geneva, Switz., Broadcast; Sun. 0830-0915.
39.41. 7,612, X26A, Nuevo Laredo, Tamps, Mex., Broadcast; Thurs. 0200-0300.
39.42, 7,610, HKF, Bogota, Colombia, Broadcast; 1000-1400.
39.82, 7,530, ..., Riobamba, Ecuador, Broadcast; Thur. 1200-1400.
39.89, 7.520. KDK-KKH, Kauhuku, Hawaii, Phone to KWO; 1200-1700.
40.30, 7,443, HBQ, Prangins, Switz., Mon. 0800-0845.
40.48, 7,410, ..., Eberswalde, Ger., Broadcast; Thur. 0405.
40.70, 7,370, X26A, Nuevo Laredo, Mexico, Broadcast; 0000-0100.
40.99, 7,320, ZTJ, Johannesburg, Broadcast; 0030-0530.
41.04, 7,310, CM5RY, Matanzas, Cuba, Broadcast; 1345-1430.
41.06, 7,305, HSP2, Bangkok, Siam, Tests Mon.; 0300-0200.
41.07, 7,300, CM6DW, Cienfuegos, Cuba, Broadcast.
41.47, 7,230, DOA, Doeberitz, Ger., Broadcast.
41.53, 7,220, HB9XD, Zurich, Switz., Broadcast; 2200-1700.
41.53, 7,220, ..., Budapest, Broadcast; 1730-1810.
41.60, 7,207, EAR58, Teneriffe, Canary Islands, Broadcast; 0730-0900.
41.67, 7,195, VS1AB, Singapore, Broadcast; Sun., Wed., 0130.
41.80. 7.184, CM2MK, Havana, Cuba, Broadcast.
42.00, 7,139, HKT, Manizales, Colombia, Broadcast; 0200-0300.
42.50, 7,055, VS3AB, Johore Bahru, British Malaya, Broadcast.
42.92, 6,990, CT1AA, Lisbon, Broadcast; Fri. 0700-0900.
43.60, 6,875, F8MC, Casablanca, Morocco, Broadcast; Sun., Tues., Wed., Sat.
44.00, 6,818, XDA, Mexico City, Broadcast.
45.38, 6,611, RW72, Moscow, U.S.S.R., Relays Stalin.
45.98, 6,525, RUI, Moscow, U.S.S.R., Relays Moscow; 0400-0900.
46.73, 6,420, RGX, Minsk, U.S.S.R., Broadcast, irregular.
46.96, 6,425, W3XL, Bound Brook, N.J., Relays WJZ, irregular.
48.00, 6,250, CN8MC, Casablanca, Morocco, Relays Rabat; 0600-0700.
48.86, 6,140, W8XK, Saxonburg, Pa., Broadcast; 0700-1400.
48.90, 6,131, F3ICD, Saigon, French Indo-China, Broadcast 2130-0130.
48.94, 6,130, VE9BA, Montreal, Broadcast.
49.02, 6,120, W2XE, New York City, Broadcast.
49.02, 6,120, FL, Eiffel Tower, Broadcast.
49.02, 6,120, ..., Toulouse, France, Broadcast; 0530-0700.
49.10, 6,110, VUC, Bombay, India, Broadcast.
49.20, 6,098, ZTJ, Johannesburg, week days, 0300, 1900, 2400; Sun. 0030, 2300; Mon. 0230.
49.22, 6,095, VE9GW, Bowmanville, Ont. Can., Broadcast; daily 0600.
49.34, 6,080, W9XAA, Chicago, Ill., Broadcast; 2100-2200, 1000-1100, 1230-1315, 1415.
49.40, 6,073, ZTJ, Johannesburg, Broadcast; 0130-0630.
49-41, 6,072, UOR2, Vienna, Austria, Broadcast.
49.42, 6,070, VE9CS, Vancouver, B.C., Broadcast; Fri. before 1630-0630.
49.50, 6,060, VQ7LO, Nairobi, Kenya, Broadcast; 0200-0530.
49-50, 6,060, W3XAU, Byberry, Pa., Relays WCAU; Thur, Fri., 2115-1500.
49.50, 6,060, W8XAL, Cincinnati, O., Relays WLW; 2000-0030.
49.50, 6,060, ZL2ZX, Wellington, N.Z., Broadcast; 1715-2115 Mon.
49.58, 6,050, GSA, Empire Broadcasting Zones 3-5.
49.59, 6,050, VE9HX, Halifax, N.S., Broadcast; Mon., Tues.
49.67, 6,040, ..., Tandjong, Priok, Java, Broadcast.
49.67, 6,040, PK3AN, Soerabaya, Java, Broadcast; 2100-2400.
49.75, 6,030, VE9CA, Calgary, Alba, Can., Broadcast.
49.83, 6,020, W9XF, Chicago, Ill., Broadcast.
49.88, 6,015, VE9CX, Wolfville, N.S., Can., Broadcast.
49.96, 6,005, VE9DN, Montreal, Can., Broadcast.
49.97, 6,000, YV2BC, Caracas, Venezuela, Broadcast; 1045-1400 daily except Tues.
50.00, 6,000, RW59, Moscow, U.S.S.R., Broadcast; Mon. Tues., Fri., Sun., 0700-0800, Sun. 2000-2100.
50.00, 6,000, ZL3ZC Christchurch, N.Z., Broadcast.
50.00, 6,000, ..., Tannarive, Madagascar, Broadcast; Wed., Thur., Fri., Sat., 0030-0230, Sun., Mon., 400-0600.
50.00, 6,000, ..., Eiffel Tower, Broadcast; 2130-2145, 0415-0430, 0815-0845.
50.00, 6,000, PK2AF, Djokjakarta, Java, Broadcast; 2140-0040.
50.00, 6,000, EAR25, Barcelona; Sun., 0600.
50.03, 5,996, HKD, Barranquilla, Colombia, Broadcast; daily 1045-1330, Tues., Thur., 1100-1330, Mon. 1045-1130.
50.27, 5,968, HVJ, Vatican City, Broadcast; 0500-0515, daily; Sun., 2000-2030.

50.64, 5,925, HKO, Medellin, Colombia, Broadcast; Tues., Thur., Sat., 1100-1300; Wed., Fri., Sun., Mon., 0900-1100.
51.72, 5,800, VKQ, Melbourne, Phone.
52.70, 5,692-5, FIUI, Tannarive, Madagascar, Broadcast; Sun., Mon., 0400-0600, Tues., Wed., Thur., Fri., Sat., 1215-1415.
58.03, 5,170, PMB, Soerabaya, Java, Broadcast.
58.30, 5,145, PMY, Bandoeng, Java, Phone to Australia; 0200.
60.99, 4,920, F8GC, Paris, Broadcast.
62.91, 4,770, XL2XX, Wellington, N.Z., Phone.
63.02, 4,760, ..., Paris, Phone.
67.72, 4,430, DOA, Doeberitz., Ger., Broadcast; Tues., Thur., Sat., 0900-1000, 0500-0600.
70.10, 4,280, OHK2, Vienna, Austria, Broadcast & Sun. first 15 minutes of hour from 0400-1000.
70.21, 4,273, RW15, Khabarovsk, Siberia, Broadcast.
74.72, 4,015, NAA, Arlington, Va., Time Signal 1255 and 0255.
75.16, 3,998, PK1AA, Batavia, Java, Broadcast.
80.00, 3,750, 12RO, Prato Smeraldo, Rome, Broadcast; 0600-0800.
84.28, 3,560, OZ7RL, Copenhagen, Broadcast; Wed., Sat., after 0900.

Frequency Band.

It should be particularly noted that there are definite frequencies around which the short wave broadcasters are located. These are:—

16,000	Kc.	19	metres.
12,000	„	25	„
9,500	„	31	„
6,000	„	49	„
4,300	„	70	„

Standard Times

Referred to Greenwich Time

Great Britain, France, Portugal, Belgium, Spain, Ireland	Greenwich time
Austria, Denmark, Germany, Italy, Norway, Switzerland	1 hour fast
British South Africa, Egypt, Turkey	1½ or 2 hours fast
Japan	9 hours fast
Australia	8, 9½ or 10 hours fast
New Zealand	11½ hours fast
Canada and United States	4, 5, 6, 7 or 8 hours slow.

All readers who are connected with the radio or electrical trade should always read the weekly trade journal, the "Radio and Electrical Merchant" which is published every Friday by the publishers of this Radio Trade Annual. The annual subscription is only 10/- post free and will be posted regularly on receipt of a postal note for 10/- sent to Box 3765 G.P.O., Sydney.

OVERLOADING THE FIELD COIL

Quite a lot of trouble is experienced at one time and another by servicemen in having to replace burnt out speaker field coils. It should be remembered that there is a maximum safe value to the power (in watts) which may be dissipated by the field coil of any speaker. This depends on both the size of the speaker and the gauge of the wire used in the field coil.

To calculate the watts being dissipated in the field coil the following formula should be used:—

$$W = \frac{I^2R}{1{,}000{,}000}$$

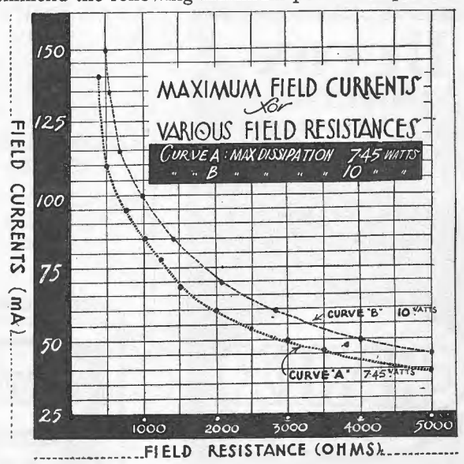
Where W = Power being dissipated in watts.
I = Current passing in milliamps.
R = Resistance of field coil in ohms.

Alternatively,

$$W = \frac{E^2}{R}$$

Where E = Voltage Drop across Coil.
R = Resistance of Field Coil, ohms.

Two curves are shown in the accompanying figure, curve A for a maximum dissipation of 7.45 watts and curve B for 10 watts. The various manufacturers recommend the following maximum power dissipations.



JENSEN—
7 inch Speakers .... 7.45 watts.
10 inch Speakers .... Allow 10 m.A. more than for 7 inch Speakers.

AMPLION—
Type Q (7in.) .... 10 watts.
Type M (4in.) .... 6 watts.
Type P (7in.) .... 12 watts.
Type A108 (Horn) .... 15 watts.

JUBILEE—
Closed Pot Type .... 12 watts.
Open Pot Type .... 15 watts.

MAGNAVOX—
Magnavox replacement field coils should be ordered by the marking on the original unit since all Speakers of this make are supplied to the specifications of the various set designers employing them.

SAXON—
A round figure of 10 watts applies to Saxon Speakers

WAVELENGTH—FREQUENCY CHART

Kilocycles to Metres.

In using this table it is important to note that Kilocycles may be read in the second column against metres in the first, e.g., while 630 k.c. is given as 475.9 metres from the same line we may read off that 630 metres is 475.9 k.c.

Kc.	M.	Stn.	Kc.	M.	Stn.	Kc.	M.	Stn.	Kc.	M.	Kc.	M.	Kc.	M.
500	599.6		900	302.8		1255	239.0		1800	166.6	7000	42.83	12200	24.58
510	587.9		1000	299.8	4GR	1260	238.0	3WR	1900	157.8	7100	42.23	12300	24.38
520	576.6		1005	298.4		1265	237.1		2000	149.9	7200	41.64	12400	24.18
530	565.7		1010	296.9	3HA	1270	236.1	2SM	2100	142.8	7300	41.07	12500	23.99
540	555.2		1015	295.4		1275	235.2		2200	136.3	7400	40.52	12600	23.80
550	545.1		1020	293.9		1280	234.2	3TR	2300	130.4	7500	39.98	12700	23.61
560	535.4	2CO	1025	292.5	2UE	1285	233.3		2400	124.9	7600	39.45	12800	23.42
570	526.0	2YA (N.Z.)	1030	291.1		1290	232.4	4BK	2500	119.9	7700	38.94	12900	23.24
580	516.9	7ZL	1035	289.7		1295	231.5		2600	115.3	7800	38.44	13000	23.06
590	508.2		1040	288.0	5PI	1300	230.6	3BA	2700	111.0	7900	37.95	13100	22.89
600	499.7		1045	286.9		1305	229.7		2800	107.1	8000	37.48	13200	22.71
610	491.5	3AR	1050	285.5	2CA	1310	228.9	5AD	2900	103.4	8100	37.01	13300	22.54
620	483.6		1055	284.2		1315	228.0		3000	99.94	8200	36.56	13400	22.37
630	475.9		1060	282.8	4MB	1320	227.1	2MO	3100	96.72	8300	36.12	13500	22.21
635	472.2	5CK	1065	281.5		1325	226.3		3200	93.69	8400	35.69	13600	22.04
640	468.5		1070	280.2	2KY	1330	225.4	4RO	3300	90.86	8500	35.27	13700	21.88
650	461.3	1YA (N.Z.)	1075	278.9		1335	224.6		3400	88.18	8600	34.86	13800	21.73
660	454.3		1080	277.6	3SH	1340	223.7	2XN	3500	85.66	8700	34.46	13900	21.57
665	450.9	2FC	1085	276.4		1345	222.9		3600	83.28	8800	34.07	14000	21.42
670	447.5		1090	275.1		1350	222.1	3KZ	3700	81.03	8900	33.69	14500	20.68
680	440.9		1095	273.9		1355	221.3		2800	78.90	9000	33.31	15000	19.99
690	434.4	6WF	1100	272.6	7LA	1360	220.4		3900	76.88	9100	32.95	15500	19.34
700	428.3		1105	271.4		1365	219.6		4000	74.96	9200	32.59	16000	18.74
710	422.3		1110	270.1	2HD	1370	218.8		4100	73.13	9300	32.24	16500	18.17
720	416.4	3YA (N.Z.)	1115	268.9		1375	218.1		4200	71.39	9400	31.90	17000	17.64
730	410.7	5CL	1120	267.7		1380	217.3	4BH	4300	69.73	9500	31.56	17500	17.13
740	405.2		1125	266.5	2UW	1385	216.5		4400	68.14	9600	31.23	18000	16.63
750	399.8		1130	265.3		1390	215.7	2GN	4500	66.63	9700	30.91	18500	16.21
760	394.5	4QG	1135	264.2	6ML	1395	215.0		4600	65.18	9800	30.59	19000	15.78
770	389.4		1140	263.0		1400	214.2	3GL	4700	63.71	9900	30.28	19500	15.38
780	384.4		1145	261.9	{4BC 3YB	1405	213.4		4800	62.46	10000	29.98	20000	14.99
790	379.5	4YA (N.Z.)	1150	260.7		1410	212.6		4900	61.19	10100	29.69	20500	14.63
800	374.8	3LO	1155	259.6	2WG	1415	211.9	2KO	5000	59.96	10200	29.39	21000	14.28
810	370.2		1160	258.5		1420	211.1		5100	58.79	10300	29.11	21500	13.95
820	365.6		1165	257.4		1425	210.4	3AW	5200	57.66	10400	28.83	22000	13.63
830	361.2		1170	256.3	4TO	1430	209.7		5300	56.57	10500	28.55	22500	13.33
840	356.9	2YC (N.Z.)	1175	255.2		1435	209.0	2WL	5400	55.52	10600	28.28	23000	13.04
850	352.7		1180	254.1	3DB	1440	208.2		5500	54.51	10700	28.02	23500	12.76
855	350.7	2BL	1185	253.1		1445	207.5		5600	53.54	10800	27.76	24000	12.49
860	348.6		1190	252.0	4MK	1450	206.8		5700	52.60	10900	27.51	24500	12.24
870	344.6		1195	251.0		1455	206.1		5800	51.69	11000	27.26	25000	11.99
880	340.7	{1YX (N.Z.) 6PR	1200	249.9	{3YL (N.Z.) 5KA	1460	205.4	7UV	5900	50.82	11100	27.01	25500	11.76
890	336.9	7HO	1205	248.9		1465	204.7		6000	49.97	11200	26.77	26000	11.53
900	333.1	3MA	1210	247.8	2CH	1470	204.0	6IX	6100	49.15	11300	26.53	26500	11.31
910	329.5	4RK	1215	246.8		1475	203.3		6200	48.36	11400	26.30	27000	11.10
920	325.9		1220	245.8	{2GF 6KG	1480	202.6	2AY	6300	47.59	11500	26.07	27500	10.90
930	322.4	3UZ	1225	244.8		1485	201.9		6400	46.85	11600	25.85	28000	10.71
940	319.0		1230	243.8		1490	201.2		6500	46.13	11700	25.63	28500	10.52
950	315.6	2GB	1235	242.8		1495	200.6		6600	45.43	11800	25.41	29000	10.34
960	312.3	5DN	1240	241.8		1500	199.9	3AK	6700	44.75	11900	25.20	29500	10.16
970	309.1	3BO	1245	240.9	2NC	1600	187.4		6800	44.09	12000	24.99	30000	9.99
980	303.9	6BY	1250	239.9		1700	176.4		6900	43.45	12100	24.78	60000	4.99

Valve Data

Unquestionably the valve is the heart of a radio receiver and upon its correct choice and operation the efficiency of the whole set is dependent. The following data pages will enable intelligent design and replacement calculations to be carried out. The valves are divided into nine main classes to facilitate quick reference.

Variable-Mu Valves. The use of this type of valve is standard practice for R.F. amplifiers in which, of course, we include the I.F. stages of a superhet. The great advantage of this type is its provision for an almost distortionless and exceedingly effective form of variable-bias volume control. In addition cross-modulation and other evils present when the fixed-bias S.G. valve is used, are practically non-existent. In all cases (except where "B" batteries are the source of supply) the screen voltage should be maintained at its constant optimum value throughout the range of control-grid bias by means of voltage divider. A series resistor for voltage dropping is absolutely useless. The screen should always be bypassed by a good quality paper condenser of about 0.1 mfd. capacity, as should also the cathode be bypassed to earth across the automatic bias potentiometer. In the case of most battery sets where the screen is led to a low voltage tap, the screen bypass may be omitted but the cathode bypass is still necessary. Using modern screened coils of low dynamic resistance a simple relation exists enabling us to calculate the stage gain. The stage gain is given by the product of the dynamic resistance of the coil in ohms and the mutual conductance of the valve in amps. per volt. It should be noted that the g.m. is usually given in m.A. per volt or else in micromhos. In the case of transformer coupled R.F. stages the reflected impedance of the secondary is used. The reflected impedance is equal to the dynamic resistance of the secondary circuit divided by the square root of the turns ratio. Further information on this will be found in the section devoted to formulae.

For example, a 58 valve of mutual conductance, 1600 micromhos per volt at -3 volts bias feeding a coil of dynamic resistance 60,000 ohms, would give a stage gain of $60{,}000 \times 1{,}600 \times \frac{1}{1{,}000{,}000}$ or 96.

The above formula applies only when the load impedance of the coupling device is small compared to the plate impedance of the valve. It should be remembered that doubling the stage gain of any one R.F. stage will raise the power output level of the receiver by 6 decibels, an amount which is just audible.

Screen Grid Valves. The main use for this type of fixed-bias valve is restricted to grid or plate detection in straight sets or the second detector of a superhet. The screen volts should always be obtained from a resistance network across the high voltage supply or from a voltage divider and should be bypassed. This, of course, does not apply to battery sets.

Miscellaneous Triodes. In this section are listed the triodes whose plate impedances are greater than 7,000 ohms. From this section we may choose valves for leaky-grid and power-grid detection and for the first audio stage. For power grid detection a valve with a plate impedance between about 8,000 and 17,000 ohms should be chosen. The grid bias figures in this section refer to amplifying conditions and not to detection.

Output Triodes. The maximum undistorted output (D) is the energy developed in the load given in the next column (E), when the valve is supplied with its full operating voltages. The figures given are for a maximum content of 5 per cent. second harmonic which is generally accepted as an unobjectionable amount. The load figures refer to the impedance offered by the speaker at about 256 cycles (middle C).

In the case of an output choke and condenser the effect of these may be usually neglected. When an output transformer is used the reflected impedance of the secondary circuit (or voice coil) is used. This is further explained in the section on speaker matching.

Grid biases are worked out for D.C. conditions except in the case of those A.C. valves which have directly heated filaments, in which case a bias voltage increment of fil. volts $\div \sqrt{2}$ has been added. The values given for the automatic bias resistors hold approximately for plate voltages below the maximum.

Pentodes Output. Only output pentodes are listed in this section, the R.F. pentodes being listed in the first two sections. The constants given are very similar to those of the output series. It is necessary to adhere to the load value much more strictly than with triodes in order to prevent distortion, and as third harmonic distortion is more likely to occur than second, the power output values have been worked out for a maximum of 5% of the former. Included also are Output Tetrodes.

Special Purpose Valves. In this section are listed such valves as the duo-diode detector-amplifiers, the pentagrid converter.

Class "B" Valves. In this section twin valves are marked with an asterisk.

Rectifying Valves. In this section the figures for the output refer to the voltage developed across a 4 mfd. condenser, which is the standard condition for the various currents listed.

Transmitting Valves. Included in this section are valves intended for service as oscillators, R.F. amplifiers and modulators.

Base. In order to identify the type of base the various letters in the last column refer to the following:—

X	UX base	E	English 4-pin base
Y	UY base	O	English 5-pin base
6	Std. 6-pin base	7P	Eng. English 7-pin base
7	Std. 7-pin base	M	Can be obtd. metallized
3	English 3-pin base.	G	Metallized Golden Ser.

MISCELLANEOUS TRIODES

	Type	Filament Volts	Filament Amps	Plate Impedance (Ohms)	Amplification Factor	Mutual Conductance (μ mhos)	A. Max. Plate Volts	B. Grid Bias (for A.) Volts	Average Plate Current (for A. and B.) (m.A.)	Base
Cossor.	27	2.5 (h)	1.75	9250	9.0	975	250	21.0	5.2	Y
	56	2.5 (h)	1.0	9500	13.8	1450	250	13.5	5.0	Y
	210RC	2.0	0.1	50000	36.0	720	150	1.0	1.2	XE
	210HL	2.0	0.1	22000	24.0	1100	150	3.0	1.6	E
	210HF	2.0	0.1	15800	24.0	1500	150	3.0	1.6	MX
	210 Det.	2.0	0.1	13000	15.0	1150	150	—	—	MX
	210LF	2.0	0.1	10000	14.0	1400	150	4.5	4.8	X
	410RC	4.0	0.1	50000	40.0	800	150	1.5	0.6	X
	410HF	4.0	0.1	20000	22.0	1100	150	3.0	1.2	X
	410LF	4.0	0.1	10000	17.0	1700	150	3.0	4.5	X
	610RC	6.0	0.1	50000	40.0	800	150	1.5	0.75	X
	610HF	6.0	0.1	20000	20.0	1000	150	3.0	3.0	X
	610LF	6.0	0.1	7500	15.0	2000	150	3.0	6.2	X
	41MH	4.0 (h)	1.0	18000	72.0	4000	200	1.5	3.2	Y
	41MRC	4.0 (h)	1.0	19000	50.0	2600	200	2.0	2.7	YO
	41MHF	4.0 (h)	1.0	14500	41.0	2800	200	3.0	3.0	Y
	41MHL	4.0 (h)	1.0	11500	52.0	4500	200	3.0	4.0	Y
	41MLF	4.0 (h)	1.0	7900	15.0	1900	180	5.5	9.0	Y
	DHL	16.0 (h)	0.25	13000	58.0	4500	200	2.0	5.0	O
Ken-Rad.	01A	5.0	0.25	10000	8.0	800	135	9.0	3.0	X
	26	1.5	1.05	7000	8.2	1170	180	13.5	7.4	X
	27	2.5 (h)	1.75	9250	9.0	975	250	21.0	5.2	Y
	30	2.0	0.06	10300	9.3	900	180	13.5	3.1	X
	37	6.3 (h)	0.3	10000	9.0	900	180	13.5	4.7	Y
	40	5.0	0.25	150000	30.0	200	180	3.0	0.2	X
	56	2.5 (h)	1.0	9500	13.8	1450	250	13.5	5.0	Y
	76	6.3 (h)	0.3	9500	13.8	1450	250	13.5	5.0	Y
	99	3.3	0.063	15500	6.6	425	90	4.5	2.5	X
Mullard.	56	2.5 (h)	1.0	9500	13.8	1450	250	13.5	5.0	Y
	AC3 (26)	1.5	1.05	7600	8.3	1100	135	10.0	5.5	X
	27	2.5 (h)	1.75	9250	9.0	975	250	21.0	5.2	Y
	PM1A	2.0	0.1	41600	50.0	1200	150	1.0	1.0	XE
	PM1HF	2.0	0.1	22500	9.0	800	150	4.5	1.5	XE
	PM1HL	2.0	0.1	21000	19.0	900	150	3.0	2.0	X
	PM1LF	2.0	0.1	12000	11.0	900	150	7.5	3.4	XE
	PM2DX	2.0	0.1	10000	16.0	1600	150	4.5	4.5	XE
	PM3	4.0	0.075	12000	14.0	1200	150	4.0	4.0	XE
	PM4DX	4.0	0.1	9000	15.0	1700	150	5.0	4.0	XE
	PM5X	6.0	0.075	14700	17.5	1200	150	4.5	2.0	XE
	244V	4.0 (h)	1.0	9000	24.0	2800	200	5.5	5.0	YO
	4V	4.0 (h)	1.0	10000	35.0	3500	200	4.0	4.0	MYO
	904V	4.0 (h)	1.0	34000	75.0	2200	200	2.0	1.8	MYO
National Union.	27	2.5 (h)	1.75	9250	9.0	975	250	21.0	5.2	Y
	30	2.0	0.06	10300	9.3	900	180	13.5	3.1	X
	37	6.3 (h)	0.3	8400	9.2	1100	250	18.0	7.5	Y
	56	2.5 (h)	1.0	9500	13.8	1450	250	13.5	5.0	Y
Osram.	27	2.5 (h)	1.75	9250	9.0	975	250	21.0	5.2	Y
	56	2.5 (h)	1.0	9500	13.8	1450	250	13.5	5.0	Y
	H210	2.0	0.1	50000	35.0	700	150	1.5	1.5	XE
	H2	2.0	0.1	35000	35.0	1000	150	1.5	1.5	XE
	HL210	2.0	0.1	20000	24.0	1200	150	3.5	1.5	XE
	HL2	2.0	0.1	18000	27.0	1500	150	3.0	2.0	XE
	L210	2.0	0.1	12000	11.0	920	150	7.0	3.0	XE
	L21	2.0	0.1	8900	16.0	1800	150	6.0	2.2	XE
	MH4	4.0 (h)	1.0	11100	40.0	3600	200	3.0	4.5	YO
	MH41	4.0 (h)	1.0	13300	80.0	6000	200	1.5	5.0	YO
	MHL4	4.0 (h)	1.0	8000	20.0	2500	200	6.0	8.0	YO
	DH	16.0 (h)	0.25	10800	40.0	3700	200	3.0	6.0	YO
	Catkin MH4	4.0 (h)	1.0	11100	40.0	3600	200	3.0	4.5	YO

Miscellaneous Triodes—(Continued).

Type		Filament Volts	Filament Amps	Plate Impedance (Ohms)	Amplification Factor	Mutual Conductance (μ mhos)	A. Max. Plate Volts	B. Grid Bias (for A.) Volts	Average Plate Current (for A. and B.) (m.A.)	Base
Philips.	27	2.5 (h)	1.75	9250	9.0	975	250	21.0	5.2	Y
	30	2.0	0.06	10300	9.3	900	180	13.5	3.1	X
	37	6.3 (h)	0.3	10000	9.0	900	180	13.5	4.7	Y
	56	2.5 (h)	1.0	9500	13.8	1450	250	13.5	5.0	Y
	A409	4.0	0.06	10000	9.0	900	150	9.0	3.5	XE
	A415	4.0	0.08	12000	14.0	1200	150	4.0	4.0	XE
	A425	4.0	0.06	80000	25.0	1200	200	2.5	0.25	XE
	A435	4.0	0.06	70000	35.0	500	200	0	2.1	XE
	A630	6.0	0.06	20000	30.0	1500	150	1.5	0.7	X
	A635	6.0	0.06	70000	35.0	500	200	0	2.1	X
	E424	4.0 (h)	1.0	13000	26.0	2000	200	6.0	6.0	Y
	E438M	4.0 (h)	1.0	120000	38.0	1500	200	2.5	0.3	MY
Radiotron.	01A	5.0	0.25	10000	8.0	800	135	9.0	3.0	X
	26	1.5	1.05	7300	8.3	1150	180	14.5	6.2	X
	27	2.5 (h)	1.75	9250	9.0	975	250	21.0	5.2	Y
	30	2.0	0.16	10300	9.3	900	180	13.5	3.1	X
	37	6.3 (h)	0.3	8400	9.2	1100	250	18.0	7.5	Y
	56	2.5 (h)	1.0	9500	13.8	1450	250	13.5	5.0	Y
	864	1.1	0.25	12700	8.2	645	135	9.0	3.5	X
	99	3.3	0.06	15500	6.6	425	90	4.5	2.5	X
Sylvania.	30	2.0	0.06	10300	9.3	900	180	13.5	3.1	X
	37	6.3 (h)	0.3	8400	9.2	1100	250	18.0	7.5	Y
	56	2.5 (h)	1.0	9500	13.8	1450	250	13.5	5.0	Y
	76	6.3 (h)	0.3	11750	13.8	1250	250	13.5	4.2	Y
Tung-Sol.	56	2.5 (h)	1.0	9500	13.8	1450	250	13.5	5.0	Y

(h) :—Heater type cathode.

OUTPUT TRIODES

Type		Filaments Volts	Filaments Amps	Plate Impedance (Ohms)	Mutual Conductance (μ mhos)	A Max. Plate Volts	B Grid Bias (for A)	C Average Plate Current (for A and B) (m.A.)	D Max. Undistorted Output (for A, B & C) (m.W.)	E Optimum load (for D) (Ohms)	F Automatic Bias Resistance (for A, B & C)	Base
Cossor.	45	2.5	1.5	1610	2175	250	50.0	34.0	1600	3900	1500	X
	71A	5.0	0.25	1750	1700	180	43.0	20.0	790	4800	2150	X
	215P	2.0	0.15	4000	2250	150	7.5	10.0	—	9000	—	X
	220P	2.0	0.2	4000	2250	150	7.5	11.0	170	9000	—	X
	220PA	2.0	0.2	4000	4000	150	4.5	10.0	150	9000	—	X
	410P	4.0	0.1	4000	2000	150	9.0	11.0	170	9000	—	X
	415XP	4.0	0.15	1500	3000	150	18.0	22.0	450	3500	—	X
	425XP	4.0	0.25	2000	3500	150	10.5	20.0	330	5000	500	X
	610P	6.0	0.1	3500	2280	150	7.5	11.0	150	8000	—	X
	610XP	6.0	0.1	2000	2500	150	15.0	23.0	400	4500	—	X
	625P	6.0	0.25	2500	2800	200	4.0	25.0	650	6000	500	X
	41MP	4.0 (h)	1.0	2500	7500	200	7.5	24.0	1250	3000	300	Y
	41MXP	4.0 (h)	1.0	1500	7500	200	12.5	40.0	2000	2000	300	Y
	230XP	2.0	0.3	1500	3000	150	18.0	22.0	450	3500	—	X
	4XP	4.0	0.6	1200	4000	200	23.0	45.0	1000	2800	500	X
	DP	16.0 (h)	0.25	2800	6000	200	7.5	25.0	750	3500	300	Y
Ken-Rad.	10	7.5	1.25	5000	1600	425	39.0	18.0	1600	12000	2100	X
	12A	5.0	0.25	5000	1700	180	13.5	7.6	285	10650	—	X
	31	2.0	0.13	3600	1050	180	30.0	12.3	375	5700	—	X
	45	2.5	1.5	1700	2050	275	56.0	36.0	2000	4600	1500	X
	46	2.5	1.75	2380	2350	250	33.0	22.0	1200	6400	1500	Y
	49	2.0	0.12	4000	1125	135	20.0	5.7	170	8000	—	Y
	50	7.5	1.25	1800	2100	450	84.0	55.0	4600	4350	1500	X
	53	2.5 (h)	2.0	11300	3100	250	5.0	6.0	400	30000	—	7
	59	2.5 (h)	2.0	2400	2600	250	28.0	26.0	1250	5000	1100	7
	71A	5.0	0.25	1750	1700	180	43.0	20.0	790	4800	2150	X
	89	6.3 (h)	0.4	2600	1800	250	31.0	32.0	900	5500	1000	6
	2A3	2.5	2.5	765	5500	250	45.0	60.0	3500	2500	750	X

Output Triodes—(Continued).

Type		Filaments Volts	Filaments Amps	Plate Impedance (Ohms)	Mutual Conductance (μ mhos)	A Max. Plate Volts	B Grid Bias (for A)	C Average Plate Current (for A and B) (m.A.)	D Max. Undistorted Output (for A, B & C) (m.W.)	E Optimum load (for D) (Ohms)	F Automatic Bias Resistance (for A, B & C)	Base
Mullard.	45	2.5	1.5	1750	2000	250	50.0	30.0	1600	3900	1500	X
	59	2.5 (h)	2.0	2400	2600	250	28.0	26.0	1250	5000	1100	7
	AC4 (71A)	5.0	0.25	1750	1700	180	43.0	20.0	800	4800	2150	X
	PM2A	2.0	0.2	3600	3500	150	6.0	8.0	200	8000	—	XE
	PM2	2.0	0.2	4400	1700	150	12.0	7.0	150	9000	—	XE
	PM202	2.0	0.2	2000	3500	150	13.0	14.0	350	4000	—	XE
	PM252	2.0	0.4	1900	3700	150	11.0	17.0	320	4000	—	XE
	PM4	4.0	0.1	4000	2000	150	8.0	10.0	170	9000	—	XE
	PM254	4.0	0.2	2150	3000	200	21.0	15.0	400	4000	—	XE
	PM256	6.0	0.25	1850	3250	250	27.0	20.0	800	5000	—	XE
	AC064	4.0	1.0	2000	3000	200	21.0	20.0	750	4300	1050	XE
	AC044	4.0	1.0	1150	3500	200	32.0	30.0	1000	2300	1070	X
	PM6	6.0	0.1	3550	2250	150	9.0	10.0	150	8000	—	X
	104V	4.0 (h)	1.0	2850	3500	200	12.0	17.0	600	6000	—	Y
	164V	4.0 (h)	1.0	4850	3300	200	8.5	—	—	—	—	Y
	DO/26	4.0	1.0	600	6300	400	92.0	62.5	7500	4000	—	X
National Union.	31	2.0	0.13	3600	1050	180	30.0	12.3	375	5700	—	X
	45	2.5	1.5	1610	2175	250	50.0	34.0	1600	3900	1500	X
	46	2.5	1.75	2380	2350	250	33.0	22.0	1250	6400	1500	Y
	49	2.0	0.12	4000	1125	135	20.0	5.7	170	8000	—	Y
	59	2.5 (h)	2.0	2400	2600	250	28.0	26.0	1250	5000	1100	7
	89	6.3 (h)	0.4	2600	1800	250	31.0	32.0	900	5500	1000	6
	2A3	2.5	2.5	765	5500	250	45.0	60.10	3500	2500	750	X
Osram.	45	2.5	1.5	1610	2175	250	50.0	34.0	1600	3900	1500	X
	46	2.5	1.75	2380	2350	250	33.0	22.0	1250	6400	1500	X
	59	2.5 (h)	2.0	2400	2600	250	28.0	26.0	1250	5000	1100	7
	2A3	2.5	2.5	765	5500	250	45.0	60.0	3500	2500	750	X
	P215	2.0	0.15	5000	1400	150	12.0	8.5	150	12000	—	XE
	LP2	2.0	0.2	3900	3850	150	4.5	11.5	150	7100	—	XE
	P2	2.0	0.2	2150	3500	150	10.5	19.0	300	4500	—	XE
	ML4	4.0 (h)	1.0	2860	4200	200	9.0	20.0	650	7000	400	YO
	DL	16.0 (h)	0.25	2660	4500	200	8.0	25.0	600	7000	350	YO
	PX4	4.0	1.0	830	6000	250	34.0	48.0	2500	3200	750	XE
	LS6A	6.0	2.0	1300	2300	400	91.0	63.0	5000	3250	1500	XE
	PX25	4.0	2.0	1265	8000	400	31.0	62.5	5500	3200	530	XE
	DA60	6.0	4.0	835	3000	500	35.0	120.0	10000	3000	1150	Special
Philips.	31	2.0	0.13	3600	1050	180	30.0	12.3	375	5700	—	X
	45	2.5	1.5	1610	2175	250	50.0	34.0	1600	3900	1500	X
	46	2.5	1.75	2380	2350	250	33.0	22.0	2250	6400	1500	Y
	50	7.5	1.25	1800	2100	450	84.0	55.0	4600	4350	1500	X
	59	2.5 (h)	2.0	2400	2600	250	28.0	26.0	1250	4000	1100	7
	89	6.3 (h)	0.4	2600	1800	250	31.0	32.0	900	5500	1000	6
	2A3	2.5	2.5	765	5500	250	45.0	60.0	3500	2500	750	X
	A609	6.0	0.06	6000	1500	150	9.0	4.0	—	—	—	X
	A615	6.0	0.08	6250	2400	150	4.5	4.0	—	—	—	X
	B403	4.0	0.15	2500	1200	150	30.0	15.0	500	4000	—	X
	B405	4.0	0.15	3000	1600	150	18.0	11.0	500	5000	—	XE
	B406	4.0	0.1	4500	1300	150	12.0	12.0	300	7000	—	X
	B409	4.0	0.15	5000	1800	250	18.0	12.0	650	12000	—	X
	B605	6.0	0.12	2800	1800	150	18.0	9.0	—	—	—	X
	C603	6.0	0.25	1500	2000	180	40.0	18.0	—	—	—	X
	C606	6.0	0.25	1850	3250	250	24.0	20.0	1000	3000	—	X
	E406	4.0	1.0	1500	4000	250	24.0	48.0	1750	2500	500	X
	E409	4.0 (h)	1.0	7000	1300	200	9.0	12.0	—	—	750	Y
Radiotron.	10	7.5	1.25	5000	1600	425	39.0	18.0	1600	10200	2100	X
	12A	5.0	0.25	4700	1800	180	13.5	7.7	385	10650	—	X
	20	3.3	0.132	6300	525	135	22.5	6.5	110	6500	—	X
	31	2.0	0.13	3600	1050	180	30.0	4.3	375	5700	—	X
	45	2.5	1.5	1610	2175	250	50.0	34.0	1600	3900	1500	X
	46	2.5	1.75	2380	2350	250	33.0	22.0	1250	6400	1500	X
	49	2.0	0.12	4000	1125	135	20.0	5.7	170	8000	—	Y
	50	7.5	1.25	1800	2100	450	84.0	55.0	4600	4350	1500	X
	53	2.5 (h)	2.0	11000	3200	294	6.0	7.0	400	30000	—	7
	59	2.5 (h)	2.0	2400	2600	250	28.0	26.0	1250	5000	1100	7
	71A	5.0	0.25	1750	1700	180	43.0	20.0	790	4800	2150	X
	842	7.5	1.25	2500	1200	425	100	28.0	3000	8000	3500	X
	89	6.3 (h)	0.4	2600	1800	250	31.0	32.0	900	5500	1000	6
	2A3	2.5	2.5	765	5500	250	45.0	60.0	3500	2500	750	X

Output Triodes—(Continued).

Type		Filaments		Plate Impedance (Ohms)	Mutual Conductance (μ mhos)	A Max. Plate Volts	B Grid Bias (for A)	C Average Plate Current (for A and B) (m.A.)	D Max. Undistorted Output (for A, B & C) (m.W.)	E Optimum load (for D) (Ohms)	F Automatic Bias Resistance (for A, B & C)	Base
		Volts	Amps									
Sylvania.	31	2.0	0.13	3600	1050	180	30.0	12.3	375	5700	—	X
	45	2.5	1.5	1610	2175	250	50.0	34.0	1600	3800	1500	X
	50	7.5	1.25	1800	2100	450	84.0	55.0	4600	4350	1500	X
	59	2.5 (h)	2.0	2400	2600	250	28.0	26.0	1250	5000	1100	7
	71A	5.0	0.25	1750	1700	180	43.0	20.0	790	4800	2150	X
	89	6.3 (h)	0.4	3300	1425	160	20.0	17.0	300	7000	900	6
	2A3	2.5	2.5	800	5250	250	45.0	60.0	3500	2500	750	X
Tung-Sol.	45	2.5	1.5	1700	2050	275	56.0	36.0	2000	4600	1500	X
	46	2.5	1.75	2380	2350	250	33.0	22.0	1250	6400	1500	X
	59	2.5 (h)	2.0	2400	2600	250	28.0	26.0	1250	5000	1100	7
	2A3	2.5	2.5	765	5500	250	45.0	60.0	3500	2500	750	X

(h):—Heater type cathode.

OUTPUT PENTODES

Type	Filament		Mutual Conductance (μ mhos)	A Max. Plate Voltage	B Max. Screen Voltage	C Grid Bias (for A and B)	D Average Plate Current (for A, B & C) (mA)	E Average Screen Current (for A, B & C) (mA)	F Max. Undistorted Output (for A, B & C) (Milliwatts)	G Optimum Load (for F) (Ohms)	Automatic Bias Resistance (for A, B & C) (Ohms)	Base
	Volts	Amps										
Cossor.												
247C	2.5	1.75	2500	250	250	16.5	31.0	6.0	2500	7000	440	Y
220PT	2.0	0.2	2500	150	150	9.0	19.0	—	—	7500	—	X
220HPT	2.0	0.2	2500	150	150	4.5	8.0	1.5	500	17000	—	XE
230PT	2.0	0.3	2000	150	150	15.0	14.0	—	4000	10000	—	X
410PT	4.0	0.1	2500	150	150	9.0	17.0	3.0	900	7500	—	X
415PT	4.0	0.15	2000	150	150	15.0	14.0	—	—	10000	—	X
615PT	6.0	0.15	2000	150	150	15.0	14.0	3.0	380	10000	—	XY
PT41	4.0	1.0	3000	250	200	4.5	30.0	6.0	—	8000	350	YO
PT41B	4.0	1.0	2250	400	300	40.0	30.0	6.0	3600	8000	1100	O
MP/PEN	4.0 (h)	1.0	3500	250	250	16.0	30.0	6.0	2000	10000	450	Y
DP/PEN	16.0 (h)	0.25	3500	250	250	10.0	30.0	6.0	—	10000	300	O
Ken-Rad.												
18	14.0 (h)	0.3	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
33	2.0	0.26	1400	135	135	13.5	14.0	3.0	650	7000	—	Y
38	6.3 (h)	0.3	975	135	135	13.5	9.0	2.5	525	13500	1170	Y
41	6.3 (h)	0.4	2200	250	250	18.0	32.0	5.7	3400	7600	480	6
42	6.3 (h)	0.7	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
43	25.0 (h)	0.3	2300	135	135	20.0	34.0	7.0	2000	4000	480	6
47	2.5	1.75	2650	250	250	16.5	31.0	6.0	2700	7000	400	Y
48	30.0 (h)	0.4	2800	125	100	22.5	50.0	9.0	2500	2000	—	6
59	2.5 (h)	2.0	2220	250	250	18.0	35.0	9.0	3000	6000	400	7
89	6.3 (h)	0.4	1800	250	250	25.0	32.0	5.5	3400	6750	700	6
2A5	2.5 (h)	1.75	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
6A4	6.3	0.3	2200	180	180	12.0	22.0	3.9	1400	8000	450	5
Mullard.												
41	6.3 (h)	0.4	2200	250	250	18.0	32.0	5.5	3400	7600	480	6
42	6.3 (h)	0.7	2200	250	250	16.5	74.0	6.5	3000	7000	400	6
43	25.0 (h)	0.3	2300	135	135	20.0	34.0	7.0	2000	4000	480	6
47	2.5	1.75	2500	250	250	16.5	31.0	6.0	2700	7000	400	Y
59	2.5 (h)	2.0	2500	250	250	18.9	35.0	9.0	3000	6000	400	7
2A5	2.5 (h)	1.75	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
PM243	2.5	0.6	2000	300	200	28.0	20.0	—	1200	15000	—	Y
PM22A	2.0	0.2	2500	150	150	4.5	9.5	2.0	470	15000	—	Y
PM22	2.0	0.3	1300	150	150	10.0	15.0	4.0	600	8000	—	XYE
PM24A	4.0	0.25	2000	300	2000	22.5	20.0	3.5	1900	10000	950	YO
PM24	4.0	0.15	7500	150	150	12.0	20.0	5.0	500	10000	—	XYE
PM24B	4.0	1.0	2100	400	300	40.0	30.0	7.0	3000	8000	1100	Y
PM24M	4.0	1.0	3000	250	250	18.0	30.0	7.5	3000	8000	500	Y
PM26	6.0	0.17	2000	150	150	15.0	19.0	5.0	750	10000	—	X

Output Pentodes—(Continued).

Type	Filament		Mutual Conductance (μ mhos)	A Max. Plate Voltage	B Max. Screen Voltage	C Grid Bias (for A and B)	D Average Plate Current (for A, B & C) (mA)	E Average Screen Current (for A, B & C) (mA)	F Max. Undistorted Output (for A, B & C) (Milliwatts)	G Optimum Load (for F) (Ohms)	Automatic Bias Resistance (for A, B & C) (Ohms)	Base
	Volts	Amps										
National Union.												
33	2.0	0.26	1400	135	135	13.5	14.5	3.0	700	7000	—	Y
41	6.3 (h)	0.4	2200	250	250	18.0	32.0	5.7	3400	7600	480	6
42	6.3 (h)	0.7	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
43	25.0 (h)	0.3	2300	135	135	20.0	34.0	7.0	2000	4000	480	6
47	2.5	1.75	2650	250	250	16.5	31.0	6.0	2700	7000	400	Y
59	2.5 (h)	2.0	2220	250	250	18.0	35.0	9.0	3000	7000	400	7
89	6.3 (h)	0.4	1800	250	250	25.0	32.0	5.5	3400	6750	700	6
2A5	2.5 (h)	1.75	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
Osram.												
47	2.5	1.75	2300	250	250	16.5	31.0	6.0	2700	7000	400	Y
59	2.5 (h)	2.0	2500	250	250	18.0	35.0	9.0	3000	6000	400	7
2A5	6.3 (h)	0.4	1800	250	250	25.0	32.0	5.5	3400	6750	650	6
PT2	2.0	0.2	—	150	150	4.5	6.5	1.9	500	17000	—	YO
PT4	4.10	1.0	—	250	250	11.0	32.0	8.0	2500	7500	270	YO
MPT4	4.0 (h)	1.0	—	250	250	13.0	32.0	8.0	3200	9000	340	YO & 7P Eng.
PT16	4.0	1.0	—	300	300	15.0	53.0	10.0	6300	5000	270	YO
PT25	4.0	2.0	—	400	200	22.0	62.5	10.0	10000	6000	330	YO
DPT	16.0 (h)	0.25	—	200	200	10.0	40.0	6.5	2000	8000	250	YO
Catkin MPT4	4.0 (h)	1.0	—	250	250	13.0	32.0	8.0	3200	9000	340	YO & 7P Eng.
Philips.												
33	2.0	0.26	1450	135	135	13.5	14.0	3.5	700	7000	750	Y
38	6.3 (h)	0.3	975	180	180	18.0	14.0	2.4	1000	11600	1100	Y
41	6.3 (h)	0.4	2200	180	180	13.5	18.5	4.5	3400	7600	650	6
42	6.3 (h)	0.7	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
43	25.0 (h)	0.3	2300	135	135	20.0	34.0	7.0	2000	4000	480	6
47	2.5	1.75	2650	250	250	16.5	31.0	6.0	2700	7000	400	Y
59	2.5 (h)	2.0	2220	250	250	18.0	35.0	9.0	3000	6000	400	7
89	6.3 (h)	0.4	1800	250	250	25.0	32.0	5.5	3400	6750	670	6
2A5	2.5 (h)	1.75	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
E443H	4.0	1.1	3000	250	250	15.0	36.0	7.0	3000	7500	350	Y
E443M	4.0	1.0	2700	250	250	39.0	48.0	9.0	4000	6000	700	Y
B443	4.0	0.15	1750	250	150	19.0	12.0	—	950	20000	—	XEO
C243	2.0	0.27	1700	150	150	15.0	17.0	—	500	15000	—	XY
C443	4.0	0.25	1700	300	200	25.0	20.0	4.5	1800	15000	—	Y
C643	6.0	0.25	1500	300	200	20.0	21.0	—	—	—	—	X
B243	2.5	0.6	2000	300	200	28.0	20.0	—	1200	15000	—	Y
Radiotron.												
33	2.0	0.26	1500	135	135	13.5	14.5	3.0	700	7000	—	Y
38	6.3 (h)	0.3	1200	250	250	25.0	22.0	3.8	2500	10000	1000	Y
41	6.3 (h)	0.4	2200	250	250	18.0	32.0	5.5	3400	7600	480	6
42	6.3 (h)	0.7	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
43	25.0 (h)	0.3	2300	135	135	20.0	34.0	7.0	2000	4000	480	6
47	2.5	1.75	2300	250	250	16.5	31.0	6.0	2700	7000	400	Y
48	30.0 (h)	0.4	2800	125	100	22.5	50.0	9.0	2500	2000	—	6
59	2.5 (h)	2.0	2500	250	250	18.0	35.0	9.0	3000	6000	400	7
89	6.3 (h)	0.4	1800	250	250	25.0	32.0	5.5	3400	6750	650	6
2A5	2.5 (h)	1.75	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
6A4	6.3	0.3	2200	180	180	15.0	22.0	3.9	1400	8000	580	Y
Sylvania.												
18	14.0 (h)	0.3	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
38	6.3 (h)	0.3	1050	180	180	18.0	14.0	2.4	1000	11600	1100	Y
41	6.3 (h)	0.4	2200	250	250	18.0	32.0	5.5	3400	7600	480	6
42	6.3 (h)	0.65	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
43	25.0 (h)	0.3	2300	135	135	20.0	38.0	7.0	2000	4000	480	6
47	2.5	1.5	2500	250	250	16.5	31.0	6.0	2700	7000	400	Y
59	2.5 (h)	2.0	2500	250	250	18.0	35.0	9.0	3000	6000	400	7
89	6.3 (h)	0.4	1550	180	180	18.0	20.0	3.0	1500	8000	700	6
2A5	2.5 (h)	1.75	2200	250	250	16.5	34.0	6.5	3000	7000	400	6
6A4/LA	6.3	0.3	2200	180	180	12.0	22.0	3.9	1500	8000	450	Y
Tung-Sol.												
33	2.0	0.26	1500	135	135	13.5	14.5	3.0	700	7000	—	Y
43	6.3 (h)	0.3	1200	250	250	25.0	22.0	3.8	2500	10000	1000	Y
47	2.5	1.75	2300	250	250	16.5	31.0	6.0	2700	7000	400	Y
59	2.5 (h)	2.0	2500	250	250	18.0	35.0	9.0	3000	6000	400	7
89	6.3 (h)	0.4	1800	250	250	25.0	32.0	5.5	3400	6750	650	6
2A5	2.5 (h)	1.75	2200	250	250	16.5	34.0	6.5	3000	7000	400	6

VARIABLE - MU VALVES

Type		Filament		Max. Plate Voltage	Optimum Screen Voltage	Grid Bias		Average Plate Current (m.A.) at Min. Bias	Mutual Conductance (μ mhos)		Base
		Volts	Amps			Min.	Max.		At Min. Bias	At Max. Bias	
Cossor.	35	2.5 (h)	1.75	250	90	3.0	35	6.3	1050	20	Y
	58	2.5 (h)	1.0	250	100	3.0	50	8.2	1600	2	6
	220VSG	2.0	0.2	150	80	0	15	2.6	1600	50	XE
	220VS	2.0	0.2	150	80	0	9	1.6	1600	—	XE
	MVSG	4.0 (h)	1.0	200	100	1.5	35	7.8	2500	60	O
	DVSG	16.0 (h)	0.25	200	100	1.5	35	7.5	2500	30	YO
	MVS/Pen.	4.0 (h)	1.0	200	100	1.5	16	4.2	2200	30	YO7P Eng.
	DVS/Pen.	16.0 (h)	0.25	200	100	1.5	16	5.0	200	40	YO
Ken-Rad.	34	2.0	0.06	180	67.5	3.0	22.5	2.8	620	15	X
	35	2.5 (h)	1.75	250	90.0	3.0	35.0	6.5	1050	20	Y
	39	6.3 (h)	0.3	250	90.0	3.0	30.0	4.6	1050	10	Y
	44	6.3 (h)	0.3	250	90.0	3.0	30.0	6.5	1050	10	Y
	58	2.5 (h)	1.0	250	100	3.0	50.0	8.2	1600	2	6
	78	6.3 (h)	0.3	250	100	3.0	42.5	7.0	1450	2	6
	6D6	6.3 (h)	0.3	250	100	3.0	35.0	8.2	1280	10	6
Mullard.	35	2.5 (h)	1.75	250	90	3	35	6.5	1050	20	Y
	58	2.5 (h)	1.0	250	100	3	50	8.2	1600	2	6
	78	6.3 (h)	0.3	250	100	3.0	42.5	7.0	1450	2	6
	6D6	6.3 (h)	0.3	250	100	3.0	35.0	8.2	1280	10	6
	PM12V	2.0	0.18	150	90	0	15	5.0	750	5	XE
	PM12M	2.0	0.18	150	90	0	9	2.5	1400	14	XE
	VP4	4.0 (h)	1.0	200	100	1.5	40	5.5	2500	2	YO
National Union.	34	2.0	0.06	180	67.5	3.0	22.5	2.8	620	15	X
	35	2.5 (h)	1.75	250	90	3.0	35.0	6.5	1050	20	Y
	39	6.3 (h)	0.3	250	90	3.0	30.0	4.6	1050	10	Y
	58	2.5 (h)	1.0	250	100	3	50	8.2	1600	2	6
	78	6.3 (h)	0.3	250	100	3	42.5	7.0	1450	2	6
Osram.	35	2.5 (h)	1.75	250	90	3.0	35.0	6.5	1050	20	Y
	58	2.5 (h)	1.0	250	100	3	50	8.2	1600	2	6
	VS24	2.0	0.15	150	75	0	9	4.4	1500	16	XE
	VP21	2.0	0.1	150	75	0	9	2.85	1100	8	7P Eng.
	VMS4	4.0 (h)	1.0	200	80	1.0	30	10.0	2600	30	YO
	VMS4V	4.0 (h)	1.0	200	80	1.0	15	5.0	2900	40	YO
	VMP4	4.0 (h)	1.0	200	100	1.0	30	6.0	3500	4	7P Eng.
	VDS	16.0 (h)	0.25	200	80	1.0	30	10.0	2400	13.0	YO
	VDSB	16.0 (h)	0.25	200	80	1.0	15	6.0	3000	35.0	YO
	Catkin VMS4	4.0 (h)	1.0	200	80	1.0	30	10.0	2600	30	YO
Philips.	34	2.0	0.06	180	67.5	3.0	22.5	2.8	620	15	X
	35	2.5 (h)	1.75	250	90	3	50	6.5	1100	20	Y
	39	6.3 (h)	0.3	180	90	3	30	4.5	1000	10	Y
	58	2.5 (h)	1.0	250	100	3.0	50	8.2	1600	2	6
	78	6.3 (h)	0.3	250	100	3.0	42.5	7.0	1450	2	6
	6D6	6.3 (h)	0.3	250	100	3.0	35	8.2	1280	10	6
	E445	4.0 (h)	1.0	200	100	2.0	40	6.0	1000	5	GY
	E455	4.0 (h)	1.0	200	100	1.5	40	3.0	2000	5	GY
Radiotron.	34	2.0	0.06	180	67.5	3	22.5	2.8	620	15	X
	35	2.5 (h)	1.75	250	90	3.0	35	6.5	1050	20	Y
	39	6.3 (h)	0.3	250	90	3	30	4.6	1050	10	Y
	44	6.3 (h)	0.3	250	90	3	30	6.5	1050	10	Y
	58	2.5 (h)	1.0	250	100	3	50	8.2	1600	2	6
	78	6.3 (h)	0.3	250	100	3	42.5	7.0	1450	2	6
Sylvania.	34	2.0	0.06	180	67.5	3	22.5	2.8	620	15	X
	35	2.5 (h)	1.75	250	90	3	35	6.5	1050	20	Y
	39	6.3 (h)	0.3	250	90	3	30	5.8	1050	10	Y
	44	6.3 (h)	0.3	250	90	3	30	5.8	1050	10	Y
	58	2.5 (h)	1.0	250	100	3	50	8.2	1600	2	6
	78	6.3 (h)	0.3	250	100	3	42.5	7.0	1450	2	6
	6D6	6.3 (h)	0.3	250	100	3	35	8.2	1280	10	6
Tung-Sol.	34	2.0	0.06	180	67.5	3	22.5	2.8	620	15	X
	58	2.5 (h)	1.0	250	100	3	50	8.2	1600	2	6
	6D6	6.3 (h)	0.3	250	100	3	35	8.2	1280	10	6

(h) :—Heater type cathode.

SCREEN-GRID VALVES

Type		Filament Volts	Filament Amps	Max. Plate Voltage	Optimum Screen Voltage	Average Plate Current (m.A.)	Amplification Factor	Plate Impedance (Ohms)	Mutual Conductance (μ mhos)	Base
Cossor.	24A	2.5 (h)	1.75	250	90	4.0	630	600,000	1050	Y
	57	2.5 (h)	1.0	250	100	2.3	3600	3.0 meg.	1225	6
	215SG	2.0	0.15	150	80	2.4	330	300,000	1100	XE
	220SG	2.0	0.2	150	80	3.1	320	200,000	1600	XE
	410SG	4.0	0.1	150	80	1.2	800	800,000	1000	XE
	610SG	6.0	0.1	150	80	4.1	200	200,000	1000	XE
	41MSG	4.0 (h)	1.0	200	80	0.8	1000	400,000	2500	MYO
	MSG/HA	4.0 (h)	1.0	200	100	2.1	1000	500,000	2000	MY
	MSG/LA	4.0 (h)	1.0	200	100	5.2	750	200,000	3750	MY
	MS/Pen.	4.0 (h)	1.0	200	100	—	—	—	3500	MY
	MS/Pen.-A	4.0 (h)	1.0	200	150	9.0	—	—	4000	MY
Ken-Rad.	22	3.3	0.132	135	67.5	3.7	160	325,000	500	X
	24A	2.5 (h)	1.75	250	90.0	4.0	630	600,000	1050	Y
	32	2.0	0.06	180	67.5	1.7	780	1.2 meg.	650	X
	36	6.3 (h)	0.3	250	90.0	3.2	595	550,000	1080	Y
	57	2.5 (h)	1.0	250	100	2.3	3600	3.0 meg.	1225	6
	77	6.3 (h)	0.3	250	100	2.3	1500	1.5 meg.	1250	6
	6C6	6.3 (h)	0.3	250	100	2.0	1500	1.5 meg.	1225	6
Mullard.	24A	2.5 (h)	1.75	250	90	4.0	630	600,000	1050	Y
	57	2.5 (h)	1.0	250	100	2.3	3600	3.0 meg.	1225	6
	77	6.3 (h)	0.3	250	100	2.3	1500	1.5 meg.	1250	6
	6C6	6.3 (h)	0.3	250	100	2.0	1500	1.5 meg.	1225	6
	PM12A	2.0	0.18	150	90	2.75	500	330,000	1500	XE
	PM14	4.0	0.075	150	75	1.5	200	230,000	870	XE
	PM16	6.0	0.075	150	75	1.75	200	200,000	1000	XE
	S4V	4.0 (h)	1.0	200	75	0.85	1000	909,000	1100	MYO
	S4VA	4.0 (h)	1.0	200	110	2.5	1500	430,000	3000	MYO
	S4VB	4.0 (h)	1.0	200	110	3.5	900	257,000	3600	MYO
	SP4	4.0 (h)	1.0	200	100	—	2700	770,000	3500	YO
National Union.	24A	2.5 (h)	1.75	250	90	4.0	630	600,000	1050	Y
	32	2.0	0.06	180	67.5	1.7	780	1.2 meg.	650	X
	36	6.3 (h)	0.3	250	90.0	3.2	595	550,000	1080	Y
	57	2.5 (h)	1.0	250	100.0	2.3	3600	3.0 meg.	1225	6
	77	6.3 (h)	0.3	250	100	2.3	1500	1.5 meg.	1250	6
Osram.	24	2.5 (h)	1.75	250	90	4.0	630	600,000	1050	Y
	57	2.5 (h)	1.0	250	100	2.3	3600	3.0 meg.	1225	6
	77	6.3 (h)	0.3	250	100	2.3	1500	1.5 meg.	1250	6
	S21	2.0	0.1	150	70	2.0	220	200,000	1100	XE
	S22	2.0	0.2	150	75	1.5	350	200,000	1750	XE
	S23	2.0	0.1	150	70	1.4	275	250,000	1100	XE
	S24	2.0	0.15	150	70	1.4	350	250,000	1400	XE
	MS4	4.0 (h)	1.0	200	60	2.4	550	500,000	1100	YO
	MS4B	4.0 (h)	1.0	200	80	3.4	1120	350,000	3200	YO
	MSP4	4.0 (h)	1.0	200	100	3.0	3000	750,000	4000	7P Eng.
	DS	16.0 (h)	0.25	200	70	2.4	550	500,000	1100	YO
	DSB	16.0 (h)	0.25	200	80	3.4	1120	350,000	3200	YO
	Catkin MS4B	4.0 (h)	1.0	200	80	3.4	1120	350,000	3200	YO
Philips.	24A	2.5 (h)	1.75	250	90	4.0	630	600,000	1050	Y
	32	2.0	0.06	180	67.5	1.7	780	1.2 meg.	650	X
	36	6.3 (h)	0.3	250	90	3.2	595	550,000	1080	Y
	57	2.5 (h)	1.0	250	100	2.3	3600	3.0 meg.	1225	6
	77	6.3 (h)	0.3	250	100	2.3	1500	1.5 meg.	1250	6
	6C6	6.3 (h)	0.3	250	100	2.0	1500	1.5 meg.	1225	6
	B242	2.0	0.15	200	100	4.5	150	400,000	600	X
	A442	4.0	0.06	200	100	4.0	280	400,000	700	XE
	A642	6.0	0.06	200	100	3.5	300	350,000	900	X
	E442	4.0 (h)	1.0	200	100	1.5	700	800,000	900	Y
	E452T	4.0 (h)	1.0	200	100	3.0	900	450,000	2000	GY
	E442S	4.0 (h)	1.0	200	60	4.0	400	400,000	1000	YO
Radiotron.	22	3.3	0.132	135	67.5	3.7	160	325,000	500	X
	24A	2.5 (h)	1.75	250	90	4.0	630	600,000	1050	Y
	32	2.0	0.06	180	67.5	1.7	780	1.2 meg.	650	X
	36	6.3 (h)	0.3	250	90	3.2	595	550,000	1080	Y
	57	2.5 (h)	1.0	250	100	2.3	3600	3.0 meg.	1225	6
	77	6.3 (h)	0.3	250	100	2.3	1500	1.5 meg.	1250	6
Sylvania.	32	2.0	0.06	180	67.5	1.7	780	1.2 meg.	650	X
	57	2.5 (h)	1.0	250	100	2.0	1500	1.5 meg.	1225	6
	77	6.3 (h)	0.3	250	100	2.3	1500	1.5 meg.	1250	6
	6C6	6.3 (h)	0.3	250	100	2.0	1500	1.5 meg.	1225	6
Tung-Sol.	32	2.0	0.06	180	67.5	1.7	780	1.2 meg.	650	X
	57	2.5 (h)	1.0	250	100	2.3	3600	3.0 meg.	1225	6
	6C6	6.3 (h)	0.3	250	100	2.0	1500	1.5 meg.	1225	6

(h) :—Heater type cathode.

Special Purpose Valves

Type	Description	Filament Volts	Filament Amps	Max. Plate Voltage	Max. Screen Voltage	Grid Bias (Volts)	Plate Current (mA)	Plate Impedance (Ohms)	Amplification Factor	Mutual Conductance (μ mhos)	Base
Cossor.											
210DG	Bi-Grid Detector	2.0	0.1	100	—	0	—	27000	5.1	190	YO
41MDG	Bi-Grid Detector	4.0	1.0	200	—	0	—	40000	10.0	250	MO
DD/Pen.	Duo-Diode-Pentode	4.0 (h)	1.0	250	200	1.5	7.0	—	—	2700	7P Eng.
DDT	Duo-Diode-Triode	4.0 (h)	1.0	200	—	3.0	3.4	17000	41.0	2400	7P Eng.
DDT16	Duo-Diode-Triode	16.0 (h)	0.25	200	—	3.5	4.0	16000	40.0	2500	7P Eng.
Ken-Rad.											
1A6	Pentagrid Converter Anode Grid 135 V. 2.3 mA. Oscill. Grid Resistor 50,000 Ohms. Conv. Conductance 300 μ mhos.	2.0	0.06	180	67.5	3.0	1.3	50000	Screen Curr 2.4	mA. 6	
55	Duo-Diode-Triode	2.5 (h)	1.0	250	—	20.0	8.0	7500	8.3	1100	6
75	Duo-Diode-Triode	6.3 (h)	0.3	250	—	2.0	0.8	91000	100	1100	6
90	Double-Grid-Detect.	2.5 (h)	1.0	250*	—	—	3.5	10000	14.0	1400	6
92	Double-Grid-Detect.	6.3 (h)	0.4	250*	—	—	3.5	10000	14.0	1400	6
2A6	Duo-Diode-Triode	2.5 (h)	0.8	250*	—	2.0	0.8	91000	100	1100	6
2A7	Pentagrid Converter Anode Grid 200 V. Oscill. Grid Resistor 50,000 Ohms. Conversion Conductance 520 μ mhos.	2.5 (h)	0.8	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA 7	
2B7	Duo-Diode-Pentode	2.5 (h)	0.8	250	125	3.0	9.0	650000	730	1125	7
6A7	Pentagrid Converter Anode Grid 200 V. Oscill. Grid Resistor, 50,000 Ohms. Conversion Conductance 520 μ mhos.	6.3 (h)	0.3	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA. 7	
6B7	Duo-Diode-Pentode	6.3 (h)	0.3	250	125	3.0	9.0	650000	730	1125	7
6F7	Triode-Pentode-Converter	6.3 (h)	0.3	Triode Section.		Oscillator	Peak Volts. 7.0				
				100	—	3.0	3.5	17800	8	450	7
		Pentode Section		250	100	10.0	2.8	Screen	Current	0.6 mA.	
				Conversion Conductance 300 μ mhos.							
Mullard.											
55	Duo-Diode-Triode	2.5 (h)	1.0	250	—	20.0	8.0	7500	8.3	1100	6
2A6	Duo-Diode-Triode	2.5 (h)	0.8	250*	—	2.0	0.8	91000	100	1100	6
2A7	Pentagrid Converter Anode Volts 200 V. Oscill. Grid Resistor 50,000 Ohms. Conversion Conductance 520 μ mhos.	2.5 (h)	0.8	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA. 7	
2B7	Duo-Diode-Pentode	2.5 (h)	0.8	250	125	3.0	9.0	650000	730	1125	7
6A7	Pentagrid Converter Anode Grid 200 V. Oscill. Grid Resistor 50,000 Ohms. Conversion Conductance 520 μ mhos.	6.3 (h)	0.3	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA. 7	
6B7	Duo-Diode-Pentode	6.3 (h)	0.3	250	125	3.0	9.0	650000	730	1125	7
6F7	Triode-Pentode-Converter	6.3 (h)	0.3	Triode Section.		Oscillator	Peak Volts 7.0				
				100	—	3.0	3.5	17800	8	450	7
		Pentode	Section.	250	100	10.0	2.8	Screen	Current	0.6 mA.	
				Conversion Conductance 300 μ mhos.							
PM1DG	Bi-Grid-Detector	2.0	0.1	80	—	0	—	—	—	800	Y
TDD4	Duo-Diode-Triode	4.0 (h)	1.2	200	—	3.5	3.5	15000	30	2000	M7
National Union.											
55	Duo-Diode-Triode	2.5 (h)	1.0	250	—	20.0	8.0	7500	8.3	1100	6
75	Duo-Diode-Triode	6.3 (h)	0.3	250	—	2.0	0.8	91000	100	1100	6
85	Duo-Diode-Triode	6.3 (h)	0.3	250	—	20.0	8.0	7500	8.3	1100	6
1A6	Pentagrid Converter Anode Grid 135 V. 2.3 mA. Oscill. Grid Resistor 50,000 Ohms. Conv. Conductance 300 μ mhos.	2.0 (h)	0.06	180	67.5	3.0	1.3	50000	Screen Curr. 2.4	mA. 6	
2A6	Duo-Diode-Triode	2.5 (h)	0.8	250*	—	2.0	0.8	91000	100	1100	6
2A7	Pentagrid Converter Anode Grid 200 V. Oscill. Grid Resistor 50,000 Ohms. Conversion Conductance 520 μ mhos.	2.5 (h)	0.8	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA. 7	
2B7	Duo-Diode-Pentode	2.5 (h)	0.8	250	125	3.0	9.0	650000	730	1125	7
6A7	Pentagrid Converter Anode Grid 200 V. Oscillator Grid Resistor 50,000 Ohms. Conversion Conductance 520 μ mhos.	6.3 (h)	0.3	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA. 7	
6B7	Duo-Diode-Pentode	6.3 (h)	0.3	250	125	3.0	9.0	650000	730	1125	7
6F7	Triode-Pentode Converter	6.3 (h)	0.3	Triode Section.		Oscillator	Peak Volts 7.0				
				100	—	3.0	3.5	17800	8	450	7
		Pentode	Section.	250	100	10.0	2.8	Screen	Curr. 0.6	mA.	
				Conversion Conductance 300 μ mhos.							
Osram.											
55	Duo-Diode-Triode	2.5 (h)	1.0	250	—	20.0	8.0	7500	8.3	1100	6
75	Duo-Diode-Triode	6.3 (h)	0.3	250	—	2.0	0.8	91000	100	1100	6
2A7	Pentagrid Converter Anode Grid. 200 V. Oscillator Grid Resistor 50,000 Ohms. Conversion Conductance 520 μ mhos.	2.5 (h)	0.8	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA. 7	
2B7	Duo-Diode-Pentode	6.3 (h)	0.3	250	125	3.0	9.0	650000	730	1125	7
MHD4	Duo-Diode-Triode	4.0 (h)	1.0	200	—	3.0	3.0	18200	40	2200	7
DHD	Duo-Diode-Triode	16.0 (h)	0.25	200	—	3.2	3.2	18200	40	2200	7
DG2	Bi-Grid-Detector	2.0	0.2	100	—	—	—	3750	5	1200	YO

Special Purpose Valves—(Continued).

Type	Description	Filament Volts	Filament Amps	Max. Plate Voltage	Max. Screen Voltage	Grid Bias (Volts)	Plate Current (mA)	Plate Impedance (Ohms)	Amplification Factor	Mutual Conductance (μ mhos)	Base
Philips.											
55	Duo-Diode-Triode	2.5 (h)	1.0	250	—	20.0	8.0	7500	8.3	1100	6
75	Duo-Diode-Triode	6.3 (h)	0.3	250	—	2.0	0.8	91000	100	1100	6
85	Duo-Diode-Triode	6.3 (h)	0.3	250	—	20.0	8.0	7500	8.3	1100	6
1A6	Pentagrid Converter	2.0	0.06	180	67.5	3.0	1.3	50000	Screen Curr. 2	1.2 mA.	6
	Anode Grid 135 V. 2.3 mA. Oscillator Grid Resistor 50,000 Ohms. Conv. Conductance 300 μ mhos.										
2A6	Duo-Diode-Triode	2.5 (h)	0.8	250*	—	2.0	0.8	91000	100	1100	6
2A7	Pentagrid Converter	2.5 (h)	0.8	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA.	7
	Anode Grid 200 V. Oscillator Grid Resist or 50,000 Ohms. Conversion Conductance 520 μ mhos.										
2.B7	Duo-Diode-Pentode	2.5 (h)	0.8	250	125	3.0	9.0	650000	730	1125	7
6A7	Pentagrid Converter	6.3 (h)	0.3	250	100	3.0	3.5	300000	Screen Curr. 2	.2 mA.	7
	Anode Grid 200 V. Oscillator Grid Resist or 50,000 Ohms. Conversion Conductance 520 μ mhos.										
6B7	Duo-Diode-Pentode	6.3 (h)	0.3	250	125	3.0	9.0	650000	730	1125	7
6F7	Triode-Pentode Converter	6.3 (h)	0.3	Triode 100	Section. —	Oscillator Peak Volts 7.0 3.0		17800	8	450	7
		Pentode	Section.	250	100	10.0	2.8	Screen	Curr.	0.6 mA.	
						Conversion Conductance 300 μ mhos.					
E444	Diode Tetrode	4.0 (h)	1.0	200	25	2.3	0.3	2.5 meg.	3000	3000	G6
		—	—	—	65	2.3	3.2	300000	1000	max.	
Radiotron.											
55	Duo-Diode-Triode	2.5 (h)	1.0	250	—	20.0	8.0	7500	8.3	1100	6
75	Duo-Diode-Triode	6.3 (h)	0.3	250	—	2.0	0.8	91000	100	1100	6
85	Duo-Diode-Triode	6.3 (h)	0.3	250	—	20.0	8.0	7500	8.3	1100	6
1A6	Pentagrid Converter	2.0	0.06	180	67.5	3.0	1.3	50000	Screen Curr. 2.4	mA.	6
	Anode Grid 135 V. 2.3 mA. Oscillator Grid Resist or 50,000 Ohms. Conv. Conductance 300 μ mhos.										
2A6	Duo-Diode-Triode	2.5 (h)	0.8	250*	—	2.0	0.8	91000	100	1100	6
2A7	Pentagrid Converter	2.5 (h)	0.8	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA.	
	Anode Grid 200 V. Oscillator Grid Resist or 50,000 Ohms. Conversion Conductance 520 μ mhos.										
2B7	Duo-Diode-Pentode	2.5 (h)	0.8	250	125	3.0	9.0	650000	730	1125	7
6A7	Pentagrid Converter	6.3 (h)	0.3	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA.	7
	Anode Grid 200 V. Oscillator Grid Resist or 50,000 Ohms. Conversion Conductance 520 μ mhos.										
6B7	Duo-Diode-Pentode	6.3 (h)	0.3	250	125	3.0	9.0	650000	730	1125	7
868	Photo-Tube Window 0.9 sq. ins. Static Sensitivity:		Load 0.1—5 neg. 55 micro		Applied voltage 90 amps per lumen.		0 current Gas $\mu = 7$	0.02 mA.			
Sylvania.											
55	Duo-Diode-Triode	2.5 (h)	1.0	250	—	20.0	8.0	7500	8.3	1100	6
75	Duo-Diode-Triode	6.3 (h)	0.3	250	—	2.0	0.8	91000	100	1100	6
85	Duo-Diode-Triode	6.3 (h)	0.3	250	—	20.0	8.0	7500	8.3	1100	6
1A6	Pentagrid Converter	2.0	0.06	180	67.5	3.0	1.3	50000	Screen Curr. 2.4	mA.	6
	Anode Grid 135 V. 2.3 mA. Oscillator Grid Resistor 50,000 Ohms. Conv. Conductance 300 μ mhos.										
2A6	Duo-Diode-Triode	2.5 (h)	0.8	250*	—	2.0	0.8	91000	100	1100	6
2A7	Pentagrid Converter	2.5 (h)	0.8	250	100	3.0	3.5	300000	Screen Curr. 2	1.2 mA.	7
	Anode Grid 200 V. Oscillator Grid Resist or 50,000 Ohms. Conversion Conductance 520 μ mhos.										
2B7	Duo-Diode-Pentode	2.5 (h)	0.8	250	125	3.0	9.0	650000	730	1125	7
6A7	Pentagrid Converter	6.3 (h)	0.3	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA.	7
	Anode Grid 200 V. Oscillator Grid Resist or 50,000 Ohms. Conversion Conductance 520 μ mhos.										
6B7	Duo-Diode-Pentode	6.3 (h)	0.3	250	125	3.0	9.0	650000	730	1125	7
6F7	Triode-Pentode Converter	6.3 (h)	0.3	Triode 100	Section. —	Oscillator Peak Volts 7.0 3.0		17800	8	450	7
		Pentode	Section.	250	100	10.0	2.8	Screen	Curr. 0.6	mA.	
						Conversion Conductance 300 μ mhos.					
Tung-Sol.											
55	Duo-Diode-Triode	2.5 (h)	1.0	250	—	20.0	8.0	7500	8.3	1100	6
2A7	Pentagrid Converter	2.0	0.06	180	67.5	3.0	1.3	50000	Screen Curr. 2.4	mA.	6
	Anode Grid 135 V. 2.3 mA. Oscillator Grid Resistor 50,000 Ohms. Conv. Conductance 300 μ mhos.										
2B7	Duo-Diode-Pentode	2.5 (h)	0.8	250	125	3.0	9.0	650000	730	1125	7
6A7	Pentagrid Converter	6.3 (h)	0.3	250	100	3.0	3.5	300000	Screen Curr. 2.2	mA.	7
	Anode Grid 200 V. Oscillator Grid Resist or 50,000 Ohms. Conversion Conductance 520 μ mhos.										
6B7	Duo-Diode-Pentode	6.3 (h)	0.3	250	125	3.0	9.0	650000	730	1125	7

* 100,000 ohms, Plate Coupling Resistor; (h):—Heater type cathode.

Class "B" Valves

Type		Filament Volts	Filament Amps	Max. Plate Volts	No Signal Plate Current (Total) (mA)	Plate Current Under Average Signal (mA)	Input Impedance (Grid to Grid) (Ohms)	Grid Bias	Optimum Load (Ohms)	Base
Cossor.	220B*	2.0	0.2	120	2.5	6.0	2900	0	12000	7P Eng.
	240B*	2.0	0.4	150	3.0	8.5	2500	0	8000	7P Eng.
Ken-Rad.	19*	2.0	0.26	135	10.0	—	—	0	10000	6
	46	2.5	1.75	400	6.0	—	—	0	5800	Y
	49	2.0	0.12	180	2.0	—	—	0	12000	Y
	53*	2.5 (h)	2.0	300	35.0	—	—	0	10000	7
	59	2.5 (h)	2.0	400	13.0	—	—	0	6000	7
	79*	6.3 (h)	0.6	250	10.5	—	—	0	14000	6
	89	6.3 (h)	0.4	180	3.0	—	—	0	9400	6
Mullard.	2B*	2.0	0.2	150	3.0	4.2	4000	0	14000	7
National Union.	46	2.5	1.75	400	6.0	—	—	0	5800	Y
	49	2.0	0.12	180	2.0	—	—	0	12000	Y
	59	2.5 (h)	2.0	400	13.0	—	—	0	6000	7
	79*	6.3 (h)	0.6	250	10.5	—	—	0	14000	6
	89	6.3 (h)	0.4	180	3.0	—	—	0	9400	6
Osram.	B21*	2.0	0.2	150	2.2	7.5	36000	6	12000	7P Eng.
Philips.	46	2.5	1.75	400	6.0	—	—	0	5800	Y
	59	2.5 (h)	2.0	400	13.0	—	—	0	6000	7
	79*	6.3 (h)	0.6	250	10.5	—	—	0	14000	6
	89	6.3 (h)	0.4	180	3.0	—	—	0	9400	6
Radiotron.	19*	2.0	0.26	135	10.0	—	—	0	10000	6
	46	2.5	1.75	400	6.0	—	—	0	5800	Y
	49	2.0	0.12	180	2.0	—	—	0	12000	Y
	53*	2.5 (h)	2.0	300	35.0	—	—	0	10000	7
	59	2.5 (h)	2.0	400	13.0	—	—	0	6000	7
	79*	6.3 (h)	0.6	250	10.5	—	—	0	14000	6
	89	6.3 (h)	0.4	180	3.0	—	—	0	9400	6
Sylvania.	19*	2.0	0.26	135	10.0	—	—	0	10000	6
	59	2.5 (h)	2.0	400	13.0	—	—	0	6000	7
	79*	6.3 (h)	0.6	250	10.5	—	—	0	14000	6
	89	6.3 (h)	0.4	180	3.0	—	—	0	9400	6
Tung-Sol.	46	2.5	1.75	400	6.0	—	—	0	5800	Y
	59	2.5 (h)	2.0	400	13.0	—	—	0	6000	7
	89	6.3 (h)	0.4	180	3.0	—	—	0	9400	6

* These are complete Twin Valves.

Rectifying Valves

Type		Filament Volts	Filament Amps	A.C. Volts per Plate (r.m.s.)	Max. Volts Heater to Cathode	D.C. Output Volts	D.C. Output Current (mA)	Other Characteristics	Base
Cossor.	80	5.0	2.0	400	—	350	110	—	X
	506BU	4.0	1.0	250	—	230	60	—	X
	442BU	4.0	2.5	350	—	350	120	—	X
	460BU	4.0	2.5	500	—	520	120	—	X
Ken-Rad.	80	5.0	2.0	550	—	—	135	—	X
	81	7.5	1.25	700	—	—	85	Half-Wave	X
	82	2.5	3.0	500	—	—	125	Max. Peak Volts 1400 and 400 mA	X
	83	5.0	3.0	500	—	—	250	,, 1400 and 800 mA	X
	84 (6Z4)	6.3 (h)	0.5	225	300	—	50	Half-Wave 75 mA	Y
	1V	6.3 (h)	0.3	350	500	—	50	Half-Wave	X
	5Z3	5.0	3.0	500	—	475	250	—	X
	12Z3	12.6 (h)	0.3	250	350	—	60	Half-Wave	X
	25Z5	25.0 (h)	0.3	125	125	145	100	Voltage-Doubler 8 Mfd. Cond. Input	6

Rectifying Valves—(Continued).

Type		Filament		A.C. Volts per Plate (r.m.s.)	Max. Volts Heater to Cathode	D.C. Output		Other Characteristics	Base
		Volts	Amps			Volts	Current (mA)		
Mullard.	80	5.0	2.0	400	—	—	110	—	X
	1V	6.3 (h)	0.3	350	500	—	50	Half-Wave	X
	12Z3	12.6 (h)	0.3	250	350	—	60	Half-Wave	X
	DU10	4.0	1.0	250	—	—	75	Half-Wave	XE
	DU2	4.0	1.0	250	—	—	75	—	XE
	DW3	4.0	2.0	350	—	320	120	—	X
	DW4	4.0	2.0	500	—	500	120	—	X
	DW15	7.5	0.6	500	—	—	60	—	X
National Union.	80	5.0	2.0	400	—	—	110	—	X
	82	2.5	3.0	500	—	—	125	Max. Peak Volts 1400 and 400 mA	X
	5Z3	5.0	3.0	500	—	475	250	—	X
	25Z5	25.0 (h)	0.3	125	125	145	100	Voltage Doubler 8 Mfd. Cond. Input	6
Osram.	80	5.0	2.0	350	—	—	125	—	X
	U10	4.0	1.0	250	—	260	60	—	XE
	U12	4.0	2.5	350	—	325	120	—	XE
	U14	4.0	2.5	500	—	540	120	—	XE
	MU12	4.0	2.5	350	350	340	120	—	XE
	MU14	4.0	2.5	500	500	540	120	—	XE
	GU1	4.0	3.0	1000	—	1100	250	Half-Wave Merc. Vap.	XE
Philips.	80	5.0	2.0	550	—	—	135	With 20H Choke	X
		—	—	400	—	—	110	Normal	—
	81	7.5	1.25	750	—	—	110	Half-Wave	X
	82	2.5	3.0	500	—	—	125	Merc. Vap.	X
	1V	6.3 (h)	0.3	350	500	—	50	Half-Wave	X
	5Z3	5.0	3.0	500	—	475	250	—	X
	505	4.0	1.0	400	—	—	60	Half-Wave	3 Pen.
	506	4.0	1.0	300	—	—	75	Full-Wave	XE
	1561	4.0	2.0	500	—	—	120	—	X
Radiotron.	80	5.0	2.0	400	—	—	110	—	X
		—	—	550	—	—	135	With 20H Choke	—
	81	7.5	1.25	700	—	—	85	Half-Wave	X
	82	2.5	3.0	500	—	—	125	—	X
	83	5.0	3.0	500	—	—	250	—	X
	84	6.3 (h)	0.5	350	300	—	50	(Half-Wave 75mA)	Y
	866	2.5	5.0	Max. Peak Volts 7500 Max. Peak Current 600mA approx. Volts Drop 15V. Half-Wave Merc. Vap.					X
	1V	6.3 (h)	0.3	350	500	—	50	Half-Wave	X
	5Z3	5.0	3.0	500	—	475	250	—	X
	12Z3	12.6 (h)	0.3	250	350	—	60	Half-Wave	X
	25Z5	25.0 (h)	0.3	125	125	145	100	Voltage-Doubler 8 Mfd. Cond. Input.	6
Sylvania.	80	5.0	2.0	400	—	—	110	—	X
	81	7.5	1.25	700	—	—	85	Half-Wave	X
	1V	6.3 (h)	0.3	250	500	—	50	Half-Wave	X
	5Z3	5.0	3.0	500	—	475	250	—	X
	12Z3	12.6 (h)	0.3	250	350	—	60	Half-Wave	X
	25Z5	25.0 (h)	0.3	125	125	145	100	Voltage Doubler 8 Mfd. Cond. Input.	6
Tung-Sol.	80	5.0	2.0	400	—	—	110	—	X
	5Z3	5.0	3.0	500	—	475	250	—	X
	25Z5	25.0 (h)	0.3	125	125	145	100	Voltage Doubler 8 Mfd. Cond. Input.	6

Transmitting Valves

Type	Purpose	Filament Volts	Filament Amps	Total Emission Amps	Max. Plate Voltage Ep.	Max. Plate Current (Amps)	Max. Plate Dissipation (Watts)	Plate Dissipation on Test (Watts)	Screen Voltage	Grid Bias for Ep.	Amplification Factor	A.C. Plate Resistance. (Ohms)	Mutual Conductance (μ mhos)	Max. Overall Dimensions (Inches)
Mullard.														
DO/26	Gen.	4.0	2.0	—	400	—	26	—	—	—	3.8	600	6300	—
DO/40	Gen.	6.0	2.0	—	1000	—	40	—	—	—	8	4000	2000	—
T6D	Gen.	6.0	4.5	—	2000	—	60	—	—	—	21	4700	4500	—
VO/150	Osc. Amp.	10.0	6.5	—	2500	—	80	—	—	—	31	15000	2060	—
SW/50	Osc. Amp.	8.5	4.4	0.25	1500	—	40	—	—	—	15	11000	1360	—
VO/250	Osc. Amp.	11.0	10.0	0.15	4000	—	150	—	—	—	22.5	13000	1720	—
VM/150	Mod.	10.0	6.25	0.45	2500	—	50	—	—	—	8.5	8000	1060	—
T7A	Silica. Osc. Amp.	12.5	18	0.2	7000	—	750	—	—	—	40	17500	2200	—
M25B	Silica. Mod.	15	20	1.0	7000	—	2000	—	—	—	7	2600	2700	—
Osram.														
DET1	Osc.	6.0	1.9	—	1000	0.08	35	—	—	—	11	6500	—	3.1 x 7.1
DET1SW	S.W. Osc.	6.0	2.0	—	800	0.08	40	—	—	—	8.5	5000	—	3.1 x 10.0
DET2	Osc. Amp.	12.5	3.0	—	2500	0.2	150	—	—	—	15	4500	—	4.9 x 12.6
DET3	Osc. Amp.	15.0	4.0	—	3000	0.33	250	—	—	—	16	3000	—	6.3 x 15.7
T50	Osc. Amp.	7.0	2.5	0.15	1500	0.04	25	—	—	—	30	3500o	—	3.1 x 5.7
T250	Osc. Amp.	12.5	5.5	0.45	4000	0.10	125	—	—	—	20	17000	—	4.9 x 11.0
MT3	Osc. Amp.	6.0	2.2	0.18	2000	0.05	40	—	—	—	100	300000	—	3.0 x 6.5
MT5	Osc. Amp.	5.8	2.0	0.10	1500	0.03	15	—	—	—	40	100000	—	2.0 x 5.4
MT7A	Osc. Amp.	12.5	24.0	1.5	10000	—	600	1000	—	—	80	40000	—	7.1 x 20.8
MT11SW	SW Osc. Am.	10	5.5	0.3	1500	0.07	—	—	—	—	20	15000	—	4.2 x 8.7
MT14	SW Osc. Am.	13.5	13.5	1.0	4000	0.15	400	—	—	—	30	10000	—	6.3 x 13.0
DA60	A.F. Amp.	6.0	4.0	—	500	0.15	60	—	—	—	30	835	3000	3.1 x 8.1
DA100	A.F. Amp.	6.0	2.7	—	1000	0.10	100	—	—	150	2.5	1410	3900	3.5 x 11.4
DEM2	Mod.	12.5	3.0	—	2500	—	150	—	—	146	5.5	1500	—	4.9 x 12.6
DEM3	Mod.	15.0	4.0	—	2000	—	250	—	—	450	5	1500	—	6.3 x 15.7
MT7B	Mod.	15.0	10.0	0.4	10000	—	500	—	—	325	5	30000	—	7.1 x 17.7
MT9L	Mod.	17.0	9.2	0.6	4000	—	800	—	—	245	35	2500	—	7.1 x 18.9
MT12A	Mod.	12.5	5.5	0.3	3000	—	175	2,000 v.	—	410	7.5	7500	—	4.9 x 12.6
MT11A	Mod.	10.0	3.5	0.15	2000	—	60	at 1,500 v.	—	240	9	8000	—	3.9 x 8.2
——	R.F. Amp.	13.25	5.8	0.475	2000	100	200	—	—	200	7.5	7500	—	—
		Information may be had on the following types MT11, MT12. Modulators MT4B, MT9A. CAT10, M1, CAM2, CAM3, CAR2, CAR4, CAR5. Rectifiers MR1, MR2, MR4, MR6, MR9. Water cooled valves CAT2, CAT6,												
Philips.														
QC 05/15	S.G. Amp.	4.0	1.1	0.4	500	—	15	20	125	—	—	—	1500	3.0 x 6.3
QB 2/75	S.G. Amp.	10.0	3.25	2.0	2000	—	75	150	500	—	—	—	1500	5.9 x 9.3
QB 3/500	S.G. Amp.	11.0	10.0	7.0	3000	—	350	600	800	—	—	—	2250	9.8 x 17.3
TC 03/5	S.W. Osc.	4.0	0.28	0.1	300	—	6	10	—	—	—	—	1500	3.3 x 5.5
TC 04/10	S.W. Osc. Amp.	4.0	1.1	0.4	500	—	10	20	—	—	6	4000	1500	3.3 x 6.3
TC 1/75	S.W. Osc. Amp.	10.0	1.6	1.5	1500	0.12	75	100	—	—	25	11400	2200	3.3 x 7.7
TB 2/250	Osc. Amp.	11.0	3.8	2.0	2000	0.225	200	250	—	—	25	5000	5000	4.3 x 14.8
TA/500	Osc. Amp.	16.0	8.5	0.7	4000	—	400	600	—	—	40	13500	3000	7.9 x 18.5
TA 3/500K	S.W. Osc. Amp.													
TA 4/250	Osc. Amp.	12.5	5.5	0.45	4000	—	250	300	—	—	30	25000	1200	5.9 x 15.6
TA 4/1500	Osc. Amp.	16.0	16	1.5	5000	—	750	1000	—	—	40	10000	4000	9.8 x 21.6
TA 4/1500K	S.W. Osc. Amp.													9.8 x 21.0
TA 7/700	Osc. Amp.	12.5	7.7	0.45	7000	—	400	500	—	—	75	45000	1700	7.1 x 17.7
TA 10/2, 500	Osc. Amp.	12.5	24	1.5	12000	—	750	1000	—	—	130	50000	2500	8.7 x 23.2
TA 10/5000K	Osc. Amp.*	21.5	26	3.0	12000	—	5000	7500	—	—	20	5000	4000	3.5 x 24.8
			On 14	metres 5,000 volts, max. input 4 k. w.										

Transmitting Valves—(Continued).

Type	Purpose	Filament Volts	Filament Amps	Total Emission Amps	Max. Plate Voltage Ep.	Max. Plate Current (Amps)	Max. Plate Dissipation (Watts)	Plate Dissipation on Test (Watts)	Screen Voltage	Grid Bias for Ep.	Amplification Factor	A.C. Plate Resistance. (Ohms)	Mu-tual Conductance (μ mhos)	Max. Overall Dimensions (Inches)
Philips *(Continued)*														
TA 12/20,000	Osc. Amp.*	21.5	79	11	15000	—	—	—	—	—	40	4000	10000	8.9 x 31.5
TA12/20,000K	S.W. Osc. Amp.*	—	—	—	12000	—	12000	15000	—	—	34	4250	8000	8.5 x 35.5
TA 18/100000	Amp.*	33	207	50	18000	—	70000	85000	—	—	45	2250	20000	5.1 x 52.
F708	Mod. Amp.	7.5	1.1	0.8	450	0.035	—	—	—	—	8	4500	1800	2.2 x 5.5
MC 1/50	Mod.	10.0	1.1	1.1	1000	0.06	15	—	—	—	10	2250	4500	2.0 x 7.5
MG 1/60	Mod.	4.0	3.3	1.3	1000	0.06	15	—	—	—	12.5	2100	6000	2.0 x 7.5
MG 2/200	Mod.	11.0	2.5	2.5	2000	0.06	75	—	—	—	15	2500	6000	4.8 x 14.8
MA 4/500	Mod.	17.0	9.2	0.6	4000	0.035	250	—	—	—	7.5	5000	1500	8.7 x 21.8
MA 4/800	Mod.*	16.0	16	1.5	4000	0.06	300	—	—	—	25	5000	5000	4.7 x 17.7
MA 12/15000	Mod.*	21.5	79	11	12000	0.06	600	750	—	—	14	1900	7500	8.2 x 31.5
	Amp.*	—	—	—	15000	2.0	10000	—	—	—	—	—	—	—
Radiotron.														
800	Gen. & Uth. S.W.	7.5	3.25	—	1000	0.035	—	—	—	33	15	6800	2300	2 1/16 x 6 3/8
841	Osc. Amp.	7.5	1.25	—	450	0.06	15	—	—	30 (c)	30	—	—	2 3/16 x 5 5/8
842	Osc. Amp.	7.5	1.25	—	450	0.06	15	—	—	—	3	2500	1200	2 3/16 x 5 5/8
843	Osc. Amp.	2.5 (h)	2.5	—	450	0.04	15	—	—	100 (c)	7.7	4800	1600	2 3/16 x 5 5/8
844	S.G. Osc. Amp.	2.5 (h)	2.5	—	500	0.03	15	—	150	7 (c)	75	125000	600	2 1/16 x 6 1/4
863	S.G. Osc. Amp.	7.5	2.0	—	500	0.06	15	—	125	75 (c)	150	200000	750	2 1/16 x 7 1/2
203A	Osc. Amp.	10	3.25	—	1250	0.175	100	—	—	100 (c)	25	6000	4200	2 1/16 x 7 1/2
211	Gen.	10	3.25	—	1250	0.060	75	—	—	68 (m)	12	3400	3530	2 1/16 x 7 1/2
845	Mod.	10	3.25	—	1250	0.06	75	—	—	200 (m)	5	1800	3000	2 1/16 x 7 1/2
850	S.G. Amp.	10	3.25	—	3000	0.175	100	—	200	200 (c)	550	200000	2750	2 1/16 x 8 1/2
852	S.W. Osc. Amp.	10	3.25	—	3000	0.10	100	—	—	325 (c)	12	10000	1200	6 1/8 x 8 1/2
860	S.G. S.W. Amp.	10	3.25	—	3000	0.10	100	—	500	300 (c)	200	180000	1100	6 1/8 x 8 1/2
204A	Osc. Amp.	11	3.85	—	2500	0.275	250	—	—	275 (c)	25	6300	4000	4 1/16 x 14 1/4
849	Gen.	11	5	—	3000	0.10	300	—	—	135 (m)	19	3200	6000	4 1/16 x 14 1/4
861	S.G. Osc. Amp.	11	10	—	3500	0.35	400	—	750	250 (c)	300	143000	2100	10 1/8 x 17 3/8
831	Osc. Amp.	11	10	—	3500	0.35	400	—	—	350 (c)	14.5	6450	2250	10 1/8 x 17 3/8
851	Gen.	11	15.5	—	2500	0.24	600	—	—	85 (m)	20	1400	15000	6 1/8 x 17 1/4
846	Osc. Amp.*	11	51	—	7500	1.0	2500	(Telegraphy)	—	600 (c)	40	18500	2160	4 1/4 x 8 3/8
1652	Gen.*	14.5	62	—	7500	1.25	5000	—	—	1500 (c)	14	3000	47000	7 1/16 x 20 1/4
207	Osc. Amp.*	22	52	—	15000	1.0	10000	(Telephony)	—	800 (b)	20	3500	57000	7 1/16 x 20 1/4
848	Mod.*	22	52	—	12000	0.6	7500	—	—	1250 (m)	8	2400	3300	7 1/16 x 20 1/4
863	Osc. Amp.*	22	62	—	15000	2.0	10000	—	—	2500 (c)	50	7200	7000	7 1/16 x 20 1/4
858	Osc. Amp.*	22	52	—	20000	2.0	20000	—	—	3900 (c)	42	8700	4800	8 5/8 x 24 1/4
862	Osc. Amp.*	33	207	—	20000	10.0	100000	—	—	400 (c)	48	2800	17150	14 1/8 x 60 3/8
Sylvania.														
203A	Osc. Amp.	10	3.25	—	1250	0.175	100	—	—	250 (c)	25	6000	4200	2 1/16 x 7 7/8
204A	Osc. Amp.	11	3.85	—	2500	0.275	250	—	—	200 (c)	25	6300	4000	4 1/16 x 14 3/8
210	Osc. Amp.	7.5	1.25	—	600	0.07	20	—	—	125 (c)	8	5450	1550	2 1/16 x 5 5/8
211	Gen.	10	3.25	—	1250	0.175	100	—	—	250 (c)	12	3400	3530	2 1/16 x 7 1/2
242A	Mod.	10	3.25	—	1250	—	85	Output 55w)	—	75 (m)	12.5	3500	3600	2 1/16 x 7 1/2
830	Gen.	10	2.15	—	750	0.11	(Max. 75	—	—	180 (c)	8	4000	2000	2 1/16 x 5 5/8
845	Mod.	10	3.25	—	1250	—	—	—	—	180 (m)	5	1800	3000	2 1/16 x 7 7/8
849	Gen.	11	5	—	2000	0.35	350	—	—	325 (c)	19	3200	6000	4 1/16 x 14 3/8
851	Gen.	11	15.5	—	2500	1.0	750	—	—	250 (c)	20	1400	15000	6 1/8 x 17 7/8
852	S.W. Osc. Amp.	10	3.25	—	3000	0.1	100	—	—	250 (c)	12	10000	1200	4 1/4 x 8 3/8
860	S.G. Amp.	10	3.25	—	3000	0.1	100	—	450	300 (c)	200	180000	1100	4 1/4 x 8 3/8
865	S.G. Amp.	7.5	2.0	—	750	0.06	15	—	125	75 (c)	150	200000	750	2 3/8 x 6 1/4
207	Osc. Amp.*	22	52	—	10000	2.0	10000	—	—	2000 (c)	20	3500	5700	5 x 20 1/4

Sylvania air cooled transmitters and rectifiers incorporate a graphite Anode. Information on additional Sylvania types are available on application to the distributors, Tyme Ltd.

The letters indicate the following :—(b) Class " B " service. (h) Heater type cathode. (m) Modulator service. Class " C " service. Applying to all makes. (c) Water cooled valve.

Transmitting Rectifier Valves

Type	Description	Filament Volts	Filament Amps	Total Emission (Amps)	Max. A.C. Plate Voltage (r.m.s.)	Max. D.C. Current (Amps)	Max. Cont. Plate Dissipation (Watts)	Internal Impedance (Ohms)	Max. Overall Dimensions
Mullard.									
VU/150	Half-Wave	10.5	6.5	0.25	5000	0.055	—	1000	—
U/10	Half-Wave	16.5	15.5	1.25	10000	0.20	300	800	—
U/15	Half-Wave	15	23.5	1.75	10000	0.325	750	400	—
U.4Kw.	Silica, Half-Wave	18	40	3.0	12000	0.70	3000	500	—
Osram.									
GU.1	Merc. Vap. Half-Wave	4.0	3.0	—	1000	0.25	Volts Drop 15V.		—
U.6	Half-Wave	6.0	2.0	0.4	1000	0.08	—	350	3.1 x 7.1
MR.7A	Half-Wave	12.5	24.0	1.5	10000	0.35	600	800	7.1 x 20.8
Philips.									
D.C. 1/50	Full-Wave	2.2	4.0	—	1000	0.075	—	500	3.3 x 7.3
D.C. 1/60	Full-Wave	2.2	4.0	—	1000	0.075	—	500	2.0 x 7.3
D.C. 2/200	Full-Wave	4.0	2.2	—	1825	0.1	—	650	4.3 x 7.5
D.A. 6/1500	Half-Wave	14.0	12.5	1.0	6000	0.25	200	500	3.5 x 17.7
D.C. 7/700	Half-Wave	12.5	7.7	0.45	7000	0.1	400	1500	6.3 x 17.7
D.A. 10/2000	Half-Wave	16.6	16.5	1.5	10000	0.2	400	300	5.5 x 21.6
D.A. 10/5000	Half-Wave	28.0	20	3.0	12000	0.5	1000	325	7.9 x 23.2
D.A. 12/24000	Half-Wave	21.5	76	10.0	12000	2.0	12000	125	3.9 x 31.5
Radiotron.				Max. verse	Peak Inverse Voltage	Max. Peak Current	k Plate (amps)	Voltage Drop	
217A	Half-Wave	10.0	3.25	—	3500	0.6	—	—	2 5/16 x 7 3/4
217C	Half-Wave	10.0	3.25	—	7500	0.6	—	—	2 5/16 x 8 1/8
866	Half-Wave Merc. Vap.	2.5	5.0	—	7500	0.6	—	15	2 7/16 x 6 5/8
866A	Half-Wave Merc. Vap.	2.5	5.0	—	10000	0.6	—	10	2 7/16 x 6 5/8
871	Half-Wave Merc. Vap.	2.5	2.0	—	5000	0.3	—	15	1 7/16 x 4 1/8
872	Half-Wave Merc. Vap.	5.0	10.0	—	1500	2.5	—	15	2 5/8 x 8 1/2
872A	Half-Wave Merc. Vap.	5.0	6.75	—	10000	2.5	—	10	2 5/8 x 8 1/2
869A	Half-Wave Merc. Vap.	5.0	20.0	—	20000	5.0	—	10	5 1/16 x 14 1/2
218	Half-Wave	11	14.75	—	50000	0.75	—	—	5 1/16 x 15 1/2
219	Half-Wave	22	24.5	—	50000	2.5	—	—	6 1/8 x 22 1/4
214	Half-Wave	22	52	—	50000	7.5	—	—	4 5/32 x 20 1/4
857	Half-Wave Merc. Vap.	5.0 (h)	37	—	20000	20	—	10	7 1/8 x 19 1/2
Sylvania.									
866	Merc. Vap.	2.5	5	—	7500	0.6	15	—	2 7/16 x 6 5/8
869	Merc. Vap.	5	20	—	20000	5	15	—	5 1/16 x 14 3/8
872	Merc. Vap.	5	10	—	7500	2.5	15	—	2 5/8 x 7 1/8
867	Grid Control	2.5	3.75	—	1000	0.6	Grid Voltage 2.0–3.5V.		2 7/16 x 6 5/8
873	Grid Control	5.0	7.5	—	1000	2.5	Grid Voltage 3.0–6.0V.		2 7/16 x 7 7/8

Audio Output

The power output of a triode can also be calculated from the following formula.

$$P = \frac{Eg^2}{2R_p}$$

where P = Power output watts.
u = Amplification factor.
E_g = Grid Swing Volts (r.m.s.)
R_p = Plate impedance.

In this formula no account is taken of the amount of distortion involved by incorrect load, over-swing of the grid etc., as it is assumed that all these operating conditions have been correctly adjusted or designed for, and therefore R_L the load resistance is assumed as twice R_p.

A more general formula, taking into account the value of R_L is given below:—

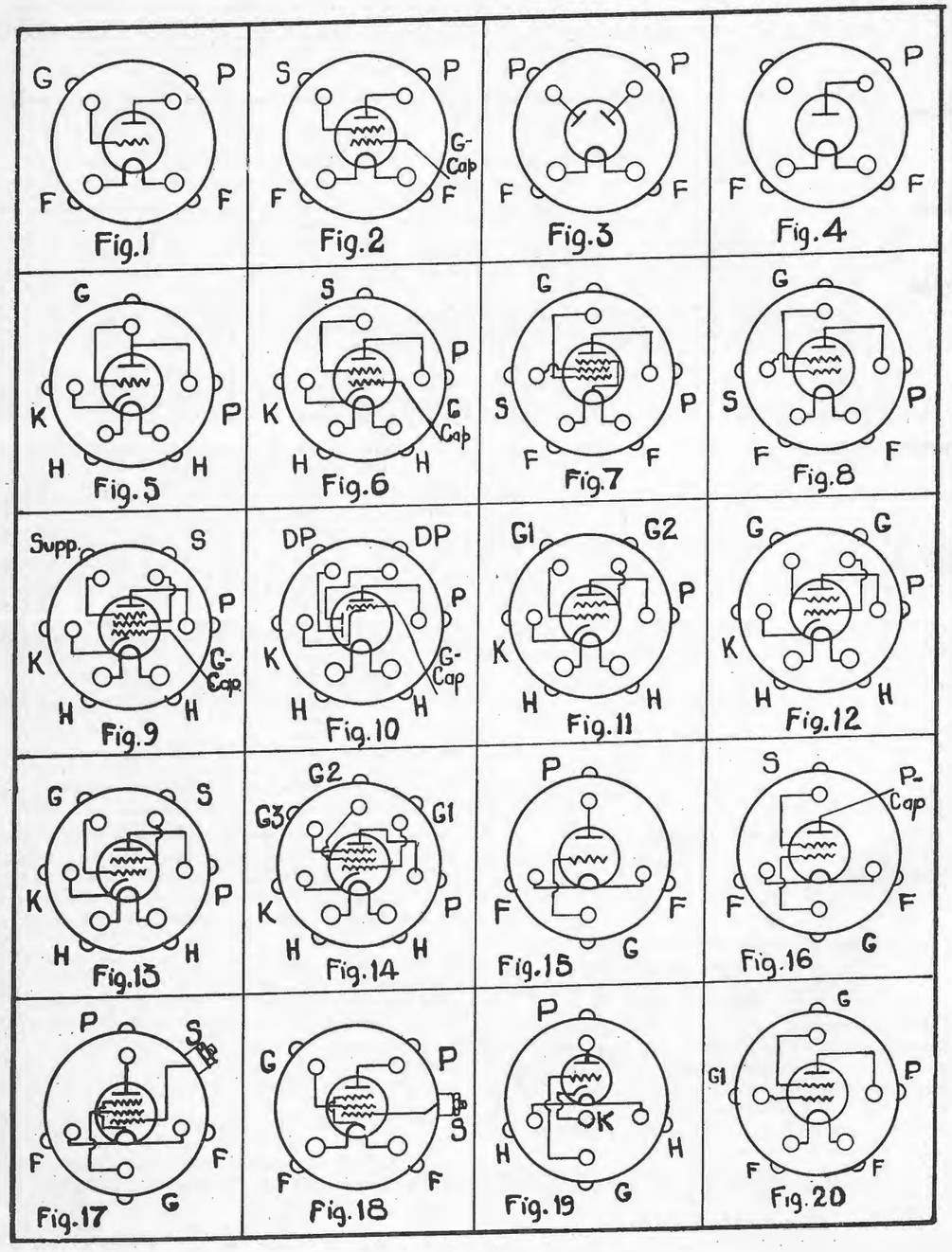
$$P = \frac{Eg^2 R}{(R_L + R_p)^2}$$

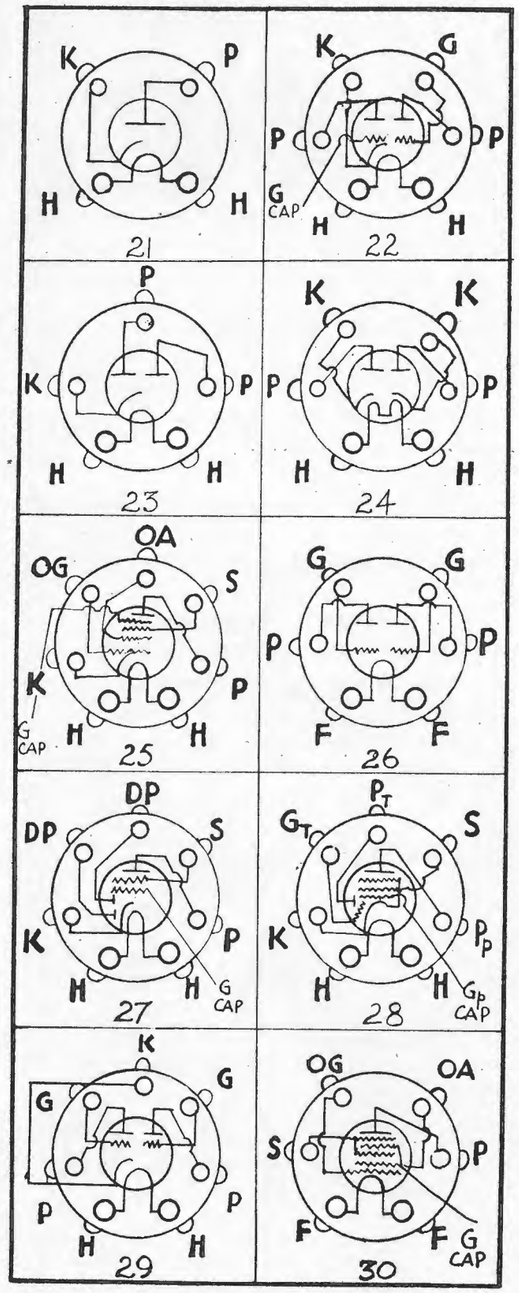
Directly Heated Valves

When considering the grid swing on a directly heated valve, it is important to note that the grid should never swing positive with respect to any point on the filament. The grid return is, of course, taken to the centre tap of the A.C. voltage which is used to heat the filament. This means that at some instant one end of the fllament is a certain amount negative with respect to the grid return. The grid should never be allowed to swing positive with respect to this point on the filament. For example, consider a valve with a 2.5 volt filament supply and with the grid bias 16.5 volts negative with respect to the centre tap. The peak value of 2.5 volts r.m.s. is approximately 3.5 volts. Thus the peak value of the voltage which might exist between the centre tap and one end of the filament is half this.

In any calculations we cannot allow a grid swing of more than 16.5 minus 1.75, or 14.75 volts. It is easily seen that the valve mentioned in the example is a type 47, so that in this case the maximum grid swing is further limited by the distortion which would occur. In the case of a 247 the curved characteristic limits the grid swing 12.5 volts, on the assumption that a 5% content of harmonics in the output is tolerable.

Top View Valve Socket Connections





VALVE SOCKET CONNECTIONS

Referring to the diagrams of the valve socket connections shown in Figs. 1-30, the socket number for each valve type is shown below.

It should be particularly noted that the sketches are top views of the socket.

The letters in the various diagrams refer to the following terms:—

G—Control Grid.
OG—Oscillator Grid.
OA—Oscillator Anode Grid
G_p—Pentode Grid.
G—Triode Grid.
G_1—Grid No. 1.
G_2—Grid No. 2.
G_3—Grid No. 3.
S—Screen Grid.
Supp—Suppressor Grid.
P—Plate.
P_p—Pentode Plate.
Pt—Triode Plate.
DP—Diode Plate.
K—Cathode.
F—Filament.
H—Heater.

AMERICAN VALVES

Valve Type.	Socket No.	Valve Type.	Socket No.
01A	1	53	29
10	1	55	10
12A	1	56	5
18	13	57	9
19	26	58	9
20	1	59	14
22	2	71A	1
24A	6	75	10
26	1	76	5
27	5	77	9
30	1	78	9
31	1	79	22
32	2	85	10
33	7	864	1
34	2	89	9
35	6	90	12
36	6	92	12
37	5	99	1
38	6	1A6	30
39	6	2A3	1
40	1	2A5	13
41	13	2A6	10
42	13	2A7	25
43	13	2B7	27
44	6	6A4	8
45	1	6A7	25
46	8	6B7	27
47	7	6C6	9
48	13	6D6	9
49	8	6F7	28
50	1		

Rectifiers

Valve Type.	Socket No.	Valve Type.	Socket No.
80	3	1	21
81	4	1V	21
82	3	5Z3	3
83	3	6Z4	23
84	23	12Z3	21
866	4	25Z5	24

(Continued on Page 220).

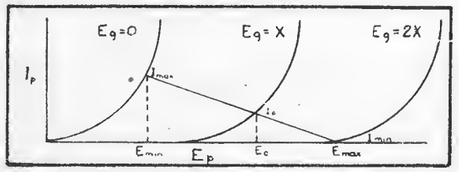
English and Continental Valves

Valve Type.	Socket No.
Battery Triodes English 4 pin base	15
Battery Screen Grid Valves, English 4 pin and cap	16
Battery Pentodes, English 4 pin, with terminal	17
Battery Pentodes, UX base, with terminal	18
Heater type Triodes, English 5 pin	19
Double Grid Detectors — UY base	20

N.B.—It is to be particularly noted that all English and continental screen grid valves (excepting American replicas) have the plate connection on the metal cap situated on top of the valve with the screen connection taken to what is normally the plate pin on the base. This holds good no matter whether English 4 or 5 pin bases of UX or UY type bases are employed.

Valve Formulae

TRIODES.



In the valve formulae given below the various symbols denote the quantities shown in the column or valve notation. When calculating the undistorted power output of a triode reference must be made to the plate characteristic as shown. If the grid bias is X volts, select the correct operating point E_0 (plate volts), I_0 (Plate current). Through this is drawn the load line, whose slope represents graphically the impedance of the load or output device. The peak grid swing allowable is then decided on and the plate characteristics for the minimum and maximum biases chosen. In the drawing these are shown as zero and 2X volts bias, indicating a grid swing somewhat in excess of normal practice. The various currents I_{max}, I_0, I_{min} and voltages E_{min}, E_0, E_{max} are then read off and substituted in the formulae. Note that I should be converted to amps.

Plate Resistance: $$R_p = \frac{\mu}{g_m} = \frac{\delta E_p}{\delta I_p}$$

Plate Conductance: $$g_p = \frac{g_m}{\mu} = \frac{\delta I_p}{\delta E_p}$$

Amplification Factor: $$\mu = g_m \times R_p = \frac{\delta E_p}{\delta E_g}$$

Mutual Conductance: $$g_m = \frac{\mu}{R_p} = \frac{\delta I_p}{\delta E_g}$$

Power Output: $$O.P = \frac{(I_{max} - I_{min})(E_{max} - E_{min})}{8}$$

Percentage of 2nd Harmonic Distortion:

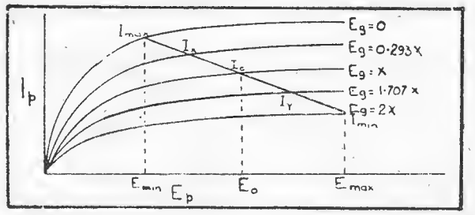
$$= \frac{\frac{1}{2}(I_{max.} + I_{min.}) - I_0}{I_{max.} - I_{min.}} \times 100 = \frac{\frac{1}{2}(E_{max.} + E_{min.}) - E_0}{E_{max.} - E_{min.}} \times 100$$

(These formulæ hold when g_m is expressed in micromhos and r_p in megohms.)

Approximate Undistorted Power Output: $$= \frac{E_p \times I_p}{5}$$

(This formula does **not** hold for types 20, 89 or very small valves.)

POWER PENTODES.



Power Output: $$O.P = \frac{[(I_{max} - I_{min}) + 1{\cdot}414(I_x - I_y)]^2 R_p}{32}$$

Load Resistance or Slope of Load Line: $$R_p = \frac{E_{max} - E_{min}}{I_{max} - I_{min}}$$

% 2nd Harmonic Distortion: $$\frac{I_{max.} + I_{min.} - 2I_o}{(I_{max} - I_{min}) + 1{\cdot}414(I_x - I_y)} \times 100$$

% 3rd Harmonic Distortion: $$= \frac{I_{max} - I_{min} - 1{\cdot}414(I_x - I_y)}{I_{max} - I_{min} + 1{\cdot}414(I_x - I_y)} \times 100$$

% Total Distortion: $$= \sqrt{(\%\ 2^{nd}\ Har.\ Dis.)^2 + (\%\ 3^{rd}\ Har.\ Dis)^2}$$

Approximate Undistorted Power Output: $$= \frac{E_p \times I_p}{4}$$

Accumulators and Batteries

While present day accumulators, thanks to the manufacturer, are practically trouble free, there are several details to which attention must be paid in their care and maintenance if the most efficient operation is desired.

They may be divided into three classes:
(1) Radio "A" Batteries.
(2) Car, used as "A" batteries for automotive radio.
(3) Accumulator "B" Batteries.

It is essential that a new or replacement cell should be given its correct initial charge. Fortunately this is usually attended to by the makers, so it is only necessary to fill the cells with sulphuric acid of the specific gravity (Sp. Gr.) recommended by the makers and allow to stand for at least four hours when it will be ready for service. A light freshening charge is desirable at this stage. Information as to correct specific gravity, level of acid and charging rate, may be had from the maker's catalogues if it does not accompany the battery. The acid should never be allowed to fall to a level which exposes the plates to the air while if filled brimful the cell will probably overflow on recharging. Unless acid has been split, only distilled water should be added to top up to the correct level. If however, acid has been split, the amount lost should be replaced by acid of the same Sp. Gr.

After charging, all moisture or acid should be carefully wiped off the tops and cases of batteries with a damp cloth, and it is desirable to grease exposed lead parts with pure vaseline to prevent corrosion. Indications of full charge are several and are listed in their order of importance.

Sp. Gr. of the Acid. This remains constant when further charged above the full charge and may vary from 1.220 to 1.300, being usually higher for small batteries.

Voltage of Each Cell. With charging current on, this is from 2.65 down to 2.3 for old cells.

Gassing. A sulphated cell will gas throughout its charge, but the gassing which indicates a full charge comes off in much larger bubbles.

Colour of Plates. Fully charged, the positive plate is a dark chocolate and the negative a slate grey.

Battery testers consisting of a voltmeter and a shunt which draws a certain current from the battery are useful in ensuring that the voltage is measured in the "on load" condition. A freshly charged battery should show from 2 to 2.05 volts which gradually drops to 1.85 volts at the end of the discharge period.

Sulphation consists of a white deposit on the plates and is also indicated by a low Sp. Gr. and a loss of capacity. It is caused by undue demands on the battery when almost discharged or long standing in a discharged state. It may often be removed by emptying, filling with a solution made of half a pound of chemically pure caustic potash in two quarts of water and charging at a low rate, then discharging and again charging. The second time it should not be discharged although it should give a voltage reading of six. The caustic solution which has now become potassium sulphate, is removed by standing the battery overnight while filled with pure water. Then new acid and a full charge completes the process. When mixing new acid for batteries it is important to add the acid to the water and stir with a glass rod. If water is added to concentrated sulphuric acid (also known as oil of vitriol) a dangerous explosion is liable to occur due to the intense heat generated. A table for mixing is given below. Concentrated acid has a Sp. Gr. of 1.835.

Acid Mixing Table

Sp. Gr. Required	Water Parts by Volume.	
1.300	24.7	
1.290	26.0	
1.280	27.5	To be mixed with 10 parts by volume of concentrated sulphuric acid.
1.270	29.0	
1.260	30.0	
1.250	32.2	
1.240	34.0	
1.230	36.0	
1.220		

It is to be noted that when operated at a higher temperature, the maximum permissible Sp. Gr. is lower, otherwise a shortened life is the result.

When Battery Is	In N.S.W., Vic., S.A. & Tas.		In Q'land, W.A. and N.T.	
	Sp. Gr.	Max. Temp.	Sp. Gr.	Max. Temp.
Fully Charged	1.250 (1.240-1.260)	110°F.	1.220 (1.210-1.230)	125°F.
Half discharged	1.180 (1.170-1.190)	"	1.150 (1.140-1.160)	"
Fully discharged	1.120 (1.110-1.130)	"	1.090 (1.080-1.100)	"

The Sp. Gr. should always be measured with a reliable hydrometer.

Accumulator "B" Batteries

The main points in the care of accumulator "B" batteries are identical with those given above. The charging rate should never exceed .25 amps. and the electrolyte should be kept up to the right level. It is especially injurious to allow these small cells to stand for any length of time in a discharged state.

If the cells are not going to be used for some time, they should be given a full charge and preferably emptied of electrolyte. This applies also to larger accumulators, when storing.

Accumulators & Batteries—(Continued).

Charging Plants

The type and size of plant which is installed will be governed entirely by the amount of charging which is to be done. Where direct current mains are available charging can be accomplished by one of two systems. The simpler is to insert an appropriate series resistor to cut down the current to the required value. In practice this would consist of some sort of rheostat or possibly open framework of wire, connection to which could be made by means of clips. Direct charging from the mains is not an economical proposition unless a large number (more than 50 say) of cells have to be charged, and even in this case the charging current will have to be regulated so as not to ruin the smallest cell in circuit. A suitable motor generator set will charge these batteries in parallel and prove a far more economical installation despite its higher initial cost.

However in the majority of instances supply is A.C., in which case we can class the suitable plants under five heads.

(i) Rotating machinery, e.g., motor generators, motors driving dynamos, synchronous rectifiers; (ii) Vibrating rectifiers; (iii) metal rectifiers; (iv) valve rectifiers; (v) mercury arc rectifiers.

The cost of upkeep and attention to the last three named are very low, since there are no moving parts and replacements of the rectifying units are rare, providing that they are operated within their rating. In any class of charging equipment it is important not to overload any portion of the apparatus. A good motor generator set will give long service with little attention beyond regularly oiling or greasing the bearings and cleaning the commutator and brushes; this last item being particularly important to ensure efficient running of the plant. The contacts of vibrating rectifiers also need a regular touching up. With mechanical rectifiers it is essential to instal an automatic cut-out similar to that on a car, so that if the generator stops running (on the failure of the line voltage or for some other reason) the batteries will not discharge back through the generator.

It is necessary to employ external rheostats to adjust the various charging rates needed. One convenient and inexpensively made form takes the shape of an open wooden framework with small button insulators across which are stretched a number of resistance wires either taut or slightly spiralled. Connection is made to one end of each and the desired resistance is tapped off with battery clips on each wire. Information as to resistance and current carrying capacity is available in the tables to be found elsewhere.

Treatment of Batteries

A systematic system of time keeping and charging currents should be adopted to avoid over- or under-charging and consequent complaints. After charging the cells should be carefully wiped down, paying particular attention to the tops, where acid spray and dust accumulate. Terminals and connecting links should be plentifully greased with vaseline after cleaning with a file or emery paper where necessary.

In old batteries an internal short circuit may have developed by reason of buckled plates or a sludge of once active material forming in the bottom of the cell. Outward indications are the same as for a sulphated cell, i.e., refusal to charge and gas properly, permanent low density of the acid and low voltage readings compared to the other cells, both on charge and discharge. There is, of course, no white deposit. Sludge may be largely removed by several fillings with water and vigorous shakings, followed by immediate emptying of the cell. By this means the fine sludge is removed through the filling vent, but not, of course, any larger pieces which may have become detached and are forming a short between plates.

To proceed further it is necessary to remove the plates from the cell by cutting the supporting compound top around its edge. Plates should be cleaned and smoothed and the container thoroughly cleaned. Slightly buckled plates may be pressed flat, but if badly buckled or sulphated the plates or the whole cell should be scrapped.

Special Care Necessary.

No apparatus should be placed near the cells during charging on acount of the corrosive fumes. For the same reason it is dangerous to approach the cells with a naked light as portion of the fumes (hydrogen and oxygen) form a highly explosive mixture. Always switch off the charging current when disconnecting cells, as it is quite possible that a spark on breaking circuit will ignite the fumes. Any acid which burns on skin should be immediately neutralised by an alkali, ammonia being very convenient. Even if washed under a tap drops of acid on clothes will continue to rot and darken the cloth. Again ammonia is indicated (immediately) before washing.

It is to be noted that the S.A.A. rules for the installation of battery chargers not exceeding 1200 volt-amps input rating are identical with those for radio sets.

Use of Radio "B" Batteries

"B" Batteries should be installed in a cool, dry place. Heat quickly dries up the active material contained in the cells, while moisture is both injurious to the insulation between adjacent cells and causes the zinc containers to be dissolved more quickly. Many people send a boy to do a man's work, by using light duty B batteries to operate a powerful radio receiver. Even though the initial outlay is greater, a heavy duty battery, costing perhaps twice as much, will last more than twice as long. In addition, the operation and tonal qualities of the set will not fall off so markedly as the battery runs down if the heavier type of batteries are employed.

Light duty batteries are rated for discharge currents up to 6 milliamperes. Heavy duty batteries are rated for discharges up to 16 milliamperes, while super-service or triple duty B batteries should be employed for a current drain of 25 milliamperes or over.

For excessively heavy current draw it is economical to instal a bank of accumulator B batteries. B batteries are tested by their voltage, using a high resistance voltmeter, both on and off load. Too great a variation between the two figures means that the battery should be replaced.

Impedance Matching with Respect to Loudspeakers

The importance of matching the impedance of the speaker with that of the output stage cannot be too highly stressed. If these two do not bear a certain relation to one another distortion will certainly appear, in all probability affecting both the upper and lower registers. Further a certain output valve or combination of valves will give its maximum power output only when working into a certain impedance, usually termed the load impedance. The correct value of this depends, of course, upon the characteristic curve of the valve, but with normal types of power triodes, it can be taken at about twice the plate impedance of the valve.

IN very small output valves this figure may be as low as 1.5. On the other hand, in the case of larger valves with plate dissipations of 10 watts or more, the load impedance may quite well be three times the plate impedance. The plate dissipation should not be confused with the A.C. power output, as it really represents the amount of heat actually dissipated within the valve.

In the case of Class A triodes it can be obtained by multiplying the plate current by plate voltage and subtracting the average value of the audio power output.

Moving Iron Speakers

A MOVING iron speaker is one operated by coils wound over the legs of a permanent magnet. The A.C. output of the last stage varies the magnetization and hence the attraction on an iron diaphragm or an iron armature connected to a diaphragm or cone.

In this type of speaker, absolutely accurate matching is not essential for good results, nor indeed is it possible over the whole range of frequencies. In such a speaker the impedance rises and falls greatly with the applied frequency, so it is easy to see that with a certain output valve feeding a moving iron speaker, the two will be correctly matched only when certain frequencies are being reproduced. As the maximum power transference from valve to speaker occurs when the load impedance is optimum, these frequencies will be accentuated in the reproduction of the receiver. If, for instance, the load impedance at 1200 cycles is the optimum value for the particular output valve, then the band of frequencies around 1200 will be accentuated, and the general tone will appear high. At the same time the lower notes will be particularly reduced.

A satisfactory compromise is obtained if the impedance of the speaker at about 256 cycles per second or middle C is taken as the matching impedance, and a suitable output valve or transformer thus chosen. The impedance of most commercial moving iron speakers at 250 cycles lies between 3,500 ohms and 6,000 ohms.

Moving Coil Speakers

Moving coil or dynamic speakers are those in which the moving element, usually a cone, is actuated by a coil moving in a constant magnetic field. The moving or voice coil is usually of low resistance and relatively few turns. It is thus necessary to match the voice coil to the plate impedance of the output stage by means of a step-down transformer which can supply the large A.C. current needed by the voice coil.

Moving coil speakers are very much more susceptible to matching inaccuracies than those of the moving iron type. The majority of low impedance moving coil speakers are supplied with transformers to suit either a pentode or other popular type of output valve. In this connection it should be noted that the load impedance of a moving coil speaker is due to three factors—the coil resistance, the coil reactance, and the equivalent motional capacity which is due to the damping exerted on the vibrating cone by the surrounding air. In most cases, however, the impedance of the moving coil is sensibly constant over the range of audio frequencies.

In fact with normal designs it is possible to arrive at the impedance of the moving coil quite accurately by estimating it as 25 to 30 per cent. higher than the D.C. resistance in ohms. The factor 1.3 is most likely to be correct. Thus a voice coil of D.C. resistance 2.7 ohms would have an impedance of 2.7 X 1.3 or 3.5 ohms. This impedance is denoted by the symbol Z_s.

It is a simple matter to find mathematically the correct ratio for the output transformer for any impedance moving coil speaker. The formula for this calculation is:—

$$n = \sqrt{\frac{2 R_a}{Z_s}}$$

Where R_a = plate impedance
Z_s = average impedance of speaker.
2 = assumed factor (see above).

In the case of a high impedance moving coil, the average impedance can be taken as twice the D.C. resistance.

Let us work out an example. Suppose we have a moving coil speaker with a voice coil resistance of 10 ohms. The impedance is thus 13 ohms and we wish to match this to a triode of impedance 2,400 ohms where the figure for the correct load impedance cannot be obtained from valve data sheets. The correct transformer ratio is :—

$$\sqrt{\frac{4{,}800}{13}} = \sqrt{369} = 19.2$$

Suppose we wish to match this same speaker to a 59 whose operating load is given by the makers as 6,000 ohms. The figure 6,000 is then substituted for the term $2R_a$ and we have:—

$$n = \sqrt{\frac{6,000}{13}} = \sqrt{462} = 21.5$$

Consider another example in which a low impedance moving coil has to be matched to a push-pull output stage. Suppose the moving coil has an average impedance of 12 ohms, and the valves have each an impedance of 1,600 ohms. Then the effective plate impedance is twice this or 3,200 ohms. The correct turns ratio is therefore:—

$$\sqrt{\frac{3200 \times 2}{12}} = 23$$

As mentioned above, taking twice the plate impedance of the valve as the load impedance is only useful for general work. Far better results are obtained graphically by the use of what is known as a 5% distortion scale in conjunction with the plate current characteristic curve of the output valve in question. This curve should not be confused with the more usual characteristic curve of grid volts against plate current. As a rule in the characteristics of output valves the manufacturers will indicate the correct load impedance.

Pentodes

THESE same rules apply only in part when pentodes are used. The pentode valve has a very high plate impedance compared with that of an output triode. However, under normal working conditions a pentode behaves somewhat as a triode with a plate impedance of about 3,000 ohms. Thus, we have some explanation of the fact that a pentode is usually worked into a load impedance of 6,000 or 7,000 ohms. Some of the Continental pentodes are designed to work into impedances slightly higher than this. If, however, the impedance of the output circuit is considerably more than this, as for instance, when the speaker is disconnected from the secondary of the output transformer, then under certain conditions excessive peak voltages may be developed across this output circuit, resulting either in damage to the valve or to the output device.

All this means that the load impedance into which a pentode works should never be greater than 10,000 ohms.

While working a pentode into this impedance implies that a certain amount of distortion is present, more in fact than with a triode of equal A.C. power output, it must be born in mind that the pentode achieves this with considerably lower plate voltages and currents. In calculating the correct step-down ratio for an output transformer, we do not employ the formula given above, but in place of the term "$2R_a$," we substitute the figure 7,000.

In other cases, where the impedance cannot match exactly, it is better to have the load impedance higher than the optimum value than lower, for less distortion occurs. This is explainable by considering the load line as drawn on the characteristic, plate volts-plate current. If the load impedance is low, this line will be more nearly vertical, and a smaller swing in plate volts will bring the operating point down on to the curved portion of the characteristic.

These remarks about matching the load of an output valve, also apply to any valve in a radio receiver, R.F. amplifier, detector, or first audio stage. It is, of course, hard to obtain a load impedance, which matches at all well with that of a screen grid valve, but if full advantage is to be taken of the enormous amplification factor, this phase of the matter has to be considered.

Radio Inductive Interference Elimination

Practically everyone is acquainted with the annoying interference which at times spoils our radio reception. This may roughly be divided into two classes—(1) Natural, (2) Man-made. The first class occurs during redistributions of the electrical state of the atmosphere or the magnetic state of the earth, and is usually known as static. Static is particularly bad during the summer months and can never be entirely eliminated, although it may sometimes be reduced by the use of a smaller aerial or a directional aerial such as a loop. Even though the static may be very bad on interstate stations, it is usually possible to listen with enjoyment to local stations unless a thunderstorm is passing directly overhead, when it is advisable to connect the aerial directly to earth. In many cases it is possible to eliminate or greatly reduce the man-made interference. By this type of interference is meant artificial disturbances generated by electrical machinery or apparatus, very often when operating in a defective state.

Such interference may be eliminated by preventing the generation of the noise energy or by absorbing it at some point in its path to the set. We will confine our remarks to the elimination of high-frequency interference, as any hum in the speaker due to low frequency ripples (usually multiples of 50 cycles) can almost invariably be eliminated by more efficient filtering. High frequency interference usually consists of highly damped and hence very broadly tuned waves similar to the old spark type of transmission, and may arrive at the set by direct conduction through the power mains or by radiation from some portion of the power mains as from an aerial and consequent pick-up by the receiving aerial. The latter type of interference may be recognised by the great diminution in strength which occurs when the aerial is disconnected from the set.

Radio Inductive Interference—(Continued).

Defective Power System

Very frequently the noise energy is generated by some portion of the power system when in a defective state. Such interference may be readily tracked by an "Interference Indicator," or in fact, by any portable battery set of sufficient sensitivity. The obvious remedy in such cases is to rectify the fault in the apparatus.

Much valuable data on the location and suppression of interference is contained in the circulars issued by the P.M.G.'s Department entitled "Radio Inductive Interference, No. 1" and "Suppression of Radio Inductive Interference, Nos. 2 and 3." The whole field of interference from electrical machinery is covered very concisely in a paper (No. 137) of the Institution of Post Office Electrical Engineers (Great Britain) by Col. A. S. Angwin, entitled "Interference with Wireless Reception Arising from the Operation of Electrical Plant."

Very often intermittent noises may be caused by a defect in the wiring system such as the following:—

A loose plug in a power point.

A lamp making poor or intermittent contact with the pins in the socket.

Poor or intermittent contact between the fuse wire and its terminals in a fuse block.

Defective cords to radiators, irons, etc.

Poor or intermittent contact across the contacts of a switch.

Poor or intermittent contact in the bonding between conduits.

Intermittent contact between telephone earth wires and conduits, etc.

Such intermittent contacts are often noticeable when a passing vehicle or someone walking about shakes the house.

In such cases the remedy is to rectify the fault. In some cases the faulty connection may occur outside the house wiring when it becomes the job of the supply authority to remedy it.

Interfering plant may be listed as under:—

(*a*) *Motors and generators, both A.C. and D.C. types.*
(*b*) *Battery charging rectifiers.*
(*c*) *H.F. Medical apparatus.*
(*d*) *Flashing signs, electric ovens and heating pads.*
(*e*) *Neon signs.*
(*f*) *Lifts.*
(*g*) *Tramways.*
(*h*) *Mercury arc rectifiers.*

The suppression of H.F. noises is carried out by the insertion of coils (really R.F. chokes) in series with the leads coming from the source of interference (e.g., a small motor) and the short circuiting of the spurious oscillations by a condenser, or as is more common the separate bypassing of each lead to earth. This method, in effect, also provides a short-circuit for the oscillations through the two condensers in series. Special condensers for the elimination of interference may be obtained consisting of two sections in series together with a third condenser of high breakdown voltage

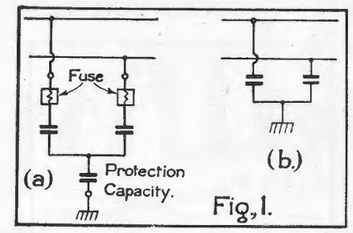


Fig. 1.

connected as shown in Fig. 1 (a). This small capacity also limits the flow of A.C. current to earth to less than one milliamp when used on A.C. mains. When this small capacity is not inserted the earth lead should be very well grounded as a "dry" ground with a considerable current flowing through it may itself readily cause an annoying form of noise.

Thus the circuit of Fig. 1 (b), is really only suitable for D.C. mains and if any breakdown occurs the house fuses will blow. Hydra condensers are supplied with the arrangement of Fig. 1 (a) done up in one can, in 2 x 2 mfd. and 2 x 0.1 mfd. sizes.

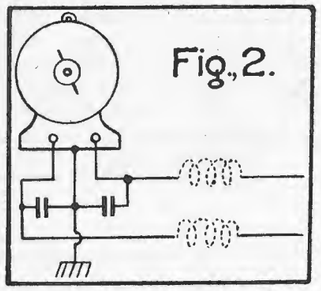
Motors and generators may be quietened as in Fig. 2 by connecting the bypass unit across the armature leads as close as possible to the machine. Choke coils as shown dotted may also help the bypass in preventing the unwanted oscillations from reaching the power line.

With A.C. motors of the wound rotor induction type three condensers will be necessary, one from each phase of the armature to earth. It should be noted that the lower the speed of a motor the higher the bypass capacity needed.

In the case of motors remotely controlled, as in the case of lift motors, the interference caused by the opening of the contactors is likely to be bad. Due to the large currents being broken a condenser cannot be connected directly across the contacts, but often a 0.1 mfd. condenser in series with a resistor (50-100 ohms) will alleviate the trouble. Where resistors are included in series with condenser they should be of the non-conductive type. The usual wire wound resistor should **not** be used. In some cases the use of such a resistor in series with the two condensers bypassing a motor is advantageous.

Interference from motors does not usually extend further than 50 yards. With small machines it is often sufficient to connect the bypass centre-tap to the frame without earthing this lead. In fact earthing is sometimes even a disadvantage. Interference arising from battery charging plants is usually caused by direct radiation from the plant and batteries under charge. One arrangement which effectively cured a rotary rectifier plant consisted of a centre tapped bypass to earth across the mains together with 0.1 mfd. condenser across the low voltage output brushes and a filter after the high voltage output brushes consisting of a 4 mfd. condenser, a 100 microhenry choke in each lead and a further 0.25 mfd. condenser.

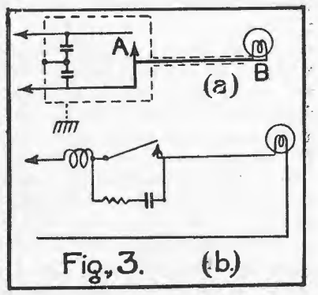
Radio Inductive Interference—(Continued).



Medical Equipment

The interference from high frequency medical apparatus is particularly pernicious, but fortunately such plants are not common.

In this type of equipment, which is sometimes known as ultra-violet ray or diathermy apparatus, long wave damped oscillations are generated by shock excitation of an oscillatory circuit and then stepped up to a high voltage by a transformer, one end of whose secondary is connected to the electrode to be applied to the patient. The other end is connected conductively or capacitively to the mains. Thus the high frequency current, usually of a wavelength between 2,000 and 5,000 metres flows through the patient and his capacity to earth back into the mains through their capacity to earth. The most effective method of cure is to isolate the secondary circuit by providing an insulated metal plate to which one end of the secondary is connected, above which the patient may stand. The insertion of bypass condensers across the mains seems to improve matters but little until this is done.



Flashing Signs

The interference from flasher signs takes the form of a "plop" each time the flashing device (usually a thermostat) operates. The interference is radiated from the lead from flasher to lamp marked AB in Fig. 3 (a). The cure shown in Fig. 3 (a) consists of shielding the flasher and associated bypass and running lead covered wire to the lamp with the lead covering securely bonded to the shield.

An alternative method is shown in Fig. 3 (b), consisting of an R.F. choke in series with the line and a quench circuit across the contacts of the flasher. The choke should be mounted as close as possible to the flasher and the values of C and R have to be chosen suitably for the conditions. R may quite well be a small 5,000 ohm. potentiometer, while C may range from 0.1 to 1 mfd.

Neon Signs

Occasionally neon signs are operated from R.F. currents somewhat after the style of the diathermy apparatus mentioned above. Usually these are small, and are used only in positions where the high voltage would be too dangerous if low frequency was used. In some cases the insulation of some portion of the high voltage secondary circuit across which the neon tube is connected, may be defective, and then leakage currents will flow to earth setting up interference. The remedy is obviously to repair the fault.

Arc lamps should be bridged at the terminals with two condensers and their centre point earthed. Chokes will very often be necessary.

In some districts, particularly the more industrialized it will often be found that there is such a multiplicity of electrical equipment nearby that bypassing and isolation by R.F. chokes is impracticable. In such cases radiation and pickup from the actual house wiring may be minimised by inserting a high frequency filter in the mains where they enter the house. This may consist of that shown in Fig. 2 with chokes of about 600 microhenries inserted if necessary. Other remedies include the erection of a counterpoise earth, a change in the orientation of the aerial or the use of a screened lead-in. Ordinary lead covered lighting cable may be used for the lead-in with the aerial (which should be erected well away from the house and any power lines) connected to the core and the sheath earthed. A condenser of about .0001 mfd. capacity should be inserted between the lead-in and the aerial terminal of the set to decrease the apparent capacity to ground of the lead-in. If an aerial coil with a high impedance primary is employed, a step up transformer with about 200 turns on the secondary and a ratio of about 10 to 1 should be employed.

When installing a set, servicemen should inspect the condition of service and fuse connections, together with all switches and appliances before considering the installation complete.

P.M.G. Methods

The means adopted by the officials of the wireless branch to alleviate interference are similar to those outlined above. Where it is necessary to use choke coils, honeycomb coils of 150 turns are recommended, or solenoids of 200-300 turns where wire of greater current carrying capacity must be employed. It should be noted that where it is necessary to suppress interference from an ungrounded appliance, such as a vacuum cleaner, it is preferable from the **safety first** point of view to fit two honeycomb coils rather than two condensers with the centre point connected to the frame. If condensers are used the frame will be placed at a high potential with respect to earth, which is definitely bad.

Although there is no compulsion in the matter of curing interfering apparatus, the owner of such apparatus can usually be made to see that it is in his own

Radio Inductive Interference—(Continued).

interest to have the trouble remedied. Where it is necessary to lodge a complaint with the Radio Inspector questionnaire forms may be obtained from any post office for forwarding to the local Radio Inspector. Of 1987 cases investigated by the Sydney Branch over the period from 1st August, 1930 to 30th June, 1933, by far the greatest percentage of cases was found to be due to sparking commutators. The figures are:

Commutation	742	37%
Electrical Apparatus (other than motors)	274	14%
Receiver Faults	217	11%
Low Tension (240 volt wiring) Faults	198	10%
High Tension (11,000 volts, etc.) Insulator Leakage (Corona)	166	8.5%
Traction Services	133	6.5%
Oscillation	50	2.5%
Street Lighting	11	0.5%
Unknown; noise disappeared	196	10%

The low number of cases of interference from the street lighting is to be particularly noted, proving the fallacy of blaming leaky transformers, etc., and the power supply authorities, who are usually careful of the condition of their networks.

S.A.A. Wiring Rules

(As Applied to Radio.)

The Standards Association of Australia has drawn up a set of rules covering all electrical and radio installations known as the "S.A.A. Wiring Rules." In New South Wales the Fire Underwriters Association and the Supply Authorities have adopted these rules, and in most of the other Australian States either the S.A.A. rules have been adopted or the rules in force are practically the same.

We understand that revised S.A.A. wiring rules are shortly to be issued with reference to the installation of radios. These may be obtained, on issue, from the Secretary of the Standards Association, Science House, Cnr. Gloucester and Essex Streets, Sydney, at a nominal price.

The portion of these rules affecting radio aerial and earth installations and also in connection with radio and other sound reproducing equipment connected to electric light and power mains is quoted below:—

"Antennae" Exterior to Buildings.

1681. (a) **Location.** Antennae, counterpoises and stay wires exterior to buildings shall not pass over or under aerial, electric light or power wires, nor shall they be so located that failure of either antenna, counterpoise, stay wire, or of the abovementioned electric light or power wires could result in a contact between the antenna, counterpoise and/or stay wires and such electric light or power wires.

Antennae, counterpoise and their supports shall be constructed and installed in a strong and durable manner, and shall be so located as to prevent accidental contact between antenna or counterpoise wires, and light or power wires, or the wires of the Postmaster-General's Department or Fire Brigade, by sagging or swinging.

(b) **Size of Cables.** Antenna and counterpoise conductors shall be stranded, and if of copper, shall be hard drawn and shall be of cross sectional area not less than that shown in Table VIII.

The stress in such conductors shall not exceed 25,000 lbs. per sq. in.

Conductors of metals other than copper may be used provided that their breaking strength is not less than that of the copper conductors for the following given spans. Span (between supports) not exceeding 120 ft. minimum size 3/.036 in. (3/20) exceeding 120 ft. minimum size 7/.036 in. (7/20).

1682. **Location.** Antennae within buildings shall be so placed and constructed that they cannot come into contact with wires or apparatus (other than the radio receiving set) connected to the electric light or power supply. Such portions of the antennae as are within reach of the radio set shall be insulated wires of not less than 600 megohm grade.

Connections to Radio Receiving Sets.

1683. (a) **Leading in Wires.** (1) Leading in wires shall be of copper, copper-clad steel or other approved metal, which does not corrode excessively and shall, in no case, be smaller than 1/.044 in. (1/18). (2) Inside buildings, the leading-in wires shall be covered with insulation of not less than 600 megohm grade. (3) Leading-in wires, both inside and outside of buildings, shall not come nearer than 12 in. to electric light or power wires, unless separated therefrom by a continuous and firmly fixed non-conductor with a well maintained permanent separation. The non-conductor shall be in addition to any insulation on the wire.

(4) Leading-in wires shall enter a building through a non-combustible, non-absorptive insulating bushing, so arranged as to prevent the entry of moisture. Each leading-in wire shall be provided with a protective device (lightning arrester) of approved pattern, which shall be fixed outside the building. The protective device shall be mounted on a non-combustible base, away from inflammable material and shall provide an air gap not exceeding 0.005 in. between aerial and earth connections. (5) The use of an antenna earthing switch is desirable, but does not obviate the necessity for the protective device required by paragraph (4) of this rule. Such switch, if separate from the protective device, may be placed within the building, and, if installed, shall, in its closed position, form a shunt around the protective device. Where situated within reach of the radio receiving equipment, such earthing switch shall be of the all-insulated type.

S.A.A. Wiring Rules—(Continued).

(6) If cut-outs are used in the antenna circuit they shall be placed so that they cannot interrupt the circuit from the antenna to ground.

(b) **Earthing leads.** Permanent earthing conductors (exclusive of flexible earthing leads attached to portable sets) shall be of stranded copper, and shall not be smaller than 7/.029 in. (7/22). They shall, in all respects, conform with provisions of section 17 with respect to earthing, but shall be insulated cables, the insulation being 600 megohm grade.

Section 17. Earthing Precautions.

1721. **Resistance.** The earthing system used shall be such that the combined resistance of the earthing lead and of the earthing system itself shall be low enough to permit the passage of the current necessary to operate the fuse, circuit breaker, or the earth leakage release of the circuit breaker protecting the circuit. The earthing lead shall be as short as possible.

1722. **Earth System.** All earthing leads shall be taken direct without a break to an effective earth. If connected to a water supply system they shall be connected as close as practicable to the point of entry of the supply system into the building, to a section of water pipe of sufficient size to carry the maximum current likely to flow to earth under extreme faulty conditions. Where an effectively earthed water supply system is not available, a galvanised iron water pipe or pipes, as required by the authorised inspector, of not less than ¾ in internal diameter shall be driven vertically into the ground to such a depth as to insure adequate contact with the moist sub-soil. The minimum buried length of the driven pipe shall be 4 ft. Alternatively, an earth plate or plates approved by the authorised inspector may be used.

1723. (a) **Position of earth wire.** The earth wire shall be placed in such a position and attached to the pipes or plates in such a manner that it cannot be accidentally damaged or cut.

(b) **Buried earthing wires.** Where an earthing lead is buried, it shall be protected in the same manner as insulated cables, installed under similar conditions.

1724. **Prohibited Connections.** Sprinkler pipes, or pipes conveying gas, hot water, or an inflammable liquid shall not be used as an earthing system.

Earthing Leads.

1733. **Accessibility.** All connections of the earthing lead to the installation and to the earthing system itself shall be readily accessible.

1734. **Earth Clips.** Where an earthing lead is connected to a pipe a substantial earth clip, which firmly grips and makes good contact with both the metal section and the earthing lead, shall be used. Earth clips shall be made of incorrodible metal not less than No. 18 S.W.G. in thickness, and if made in one piece shall be not less than ¾ in. wide, and if made in 2 pieces shall be not less than 1 in. wide.

1736. (a) **Removal of paint, etc.** Paint, enamel compound and other non-conducting material shall be removed from the surface of contact between it and the earth lead so attached.

(b) **Connection.** The end of all earthing leads which have 7 or more strands shall be provided with soldering sockets or otherwise connected in accordance with rule 1238.

(c) **Soldering fluxes.** Soldering fluxes containing acid or other corrosive substances shall not be used.

Electricity from Supply Mains.

1684. (a) **Connection.** Electricity from supply mains shall only be conveyed to radio receiving sets through permanent wiring or through a proper authorised outlet, such as a wall plug and socket.

(b) **Flexible Cords.** All flexible cords used for connection to the supply side of radio appliances shall be of circular type and class A (High insulation) as specified in rule 1221, and shall be taken direct on to suitably protected terminals on the appliance or connected thereto by means of a contact socket.

1221. Class A. High Insulation flexible cords shall be insulated in one of the following two ways:—

(i) Each conductor, which shall be composed from plain copper wire, shall be lapped with cotton and insulated with two layers of pure rubber overlapped with cotton.

(ii) Each conductor, which shall be composed of copper wires, effectively and uniformly coated with tin free from all impurities, shall be insulated with one layer of pure rubber and two layers of vulcanising rubber.

1684. (c) **Cord Grips and Bushings.** Flexible cord shall enter metal frames only through holes which are bushed by durable insulating bushings permanently fixed into position and cord grips or other approved means shall be provided to relieve the strain from the connecting terminals.

(d) **Terminals.** Exposed live terminals or contacts, directly connected to the supply mains or energised to a pressure exceeding 100 volts directly or indirectly from the supply mains, shall not be used.

Where the maximum voltage at any terminals exceeds 100 volts, such terminals shall be of the insulated pattern and shall have the extreme voltage distinctly marked upon them. Such terminals, unless within the receiving set, shall be protected by a cover.

(e) **Switches.** All switches used on the supply connections to radio receiving sets shall be of ample capacity for the current to be carried, and of suitable design for the supply voltage. Only switches of approved pattern shall be used for this purpose.

(f) **Transformers.** All transformers, including those in battery chargers, eliminators, etc., connected to supply circuits shall have independent primary and secondary windings, not connected with one another and suitable high insulation between windings.

(g) **Earthing.** Where the receiving equipment is operated by electricity from the supply mains and is used in situations where accidental contact with earth is possible, metal containing cases and exposed metal frames shall be effectively earthed.

Where used in situations where accidental contact with earth is not possible, such metal cases and exposed metal frames shall not be earthed.

Metal covers and frames of transformers shall be provided with special terminals for this purpose. Such earthing terminals shall be distinctly marked "Earth."

S.A.A. Wiring Rules—(Continued).

(h) **Danger Notice.** Every radio receiving set which is operated by connection to the electricity mains shall be provided with a suitably worded danger notice, which shall be permanently fixed on the inside of the lid, door or cover by which access is obtained to the interior of the set. This danger notice shall draw attention to the fact that the set is operated from electric light or power mains at a pressure which may be dangerous, and shall contain a warning to the user that no adjustments or alterations shall be made to the interior portions of the apparatus unless the set is disconnected from these mains.

Special Appliances.

1672. (a) **Limiting voltage.** Radio equipment shall not be connected direct to circuits of a voltage more than 5 per cent. above the operating voltage for which they were designed and manufactured.

(b) **Reduction of voltage.** No portable appliance, battery charger with exposed live terminals or appliance such as those mentioned in Clause A, shall be connected to supply mains through a resistance, auto-transformer or any appliance for reducing the pressure other than a double wound transformer or motor generator."

Aerial Wires.

Antennae is the plural of the word "antenna," which is another name for aerial. The wire gauges given in brackets are the approximate equivalents of the diameter in inches specified in the rules. For example, 3/.036 in. means three strands of wire having a diameter of 0.036 inches, equivalent to No. 20 standard wire gauge.

The wire insulation referred to as "600 megohm grade" is a vulcanised rubber covering with an outer braid coloured black or red. It is the kind of wire used by electricians in the wiring of houses for electric light and power. The term "600 megohm" refers to the resistance of the insulation to leakage currents through it from the wire to the outside for a piece of the cable one mile long under certain conditions. Notice that the lead-in must not come within 12 inches of electric light or power wires unless special precautions are taken. This is a rule which should always be kept in mind, as it is very easily violated when installing lead-ins and indoor aerials.

The whole of the rules governing radio installations is given here for convenient reference. "Cutouts" mentioned in rule 1683 (vi) (b) are merely fuses which may be included in some forms of lightning arresters.

The Earth Wire.

The 7/22, 600 megohm wire specified for earthing a radio set is very thick and unwieldy, and it is best to keep it out of sight as far as possible by leading it out of the building as near as possible to the set.

Rule 1721 is practically certain to be complied with if the size of the wire and the manner of earthing specified are in order. Notice particularly that driven pipe grounds must be of galvanised pipe not less than ¾ in. inside diameter, and the minimum depth in the ground not less than 4 ft.

Care should be taken that the earth wire is protected against possible mechanical damage. The specifications for the earth clamp should be kept in mind when buying these small devices. Most clamps do not comply with these requirements.

Rule 1736 (b) should not be overlooked. Earth leads for radio have 7 strands, and the bared ends must be rendered solid, either by soldering or by the use of a cable socket or lug such as is used in electrical work

Power Connections.

The kind of flexible cord to be used for connection to the power socket must be rubber-insulated and further protected mechanically either by tough rubber compound (known as "Cabtyre flex") or by compound hemp, cotton, or jute with a hard cord braiding (known as "workshop flex"). The size of the conductor should be 40/.0076 in. (40/36). Note that an insulating bushing must be used where the cord enters a metal frame or chassis of the receiver, and that the connecting terminals must be relieved of mechanical strain. Both these details are important from every point of view.

Rule 1684 (d), (g), (h) mainly concern the designer of receivers, but should be carefully noted so that the man making an installation can be assured of the receiver complying with the rules in these respects.

Victorian Wiring Rules

Electricity Commission

The following regulation was issued in 1931 as portion of an amendment to the wiring regulation of the State Electricity Commission Act:—

119A. This regulation shall apply where relevant to all electro-acoustic reproducing apparatus and to rectifying appliances not exceeding 1200 volt amps. input rating, used for charging storage batteries and for similar purposes, and in addition paragraphs (a), (b), (f), (h), (i), (j) shall apply to radio transmitting equipment. The expression radio equipment where used in any part of this regulation means equipment or apparatus to which the relevant paragraph of the regulation applies. Any person who connects or permits to be connected to any supply main any radio equipment or similar apparatus shall be guilty of an offence against this regulation, unless the following conditions are complied with:—

Method of Connexion

(a) Electricity from supply mains shall be conveyed to radio equipment only through permanent wiring or through a proper authorised outlet such as a power plug or lamp holder with an adaptor.

Flexible Connexions

(b) All flexible conductors used for connexion to the supply side of radio equipment shall be of circular type and of the quality specified in regulations 40, 41, 42, and 43 of the Wiring Regulations. They shall be taken directly on to suitably protected terminals on the appliance or connected thereto by means of a contact socket. In no case shall exposed live terminals or contacts directly connected to supply mains or energised to a pressure exceeding 100 volts, directly or indirectly from supply mains, be permitted.

Entry of Connexions

(c) The holes in metal frames through which flexible conductors enter shall be bushed by durable insulating bushes permanently fixed in position and cord grips or other approved means shall be provided to relieve the strain from the connecting terminals.

Protection of Terminals

(d) Where the maximum voltage at any terminals exceeds 100 volts such terminals shall be of the insulated pattern, and shall have the extreme voltage distinctly marked thereat. Such terminals, unless otherwise enclosed, shall be protected by a cover.

Victorian Wiring Rules—(Continued).

Switches

(e) All switches used on the supply connexions to radio equipment shall be of ample capacity for the current to be carried, and of suitable design for the supply voltage. Only switches of approved pattern shall be used for this purpose.

Transformers.

(f) All transformers, including those in battery chargers, eliminators, &c., connected to lighting or power circuits shall have independent primary and secondary windings which shall not be connected with one another and shall have suitable high insulation between windings. Electricity from supply mains shall be utilised in radio equipment only by medium of transformers which comply with the requirements of this regulation.

Danger Notice.

(g) All radio equipment which is operated by connexion to supply mains shall be provided with a suitably worded danger notice which shall be permanently fixed on the inside of the lid, door, or cover by which access is obtained to the interior of the equipment. This notice shall contain the heading "DANGER" in bold letters, and the words "This equipment operates at a dangerous electrical pressure. No adjustment to the interior apparatus is to be made unless disconnected from the supply mains."

Earthing

(h) In situations where contact with earth, conducting floors, or earthed metals is possible, exposed metal containing cases, covers, and frames, including transformer frames, shall be efficiently connected to earth through suitable terminals provided for that purpose. Such terminals shall be distinctly marked "Earth." Earthing conductors within 6 feet of the radio equipment shall be covered with insulation of not less than 600 megohm grade.

Earthing Conductors

(i) Permanent earthing conductors (exclusive of flexible earthing leads attached to portable sets) shall be of stranded copper and shall be not smaller than 7/.029 inches (7/22 S.W.G.). They shall in all respects comply with the provisions of regulation 20 of the Wiring Regulations with respect to earthing.

Leading-in Wires

(j) Inside buildings the leading-in wires shall be covered with insulation of not less than 600 megohm grade.

Both inside and outside of buildings, a distance of not less than 12 inches shall be maintained between leading-in wires and electric light or power wires, unless a continuous and firmly fixed non-conductor with a well maintained permanent separation separates them. This non-conductor shall be in addition to any insulation on the wire.

With particular reference to paragraph F of this regulation, it is understood that certain makes of modern transformers A.C.-D.C. receivers (the so-called universal type) have been approved by the various authorities in N.S.W., Vic., S.A., and W.A.

Wire Tables

B.E.S.A. STANDARD SIZES OF ANNEALED COPPER WIRES

Superseded S.W.G. Size	Standard Diameter		Calculated Sectional Area		Weight per. 1,000 yards Pounds	Standard Resistance at 60° F.		Current rating Amperes @
	Inch	M/m.	Square Inch	Square M/m.		Per 1000 yds. Ohms.	Per lb. Ohms.	1,000 per Sq. Inch
50	**.0010**	**.0254**	**.0000007854**	**.0005067**	**.009083**	**30570**	**3365000**	**.0008**
49	.0012	.0305	.0000011310	.0007297	.013079	21230	1623000	.0011
48	**.0016**	**.0406**	**.000002011**	**.0012972**	**.02325**	**11941**	**513500**	**.0020**
47	.0020	.0508	.000003142	.002027	.03633	7642	210300	.0031
46	**.0024**	**.0610**	**.000004524**	**.002019**	**.05232**	**5307**	**101440**	**.0045**
45	.0028	.0711	.000006158	.003973	.07121	3899	54750	.0062
44	**.0032**	**.0813**	**.000008042**	**.005189**	**.09301**	**2985**	**32090**	**.0080**
43	.0036	.0914	.000010179	.006567	.11772	2359	20040	.0101
42	**.0040**	**.1016**	**.000012566**	**.008107**	**.14533**	**1910.5**	**13146**	**.0126**
41	.0044	.1118	.000015205	.009810	.17585	1578.9	8979	.0152
40	**.0048**	**.1219**	**.000018096**	**.011675**	**.2093**	**1326.7**	**6340**	**.0181**
39	.0052	.1321	.00002124	.013701	.2456	1130.5	4603	.0212
38	**.0060**	**.1524**	**.00002827**	**.018241**	**.3270**	**849.1**	**2597**	**.0283**
37	.0068	.1727	.00003632	.02343	.4200	661.1	1574.0	.0363
36	**.0076**	**.1930**	**.00004536**	**.02927**	**.5246**	**529.2**	**1008.7**	**.0454**
35	.0084	.2134	.00005542	.03575	.6409	433.2	676.0	.0554
34	**.0092**	**.2337**	**.00006648**	**.04289**	**.7688**	**361.2**	**469.8**	**.0665**
33	.0100	.2540	.00007854	.05067	.9083	305.7	336.5	.0785
32	**.0108**	**.2743**	**.00009161**	**.05910**	**1.0594**	**262.1**	**247.4**	**.0916**
31	.0116	.2946	.00010568	.06818	1.2222	227.2	185.87	.1057
30	**.0124**	**.3150**	**.00012076**	**.07791**	**1.3966**	**198.80**	**142.35**	**.1208**
29	.0136	.3454	.00014527	.09372	1.6800	165.27	98.37	.1453
28	**.0148**	**.3759**	**.00017203**	**.11099**	**1.9895**	**139.55**	**70.14**	**.1720**
27	.0164	.4166	.0002112	.13628	2.443	113.65	46.52	.2112
26	**.018**	**.4572**	**.0002545**	**.16417**	**2.943**	**94.35**	**32.06**	**.2545**
25	.020	.5080	.0003142	.2027	3.633	76.42	21.03	.3142
24	**.022**	**.5588**	**.0003801**	**.2453**	**4.396**	**63.16**	**14.366**	**.3801**
23	.024	.6096	.0004524	.2919	5.232	53.07	10.144	.4524
22	**.028**	**.7112**	**.0006158**	**.3973**	**7.121**	**38.99**	**5.475**	**.6158**
21	.032	.8128	.0008042	.5189	9.301	29.85	3.209	.8042
20	**.036**	**.9144**	**.0010179**	**.6567**	**11.772**	**23.59**	**2.004**	**1.0179**
19	.040	1.0160	.0012566	.8107	14.533	19.105	1.3146	1.2566
18	**.048**	**1.2192**	**.0018096**	**1.1675**	**20.93**	**13.267**	**.6340**	**1.8096**
17	.056	1.4224	.002463	1.5890	28.48	9.747	.3422	2.463
16	**.064**	**1.6256**	**.003217**	**2.0755**	**37.20**	**7.463**	**.2006**	**3.217**
15	.072	1.8288	.004072	2.6268	47.09	5.897	.12523	4.072
14	**.080**	**2.0320**	**.005027**	**3.2429**	**58.13**	**4.776**	**.08216**	**5.027**
13	.092	2.3368	.006648	4.2888	76.88	3.612	.04698	6.648
12	**.104**	**2.6416**	**.008495**	**5.4805**	**98.24**	**2.826**	**.02877**	**8.495**
11	.116	2.9464	.010568	6.8183	122.22	2.272	.018587	10.568
10	**.128**	**3.2512**	**.012868**	**8.3019**	**148.82**	**1.8657**	**.012537**	**12.868**
9	.144	3.6576	.016286	10.5071	188.34	1.4741	.007827	16.286
8	**.160**	**4.0640**	**.02011**	**12.9717**	**232.5**	**1.1941**	**.005135**	**20.11**
7	.176	4.4704	.02433	15.6958	281.4	.9868	.003507	24.33
6	**.192**	**4.8768**	**.02895**	**18.6792**	**334.8**	**.8292**	**.002476**	**28.95**
5	.212	5.3848	.03530	22.7734	408.2	.6801	.0016661	35.30
4	**.232**	**5.8928**	**.04227**	**27.2730**	**488.9**	**.5679**	**.0011617**	**42.27**
3	.252	6.4008	.04988	32.1780	576.8	.4814	.0008345	49.88
2	**.276**	**7.0104**	**.05983**	**38.5990**	**691.9**	**.4013**	**.0005800**	**59.83**
1	.300	7.6200	.07069	45.6037	817.5	.3396	.0004155	70.69
1/0	**.324**	**8.2296**	**.08245**	**53.1921**	**953.5**	**.2912**	**.0003054**	**82.45**
2/0	.348	8.8392	.09511	61.3643	1100.0	.2524	.0002295	95.11
3/0	**.372**	**9.4488**	**.10869**	**70.1202**	**1256.9**	**.2209**	**.00017574**	**108.69**
4/0	.400	10.1600	.12566	81.0732	1453.3	.19105	.00013146	125.66
5/0	**.432**	**10.9728**	**.14657**	**94.5638**	**1695.1**	**.16379**	**.00009663**	**146.57**
6/0	.464	11.7856	.16909	109.0921	1955.5	.14198	.00007260	169.09
7/0	**.500**	**12.7000**	**.19635**	**126.6769**	**2271.0**	**.12227**	**.00005385**	**196.35**

NICKEL CHROME RESISTANCE WIRE.

Size S.W.G.	Approximate Resistance per 1,000 yards. Standard Ohms.			Approximate Amperes at—			Weight per 1,000 yards.
	200° C.	400° C.	600° C.	200° C.	400° C.	600° C.	lbs.
16	452	494	538	7.1	12	18	37.6
17	591	646	703	6.0	9.6	14	28.9
18	802	879	957	4.3	7.7	11	21.2
19	1154	1266	1378	3.7	5.7	8.4	14.8
20	1426	1590	1700	3.3	4.7	6.8	12.0
21	1809	1978	2151	2.7	4.2	6.2	9.41
22	2360	2583	2820	2.2	3.5	5.1	6.71
23	3237	3535	3860	1.8	2.8	4.1	5.31
24	3828	4187	4555	1.6	2.4	3.3	4.46
25	4732	5061	5505	1.4	2.1	3.1	3.69
26	5720	6250	6870	1.1	1.9	2.6	2.98
27	6890	7535	8400	1.0	1.6	2.4	2.48
28	8400	9250	10070	.93	1.4	2.0	1.95
29	10000	10950	11920	.78	1.3	1.8	1.69
30	12040	13170	14320	.68	1.1	1.6	1.42
31	13760	15040	16370	.61	.88	1.3	1.246
32	15880	17360	18900	.55	.80	1.2	1.076
33	18530	20250	22050	.50	.72	1.1	.924
34	21880	23920	26100	.43	.63	.93	.781
35	26250	28700	31500	.37	.56	.83	.651
36	32200	35070	38380	.32	.49	.72	.532
37	40100	43800	49000	.29	.43	.63	.424
38	51400	56300	61270	.21	.34	.49	.3318
39	68500	74900	81500	.17	.26	.39	.250
40	80200	87900	95700	.16	.24	.35	.212

EUREKA RESISTANCE WIRE.

Current Necessary to Maintain Given Temperature Rise. Wire Coiled in Air with Free Radiation.

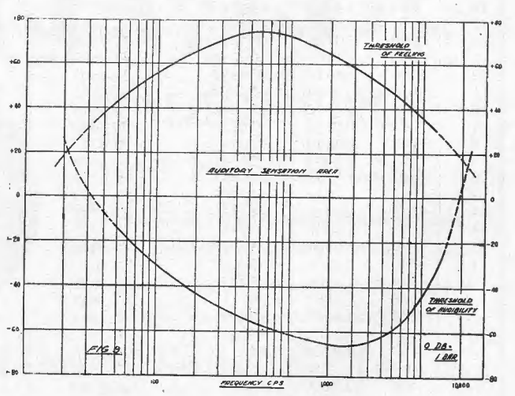
Size S.W.G.	Diam. Inch.	M/m.	Amperes for a Temperature rise of			Resistance per 1,000 yards at 60°F. Ohms.	Weight per 1,000 yards lbs.
			100° C.	200° C.	300° C.		
8	.160	4.06	33.0	52	58.5	33.5	233.5
9	.144	3.65	26.0	43	50	41.3	189.0
10	.128	3.25	22.8	36	41.5	52.3	149.2
11	.116	2.94	19.0	30	35.5	63.7	122.8
12	.104	2.64	16.8	24	29.5	79.3	98.6
13	.092	2.33	12.7	20	24.2	101.3	77.1
14	.080	2.03	9.5	15	19.5	133.9	58.4
15	.072	1.82	7.4	12.6	16.8	165.3	47.3
16	.064	1.62	6.0	10.4	14.3	209.4	37.4
17	.056	1.42	5.3	8.8	11.3	273.3	28.6
18	.048	1.21	4.3	7.0	9.1	371.8	21.0
19	.040	1.01	3.7	5.5	6.8	535.6	14.6
20	.036	.91	3.0	4.7	5.9	661.3	11.8
21	.032	.81	2.8	4.0	5.0	837.2	9.35
22	.028	.71	2.2	3.2	4.1	1093	7.15
23	.024	.60	1.8	2.6	3.3	1487	5.24
24	.022	.55	1.5	2.3	2.8	1770	4.41
25	.020	.50	1.25	2.0	2.5	2142	3.64
26	.018	.45	1.00	1.7	2.1	2645	2.96
27	.0164	.41	.90	1.5	1.9	3186	2.46
28	.0148	.37	.76	1.4	1.6	3914	2.00
29	.0136	.34	.68	1.2	1.5	4634	1.69
30	.0124	.31	.59	1.0	1.3	5575	1.40
31	.0116	.29	.52	.90	1.00	6370	1.23
32	.0108	.27	.47	.81	.95	7350	1.06
33	.0100	.25	.42	.74	.85	8571	.912
34	.0092	.23	.37	.64	.75	10128	.771
35	.0084	.21	.33	.56	.65	12149	.644
36	.0076	.19	.28	.48	.57	14840	.526
37	.0068	.17	.26	.43	.51	18536	.421
38	.0060	.15	.19	.31	.40	23808	.328
39	.0052	.13	.16	.26	.31	31696	.246
40	.0048	.12	.15	.24	.28	37184	.210
41	.0044	.11	.14	.21	.26	44268	.176
42	.0040	.10	.13	.18	.23	53564	.146
43	.0036	.09	.11	.17	.20	66136	.118
44	.0032	.08	.10	.14	.17	83664	.093
45	.0028	.07	.08	.13	.15	108648	.072
46	.0024	.06	.07	.10	.12	148764	.053
47	.0020	.05	.05	.08	.10	214284	.036
48	.0016	.040	.04	.060	.075	334000	.023
49	.0012	.030	.03	.045	.055	595000	.013
50	.0010	.025	.02	.030	.040	855000	.009

Nearest Equivalent Wire Gauges.

S.W.G.	Nearest Equivalent	S.W.G.	Nearest Equivalent	S.W.G.	Nearest Equivalent B. & S.
7/0	4/0	13	11	31	29
6/0	4/0	14	12	32	29
5/0	3/0	15	13	33	30
4/0	3/0			34	31
3/0	2/0	16	14	35	32
2/0	0	17	15		
0	0	18	17	36	32
		19	18	37	33
1	1	20	19	38	34
2	1			39	36
3	2	21	20	40	36
4	3	22	21		
5	4	23	22	41	37
		24	23	42	38
6	5	25	24	43	39
7	5			44	40
8	6	26	25	45	40
9	7	27	26		
10	8	28	27	46	40
		29	27	47	40
11	9	30	28	48	40
12	10			50	40

SENSITIVITY OF THE EAR

While the human ear is an extremely sensitive acoustic device it is also an extremely erratic one. No two ears are exactly the same when judged by "sensitivity" or frequency response curves. Each one is full of small peaks at differing frequencies. In addition the sensitivity of the ear will vary from day to day and considerably over a period of years. In general as age creeps on the ear becomes less sensitive to the higher frequencies in comparison to the lower.



Experiment has shown that the ear is most sensitive to notes of a pitch between 1,500 and 4,000. An average sensitivity curve shows that the energy ratio of just audible sounds of pitch 100 and 2,000 respectively is around 1,000.

The average energy ratio of just audible sounds of 2,000 and 8,000 cycles is about 3. Some people even find it hard to hear sounds of a frequency above 5,000.

Decimal Equivalents of Sixteenths

1	sixteenth	=	.0625
2	,,	=	.125
3	,,	=	.1875
4	,,	=	.25
5	,,	=	.3125
6	,,	=	.375
7	,,	=	.4375
8	,,	=	.5
9	,,	=	.5625
10	,,	=	.625
11	,,	=	.6875
12	,,	=	.75
13	,,	=	.8125
14	,,	=	.875
15	,,	=	.9375

Inches and Fractions as Decimal Equivalents of One Foot

Inches.	Fraction.			
	0	¼	½	¾
0	.0000	.0208	.0417	.0625
1	.0833	.1042	.125	.1458
2	.1667	.1875	.208	.229
3	.250	.270	.291	.312
4	.333	.354	.375	.395
5	.416	.437	.458	.479
6	.500	.520	.541	.562
7	.583	.604	.625	.645
8	.666	.687	.708	.729
9	.750	770	.791	.812
10	.833	.854	.875	.895
11	.916	937	.958	.979

Handy Factors

π	3.14159
π^2	9.8696
$\pi/4$	.7854
$1/\pi$	.3183
1 radian	57.3°
e	2.718
$\log_{10}e$	2.3026

Symbols and Abbreviations.

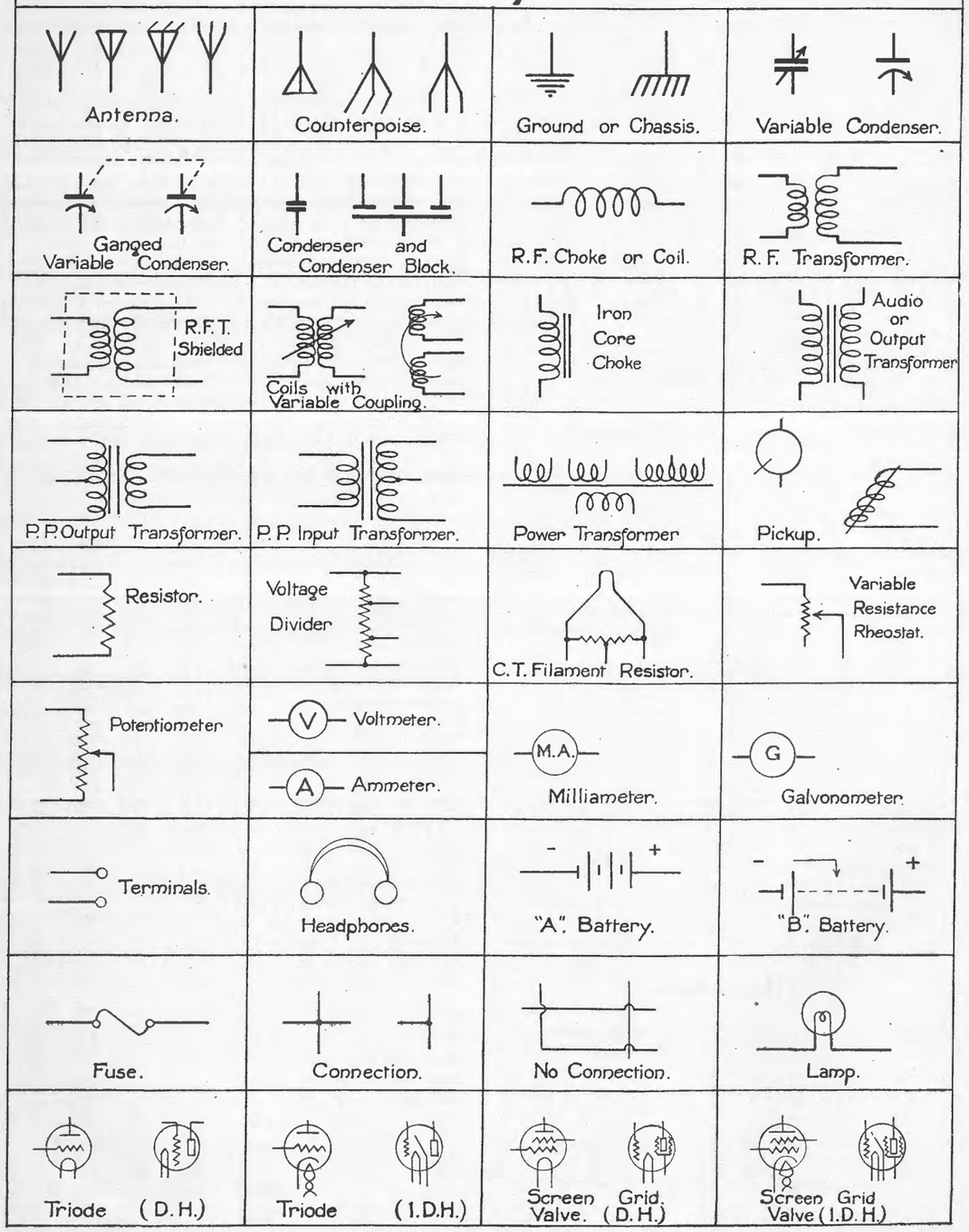
In the radio language (in many cases a closed book to the man in the street) there naturally occur many symbolical representations both pictorial and literal, which are in the nature of a shorthand. It is unfortunate that there is no universally accepted standard in this regard, but certain symbols have become universally recognised through long usage. The pictorial and graphical representations of components shown here may be accepted as the custom of Australia. In some cases, of course, there are a number of different symbols for the same part, and here each one will be found.

Many literal symbols or abbreviations given in the table below are internationally accepted, while the remainder are those adopted as standard by the R.M.A. in the United States. Many of the abbreviations are given in lower-case letters, and should, of course, be capitalised in the same way as ordinary words which are used to begin a sentence, etc. A two-word adjectival expression should contain a hyphen in the abbreviation. The Greek letter μ is sometimes written "mu." The nouns "alternating current" and "direct current" will, of course, often be seen abbreviated a.c. and d.c., while amp. is a common abbreviation for ampere.

The adjectival expressions which according to the R.M.A. standard should be abbreviated with a hyphen are commonly written in Australia as two letters, each followed by a full stop, but at the same time it would be desirable to follow the American system in this connection for the sake of standardisation.

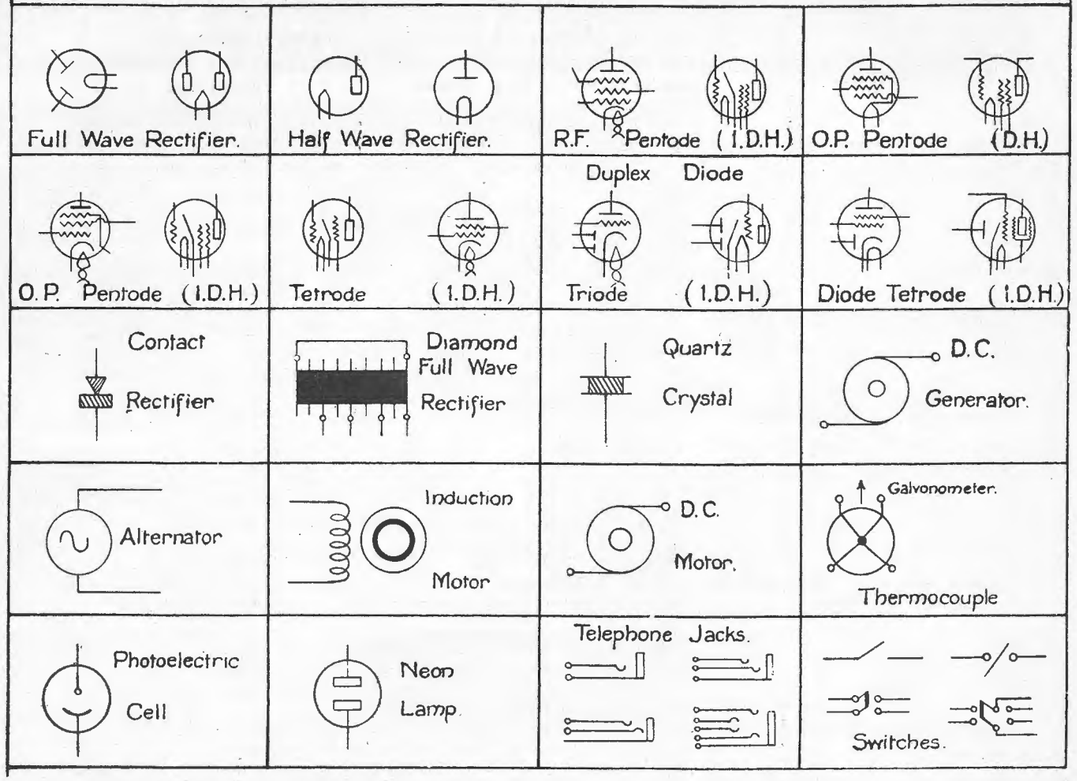
Term.	*Abbreviation or letter symbol.*
Alternating-current (adjective)	a.c.
Alternating current	spell out
Ampere	a
Antenna	ant.
Audio-frequency (adjective)	a-f.
Continuous waves	CW
Cycles per second	~
Decibel	db
Direct-current (adjective)	d-c
Direct current	spell out
Electromotive force	e.m.f
Frequency	f
Ground	Gnd.
Henry	H
Intermediate-frequency (adjective)	i-f
Interrupted continuous waves	ICW
Kilocycles (per second)	kc
Kilowatt	kw
Megohm	MΩ
Microfarad	μf
Microhenry	μh
Micromicrofarad	μμf
Microvolt	μv
Microvolt per meter	μ v/m
Millivolt per meter	mv/m
Milliwatt	mw
Ohm	Ω
Power Factor	p.f.
Radio-Frequency (adjective)	r-f.
Volt	v

Radio Symbols.



SEE PREVIOUS PAGE FOR EXPLANATION OF SYMBOLS.

Radio Symbols.



INSULATING MATERIALS

Mica

For the information of set designers the dielectric constant of clear ruby mica at radio frequencies (1,000kc) may vary from 6.6 to 8.7. Its average value can be taken as 7.2. The average value of its power factor (at R.F.) is 0.02 of 1%. This does not vary more than 0.01 to 0.04. In stained mica the power factor may reach a value of 8%. The change of dielectric constant from 0° to 120°C is 0.4 of 1%. Its breakdown strength is 3,500 K.V. per centimetre.

Moulded Insulation

Hot moulded plastics formed from an organic binder (phenolic resin in this case) gives the following properties:—

Water absorption (% in 24 hours)	0.25
Max. Safe temperature °C	135
Transverse strength (lb./sq. in)	10,000
Dielectric strength (K.V. for 0.2 in.)	50
Power factor (%)	3.0
Dielectric constant	5.8

Measurements were made at 100 kc.

Bakelite

Bakelite is moulded from a phenol—formaldehyde base. Either wood or fabric may be used as the filler. Properties are as follows:—

Filler	Wood Flour	Cut Fabric
Water absorption (% in 100 hours	0.7	2.0
Max. safe temperature (°C)	135	135
Dielectric strength (volt/mil)	400	425
Power factor at 1,000 kc. (%)	3–6	—
Dielectric constant	4.5–7.5	4.5–5.0

Laminated Bakelite

The base used may be either paper or fabric. Properties are as follows:—

Base	Paper	Fabric
Water absorption (% in 24 hours)	0.5	0.9
Max. safe temperature (°C)	125	110
Dielect. strength of ⅛in. (volt/mil)	900	450
Power factor at R.T. (%)	1.5	8.0
Dielectric Constant	4.5	5.5

Inductive and Capacitive Reactances

The following tables give the reactances of coils and condensers at various frequencies. It should be noted that the ripple frequency of 50 cycles after **full**-wave rectification is 100 cycles.

Inductance (Henries)	Reactance in Ohms at Various Frequencies				
	Audio & Power Freq. (cycles).			Radio Freq. (K.c.)	
	50	100	3,000	175	1,000
250	78,000	157,000	4,700,000	—	—
50	15,700	31,000	940,000	—	—
30	9,400	18,800	560,000	—	—
20	6,300	12,600	380,000	—	—
15	4,700	9,400	280,000	—	—
1	310	630	18,800	1,100,000	6,300,000
.1	31	63	1,880	110,000	630,000
.01	3.1	6.3	188	11,000	63,000
200 Micro H.	.063	.126	3.8	220	1,260

Capacity in Mfds.	Reactance in Ohms at Various Frequencies.				
	Audio & Power Freq. (cycles)			Radio Freq. (K.c.).	
	50	100	3,000	175	1,000
.00003	—	—	180,000	30,000	5,300
.0001	—	—	530,000	9,100	1,600
.00025	—	—	210,000	3,600	640
.0005	—	—	106,000	1,800	320
.001	3,200,000	1,600,000	53,000	910	160
.006	530,000	260,000	8,900	150	27
.01	320,000	160,000	5,300	91	16
.1	32,000	16,000	530	9.1	1.6
.5	6,400	3,200	106	1.8	.32
1	3,200	1,600	53	.91	.16
2	1,600	800	26	.45	.08
4	800	400	13	.23	.04
8	400	200	6.5	.11	.02
25	125	63	2.1	.04	.01

It is to be noted that the capacity between plate lead and earth in a screen grid valve (inter-electrode plus circuit) is of the order of .00003 mfd.

Whitworth Threads

Diam.	Diam. at Bottom of Thread.	Threads per inch.
¼ in.	.186	20
⅜ in.	.295	16
½ in.	.393	12
⅝ in.	.508	11
¾ in.	.622	10
1 in.	.840	8
1¼ in.	1.067	7
1½ in.	1.286	6
1¾ in.	1.494	5
2 in.	1.715	4½
2½ in.	2.180	4
3 in.	2.634	3½

Drills for Tapping and Clearing B.A. Sizes

B.A. Size.	Tapping (ins.).	Clearing (ins.).
0	13/64	17/64
1	11/64	9/32
2	5/32	13/64
3	9/64	3/16
4	1/8	5/32
5	3/32	1/8
6	5/64	5/64
8	3/64	5/64

Dielectric Strengths

Material	Volts per mm.
Bakelite	6, to 30,000
Glass	8,000
Paraffin	12,000
Micanite	40,000
Ebonite	30,000
Porcelain	10,000
Empire Cloth	10,000
Presspahn	5,000
Fibre	3, to 16,000

Two sharp points in air 10 inches apart will flash over at about 100,000 volts.

To obtain volts per mil divide the figures given above by 39.

To obtain volts per ☆ inch multiply the figures given given above by 1.6.

Dielectric Constants

Material.	K	Material.	K
Bakelite	5.1 – 5.8	Resin	1.8 – 2.6
Ebonite	2.7 – 2.9	Shellac	3 – 3.7
Glass, crown	5 – 7	Silica, fused	3.5 – 3.6
" hard	7 – 9	Sulphur	3.6 – 4.3
" flint	7 – 10	Vaseline	2.2
" mirror	6 – 7	Oil, castor	4.6 – 4.8
Ice (–2° C)	93.9	" Olive	3.1 – 3.2
Indiarubber	2.1 – 2.3	" Paraffin	4.6 – 4.8
Marble	8.3	Vaseline	1.9
Mica	5.7 – 7		
Paper, dry	2 – 2.5	Wood	2–5
Paraffin wax	2 – 2.3	Water	81
Pitch	1.8	" =36 m.	3.32
Porcelain	4.4 – 6.8	" =12 m.	2.79
Quartz	4.5	Air 0° C.	1.000586
Slate	10 – 30	" 20° C.	1.000576

Gases all have a value of "k" near to one while a rise in temperature causes a fall in "k." The dielectric constant is also known as the specific inductive capacity of S.I.C.

Specific Resistances of Metals and Alloys at Ordinary Temperatures

Substance	Specific Resistance Microhms per cm.	Relative conductance	Substance	Specific Resistance Michrohms per cm.	Relative conductance
Aluminium	2.94	54	Lead	20.8	6.64
Brass	6-9	26-17	Manganin	43	3.7
Climax	87	1.83	Mercury	95.7	1.66
Cobalt	9.7	16.3	Molybdenum	4.8	33.2
Constantan	49	3.24	Nickel	10.5	11.8
Copper, annealed	1.59	100	Nichrome	110	1.45
Ger. Silver (18X)	30-40	5.3-4	Platinum	10.8	14.6
Iron, pure	9	17.7	Silver	1.5	106
Iron, wrought	13.9	11.4	Tungsten	5.4	28.9

International Symbols of Quantities

Acceleration of gravity	g
Angles	a β δ
Capacity	C
Conductance	G
Current	I
Dielectric constant	k, ϵ
Difference of potential	V
Efficiency	η
Electromotive force	E
Energy or work	W
Flux density (electrostatic)	D
Flux density (magnetic)	B
Frequency	f
Impedance	Z
Intensity of magnetisation	J
Length	*l*
Mass	m
Magnetic field	H
Magnetic flux	Φ
Magnetomotive force	*
Mutual inductance	M
Permeability	μ
Phase displacement	Φ
Power	P
Quantity of electricity	Q
Reactance	X
Reluctance	S
Resistance	R
Resistivity	ϵ
Self-inductance	L
Susceptibility	K
Temperature	T
Time	t
Work	A

* Symbol yet to be fixed.

Units and Their Equivalents

This table shows the relation between electrical and mechanical units. It enables any conversion to be made.

One ft.-lb.	= 1 lb. raised 1 foot high.
One B.Th.U.	= 1 lb. of water raised 1° F.
"	= 778.8 ft.-lb.
"	= 1,005 joules.
"	= 0.252 kilogram calories.
One H.P. Hour	= 0.746 kw. hour.
"	= 1,980,000 ft.-lb.
"	= 2,545 B.T.U.'s.
One kw. hour	= 1,000 watt hours.
"	= 1.34 H.P. hours.
"	= 3,412 B.T.U.'s.
"	= 2,654,200 ft.-lb.
"	= 3,600,000 joules.
One H.P.	= 746 watts.
"	= 0.746 kw.
"	= 33,000 ft.-lb. per minute.
"	= 550 ft.—lb. per second.
"	= 2,545 B.T.U.'s per hour.
"	= 42.4 B.T.U.'s per minute.
"	= 0.707 B.T.U.'s per second.

Prefixes

The prefixes milli-, micro- and micromicro- denote that the term to which they are attached (e.g. amps or farads) must be divided by 1,000 or 1,000,000 or 1,000,000,000,000 respectively, e.g., one milliamp is $\frac{1}{1000}$ amps, while a condenser of .0005 mfd capacity may be spoken of as a 500 mmfd. condenser. Milli- is denoted by m. and micro- should be denoted by the Greek letter "mu" but is usually printed as m. due to the printer's limitations. The prefixes kilo- and meg- or mega- denote that the term to which they are attached (e.g., volts or ohms) must be multiplied by 1,000 or 1,000,000 respectively, e.g., one megacycle is 1,000,000 cycles. They are denoted by K. and M. respectively.

Standard Colour Coding for Resistors

In the RMA (American) standard coding, ten colours are assigned to the figures as shown in the following table:

Figure	Colour	Figure	Colour
0	Black	5	Green
1	Brown	6	Blue
2	Red	7	Violet
3	Orange	8	Grey
4	Yellow	9	White

The body (A) of the resistor is coloured to represent the first figure of the resistance value. One end (B) of the resistor is coloured to represent the second figure. A band, or dot (C) of colour, representing the number of ciphers following the first two figures, is located within the body colour.

Examples:—	A	B	C
10 ohms	Brown (1)	Black (0)	Black (No Ciphers)
200 ohms	Red (2)	Black (0)	Brown (One "
3,400 ohms	Orange (3)	Yellow (4)	Red (Two "
40,000 ohms	Yellow (4)	Black (0)	Orange (Three "
44,000 ohms	Yellow (4)	Yellow (4)	Orange (Three "

Units and Their Symbols

(Used after numerical values.)

	Unit of	Symbol
Ampere	Current	A
Coulomb	Quantity	C
Farad	Capacity	F
Henry	Inductance	H
Joule	Energy	J
Ohm	Resistance	Ω, O
Volt	Electromotive Force	V
Watt	Power	W

Multiples and Their Symbols

Multiple	Name	Symbol
1,000,000	Mega	M
1,000	Kilo	K
100	Hecto	—
.001	Milli	m
.000,001	Micro	μ

Modern Superheterodynes

The very great majority of receivers manufactured to-day are of the superheterodyne type. As a proper understanding of the functions of each part of the circuit is essential to "common-sense servicing," we have divided the following pages into two sections. First we have considered the principles of the superhet. system, and then we have gone on to consider a typical high-class modern receiver in detail.

The Straight T.R.F. Receiver

Before considering superhets it is desirable to say a few words about what was once the universally manufactured type of receiver, namely the tuned R.F. set.

In the T.R.F. type of receiver a number of tuned amplifier circuits are adjusted to the frequency of a required station by means of a gang condenser operated by a single dial. It is obvious that all these tuned circuits will have to track accurately with each other from a frequency of about 550 to about 1500 K.C. In addition any band pass or preselector circuits which are sometimes introduced before the first R.F. stage, will introduce further complications in the tracking if they are to be adjusted correctly over the whole range of frequencies. Further, apart from any tracking difficulties, a comparatively low gain per stage is obtained.

Due to the resultant instability if a high gain per stage is designed for, trouble will be experienced with self-oscillation. For this reason it is not possible to make use of the most efficient coils, so that a gain per stage of 40 is rarely exceeded in a T.R.F. receiver, even when screen grid valves are employed.

Many other troubles will be found, more particularly that of varying gain over the frequency spectrum. In the ordinary type of R.F. transformer the field of the primary will be considerably greater at higher frequencies so that higher voltages will be induced into the secondary at the higher frequency end of the scale. This is not such a serious objection as it may seem at first sight, for R.F. transformers may be obtained in which the primary consists of a bobbin or honeycomb wound choke, in some cases not even coupled to the secondary, which resonates at a frequency slightly below the broadcast spectrum, i.e., about 450 K.C. Coupling is obtained mainly by means of a small capacity usually introduced by a single turn around the top of the secondary. Due to the lower reactance of the coupling capacity at higher frequencies, an increasing amount of energy is fed into the grid circuit of the R.F. stage as the frequency is increased. On the other hand, due to the resonance of the primary choke, an increasing amount of energy is fed to the grid circuit as the frequency is decreased from about the middle of the scale. By this means a response curve, which rises at both ends of the frequency scale, is obtained. However, even this system has the disadvantage of an apparently poor response at the middle of the broadcast spectrum.

The Superheterodyne System

In a superheterodyne receiver, instead of amplifying the R.F. signal at its own particular frequency, by means of tuned circuits which must each be adjusted to that particular frequency, the signal frequency is changed to a certain lower and fixed frequency, so that it can be amplified by means of a fixed tuned amplifier. This lower frequency is called the intermediate frequency, and the amplifier, the intermediate or I.F. amplier.

The various signals induced in the aerial are fed to either an R.F. amplifier in the superhet at the original frequency, which is usually employed for the purposes of selectivity rather than amplification, or perhaps straight to the first detector, or so-called modulator valve. It is in one of the circuits associated with this valve that the incoming signal is mixed with a steady signal or oscillation generated locally. This local oscillator generates energy at a frequency which differs from the incoming signal frequency by a fixed amount, equal to the frequency at which the intermediate amplifier operates.

The mixing of these two oscillations causes a beat frequency which is selected and amplified by the I.F. amplifier. This signal at the beat or intermediate frequency, is modulated by the same envelope or audio frequencies as the incoming signal.

After intermediate amplification, this beat frequency is rectified or demodulated by the second detector, and amplified at audio frequency before passing to the loud-speaker. It should be noted that the use of an R.F. amplifier stage ahead of the first detector is not at all necessary for the sake of sensitivity, but if the receiver is to be operated anywhere close to a powerful station, trouble may be experienced with cross-modulation, unless this stage is inserted. On the other hand, by suitable design, cross-modulation may be eliminated even when employing only a single tuned circuit between the aerial and the first detector.

Advantages

The superheterodyne tuner has two distinct advantages which the T.R.F. receiver can never possess. In the super, so-called "arithmetical" selectivity is obtained. This is to be explained later. In addition, the amplification occurs at a comparatively low and fixed frequency, normally 175 K.C. in most modern superheterodynes. For this reason, each I.F. stage can be designed to give a gain of about 60 to 80, using screen grid valves. Of

Modern Superheterodyne—(Continued).

course, in exceptionally well designed receivers, this figure will be far surpassed. About half this gain is obtained per stage in a T.R.F. receiver. Further, it is possible to so design the I.F. circuits, that almost square top tuning is obtained. This means a high degree of selectivity and at the same time no appreciable side band cutting.

While T.R.F. receivers can be built to be just as sensitive as superheterodynes, and just as selective, it is far harder to avoid sideband cutting over the whole of the broadcast range. In fact, a T.R.F. receiver, equally sensitive with a superheterodyne, will probably give better results on far distant stations, since if both are well designed, the T.R.F. receiver will have a slightly lower noise level.

On the other hand, this does not outweight the more numerous advantages of the super.

The Occurrence of Beat Frequencies

To understand the phenomenon of beat frequencies, it is first desirable to consider the occurrence of beats with regard to sound waves. If we strike the note middle C on the piano, we hear a note with a frequency of 256. If now a second note is struck with a frequency of 252, so that both strings are vibrating at the same instant, we will hear a note which is slightly different from either of the two component tones and which regularly swells and diminishes at the rate of four times per second. The figure 4 is obtained as the difference between the two component frequencies, viz., 256 and 252. The actual frequency of the tone which is heard is not strictly a frequency at all, since it varies slightly. It is, however, approximately equal to the mean of the two frequencies, or 254.

In addition, a weak vibration with an amplitude equal to the sum of the two components, will be present, but probably not audibly.

This same phenomenon occurs when two alternating currents of slightly different frequencies are mixed or imposed upon each other in any circuit. E.g. referring to Fig. 1, a circuit will be seen in which oscillations of 10 cycles and 8 cycles per second are mixed. On the left hand side of the diagram will be seen the graphical representation of what is occurring in the mixing circuits. Reading down from the top the ten cycle

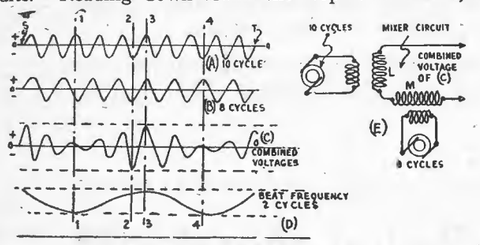


Fig. 1.

sine wave is first represented, then the 8 cycle. The third graph C, represents the combined voltage output when these two oscillations are mixed. It is easily seen that the amplitude of the resultant oscillations is varying slowly as shown in the fourth graph. The rate of variation is easily seen to be 2 times per second, or the difference between the original frequencies.

In combining the two voltages graphically as shown, the procedure is extremely simple. Starting at the point S, through which the vertical labelled "O" passes, the voltage of each alternator is zero. Hence, the resultant voltage is also zero. Referring next to the vertical labelled "1," the voltage from the 10 cycle alternator is at its maximum positive value, while that from the 8 cycle alternator is at a negative value of about two thirds of its maximum. The combined resultant of these two is thus a positive voltage having a value of one third of the maximum amplitude.

Considering next the vertical labelled "2," it will be seen that both waves are very nearly at their maximum negative values. Thus, the resultant is a negative voltage which has a value practically double that of the amplitude of each individual wave.

Half a cycle later, considering the vertical "3," both waves have their maximum positive value, so that the resultant has its maximum positive value at the same instant. At the vertical "4" the voltage is again practically cancelled.

With the fourth graph labelled D the envelope of the value of the amplitude of the combined voltage has been drawn and it is easy to see that this is a current wave of frequency 2 cycles.

The Principle Applied to Superheterodynes

Let us consider now an actual example of the beat action which occurs in superhets. Suppose that we wish to receive the signal from a broadcasting station transmitting on a frequency of 1,000 Kc. Further suppose that this is being modulated by a constant frequency 2,000 cycle note from the studio. We will assume that the intermediate amplifiers are tuned to a frequency of 460 Kc. as is the case in practically all modern superhets. The desired signal is picked up by the aerial and transferred to the grid circuit of the first detector stage, either immediately or through an R.F. amplifier and here it is mixed with the steady oscillator voltage produced locally in the receiver. This circuit or the grid circuit of the first detector valve is known as the mixer circuit. It is here that the beat action explained above takes place.

Since our intermediate amplifiers are tuned to a frequency of 460 Kc. the oscillator will have to operate on a frequency of either 1,460 Kc. or 540 Kc. For various reasons, mainly ease of tuning and tracking, it has been found preferable to use the higher of these two frequencies. Actually in the mixer circuit we have present a constant oscillation of frequency 1,460 and an oscillation of frequency 1,000 Kc. modulated at 2,000 cycles. These will combine as we have seen above and produce a quasi-frequency of 1,230 Kc. which is itself modulated at the beat frequency of 460 Kc. Further, since one of the original components was modulated at 2,000 cycles the complete resultant will also be modulated at 2,000 cycles. We have thus an oscillation of radio frequency which is modulated by a complex wave

of frequency 460 Kc. This somewhat complicated voltage is of course applied to the grid of the first detector valve, which demodulates the complex wave by the ordinary operation of a detector valve. By reason of the square law characteristic of the first detector valve and the fact that a circuit tuned to 460 Kc. is present in the plate circuit (the primary of the first I.F. transformer) the modulated 460 Kc. signal present in the plate circuit after detection is selected and passed on, usually by the ordinary method of inductance coupling, to the intermediate amplifier.

Sensitivity of the First Detector

The output or 460 Kc. voltage from the first detector depends upon a number of factors. Going back from the plate circuit of the first detector we see first that the output is dependent upon the efficiency of the first detector as a rectifier. While it is justly claimed that the grid leak and condenser method of detection is more sensitive than the bias detector it has other disadvantages which usually debar it from use. The chief of these is the trouble which is experienced with the tracking when using a leaky grid first detector. With the use of a small condenser and a high value grid leak to gain sensitivity the constant oscillator voltage very easily overloads the valves and quite upsets its normal operation. When using one valve as a combined mixer-oscillator it would be impossible to obtain a value for the grid leak satisfactory from the point of view of the valve functioning either as a mixer or as an oscillator.

It is obvious that the intermediate frequency output depends upon the amplitude of the quasi-frequency, which has a frequency of 1,200 Kc. in our example. It has been found mathematically that for a given amplitude of the signal wave the largest quasi-frequency oscillation is obtained when the amplitude of the local oscillation is exactly equal to that of the incoming signal. It is very inconvenient to adjust the amplitude of the oscillation fed into the mixer circuit, so it should be arranged in the first place for a reasonable average value of received signal. The average value of the oscillation fed to the grid of the first detector valve is about 5 volts. If the grid of the first detector swings positive distortion will occur, various harmonic frequencies being generated. These will give rise to howls and squawks as the receiver is tuned.

Coupling the Oscillator

It is very desirable that oscillator voltage fed to the first detector should be constant over the whole tuning range of the receiver. Various methods of introducing this locally generated signal into the mixer circuit are employed. Where a separate oscillator valve is used it may be coupled inductively by a small coil connected in the grid circuit of the mixer valve and coupled to the oscillator coil; by mutual inductance between the grid coil of the detector and the oscillator coil; by means of a high resistance and a small capacity in series; or by means of a small coil in the cathode circuit of the mixer valve coupled to the oscillator. In this type of superhet, the last is the most generally employed, although in short-wave converters coupling is usually by mutual induction. Coupling may also be had by making use of the screen or suppressor grid of the mixer valve. This method is not very satisfactory.

In superhets employing a combined mixer-oscillator the grid circuit is tuned to the signal frequency and oscillation is generated by a tuned circuit connected to the plate on one side of the I.F. primary, this coil being coupled back to the cathode circuit by a small coil or by a tap on the oscillator coil itself. In this case it is obvious that coupling occurs between the oscillator and the grid circuits due to the few turns of wire in the cathode circuit. In the case where the oscillator coil is connected to the bottom of the I.F. primary the trimmer across this primary acts as a by-pass condenser for the oscillator current.

Electron Coupling

Electron coupling has been made possible by the introduction of the pentagrid converter valves. In this valve there are five grids arranged in the order; oscillator grid, oscillator anode, screen, control grid, for the detector and another screen. This combination forms a triode and an ordinary screen-grid valve electrostatically screened from each other. The triode portion is made to oscillate in the ordinary manner by means of a tuned grid circuit and a reaction coil connected to the anode or second grid. The combination of cathode oscillator grid, anode and screen forms what is virtually a secondary cathode emitting a stream of electrons modulated or varied at the oscillator frequency. This modulated electron stream or current is further controlled by the detector control grid before passing on to the plate circuit where the ultimate beat or intermediate frequency will be present.

In every type of first detector it is very important that the oscillator circuit be well screened in order to prevent stray couplings which will cause unstable operation and radiation to nearby receivers. The presence of a powerful oscillation in any of the other circuits due to these stray couplings will react on the tuning. Further the voltages introduced by these stray couplings are usually of incorrect phase and will cause distortion and inefficient operation. It is desirable that the oscillator should generate a wave as free from harmonics as possible for these are a source of whistling when tuning the receiver and of inselectivity.

This may be taken care of by using a reasonably low oscillator plate voltage and attending to certain points so that the oscillator valve is not over biased. With automatic bias this is easily arranged but with the more usually employed grid leak and condenser method of providing bias for the oscillator it can be effected by employing a low value of grid leak. This low value of bias or grid leak prevents trouble from the too violent oscillation of the valve causing it to set up an audio howl which may be heard in the speaker. It should be noticed that this so called howling of the oscillator is usually much worse at the high frequency end of the band and may not be present at all at the low frequency end. This is due to the greater coupling existing between two coils as the frequency is increased and the consequent increase of reaction.

Image Frequency Interference

The problem of eliminating image frequency effects in the superhet is a decidedly real one. This effect is also known as two-spot tuning. A strong station in addition to being audible at the ordinary dial setting will also be heard at a definite second spot on the tuning dial corresponding to a frequency removed from the station frequency by twice the intermediate frequency. It is caused by the following action. Since the frequency of the beat produced is equal to the difference between the frequencies of the carrier wave and the local oscillator, it is clear that for each setting of the oscillator there is a signal frequency both lower and higher that will give a beat to which the intermediate amplifier will respond. Thus two stations may be received while the oscillator frequency remains the same. Suppose we are receiving a signal on 580 Kc. The oscillator will be tuned to 1040 Kc. and if there should be present in the mixer circuit a carrier wave of frequency 1,500 it is obvious that this will beat with the local oscillator and any modulation will be passed on to the intermediate amplifier, since 1,500 is removed from the oscillator frequency by 460 Kc. Further if the oscillator could be set at 1,020 Kc. to receive a signal of 1,480 Kc., then any signal with a frequency of 560 Kc. would also be passed on to intermediates. In the first case 1,500 Kc. is the image frequency. In the latter case 560 Kc. is the image frequency. The name image may be explained as follows. A person two feet in front of and looking into a mirror will see an image that is apparently two feet behind the mirror. Considering the oscillator frequency as the mirror or central frequency we have a real signal frequency which is receivable on one side of the oscillator frequency, and at an equal interval on the other side there is the image or interference frequency. It is also possible that when two signals in the broadcast band are separated by the frequency of the intermediate amplifier and both are present in the mixer circuit one will serve to heterodyne the other and the modulation of both stations will appear in the output of the receiver. A signal of frequency 800 Kc. could heterodyne with one of frequency 1,260 Kc. to produce this effect.

To get around this problem of image frequency it is necessary to provide a sufficient degree of off-band selectivity between the aerial and the grid of the first detector valve. This may be done in a number of ways; by the insertion of a tuned R.F. stage; by the use of a band pass filter; by very loose coupling of the aerial or by a combination of these methods. To prevent any bad effects due to the image frequency it is necessary to reduce the intensity of the interfering signal where it appears in the first detector circuit so that it is less than one five-thousandth of the wanted signal. Thus the main purpose of any tuned circuit ahead of the mixer is to provide a very high degree of selectivity with regard to signals which are removed by quite a large amount from the signal frequency. Interference from signals on adjacent frequencies of the order of 10 Kc. difference from a signal frequency can most easily be reduced by suitable design of the intermediate amplifier.

460 v. 175 Kc. as the Intermediate Frequency

The change from 175 to 460 Kc. or thereabouts as a choice of I.F. in modern superhets. has come about mainly as a result of the greater freedom from image interference with the latter. The broadcast band extending from 550 to 1,500 Kc. demands an oscillator range of 725 to 1,675 Kc. at the lower I.F. Hence, images can be formed over a range of station frequencies running from 900 to 1,500 Kc., with the receiver tuning from 500 to 1,150 Kc. In the case of 460 Kc. I.F., however, the frequency range of interfering signals which can produce an image runs only from 1,470 to 1,500 Kc., the receiver meanwhile being tuned from 550 to 580 Kc. As the stations located above 1,470 Kc. in Australia serve only a very limited number of local listeners the effect of image frequency interference can be considered as having been entirely eliminated by the change over to 460 Kc. intermediates. An I.F. of 465 Kc. reduces this still further to the range 1,480-1,500 Kc.

While it is easier to retain stability and an exceedingly high gain at 175 Kc. this advantage is balanced by the fact that it is so much easier to design the tuned circuits between aerial and first detector for the higher I.F. It is unnecessary to employ an R.F. stage or even a band pass filter. This enables far simpler and cheaper design, at the same time being more effective as a means of suppressing images.

Arithmetical Selectivity

Consider the reception of a signal on 1,235 Kc. with an interfering signal at 1,245 Kc. The beat frequency from the wanted signal will be 460 while that from the interfering signal will be 450. While on the original frequency the percentage difference is only 0.8 per cent., it is approximately 2.2 by the time the two signals have reached the intermediate amplifier and the relative selectivity problem is approximately three times simpler for the I.F. circuit than for the T.R.F. circuit of equal selectivity. Further, consider a signal on 600 Kc. with an interfering signal at 610. The percentage difference between these two frequencies is 1.6 per cent., while that between the resulting intermediate frequency is still 2.2 per cent. The selectivity of a superheterodyne with regard to adjacent channels remains constant over the whole of the tuning range of the receiver. This is known as Arithmetical Selectivity.

It should be noted that an I.F. of 175 Kc. will provide better adjacent station selectivity since, in the example given above where an interfering station is located 10 Kc. off the wanted frequency the difference in the beat frequencies, which will be 175 and 165 Kc. respectively, is 5.7 per cent. This is considerably better than the figure of 2.2 per cent. given by the 460 Kc. I.F. At the same time since there are such a large number of I.F. tuned circuits (four, even when only one I.F. is used) it is an easy matter to obtain the necessary I.F. selectivity.

The I.F. Amplifier

The reasons for and against 460 and 175 Kc. intermediates have been discussed above. The job of the I.F. amplifier is to amplify bands of frequency not more than 10 Kc. wide, that is to say, 5 Kc. on either side of the nominal intermediate frequency. Usually the

stages are coupled together by means of a tuned transformer. Since the primary and secondary circuits are tuned this represents a very simple and effective method of providing what is, virtually, a band-pass tuner for the intermediate amplifier.

Two circuits tuned to the same frequency and coupled by a certain amount of mutual inductance will show a resonance curve comprising two peaks separated by an amount which depends on the mutual inductance and the other circuit constants. By suitably choosing these the resonance curve can be made to approximate to a flat-top, 10 Kc. wide which is of course the unobtainable ideal. We are assuming that reproduction in the receiver is to go up to audio frequencies of 5,000 cycles. We will thus have side bands for 5 Kc. on each side of the nominal intermediate frequency, and the frequency band is 10 Kc. wide. This, of course, is a matter for the manufacturer rather than service men.

For the sake of stability intermediate transformers are usually shielded. In the case of midget receivers this is not always so and cases of oscillation can very frequently be tracked down to this cause. The usual type of I.F. transformer employs two honeycomb coils of small dimensions tuned by small trimmer condensers which are adjustable to the correct setting. Until recently the use of mica dielectric trimmer condensers was universal; and much trouble, of which the cause was misunderstood, was occasioned by the resultant variation in capacity. The introduction of I.F. transformers with air dielectric condensers has done and will do much, both to increase sensitivity and reliability in these units.

No attempt should be made to line up intermediate transformers unless a modulated oscillator of suitable frequency is available to be fed to the grid of the mixer valve.

The Second Detector

Modern practice tends to the use of diode detectors (usually half-wave) in place of the previously universal use of a screen valve suitably biased. The action of a diode detector is much more obvious than that of a triode or screen grid valve. The latter when employed as a biased detector has the grid voltage adjusted to a value where only a small plate-current flows. For this reason the valve is working on a curved portion of its characteristic curve. A positive increment of voltage on the grid will cause a greater increase in plate current than the corresponding decrease due to an equal negative increment of voltage on the grid. The carrier wave, consisting of alternate positive and negative cycles will thus cause an increase in the mean plate current, when it is applied to the grid. This increase in plate current is proportional to a certain power of the amplitude of the carrier. For small signals it is proportional to the square of the carrier amplitude. For large signals it is directly proportional to the carrier amplitude. For this reason, namely that the relation between the two is not independent of amplitude, there is a certain amount of distortion unavoidably associated with the use of a triode or a screen grid valve as a detector.

In the diode detector, however, the output is almost exactly in direct proportion to the input. We say that there is a linear relation between the two. For this reason practically no distortion is associated with the use of a diode detector. The audio frequencies present on the carrier wave as modulation or variations in amplitude, are reproduced in the output circuit by reason of the variation of plate current with input amplitude. These variations in input amplitude are occurring at audio frequency, hence the plate current will vary at audio frequency. This variation in plate current is made use of by inserting a load resistance in the output circuit. The variations in current flowing through this resistor cause corresponding variations in the voltage drop across it, which are made use of to swing the grid of the audio amplifier valve.

In some of the smaller receivers the second detector feeds directly to the loud-speaker. In this case the second detector is usually a pentode valve of the output type biased to a suitably higher grid voltage. In the case of diode detectors use is made of the rectified voltage appearing across the load resistor to perform the service of A.V.C. by applying it through a suitable filter to the grid of the super-control valves. This filter takes the form of a high resistance and a condenser so that any fluctuations even at low audio frequency will not be transferred to the control bias until an interval of about one-tenth of a second has elapsed

Combined Mixer-Oscillator

Originally superhet receivers made use of a separate oscillator valve coupled by some means or other to the grid circuit of the mixer or first detector valve. Development next brought to light the combined mixer-oscillator using a screen grid valve. In this case the grid circuit was tuned to the signal frequency and the plate circuit was coupled to a circuit tuned to the oscillator frequency, itself coupled back to the cathode circuit (and hence the grid circuit) to produce oscillation. This arrangement has been superseded by the introduction of the present day electron-coupled first detector in which one portion acts as a triode oscillator, and the other portion as a normal screen grid mixer valve. Coupling between the two is obtained by the common electron stream flowing from cathode to the mixer plate. Where a separate oscillator is employed, either as a separate valve or in an electron coupled valve the oscillator portion derives its bias, usually from a grid leak rather than from the voltage drop across a resistor in the cathode circuit. The mixer valve invariably is biased by a cathode resistor or similar arrangement, mainly due to the difficulties experienced with tracking in the case of grid leak first detectors.

Tracking

The problem of tracking the tuned circuits in a superhet is rather a complex one, since the oscillator circuit has to be kept tuned to a frequency higher than the signal frequency circuits by a certain definite number of kilo-cycles, viz., the intermediate frequency. If an ordinary type of gang-condenser is employed to tune both signal and oscillator circuit the tracking will be correct at only one point on the dial. The difficulty

has been overcome in a very ingenious manner by using a series condenser in the oscillator tuned circuit. This series condenser, known as the padder, has a value depending mainly on the oscillator coil size. In lining up an oscillator circuit the trimmers in parallel with the tuning gang are first adjusted so that the receiver will track over the high frequency end of the band The padder is then adjusted so that the circuits track over the low frequency end of the tuning range. Actually the tracking is not perfect, absolutely correct lining-up only occurring at two points on the dial. At the lowest frequencies the tracking is out in a negative direction, between the two points mentioned it is out in a positive direction and at the highest frequencies it is out in a negative direction. However, with the correct size of oscillator coil the deviation from perfect tracking is not sufficient to worry about. Oscillator coils have an inductance of about 80 per cent. that of the tuning coil. The value however is not extremely critical.

In explanation of the use of a padder condenser. at the high frequency end of the band where the capacity of the tuning gang is small the series capacity has only a small effect on the equivalent capacity placed across the tuning coil. Hence, the trimming condenser on the gang may be adjusted to give correct tracking at this end of the band. At the low frequency end of the band the adjustment of the padder condenser will have quite a large effect on the resultant capacity connected across the oscillator coil and can be made use of to give correct tracking over this end of the dial. In the case of all wave receivers employing a tuning gang it is usual to connect a small trimmer condenser across the first detector circuit so that it can be adjusted by a knob on the panel. Since there is no manual trimmer in the oscillator circuit the dial reading for a particular station will be constant. In some cases in order to broaden the tuning on the short-wave ranges, the condenser is connected across only a portion of the coil. Alternatively, series capacities are made use of. This is one point which is definitely bad in most all-wave receivers namely, the extremely fine tuning necessary to locate and hold a short-wave broadcasting station.

A Typical Modern Superheterodyne

The accompanying block is a diagram of a typical modern superhet. The set in question is an American model and not on the market in Australia. As will be seen it is an all-wave five valve and rectifier set, employing six volt valves. The modern tendency is in this direction, although many manufacturers stick to the old 2.5 volt series. Efforts are being made by valve manufacturers to standardise on 6-volt series valves. Slightly lower filament power is needed (1.9 watts in place of 2.5). Considering first the power supply unit this makes use of an ordinary type 80 rectifier. It will be seen that two small condensers, each of 0.015 mfd. are connected in series across the power mains, with the centre tap earthed. This cuts down hum and inductive interference which is present to a greater or less degree in any power main no matter how free the location may seem to be from such interference. The grounding of the 6.3 volt winding C.T. further cuts down hum.

Apart from the rectifier filament winding only one 6.3 volt winding is needed to supply the whole of the heater requirements for the receiver. This is only 1.9 amps. at 6.3 volts. Including the rectifier, the total filament power required is 22 watts, a very much lower figure than for the equivalent set of two years ago which, employing the older type of 2.5 valves, would draw some 32 watts to heat the filaments. Even the new 2.5 volt valves would draw about 25 watts. All this means a slight saving in transformer cost. The filter is normal, employing a pair of 8 mfd. electrolytic condensers, one on each side of the speaker field coil which is used as a choke. The resistance of this field coil, 1,125 ohms, is somewhat lower than will be found in the average Australian receiver. The connection of a 0.05 mfd. condenser across this field coil is also rather unusual. Bias for the output stage is provided by the tapped resistor, item 58 on the drawing. The total drain from the pack flows through this resistor which has a total value of 267 ohms, giving a voltage drop of about 16.5 with the current drain at 65 mA. The section of 32 ohms (giving a voltage drop of about 2.0 volts) is tapped off to provide suitable bias for the triode section of the type 75 second detector valve. The grid lead to this triode section is de-coupled by means of a 0.1 meg. resistor (57) and a 0.05 mfd. condenser (65). The 1.0 meg. resistor (56) is an ordinary grid leak. The return from the grid leak (49) of the output pentode is not de-coupled.

Further Decoupling

Further decoupling units with typical values shown on the drawing will be seen in the plate lead of the 75 valve (items 50 & 65) and in the plate lead of the second I.F. stage (items 42 & 25). The tone control is a simple switch (60) which cuts in an additional capacity (61) of 0.015 mfd. across item 59 (0.01 mfd.) connected from pentode plate to earth. Additional tone correction is provided to some slight extent by the 0.00025 mfd. condenser (47) from the plate of the 75 to earth. The output pentode employed, namely a type 42, is the exact replica of the 2A5 in the 2.5 volts series. The speaker employed has a voice coil resistance of 1.11 ohms in series with the 0.07 ohm humbucking coil. This is a typical value.

It will be noted that the plate load of the 75 is given as 70,000 ohms. This is rather a low value, but can be accounted for by the presence of the decoupling resistor (50). Any additional resistance would cause too great a voltage drop. Near the middle of the page will be seen a small power choke (item 70) running from

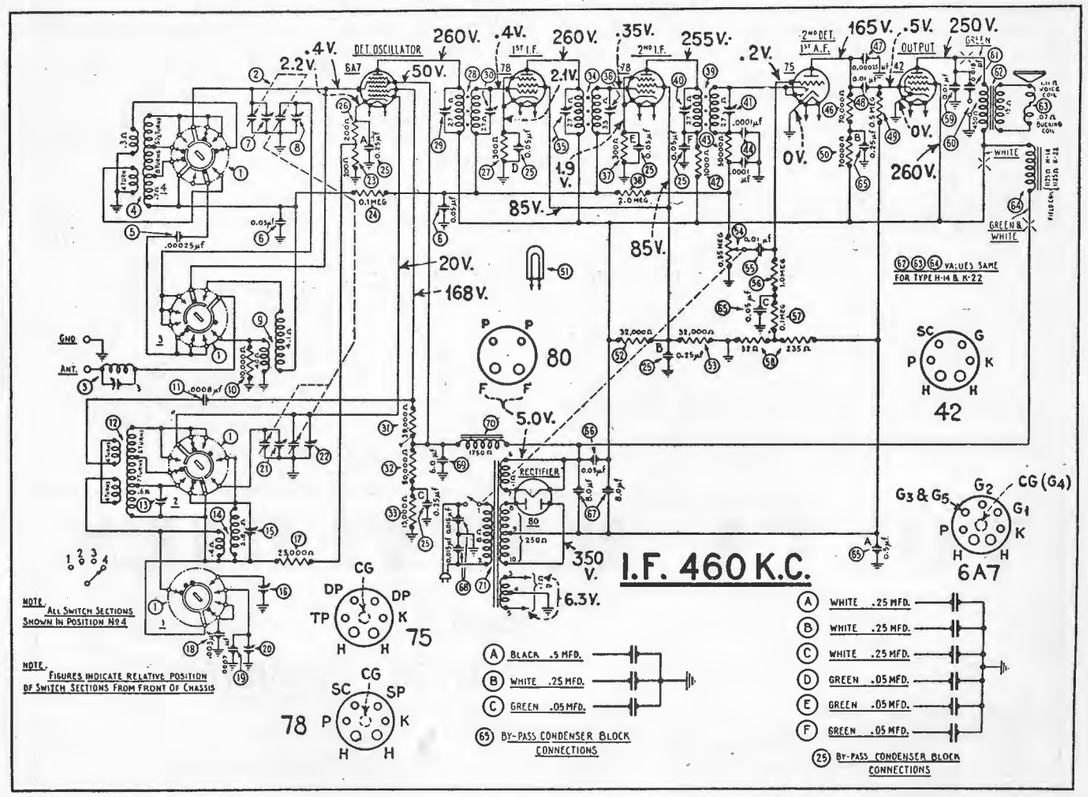
the rectifier filament. This supplies current to the various portions of the 6A7 valve. The filter is completed by item 69, a 6mfd. electrolytic condenser. Resistors 31, 32, 33, supply the requisite voltages. The plate, by which is meant the external plate of the 6A7 and not the oscillator anode grid, is, however, supplied from the ordinary voltage network. Item 51 represents the dial light.

A.V.C. (Automatic Volume Control)

A.V.C. is employed, both I.F. stages and mixer valve being controlled. Due to the rectifying action of the diode plates in the 75 which are connected together the carrier builds up a voltage across the 50,000 ohms load resistor (43). This is applied by means of the filter 38 (a 2 meg. resistor), and 6 (a 0.05 mfd. condenser), in the first place to the grids of the two I.F. stages employing type 78 valves. The control voltage is then applied through a further filter 24 (a 0.1 meg. resistor) and 6 (another 0.05 mfd. condenser) to the grid of the 6A7 valve. This second filter is rather in the nature of a decoupling unit to prevent feedback and consequent unwanted oscillation of the outer section of the 6A7. Manual volume control is provided by a quarter meg. potentiometer connected in parallel with the diode load resistance 43. The output on the sliding arm of this unit 54 is fed to the grid of the type 75 audio section by a 0.01 mfd. condenser.

I.F. Stages

The I.F. transformers, it will be seen, have a ratio of 1:1. This is quite customary, being a far easier form of construction, both in the manufacture and the subsequent lining up. The advantages of using a step-up ratio for the I.F. transformer is very doubtful. Although it improves the matching of the R.F. load impedance to that of the I.F. valves at the same time it introduces difficulties in obtaining an even square top curve which is so desirable from the viewpoint of selectivity. The 78's are provided with the necessary minimum bias of 3.0 volts by the resistances 27 and 37 of 300 ohms. These are by-passed by 0.05 mfd. condensers as shown. Screen voltage is supplied by tapping between the two resistors 52 and 53 and amounts to 85 volts. This value is lower than the rated (100 volts) and is apparently necessary in order to preserve stability. Low screen voltage is instrumental in preventing oscillation in these stages.



An error will be noticed in the diagram in the screen connection of the 6A7 which should go to the tap between resistors 32 and 33. This also is by-passed by a 0.25 mfd. condenser. The screen voltage of 50 applied to the 6A7 is very low compared with the rated 100 volts. This is necessary to maintain oscillation on the lower wave-bands, and is a tip worth remembering when trouble is experienced due to the 6A7 (or any other pentagrid converter valve) refusing to oscillate. Further the plate voltage of 168 applied to the oscillator section of the 6A7 is lower than the rated 200 volts. This is another reason for the lowered screen voltage. The method of feeding the oscillator section with its plate current is interesting as it does away with the necessity for carrying high-tension leads through the switching devices and the oscillator plate coils. The plate voltage is fed direct to the anode grid by means of a wire-wound resistor (31—39,000 ohms). This acts both as a voltage dropping resistor and as an efficient R.F. choke. The anode grid is naturally at a high R.F. potential and the construction of an efficient R.F. choke to cover the wide wave range encountered in this type of receiver would be a very difficult job. Such a wire-wound resistor makes a better choke than any of the ordinary section or honeycomb-wound commercial chokes.

The switching arrangements illustrated are much more complicated than those in the average Australian receiver. The practice of using a tapped coil to cover the three required short-wave bands is not good, particularly in this case where portion of the coil is shorted out for the two lower of these bands. The use of normal broadcast band coils entirely separate from the short-wave coils is standard practice. Further information on all-wave practice will be found in the section devoted to those receivers.

BIAS RESISTORS

The correct value for a bias resistor may be determined by the formula below:

$$R = \frac{\text{Grid Bias in Volts} \times 1000}{\text{Current through resistor in milliamps.}}$$

$$= \frac{1000\ eg}{6_c}$$

The current through the resistor the total cathode current, or if we are concerned with more than one tube the sum of their respective cathode currents. For example suppose we wish to use a pair of type 38 pentodes in a push-pull output stage. At 250 volts plate supply the 38 needs 25 volts bias and draws 22 mA. plate current and 3.8 mA. screen current. The cathode current is thus 25.8 mA. for one tube and the total current through the bias resistor will be double this or 51.6 m.A.

The bias resistor should thus be of a value

$$R = \frac{25 \times 1000}{51.6}$$

$$= 485 \text{ Ohms.}$$

A resistor of 500 ohms would be sufficiently close. This value of self-bias resistor is also near enough when the valve is used at plate voltages other than the rated 250 given in the characteristics table.

Public Address Systems

In this section it is our intention to devote ourselves rather more to the methods of application appearing in P.A. systems which are somewhat strange to the average radio man, even though he may be quite conversant with his ordinary radio practice. It is in fact written for the man already acquainted with amplifier practice in broadcast receivers. Many of the points outlined below will be found to apply not only to P.A. systems but also to amplifier systems such as are found in many broadcast stations.

THUS over a public address system we may wish to convey an announcer's voice to a large audience, to amplify gramophone music or the output of a broadcast receiver, or to amplify some form of entertainment where the performers may not always be close to the microphone. A scheme for such a system is shown in Fig. 1.

Fig. 1.

As shown this incorporates a double button microphone used for pick-up purposes which is fed into a pre-amplifier having a gain of about 30 db. This means a voltage amplification of about 31 if the input and

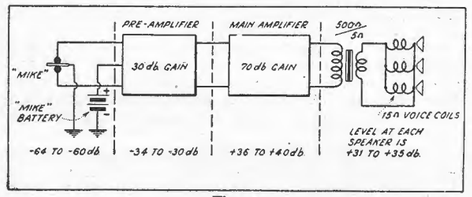


Fig. 1

load impedances are equal. Suitable transformers must of course be used for the input and output. Reference should be made to the watts-decibel chart of Fig. 4 and the table of decibels and power ratios. It is felt that the explanation of the decibel, which appears later, that rather mysterious unit of gain and level, will prove helpful.

Pre-Amplifier.

The pre-amplifier is followed by the main amplifier of 70 to 80 db. gain and comprising either three or four stages. A push-pull output stage is the rule in the main amplifier. Pick-up, radio receiver and announcement (carbon) microphone may be fed directly into the main amplifier dispensing with the use of the pre-amplifier.

The main amplifier output is fed through a suitable matching transformer to the desired number of speakers. The voice coils of these speakers are shown connected in parallel. For operation in this manner, the voice coil impedances must all be equal. In many cases the use of a pre-amplifier is unnecessary, e.g., where only the announcement microphone and the pick-up are desired. The main amplifier is sometimes operated by an incorporated power pack but more usually by an external source of power. It is convenient to build the two units into one rack or frame, with the power supply at the bottom and the amplifier above together with gain control, switches, input and output devices including (if used) resistance pads and mixer.

The Decibel

It is common practice by manufacturers to-day to rate microphones and associated units of apparatus used in P.A. work as having power outputs and or gains of so many decibels above or below a reference point or power called "zero level." This reference level or zero level for the decibel scale has been fixed at six milli watts, or .006 watts which means of course that zero db is 6 milliwatts.

Once one becomes accustomed to the use of a decibel scale it will be found much more flexible to use than one referring to amplifications. In practice it is rare to find the 'even power ratios while decibel equivalents may be expressed with sufficient accuracy by two, or at the most, three figures the addition of which is obviously more quickly done than the corresponding multiplications.

The decibel is a most convenient unit because the human ear can just recognise a **change** in the volume of sound resulting from an attenuation or a gain of one decibel.

For this reason volume controls calibrated in db give a very uniform increase in volume due to the fact that the ear recognises the changes as equal steps. Most volume controls, at least those associated with public address work as distinct from domestic radio, are set so as to change the volume in 3 db steps, as a step of 3 db is not so great that a change of one step will cause the volume to be raised from a level too low to a level too high.

Due to the fact that frequencies of the order of 30 to 10,000 cycles are to be considered and the difficulty associated with measuring the power in watts directly and also because the power levels are of the order of thousandths of a watt, it is preferable to measure either the current through a known resistance or the voltage across a known resistance. The fundamental formula therefore of:—

$$\text{Number of db} = 10 \log \frac{\text{Watts Output}}{\text{Watts Input}}$$

may not be as useful as those which follow. In order to simplify the circuits electrically most P.A. apparatus and a great deal of telephone equipment is designed so that the impedances of both input and output are equal. The value usually being 500 ohms.

Public Address Systems—(Continued).

If we substitute in place of "Watts output" and "Watts input' '(in the above formula for the "Number of db" or the "gain in db") the expression for power in terms of current and resistance it becomes;

$$\text{Gain in db} = 10 \times \log \frac{(\text{Current output})^2 \times \text{Impedance}}{(\text{Current input})^2 \times \text{Impedance}}$$

the impedances cancel out leaving the formula

$$\text{Gain in db} = 10 \times \log \frac{(\text{Current output})^2}{(\text{Current input})^2}$$

$$= 10 \times \log \frac{(I_1)^2}{(I_2)^2}$$

where I_2 represents current Input
and I_1 current output.

The log of the square of a number is equal to twice the log of that number therefore we may rewrite the above

$$\text{Gain in db} = 10 \times 2 \times \log \frac{(I_1)}{(I_2)} = 20 \log \frac{(I_1)}{(I_2)}$$

This condition is only true so long as the impedances through which the current I_1 and I_2 are flowing are equal.

If it is more convenient to measure the voltage across the impedance rather than the current through it we can say, again of course providing the impedances are equal in the two places where measurements are made.

$$\text{Gain in db} = 10 \log \frac{(\text{Voltage output})^2 \times \text{Impedance}}{(\text{Voltage input})^2 \times \text{Impedance}}$$

The Impedance cancels as before, leaving

$$\text{Gain in db} = 10 \log \frac{(V_1)^2}{(V_2)^2} = 20 \log \frac{(V_1)}{(V_2)}$$

which is exactly the same as if the current output and input were measured.

Care should be taken not to confuse the "Gain in db" with "level in db." Each is commonly expressed in decibels although strictly speaking a level should be referred to as "level in db above zero level." Thus while the **output level** of a given amplifier is, say, 30 db its **gain** is only 20 db.

"Minimum audibility" is much too small to be used as a reference intensity for relatively loud sounds such as those coming from a loud speaker therefore "zero level" of 0 db = 6 milliwatts has been generally adopted.

An idea of the intensity of sound at "zero level" may be had if it is remembered that speech from a telephone receiver held tightly against the ear is about zero level when it is just too loud to be comfortable.

Volume Required

Having given an outline of a typical P.A. system and also discussed the decibel, let us pass on to a consideration of the acoustical side of the situation which is the starting point in any particular P.A. problem. We have to fill a room of definite volume with sound.

Requirements will determine how loud this sound is to be and in order that we can become familiar with the levels of various sounds, some of the more common are given below:

75 piece orchestra (peak)	113 db
Aeroplane engine (unsilenced 10 feet away)	110 db
Bass Drum (peak)	107 db
Pipe Organ (peak)	105 db
Piano (highest peak)	100 db
Express train (12 feet away)	100 db
Peak of singing	91.8 db
Pneumatic drill (20 feet away)	90 db
Tram on very noisy rails	90 db
Peak of speech	84 db
Very loud radio music	80 db
Very loud speech	77 db
Piano—average	73 db
Very busy traffic (accelerating buses and cars)	70 db
Loud radio speech	60 db
Average speech	57 db
Conversation	50 db
Soft violin in orchestra	43 db
Loud whisper at 5 feet	40 db
Quiet garden	20 db
Soft whisper	17 db

Frequency Range

An appreciation of the range of frequencies to be reproduced by the Public Address Speakers if we are to simulate the original will be obtained from figure 2.

The frequency band between the points x-x is the most significant as the full line between these points represents the actual tone range whereas the higher and lower cut-offs as indicated by the broken lines extending beyond the points x-x indicate the accompanying noise range.

In some fields of the Radio Industry it is common to find that old conceptions of the frequency spectra of various musical instruments and common sounds still persist. As an example, many publications are available with illustrations of the piano keyboard on which are superimposed the fundamental note frequencies and some form of indication of the compass of musical instruments. To select two outstanding examples. The violin according to old authorities covered the frequency band of 192 to 3072 cycles whereas we find it actually is necessary to provide for those tones up to the region of 12,000 cycles. It will be noted that those frequencies below 245 cycles constitute for the most part "noise' 'and would appear to be due to the action of the bow on the string.

In the case of the bass tuba until recently rated at 42 to 341 cycles it will be seen that this instrument actually has for its top cut-off a frequency of approx. 6,000 cycles. Here again it will be observed that those frequencies at the lower end are now in the light of more detailed and complete data designated "noise."

The reason for this large discrepancy between old conceptions and new accepted standards lies in the fact that old sound analysing and measuring apparatus had very severe limitations and the results obtained were frequently those of aural observations whereas to-day we have the advantage of more scientific electro-acoustical instruments.

Not only must our Speakers be capable of reproducing faithfully the original but they must be able to deliver the required power. The actual power required will vary with local conditions, but apart from this we seek that realism which will come only as a result of duplication of the original. The following details are therefore interesting.

To get back to our own problem we can best take a leaf out of the Theatre Sound Equipment Companies' book where the first thing to be done before equipment types and prices are discussed is to survey the building in which sound is to be reproduced.

Having made our survey and obtained the cubic contents of the building we can refer to Figure 3, which is a chart for determining the acoustic power required to fill a room of definite volume. The acoustic power in watts is not the same as the electrical output of the amplifier since loud-speakers are very inefficient devices when one considers the ratios of their electrical input energy to their acoustical output energy.

The efficiency of an average baffle-type dynamic speaker is about 10%. The efficiency of the very best modern dynamic speaker unit using directional baffles or exponential horns may rise to 20% and in some cases even 25%.

Suppose we assume the figure 10% as the efficiency of our speakers, and we have to fill a room 30 feet high and 50 feet wide by 100 feet long. The total volume or cubical contents of this room is 30 x 50 x 100 or 150,000 cubic feet. Looking up fig. 3 which has been drawn up from the results of research and experience, we find that a little more than 0.9 watts of acoustic power will be required to satisfactorily fill this room. Since our speaker is only turning 10% or 1/10th of the energy it receives, into sound, an

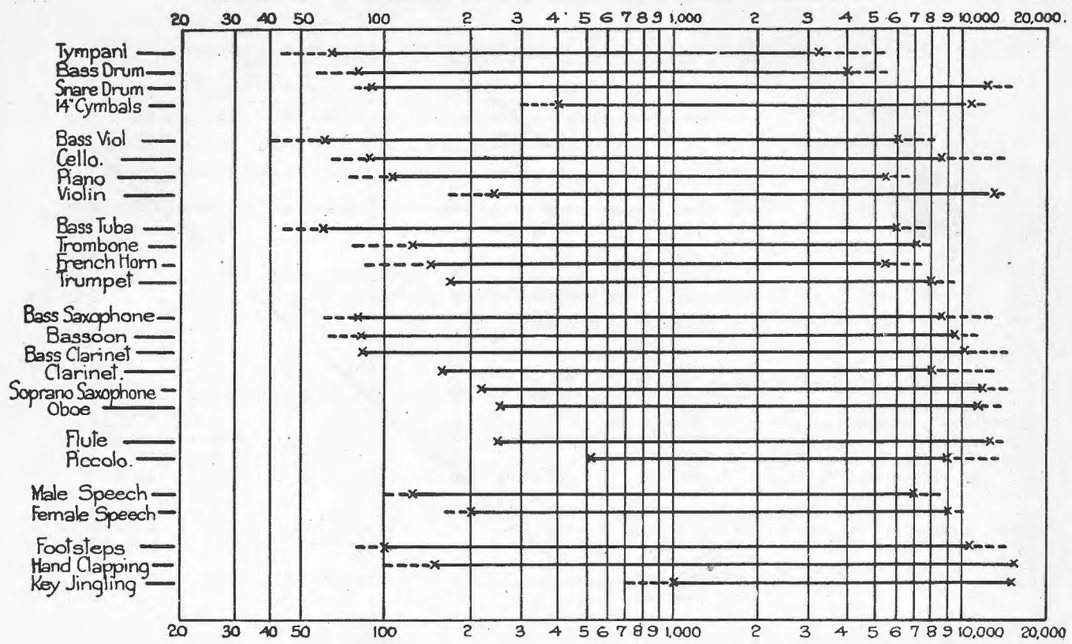


Fig. 2

Instrument	Peak power in watts over whole frequency band.	Coresponding % of intervals.	Band containing max. peaks in c.p.s.	Peak power in watts in column 4	Corresponding % of intervals
36in. Bass Drum A.	24.6	6.0	250-500	9.8	1.0
36in. Bass Drum B.	1.2	1.5	20-62.5	0.24	1.0
Snare Drum	11.9	2.5	250-500	3.7	1.0
15in. Cymbals	9.5	7.5	8000-11300	0.95	1.0
Triangle	0.05	37.0	5600-8000	0.017	6.0
Trombone	6.4	5.0	500-700 / 2000-2800	.06	3.0
French Horn	0.053	6.0	250-500	.04	17.0
Piano (average)	0.26	16	250-500	0.26	7.0
15 piece orchestra	9.0	1.5	250-500	0.45	1.5
75 piece orchestra A.	66.5	1.0	8000 ∞	5.3	1.0
75 piece orchestra B.	13.9	1.5	2000-2800	1.4	1.5
Pipe Organ A.	3.5	1.5	250-500	1.75	7.0
Pipe Organ B.	12.6	36.0	20-62.5	2.5	22.0

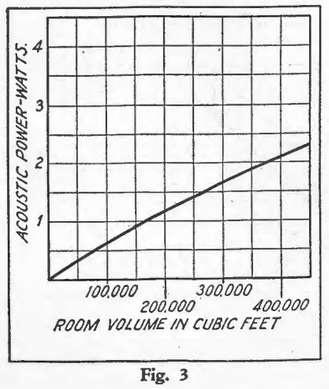


Fig. 3

electrical output of 9 watts will be necessary. Looking up Fig. 4, which is a handy reference of power levels in watts for conversion to levels in db. we find that 9 watts is equivalent to 31.75 db.

Now a carbon microphone will probably have an output of —60 db (commonly referred to as "60 db down") and as we need a gain of say 32 db (to be on the safe side of things) in the amplifier the total amplification required will be 60 + 32 = 92 db.

If a mixer were to be used an additional 10 db gain would be required to make up for the minimum loss of the mixer (even at its zero position) when included in circuit. This value of 10 db is commonly referred to as the "insertion loss."

For our purposes however, we will assume that one or both amplifiers are fitted with some form of gain control. Now the main amplifier will usually have a gain of 70—80 db. If we use the lower figure of 70 db it will be seen that to attain our overall **gain** of 92 db. (and incidentally our **level** of 32 db) we shall require a pre-amplifier with a gain of 22 db. The

usual pre-amplifier with a gain of 30 db. will provide a comfortable margin. This margin may however, be required since the figure for microphone output is that for a person talking in a normal tone at a specified distance from the "mike." Its output, it must be remembered, will vary inversely as the square of the distance between the person speaking and the microphone. A margin of 6 db will usually suffice to take care of these conditions.

It should also be born in mind that extra gain will be necessary in order to produce a higher level with which to overcome noises due to auditors themselves (consider a dance floor with couples dancing) and also to overcome absorption of the reproduced sound by the auditors' clothing, etc. This absorption will vary with the number of persons present, but a safe allowance in this regard for normal audiences would be 6 db. Reverting to the level chart of Fig. 1 we can see the various units in the amplification chain with appropriate output levels shown between the dotted lines of the sections to which they refer. Note that since three 15 ohm speech coils are used in parallel a 5 ohm output line will be needed and since each speaker will take one third of the output power the level delivered to the speakers will be 5 db less because we have here a power loss ratio of one third or 0·3 which it will be seen from the following is equal to a loss of 5 db.

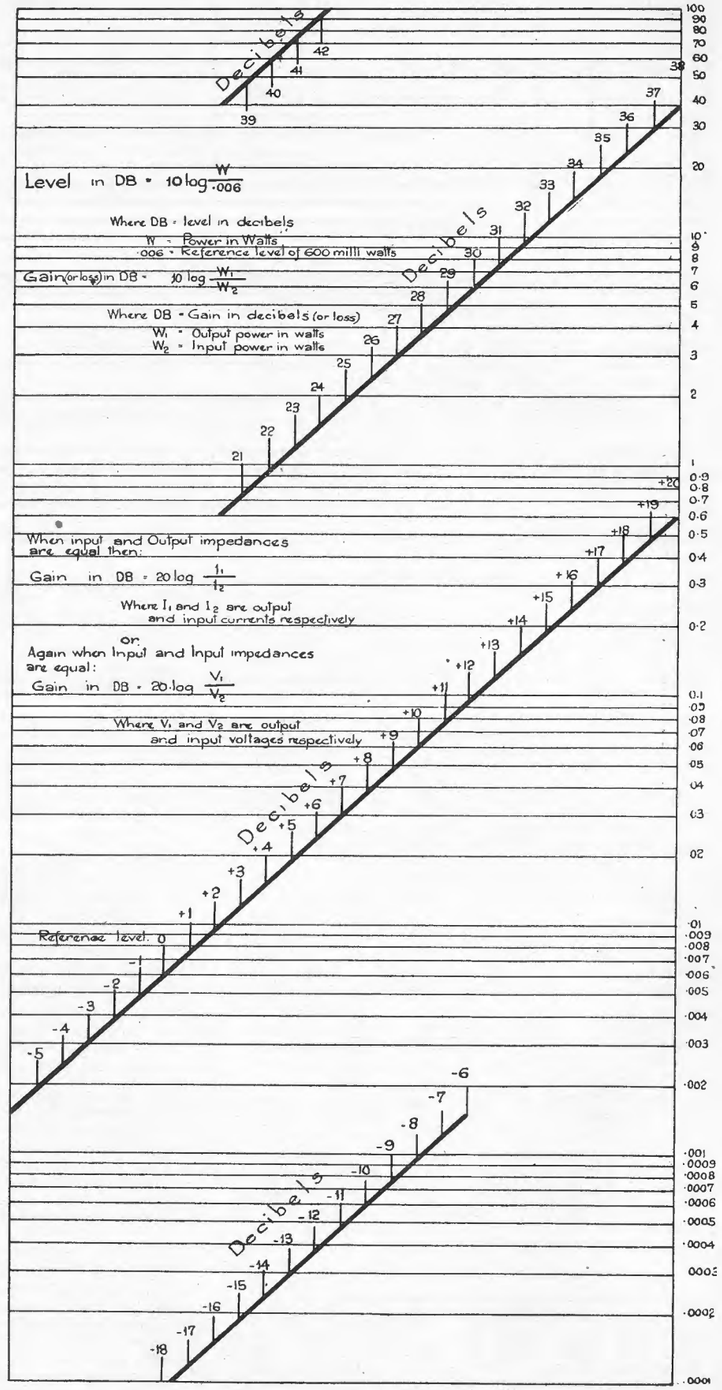


Table Showing Relationship Between Decibels and Current, Voltage, and Power Ratios (and reciprocals).

Decibels	$\frac{I_1}{I_2}$ or $\frac{V_1}{V_2}$	$\frac{P_1}{P_2}$	$\frac{I_2}{I_1}$ or $\frac{V_2}{V_1}$	$\frac{P_2}{P_1}$
1	1.122	1.259	.8913	.7943
2	1.259	1.585	.7943	.6310
3	1.413	1.995	.7080	.5012
4	1.585	2.512	.6310	.3981
5	1.778	3.162	.5623	.3162
6	1.995	3.981	.5012	.2512
7	2.239	5.012	.4467	.1995
8	2.512	6.310	.3981	.1585
9	2.818	7.943	.3548	.1259
10	3.162	10.	.3162	.1000
11	3.548	12.59	.2818	.07943
12	3.981	15.85	.2512	.06310
13	4.467	19.95	.2239	.05012
14	5.012	25.12	.1995	.03981
15	5.623	31.62	.1778	.03162
16	6.310	39.81	.1585	.02512
17	7.080	50.12	.1412	.01995
18	7.943	63.10	.1259	.01585
19	8.913	79.43	.1122	.01259
20	10.000	100.00	.1000	.01000
21	11.22	125.9	.0891	.007943
22	12.59	158.5	.0794	.006310
23	14.13	199.5	.0708	.005012
24	15.85	251.2	.0631	.003981
25	17.78	316.2	.0562	.003162

Decibels	$\frac{I_1}{I_2}$ or $\frac{V_1}{V_2}$	$\frac{P_1}{P_2}$	$\frac{I_2}{I_1}$ or $\frac{V_2}{V_1}$	$\frac{P_2}{P_1}$
26	19.95	398.1	.0501	.00251
27	22.39	501.2	.0447	.00200
28	25.12	631.0	.0398	.00159
29	28.18	794.3	.0355	.00126
30	31.62	1000.0	.0316	.00100
31	35.48		.02818	
32	39.81		.02512	
33	44.67		.02239	
34	50.12		.01995	
35	56.23		.01778	
36	63.10		.01585	
37	70.80		.01412	
38	79.43		.01269	
39	89.13		.01122	
40	100.00		.01000	
41	112.2		.00891	
42	125.9		.00794	
43	141.3		.00708	
44	158.5		.00631	
45	177.8		.00562	
46	199.5		.00501	
47	223.9		.00447	
48	251.2		.00398	
49	281.8		.00355	
50	316.2		.00316	

Decibels	$\frac{I_1}{I_2}$ or $\frac{V_1}{V_2}$	$\frac{I_2}{I_1}$ or $\frac{V_2}{V_1}$
51	354.8	.00282
52	398.1	.00251
53	446.7	.00224
54	501.2	.00200
55	562.3	.00178
56	631.0	.00158
57	708.0	.00141
58	794.3	.00126
59	891.3	.00112
60	1000.	.00100
61	1122.	.000891
62	1259.	.000794
63	1413.	.000708
64	1585.	.000631
65	1778.	.000562
66	1995.	.000501
67	2239.	.000447
68	2512.	.000398
69	2818.	.000355
70	3162.	.000316
71	3548.	.000282
72	3981.	.000251
73	4467.	.000224
74	5012.	.000200
75	5623.	.000178

Fig. 5.

Potentiometer Calibration

IF it is desired to construct a potentiometer for gain control on an amplifier, the resistances required can be calculated as follows: Set an arbitrary value of resistance that is to be the total shunt resistance across the secondary winding of the transformer. Then select the amount of gain by which each step is to be changed. From Fig. 5 find the voltage ratio corresponding to the number of decibels by which gain is to be changed on the first step. The product of this ratio and the total shunt resistance, will give the fraction of the total shunt resistance included between the grid and filament. For step number two, find the voltage ratio corresponding to the number of db from maximum, and multiply the total shunt resistance by this value, thus obtaining the value of resistance between grid and filament; and so on for each step that may be

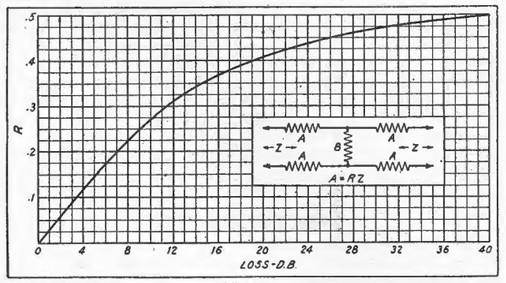


Fig. 6.

desired. For example, suppose a potentiometer is to be constructed which has a total resistance of 144,200 ohms. and has two steps of 10 db each. The first step being 10 db from maximum, this corresponds to a voltage ratio of .316, so .316 x 144,200 = 45,567 ohms. should be included between grid and filament. The second step will be 20 db from maximum; this corresponds to a ratio of .1. Hence, .1 x 144,200 = 14,420 ohms. between grid and filament.

The following equation, in which R is the total resistance and r is the resistance between grid and filament, may also be used: N = 20 log 10 R/r.

Attenuation Networks

The main gain control is normally set to a position that will give the required volume output and if we desire to switch from, say, pickup or radio, to announce microphone and at the same time have no change in volume output then it is usual practice to "pad down" these circuits so that rapid switching from one unit to the other may be accomplished without alteration of the gain control.

Whilst variable attenuators are usually purchased because their cost does not warrant their construction by the user, fixed pads of practically any loss and impedance may be constructed very cheaply. Again the construction of simple pads often makes possible the use of cheaper apparatus and reduces the

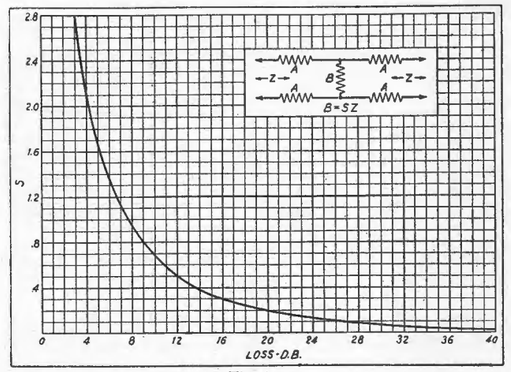


Fig. 7.

number of impedance-matching transformers required for a given job. For example in switching over to radio simply by disconnecting the loudspeaker speech coil, the output will be too high. The speech coil impedance usually of the order of 10 ohms would normally call for an impedance-matching transformer to work into an input impedance of 200 or 500 ohms. Both the high level and the transformer problem can be overcome by using an attenuator pad.

We will first consider a much simpler case and return to the speech coil problem later. Suppose we require to insert a loss of 20db and that the amplifier input impedance is 200 ohms. 20 db represents a voltage ratio loss of 0.1 as seen from the table of relations between decibels and current, voltage, and power ratios. Reference to Fig. 6 will show the relationship between the series arms of a balance H type pad and the loss in db.

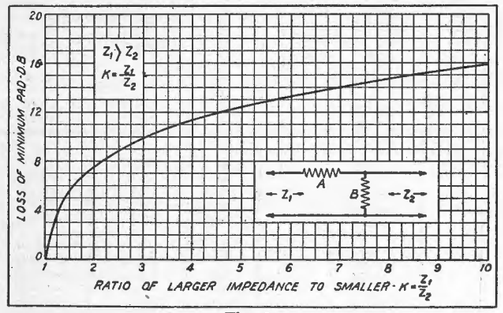


Fig. 8.

From this curve it will be found that at 20 db R = .42, and since the series arm A = RZ we have, A = .42 × 200 = 84 ohms. Likewise from Fig. 7 we obtain S for 20 db = .2 and as B = SZ we have .2 × 200 = 40 ohms. The result is four legs of the H network as shown on the graph by A of 84 ohms each and the shunt path B. of 40 ohms, input and output 200 ohms, loss 20 db., which would not be suitable for our purpose. We desire a pad with impedances of 200 ohms input and 20 ohms output.

If an unbalanced or L-type pad is required (we will come to the H-type later) refer to Fig. 8 when we see that for a ratio known as K of larger impedance to smaller impedance of 10 (from $\frac{200}{20} = 10$) we obtain an insertion loss of 15.8 db. This must be remembered and taken into consideration on final calculations. To come back to the point, Fig. 9 reveals that the series arm A = PZ, where P is a fraction depending upon the ratio of the input and output impedances and L is the input impedance. Therefore we have again $\frac{200}{20} = 10$ which from graph P gives us .95 which is of course P. Therefore: A = PZ, = .95 × 200 = 190 ohms. Also from graph Q we get .1 for our ratio of 10, and with B = QZ we obtain .1 × 200 = 20 ohms, which is what we required.

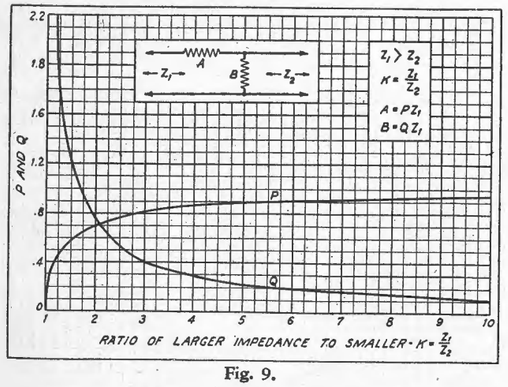


Fig. 9.

If a balanced or U-type pad had been required each series arm would be half the value A of 190 ohms or 95 ohms.

To return to our speech coil problem:

We wish to pad down the output of our radio receiver the output speech line of same having a 10 ohm impedance. We will say the receiver output is 0.6 watt (i.e., 20 db.). For other purposes before we switch over to the radio side it is necessary for us to use 70 db of our main amplifier gain, and that its output level be 30 db.

There is a loss of 10 db in the main gain control. The input to the amplifier should therefore be 30 (the output level) minus 70 (the amp. gain) which is —40 db. Allowing 10 db loss in the main gain control we get —30 db input level.

By inserting a 10 ohm resistance in series with the radio receiver speech coil we are able to use a 20 ohm pad in parallel without upsetting the impedance relation in the output of the radio receiver. Half of the power will be absorbed by the pad and half by the loud speaker speech coil plus the 10 ohm resistance.

That is, the level delivered to each half will be 3 db down from the receiver output. (Incidentally the actual power to the loud speaker itself will be down a further 3.5 db).

For ideal purposes the 10 ohms inserted in the voice coil circuit should be divided so that 5 ohms are placed in each lead but as these leads are short it is not absolutely necessary to do this.

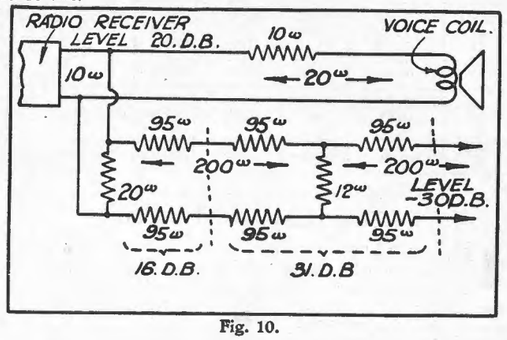


Fig. 10.

The position now is receiver output into P.A. line = 20 db —3 db = 17 db. Input required to amplifier —30 db therefore loss to be introduced = 47 db. We have already found from our previous case that a 20-200 ohm pad would have an insertion loss of 15.8 db — say 16 db. Therefore the H-type pad will only need a further 31 db loss.

A U-type pad as distinct from an H-type has already been considered, and it was found our particular example had a series leg of 190 ohms and a shunt path of 20 ohms or two half legs of 95 ohms each with a parallel path of 20 ohms. As this had an impedance of 200 ohms on one side it will be suitable for our purpose and will work into a 200 ohm H-type pad.

From the curve Fig. 6 we can find the factors to obtain A. A = RZ. R for 31 db = .475 and Z is 200, therefore, A = 95 ohms. We now want B which equals SZ. Looking up the curve (Fig. 7) to get S we find that 31 db = .06 and Z is 200 again therefore B = 12 ohms. The arrangement of Fig. 10 is the result thereof.

Microphones

Without a doubt, the double-button carbon microphone enjoys the greatest popularity of any type in use at the present time. Notwithstanding the higher background noise and fragility, the low cost, relative high output and portability outweigh the advantages of the other types, in most cases. It is not to be inferred that this is true in all installations. All types have a definite place in present-day practice.

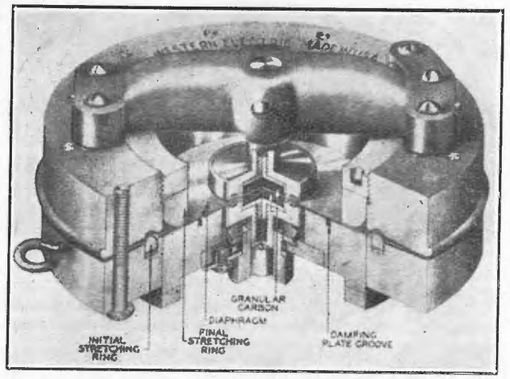
A modern high quality carbon microphone, when operated correctly, usually has a flatter and wider frequency response than the speaker and other component parts. However, improper operation can materially ruin the overall response of a fine sound or modulation system. Careful attention given to the pick-up end will well be worth the efforts spent in this direction.

(Continued on next page).

Feed-Back

All public-address operators are familiar with "feed-back," a condition that exists when the sound, leaving the speakers, returns to the microphone either directly or by reflection, causing an acoustical oscillation. This produces a "howl," the frequency of which is dependent on the distance between the speakers and the microphone. A "ring" on the end of the spoken words is a milder form of this state and is analogous to regeneration in vacuum tube circuits, the "feed-back" being additive to the impressed sound.

Because this is so often encountered in most indoor and some outdoor installations, it is not always practical to have the microphone extremely sensitive. Reduced current affects the high and low ends of the register—the parts of the audio spectrum that have the greatest bearing on quality. It must be remembered that the low frequencies are the ones that contribute to "feed-back" because they are so easily reflected. The high frequencies are absorbed and dissipated and are therefore not bothersome in this respect.



An exposed section view of the Western Electric Carbon Microphone.

For this reason, a reduction of button current and consequent lessening of the lower register is sometimes advisable to obtain greater apparent volume, because the power will be concentrated in the middle and high end and produce a greater degree of intelligibility without "feed-back." In certain installations, a reduction in button current of several milliamperes will stabilize the system and not change the response more than .5 db.—an inappreciable amount. All of this depends on individual requirements. "Cut and try" is the best method of solving the problem unless the operator has a great deal of laboratory equipment at hand.

Sound Truck Service

It is common practice in sound truck operation to use a low value of button current as the rough treatment at high current values quickly burns the grains, and being in close proximity to the speakers, "feed-back" is prevalent. In this connection, close speaking is recommended partially compensating for the lack of lows in the microphone response as a greater proportion of the lows in one's voice will be reproduced. However, extremely low values of current will attenuate the higher register and decrease the intelligibility.

With present-day engineering, the "hiss" or carbon rush does not rise greatly with increased button current. With the advent of acid treatment of the grains which reduces the ash content, the db. rise of the hiss level rarely exceeds 2.5 db. during a change from 1.5 to 20 m.A.

High current values naturally will reduce the life of the carbon granules, but far greater damage can be done by jarring the microphone with the current flowing through it. Modern design makes long life possible at current values up to 20 m.A. in most reliable makes.

Any type of shock to the microphone, electrical or mechanical, will shorten the life. It is good policy to provide a means of applying the button current gradually, through a rheostat or potentiometer, rather than by the use of a switch, alone. Current obtained from an A.C. source (D.C. from the filter or the cathode resistor or an input stage) provides gentle application and is recommended wherever practical.

Unequal Current

An off balance condition sometimes exists when the resistance of the buttons become unequal and draw different amounts of current. Unless the grains and buttons have lost the polish due to burning, it can be remedied by tapping or shaking lightly with the current off. Often a microphone will regain balance when sound is impressed on it and return to an off balance state when not being excited, a condition that is not necessarily harmful. Broadcast practice allows an unbalance of 25 per cent. and even wider tolerances are allowable in public address work before the quality is appreciably affected. A serious out-of-balance condition causes a narrowing of the acoustic spectrum and the introduction of harmonics inasmuch as a double-button microphone is essentially a push-pull device.

Serious consideration given to microphone button current will strengthen one of the most vitally important links in the chain of associated public-address equipment.

PICKUPS

On the subject of pickups one is confined to commercial products and the choice is rather limited. Pickups are available in practically any impedance from 200 to 10,000 ohms. As a rule, it is better to choose one of the low impedance type provided the level of the output is sufficient to drive the amplifier. If the pickup is to be used as one of several inputs, it is definitely advisable to choose a low impedance one, as its level will roughly correspond to the output of a carbon microphone transformer or a condenser microphone. Then, again, the overall quality of a low impedance pickup is, as a rule, somewhat better than high impedance units. A pickup should, as should any generator, be loaded with a load of equal impedance. An apparently higher volume level may be obtained by loading with an impedance several times the impedance of the pickup, but this is due to the fact that the pickup will then have a tendency to become a voltage device rather than a current device, which is an undesirable condition and tends to accentuate the high notes in preference to the low. One should be careful, however, not to use a loading impedance lower than that of the pickup lest the low notes be accentuated to, too great an extent.

INPUT TRANSFORMERS

The first-stage input transformer of an amplifier may be designed for low input impedance, such as a microphone or line; or for high-impedance input—for bridging purposes—such as volume indicators and monitor and bridged recorder amplifiers where only a small fraction of the total power is used.

For low-impedance inputs the inductance of the primary winding is so chosen that its impedance is infinite compared to that of the line, even at the lowest frequencies it is intended to transmit. For circuits which are to transmit frequencies as low as 35 cycles, it is necessary that the inductances be 10 henries, or even more. Since the gain of the amplifier depends upon the impedance of the secondary, it follows that to realise maximum gain, the turns ratio must also be high (10-20 to 1). This large impedance ratio, or turns ratio squared, requires that the primary be terminated in a resistance load equal to the impedance of the line for which the transformer is designed. This is necessary in order to prevent the input from varying in impedance with changes in frequency by reactive load. If the primary was allowed to deviate from its specified impedance, there would be a correspondingly greater change in the secondary. When a carbon microphone is used, the load is practically a pure resistance, so that this precaution is unnecessary. In other cases the resistance may be placed across the secondary, its value being equal to the line impedance multiplied by the impedance ratio of the transformer. It can also perform double duty by being part of the input potentiometer, if one is used.

A transformer for high-impedance inputs, on the other hand, must have a much higher inductance and a lower turns ratio. Its inductance may be as high as 100 henries where a turns ratio of 2-1 is used. Since its impedance is so much higher than the load, several of these amplifiers may be placed across a low-impedance load without drawing current. It follows that the gain of such an amplifier will be low.

Higher Power Output with 2A3 Valves

The introduction of the 2A3 valve made possible high power output with comparatively low plate voltage. Heretofore the type 50 valve held the spotlight in the medium-power field, but required a plate voltage of 450 and a rather large signal input voltage.

The maximum plate voltage for the 2A3 is 300, which comes within the limits of the standard power-supply units designed for radio receivers and power amplifiers. Yet, at this voltage, and plate current of only 40 mA, a pair of 2A3 valves provide an output of 15 watts as against an output of only 10 watts for a pair of 50 valves at a plate voltage of 450 and plate current of 55 mA.

When two valves are operated in a Class A push-pull circuit, the non-linear sections of their characteristics are made to complement each other to give a substantially linear overall characteristic. This method produces an output free from second-harmonic distortion. For this reason it is possible to use a higher bias voltage for push-pull operation than is usually employed for single-valve operation. An increased bias voltage lowers the internal dissipation of the valve and permits the use of higher plate voltages. Higher plate voltages, in turn, make possible higher power output.

In order to obtain the higher power output of which the 2A3 is capable, two of these valves are operated in push-pull under bias-voltage conditions which cause considerable rectification in each valve. Additional plate current, then, is drawn because of rectification but this increased plate current is useful in securing higher power outputs. Under normal recommended operating conditions in a push-pull amplifier, where a plate-supply voltage of very good regulation and a fixed-bias supply voltage are used, the plate current is not cut off during any fraction of the cycle. Consequently, even though the recommended operating conditions specify over-bias grid voltage, this system may be operated as a strictly Class A amplifier.

The 2A3 valves should not be operated with more than 300 volts on the plate. The grid-bias voltage should be —62 volts when operated from an A.C. filament supply and —60 volts when operated from a D.C. supply. The corresponding static plate current for an average 2A3 is 40 m.A. This voltage and current rating for no-signal input should not be exceeded for best results.

Fixed-Bias Operation

A circuit arrangement is possible for the 2A3 in which the bias voltage is obtained from a small triode used as a rectifier —such as a type 26 valve. This triode rectifier must be of a type whose cathode comes to an operating temperature quickly in order that bias will be available to prevent abnormal plate current in the 2A3's. High values of plate current would more than likely damage both the valves and the power-supply unit.

The plate circuits of the 2A3's should be joined in the centre-tap lead of the output transformer. This is especially important when fixed bias is used. Should the bias-voltage rectifier valve be removed or damaged, the bias on the 2A3's becomes zero In that event, unless a fuse is provided for protection, excessive plate current can flow and damage the amplifier. A suitable fuse is one similar to the small glass-enclosed type often used to fuse the power-supply line in radio sets and rated at 150 milliamperes.

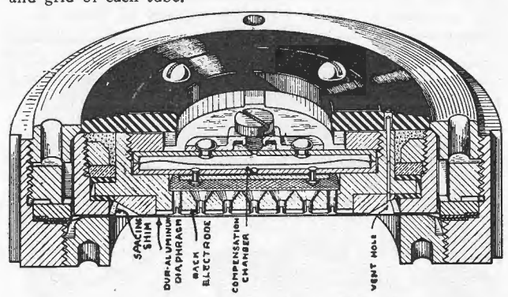
Self-Bias Operation

When 2A3's are operated in a push-pull circuit and are self-biased, a rise in D.C. plate current with increasing signal voltages increases the voltage drop across the self-biasing resistor and raises the bias on the valves. When this occurs, the operating point on the characteristic curve is shifted downward. This shift tends to increase distortion and to lower the power output. Under these conditions, operation between Class A and Class B (referred to as Class A Prime) is usually obtained at full output since the plate current is cut off for an appreciable fraction of the operating cycle. These are the conditions under which 2A3 valves are most commonly operated in public-address amplifiers

When self-biasing circuits are used for the 2A3, it is necessary. therefore, to employ a higher value of p.ate-load resistance than is used with a fixed or semi-fixed bias arrangement. The purpose of this high resistance is to lessen plate-current swings, limit distortion, and prevent plate-current cut-off at negative signal swings.

Oscillation in Push-Pull Amplifier

It sometimes happens that push-pull audio amplifiers will oscillate at frequencies near the upper limit of the audio frequency band which they are intended to reproduce. Thus a P.A. amplifier designed to have a flat response characteristic from 30 to 10,000 cycles will sometimes oscillate at or near 10,000 cycles. This is due to resonance between the leakage reactance of the input transformer and input capacity of the tubes. In order for the amplifier to operate, the output transformer must also have appreciable leakage reactance. The coupling between plate and grid circuits is normally through the capacity between plate and grid of each tube.



A section view of a Condenser Microphone.

This type of oscillation may be eliminated in just the same manner that similar oscillation is eliminated in the power stages of radio transmitters—by neutralization.

This is accomplished by small variable condensers. Temporarily disconnect the plate voltage supply and open the plate circuit of one of the valves close to the plate terminal on the socket. Connect a small variable condenser having a maximum capacity slightly larger than the grid to plate capacity of the tube (these values are given by the valve manufacturers) between the high potential side of the break just made in the plate circuit and the grid of the other valve in the push-pull arrangement. A pair of head-phones connected across the output transformer will reveal when adjustment of this condenser is at its optimum setting by the disappearance of the signal. It is of course necessary during this operation to supply a signal of normal level to the amplifier. If the minimum position of the condenser is not sharply defined adjust same to a point midway between the two positions at which the signal is barely audible.

Now close the broken plate circuit of valve No. 1 and repeat the procedure for valve No. 2, this time breaking No. 2 valve's plate circuit and connecting a condenser as before from the high potential side of the break to the grid of valve No. 1.

After the amplifier is neutralized and the plate voltages again applied, very slight readjustment of both neutralizing condensers may be necessary if oscillation still persists.

Another method of preventing high-frequency oscillation in push-pull amplifiers lies in the use of a low-resistance choke coil of 50 to 100 millihenrys inductance as a common circuit element in the grid return.

The resistance of the choke coil must be taken into account since it carries the combined plate current of both tubes and thus adds to the grid bias. If the D.C. resistance of the choke is small compared to the bias resistor it will have a negligible effect on bias. If a choke of the proper resistance is available it may be used as the grid bias member, or, in combination with a single resistor of the proper size. Such a choke coil, while effectively preventing high-frequency oscillation, will not alter the frequency characteristic of the amplifier.

Improving Push-Pull

In a perfectly balanced push-pull amplifier all even harmonics of the signal contributed by the non-linear action of the amplifier will appear in the common connection of the plate circuits. The even harmonics in the two halves of the primary of the output transformer are equal and opposite in phase, so that they are balanced out in the secondary winding. However, they will be in phase and will therefore add directly in the common plate lead. This is the principal virtue of the push-pull amplifier and the reason for its continued use.

Actual push-pull amplifiers are never perfectly balanced however. In the first place the characteristics of the tubes differ somewhat and as a result each will produce a different amount of even harmonics. In the second place, the plate circuits are never perfectly balanced so that even if each tube did produce the same amount of even harmonics an exact balance would not occur in the secondary of the output transformer.

The most obvious means of reducing the amount of even harmonics is to limit the even harmonic currents flowing through the two halves of the primary of the output transformer. This can be done by inserting a choke coil in the common plate lead; that is, the lead going to the power supply. If the impedance of the choke coil is much higher than that of the primary, most of the even harmonic voltage will appear across the choke. Or, to look at the matter in another way, the higher the impedance of the choke the less even harmonic current will flow. This, of course, reduces the amount of even harmonic transferred to the secondary of the output transformer or, what is the same thing, improves the effective balance. This is the reason that a choke coil is often used in this manner and it is usually quite effective in reducing the even harmonic output of the amplifier. As a matter of fact, it frequently permits the amplifier to operate at a higher level without undue even-harmonic distortion.

When pentode tubes are used in a push-pull amplifier, the results are not always as gratifying as when triodes are used. The difference lies in the fact that the distortion in triodes(i.e., below overload) usually consists mainly of even harmonics, whereas in pentodes odd harmonics predominate. If a large even harmonic voltage is developed across a choke coil in the common plate lead it may modulate the signal and produce the sum and difference of the two frequencies which are odd harmonics. The odd harmonics produced in this manner may either be added to or subtracted from those produced in the tubes, depending upon the relative phase of the two odd harmonic components. Of course the same thing may occur in triodes, but due to better linearity of triode characteristics very little modulation occurs and this factor is usually unimportant. However, pentodes are better modulators and as a result the additional production of odd harmonics is important.

A modern type of moving coil microphone with low impedance output. No field current or polarizing voltage is required. This microphone employs a very high grade permanent magnet.

—(Photo—Courtesy Standard Telephones & Cables).

In general, push-pull triodes will show better performance with a choke. Push-pull pentodes will be found to operate better without a choke. However, like all rules, there are some exceptions to this, although, it is a good rule to follow when in doubt.

EXTENDING LOUDSPEAKER RANGE

The average cone speaker has a very low acoustic output at frequencies above 5,000 cycles, but this can be overcome by using two speakers, one being connected in the usual manner and the other connected so as to respond to the high frequencies only. To accomplish this, the one speaker (a small one) is connected in series with a condenser, the capacity of same being such as to cause resonance at about 10,000 cycles. By connecting the speaker in this way a relatively large current will flow through the voice coil at frequencies approaching the resonant frequency of the coil and condenser combination. When this is combined with the other speaker, a fairly uniform response can be obtained.

The easiest way to select the proper capacity to cause resonance at 10,000 cycles is to tune a radio to a point between two stations on adjacent channels until a high pitched whistle is heard in this speaker combination. This whistle is a 10,000-cycle beat note caused by the heterodyning of the two carrier waves. It is then a simple matter to obtain the right size of condenser by selecting the one that allows the heterodyne whistle to be heard with the greatest intensity.

If separate current supplies are used for the field of each speaker, more latitude is given. By doing this the frequency response of the speaker combination can be altered by regulating the field current of each speaker individually to suit the characteristics of the equipment with which it is used.

Wide Range

Wide range, high fidelity or extended frequency range, call it what you will, usually implies a wide frequency range, but also a wide level range. For the average P.A. System the range of levels is usually of the order of 40 db., athough in order to do justice to a symphony concert orchestra a 60 db. level range would be imperative. For purposes of comparison it is interesting to know the best type of modern talkie sound system would have a level range of 80 db. Of course such a range imposes severe requirements on noise pick-up by the microphone and is the cause of much worry at times. As an example, suppose a high quality system delivers an output of 15 watts, that is an output level of 34 db. delivered to the speakers. Then, the maximum noise output for even a 40 db. level range would be —6 db. (0.0015 watt.); for a 60 db. level range —26 db (0.000015 watt.), and so on.

Generally, however, a 40 db. range will be satisfactory for speech and dance music.

As far as is aware, no single speaker is commercially available which will adequately cover a frequency range of more than 60 to 6,000 cycles. Actually very few will even reproduce this range without serious attenuation. It is possible, fortunately to cover the range from 30 to 10,000 cycles or even a little more with two commercially available units. The low-frequency unit of the pair is a good dynamic speaker of the auditorium type and the high frequency unit, or "tweeter" as it is familiarly termed, a miniature unit of the dynamic type commonly used with exponential horns.

This high frequency unit reproduces frequencies from 3,000 or 4,000 cycles up to 10,000 or 12,000 cycles.

In general the design of the H.F. unit is such that it could be connected in parallel with the bass response unit, but a more specialised application would allow of the output being split into two channels through a suitable transformer and network arrangement each half section of which is designed to pass only a certain frequency band.

The Computation of Decibels

The decibel, so often used in the work of audio amplification, transmission and reproduction, is simply the ratio between the loudness of any two signals. 10 decibels "up" on a signal means that the power has been increased tenfold; 10 decibels "down," that it has been divided by 10. Apart from this figure of 10 decibels, the steps up or down in power are not equal to the gain or loss in decibels, but the peculiarities of this method of rating are based on sound physiological and engineering reasons.

The decibel, as a mathematician would instantly see from the table given here, is a logarithmic unit (the number of decibels is represented by ten times the common logarithm of the ratio of change in energy). This is accounted for by the fact that a signal after amplification to an energy level a million times greater does not sound a million times louder, but only 60 times louder.

Since the sound energy of the reproducer should be approximately in proportion to the electrical power output; and since the electrical power is measured by "voltage times current," the power varies as the square of the voltage (or current). Therefore, the ratio of energy change corresponding to 10 decibels is equal to the ratio of voltage (or current) change, corresponding to 20 decibels. Put in another way, this means that a voltage gain of 7 is equivalent to an energy gain of 49, both of these being equivalent to nearly 17 decibels up.

Any signal strength may be taken as the base (or zero) in computing relative intensity. However, for voice transmission measurements, 6 milliwatts (1.73 volts across a 500 ohm line) is a standard used by engineers. The ratio of change in power and in voltage (or current) corresponding to any number of decibels, may be quickly found from the following table. For instance, to ascertain the output energy from an amplifier with a gain of 30 db., multiply the input energy by the factor in the energy column which is opposite 30 db. This particular example gives us an energy gain of 1,000.

Again, suppose we want to design an amplifier for recording on a celluloid record. For this purpose the required level at the cutting head is about +36 db. or 36 db. above the standard level given above. The input level from the usual type of carbon microphone is about —36 db. Where a succession of gains and losses is expressed in decibels, the total gain is obtained by adding all the successive figures together. As the level has to be raised 36 db. from the microphone to reach the standard level, and a further 36 db. from the standard level in order to effectively operate the cutting head, an amplifier with a gain of 72 db. is necessary. Referring to the table, we see that an amplifier with a voltage gain of about 4,000 is necessary. A good 3 stage transformer coupled job would suit the purpose.

Decibels.

Energy.	Voltage	Number of Decibels	Energy.	Voltage.
"Up"			"Down"	
1.26	1.12	1	0.794	0.891
1.59	1.26	2	.631	.794
2.00	1.41	3	.501	.708
2.51	1.59	4	.398	.631
3.16	1.79	5	.316	.562
3.98	2.00	6	0.251	0.501
5.01	2.24	7	.1999	.447
6.31	2.51	8	.158	.398
7.94	2.82	9	.126	.355
10.00	3.16	10	.100	.316
12.59	3.55	11	.079	0.282
15.85	3.98	12	.063	.261
19.96	4.47	13	.050	.224
25.12	5.01	14	.040	.200
31.62	5.62	15	.032	.178
39.81	6.31	16	.025	0.158
50.12	7.08	17	.020	.141
63.10	7.94	18	.016	.126
79.43	8.91	19	.013	.112
100.00	10.00	20	.010	.100
125.9	11.22	21	.0079	.089
158.5	12.59	22	.0063	.079
199.6	14.13	23	.0050	.071
251.2	15.85	24	.0040	.063
316.2	17.78	25	.0032	.056
398.1	19.96	26	.0020	.050
501.2	22.39	27	.0025	.047
631.0	25.12	28	.0016	.040
794.3	28.18	29	.0013	.035
1,000.0	31.62	30	.0010	.032
1,259	35.48	31	.0008	.028
1,585	39.81	32	.0006	.025
1,996	44.67	33	.0005	.022
2,512	50.12	34	.0004	.020
3,162	56.23	35	.00032	.018
3,981	63.10	36	.00020	.016
5,012	70.80	37	.00025	.014
6,310	79.43	38	.00016	.013
7,943	89.13	39	.00013	.011
10,000	100.00	40	.00010	.010
12,590	112.2	41	.00008	.0089
15,850	125.9	42	.00006	.0079
19,960	141.3	43	.00005	.0071
25,120	158.5	44	.00004	.0063
31,620	177.8	45	.000032	.0056
39,810	199.6	46	.000025	.0050
50,120	223.9	47	.000020	.0045
63,100	251.2	48	.000016	.0040
79,430	282.0	49	.000013	.0036
100,000	316.0	50	.000010	.0032
1,000,000	1,000	60	.000001	.001
10,000,000	3,162	70	.0000001	.0003
100,000,000	10,000	80	.00000001	.0001
1,000,000,000	31,620	90	.000000001	.00003
10,000,000,000	100,000	100	.0000000001	.00001

A Radio Dictionary of Definitions

Admittance is a measure of the alternating current passed by a circuit. It is the reciprocal of impedance and the unit is the MHO.

Aerial resistance is the sum of (a) Radiation resistance; (b) a resistance factor covering dielectric losses, and (c) ohmic resistance. The product of each of these components and the square of the aerial current, is (a) the useful signal power radiated into space; (b) the dielectric losses, and (c) the power converted into heat in the aerial wire.

Amplification Factor

The ratio of the change of instantaneous voltage, between filament and plate of a vacuum tube to a small change of instantaneous voltage between filament and grid for a given constant plate current:

$$\mu = g_m \times R_p = \frac{dE_p}{dE_g}$$

The ratio of power (radio signals), voltage or current output of an amplifying device to the power, voltage or current delivered to the input terminals. Generally speaking the degree of increase in amplitude or volume by insertion of an amplifying device in the circuit.

Anode-bend rectification. The use as a detector of a valve with its grid bias adjusted to the knee or bend of the characteristic curve. Also known as plate rectification.

Armature (in Radio). A short iron bar located in a magnetic field.

Attenuation. Gradual reduction in amplitude of an electromagnetic wave, or alternating current, due to resistance and dielectric losses.

Autodyne. Self-oscillating detector valve, by reason of having the plate and grid circuits coupled, usually inductively.

Automatic Volume Control. A self-acting device which maintains the output constant within relatively narrow limits, while the input voltage varies over a wide range.

Baffle. A partition which may be used with an acoustic radiator to impede circulation between front and back.

Band-pass filter. A combination of inductances and condensers designed to pass a more or less narrow band of frequencies (as distinct from the single resonant frequency of a sharply tuned circuit), with a sharp cutoff at each end of the band. Used commonly in the input circuits of receivers, and the inter-valve couplings of I.F. amplifiers.

Beat Note. An apparently sinusoidal wave due to the rise and fall in amplitude arising from the combination of two different frequencies.

Bias. The potential difference, usually negative, existing between cathode and control grid.

Blue Glow. A blue light occurring inside a valve caused by ionisation of the gas present in the envelope.

Capacitive Reactance. The opposition offered by a condenser to the passage of alternating current through it.

Cathode Rays. The stream of electrons emitted by the cathode or negative electrode of a vacuum tube. This principle is made use of for television and laboratory purposes in the cathode ray oscillograph, where the direction of the electron stream is controlled by electrical and magnetic fields.

Characteristic Curves. A curve which shows the relation between two variable quantities. Most usually applied in the case of a valve to the curve of plate current against control grid bias.

Choke. A coil so wound as to have a high reactance at a desired frequency. Low frequency chokes are usually iron-cored, but the presence of iron in a radio frequency choke would introduce too great a loss.

Circular Mil. A circular mil is a unit of circular area, equal to the area of a circle having a diameter of 1 mil, or .001 inch. It is abbreviated C.M. or Cir. Mil. A circular mil is equal to .000,000,785,4 sq. inches, or roughly three-fourths of one millionth of a square inch. To find the number of circular mils in the cross section of a wire, it is only necessary to square the diameter in mils.

Class A Amplifiers. Are generally employed in the operation of well-designed audio-frequency and radio-frequency amplifiers of radio receivers. For this use fidelity of signal reproduction is of prime importance. However, fidelity is obtained at the expense of power output and at relatively low efficiency. A radio valve used as a Class A Amplifier, is operated under such conditions that its dynamic characteristics are essentially linear.

Class B Amplifiers. Are employed in radio-frequency power amplifiers and in balanced or push-pull modulators of radio telephone transmitters. It is also finding applications for power output stages of some of the more recent designs of radio receivers. For these uses, large power output is obtained without appreciable distortion and with good efficiency. However, to obtain this large power, a larger exciting grid voltage is usually required than for the same valve in Class A Service. A radio valve used as a Class B amplifier is operated under such conditions that with no exciting grid voltage applied to the tube, the plate current is very small. Under these conditions when excitation voltage is applied, only the least negative half of this voltage produces power output.

Class C Amplifiers. Cover those applications where valves are employed as oscillators or radio-frequency power amplifiers for transmitters. For these uses, very large power output with high efficiency is of primary consideration. However, this high output is obtained at the expense of considerable harmonic distortion. This distortion introduced in the output may be an advantage, as, for example, in the case of frequency doubler circuits. In the case of a transmitting power output stage, the harmonics are removed from the fundamental frequency by means of suitable filters. A radio valve used as a Class C Amplifier is operated under such conditions that the grid is biased well beyond the point at which plate current starts. Under these conditions when excitation voltage of sufficient magnitude is applied, large peaks of plate current are obtained in the output of the valve.

Conductance. The reciprocal of resistance. (C.F. Admittance.)

Contact Resistance. The resistance between two connecting surfaces not making perfect contact.

Cross Modulation. Interference from a nearby station only heard when the receiver is tuned to the carrier of another station and arriving mainly from the curved characteristics of the R.F. amplifier valves.

Damping. The term to express the rate at which an oscillation dies away. Sometimes applied to the resistance which causes the falling off in amplitude.

Dead Beat Instrument. A measuring instrument arranged so that the needle comes quickly to rest by reason of the high damping.

Decibel. The unit in which the gain of amplifiers is expressed. It is numerically equal to 10 times the logarithm of the ratio of the output power to the input power. Since the ear hears logarithmically, the increase in loudness will be proportional to the gain in decibels. A gain of 1 decibel is just perceptible.

Detector. A device giving an audio frequency output when a modulated carrier wave is applied to its input, by reason of the different impedances presented to applied positive and negative potentials. See linear or power detection.

Dielectric. Any insulator, more particularly that between the plates of a condenser.

Diode. A valve containing only cathode and anode elements. Used as a rectifier or detector.

Displacement current. An alteration in the position of the electrons in a dielectric, caused by an applied potential difference.

Distortion, frequency. Distortion due to unequal amplification or reproduction of audio currents of different frequencies.

Distortion, harmonic. Distortion due to a change in the wave form of the audio currents being amplified or reproduced.

Doublet. An aerial cut in the middle with a double and usually twisted lead-in. Often useful in the reduction of power line interference, particularly on the short waves.

Dynatron. A valve operated with a low plate voltage and a high grid or screen grid voltage, so that the plate impedance is virtually negative, an effect arising from secondary emission. Oscillations will thus occur if a tuned circuit is placed in the plate circuit, no feed-back to the grid circuit being necessary.

Eddy Currents. Currents induced in a solid conductor due to a varying magnetic field, as in the core of a power transformer.

Electrolytic Condenser. A condenser employing a chemical solution for one plate, a metal electrode for the other, and a gaseous film between the two for the dielectric. Aluminium immersed in a solution of ammonium borate or phosphate is commonly employed.

Electron. The fundamental particle of electricity, negative in sign.

Filter, high-pass. A filter circuit arranged to permit only currents above a certain frequency to pass.

Filter, low pass. A filter circuit arranged to permit only currents below a certain frequency to pass.

Flux Density. The number of lines of force per square inch of sectional area of a magnetic path.

Forced Oscillations—are those maintained in a tuned circuit from an outside source of energy, always at the frequency of the supply.

Free Oscillations—are those which occur in a tuned circuit at the natural or resonant frequency of the circuit.

Grid Current. When the grid of a valve swings positive with respect to the cathode, grid current flows in the same way as in the plate circuit.

Grid Emission. Even at a high negative bias, a residual grid current always exists. It is a measure of the input impedance of the tube, and is due mainly to a photo-electric action by the light from the filament, and to the heat from the filament, causing electrons to be emitted which are attracted to the cathode, which is positive relative to the grid.

Grid Rectification. The use of a valve for de-modulating high frequency transmissions by utilising the one way conductivity of the grid filament circuit. During the impact of a chain of waves, the resultant flow of grid current through the resistance of the grid leak serves to depress the mean voltage level of the grid, and so reduces the value of the plate current at an audible frequency, corresponding to modulated components in the original wave.

Heaviside Layer. A stratum or layer of ionised gas particles in the upper regions of the atmosphere. It serves to reflect and refract back to earth the space waves and currents of transmissions which would otherwise escape into outer space. It is thus possible to make waves pass around the curvature of the earth's surface.

Hysteresis. The tendency of magnetisation to lag behind the magnetising force as, for instance, an iron core in a transformer. There is thus a loss of power which is the main cause of the iron loss in a transformer. This loss is directly proportional to the area of the hysteresis loop for the particular sample of iron. This can usually be obtained from the manufacturers.

Impedance. The opposition offered by a circuit to the passage of alternating current, due to the combined effects of inductance, resistance and capacity.

Inductance. The property of a conductor by virtue of which it opposes any alteration in the value of the current flowing, and hence offers opposition to A.C.

Induction Motor. An alternating current motor in which the armature is not connected to the external circuit, the input current passing only through the field coils, or stator. The armature is rotated by currents induced in the rotor windings, which are short circuited internally. This type of motor is widely used in electric gramophones.

Ion. Any small charged particle of matter; e.g., an atom plus an electron is a negative ion. Most often used to refer to an atom of a gas which has lost an electron, thus becoming positively charged.

Ionisation. The process of splitting up atoms or molecules into ions which thus act as carriers of electricity through a liquid or gas.

Jar. A unit of capacity equal to 1000 centimetres or .0011 mfd.

Kilocycle. A unit of frequency equal to 1,000 cycles. If the wavelength of a station is known it is only necessary to divide 300,000 by the wavelength in metres in order to obtain the frequency in kc. Conversely to obtain the wavelength it is necessary to divide 300,000 by the frequency in kc. Thus a wavelength of 300 metres corresponds to a frequency of 1,000 kc.

Line of Force. An imaginary line used to map out magnetic or electric fields. They are conceived as forming closed loops or circuits. The electric or magnetic force at any particular point acts directly along the one line of force which passes through that point.

Linear Detection. That form of detection in which the output voltage under consideration is substantially proportional to the carrier voltage throughout the useful range of the detecting device.

Litzendraht. (abb. Litz). A stranded conductor in which each strand is insulated from the next. This reduces R.F. resistance, but the effect of even one broken strand is serious.

Load Impedance. The impedance of the circuit connected to the output of an electrical device. In the case of a loudspeaker, the load impedance is in part due to the mechanical damping imposed on the vibrating cone by the surrounding air. The load impedance of a triode for maximum undistorted output should be about twice the plate impedance of the valve.

Megger. An instrument for measuring high resistance of the order of megohms.

Mho. The unit of admittance (A.C.) and also of conductance (D.C.).

Modulation. The variation at audio frequency of the amplitude of a radio frequency or carrier wave.

Mu. Amplification factor.

Neon Tubes. A bulb containing two electrodes in neon gas under reduced pressure. A discharge takes place between the two electrodes when the voltage between them is raised to a certain critical value.

Neutrodyne. A receiver in which the capacity between the plate and grid electrodes of the R.F. amplifiers is counterbalanced by an external capacity connected in one of several circuits. Rendered obsolete by the introduction of the screen grid valve.

Oscillograph. An instrument for recording photographically or showing visually, the waves from alternating or other periodically changing currents and voltages. In the electromagnetic type a large mirror is attached to a small coil vibrating in a magnetic field. In the cathode ray oscillograph a stream of electrons is controlled by alternating electric and magnetic fields.

Pentagrid. A valve containing five grids in addition to cathodes and anode. Usually employed as combined first detector and oscillator of a superheterodyne, when the five grids are used as: oscillator control grid, oscillator anode, screen, detector control, grid and screen respectively.

Pentode. A 5 electrode valve, differing from the screen grid valve (q.v.) by the introduction of a third grid (usually connected to the cathode) between screen and plate to suppress the effects of secondary emission from the plate.

Percentage of modulation. The ratio of half the difference between the maximum and minimum amplitudes of a modulated wave to the average amplitude, expressed in per cent.

Permeability. The ratio of the magnetic flux produced in any substance to the applied magnetising force, which is itself equal to the magnetic flux in air. The measure of magnetic conductivity.

Pot Magnet. The field magnet of a moving coil loud speaker, sometimes so called because of its shape.

Power Detection. The form of detection in which the power output of the detecting device is used to supply a substantial amount of power directly to a device such as a loud speaker or recorder.

Power Factor. The ratio of the true power (watts) in an alternating current circuit to the apparent power (volt-amperes). It is always less than one, and is necessary because the voltage and current are not in phase with each other.

Power Grid Detection. A modern development of the grid leak rectifier, in which considerably higher plate voltage is used in combination with a smaller grid condenser and leak. The result is less distortion with a large input voltage, but it is not so sensitive as the older method.

Pre-Selection. The use of highly selective tuned circuits preceding the R.F. amplifiers in a receiver in order to avoid cross-modulation and similar troubles. Often referred to as band pass filter.

Quartz Oscillator. An oscillator in which the mechanical oscillations of a quartz plate are maintained by a valve by means of the piezo electric effect.

Regulation. The regulation of an electrical device is a measure of the change in voltage at its output terminals under varying conditions of load.

Screen Grid Valve. A 4 electrode valve in which an extra grid carrying a high positive potential is interposed between the plate and the control grid, in order to electrostatically screen these elements, thus preventing capacity feedback, while at the same time the flow of electrons is not greatly impeded.

Secondary Emission. Electrons liberated from the plate or grid of a valve by the violent impact of the normal electron stream.

S.I.C. Abbreviation for Specific Inductance Capacity or dielectric constant.

Side Band. The additional frequencies which appear when a carrier wave is modulated by a low frequency current. In broadcasting they extend roughly for 5,000 cycles on each side of the fundamental carrier frequency.

Skin Effect. The name given to a crowding of alternating or oscillatory current into the surface layers of a solid conductor at the higher frequencies, resulting in an apparently increased resistance.

Space Charge. The crowd of electrons normally trapped between the cathods and grid of a valve, tending to drive back those electrons which are about to leave the cathode. The effect is to increase the internal impedance of the valve.

Specific Inductive Capacity. The ratio between the capacities of two condensers, one with the material under consideration as the dielectric, the other with an air dielectric. Known as dielectric constant.

Stenode Radiostat. A selective circuit of the super-heterodyne type, fitted with a piezo-electric crystal filter or gate to sharpen the tuning and a compensating circuit to restore the cut sidebands.

Super-Control Valve. A valve containing a control grid of varying mesh, resulting in variation of the mutual conductance with control grid bias. A very effective means of volume control.

Superheterodyne. A receiving circuit in which the modulation on the incoming frequency is transferred to an intermediate frequency for amplification.

Super-Regenerator. A receiving circuit in which a reaction detector is maintained by means of a local quenching valve, at the threshold of oscillation where it operates with increased efficiency.

Tetrode. A type of thermionic tube containing a plate, a cathode, and two additional electrodes. (Ordinarily the two additional electrodes are of the nature of grids.)

Transconductance. Another term for mutual conductance (q.v.).

Triode. A 3 electrode valve, consisting of cathode, control grid and plate.

Vector. A quantity which is represented by both the magnitude and direction of a straight line. Vector methods are largely applied in alternating current work.

Voice Coil. The coil attached to the cone of a dynamic speaker into which the voice frequency currents from a receiver are passed.

Wave Form. The shape of the curve, representing an alternating current.

Zero Beat. The central portion of a heterodyne whistle which is produced when the local oscillator has a frequency exactly equal to that of the incoming wave.

WHO'S WHO IN RADIO IN AUSTRALIA

AARONS, Albert.—Director, Eclipse Radio Pty. Ltd., Melbourne. Founded Eclipse Radio Pty. Ltd. 1926.

AARONS, Saul C.—Director, Eclipse Radio Pty. Ltd., Melbourne. Sales Manager, Corbett Derham Pty. Ltd., 1924. Sales Manager, Tunafone Wireless Pty. Ltd., 1925. Formed Eclipse Radio with brother, May, 1926. Born January, 1900.

ADAMSON, William Kenneth.—Managing Director Radio Services Ltd., 74a Pirie St., Adelaide. Amateur Licence 1922. Commenced Commercial radio career 1923. Manager Radio Dept., Duncan & Fraser Ltd., 2 years. Manager A. G. Healing Ltd., Service Dept., 4 years. Established Radio Services Ltd., 1932. Owner operator amateur Station VK5WA. Recreations: Tennis and music. Born 30/7/05.

AHRENOT, Eric Albert.—Manager Radio & Electrical Dept., Charles Birks & Co. Ltd., Rundle St., Adelaide. Finished education Melbourne University. Manager Cox Bros., Musical Dept., Adelaide, 3 years; Manager Eddys Ltd., Radio Dept., six months; Manager Charles Birks Radio Dept., 2 years; own business 2 years in Melbourne. Private address, Woolsely Terrace, Woodlands, S. Australia. Recreations: Golf, yachting. Born 5/12/1905.

ALLSOP, Raymond C.—Chief Engineer, Raycophone Ltd., Trafalgar St., Annandale, N.S.W. M.Inst. R.E. Aust. Licensed Experimenter, 1911. Radio operator War Zones, 1916-1918. Laboratory assistant Royal Australian Navy Wireless, Randwick. Considerable short wave experience telegraphy and telephony, Engineer i/c. Constructed and operated 2BL (13/11/23) from beginning of broadcasting to the taking over by Commonwealth Govt. (22/7/29). Joined Raycophone, June, 1929.

ANDERSON, Oswald, General Manager Station 2UW. Born Sydney, educated for the most part in Victoria. Joined Palings Ltd., 1919, Departmental Manager Concert Promoter and Executive. First actual participation in Radio Broadcasting, 1923, when organised first broadcasts from a public hall in Australia. With assistance of Mr. Ray Allsop on electrical side, experimental programmes (to which every artist of note in Sydney contributed) were broadcast for many weeks, and this was the small beginning of Paling's station. First commercial association with broadcasting, Dec., 1923, as Manager Farmers (2FC) Broadcasting service. In 1928 appointed Manager 2FC Ltd., 14/8/28 when 2FC and 2BL were merged into the N.S.W. Broadcasting Co. Appointed N.S.W. General Manager. When the Australian Broadcasting Co. was formed, 1929, to provide National programmes, he was again appointed Manager for these extended activities, from which he resigned in March, 1930, to take over the general management of Station 2UW. Is an executive of Federation of Broadcasting Stations, an advisory councillor of Teachers' Conference, and an associate of N.S.W. Musical Association.

APPERLEY, Geo.—(M.Inst.R.E.,Aust.). Traffic Manager, Beam Wireless, Amalgamated Wireless (A'sia) Ltd., Melbourne. Early training and experience telegraphy, telephony and wireless with N.Z. Govt. Telegraphs. 1910-1912 Wireless Service of British Colonial Government. 1913 joined A.W.A. 1914-1916 Chief of Marconi Wireless School. 1916-1919 A.W.A. Works Manager. 1919-1923 A.W.A. Technical Superintendent and i/c Patent Dept. 1924, i/c. Beam Wireless Service. Visited England and the Continent of Eupore in 1924 and again in 1933 on Beam Wireless investigation. Private address: 409 Clen Eira Rd., Caulfield, Victoria. Born, 24th March, 1887

ARMSTRONG, Oscar Reginald.—Secretary The Ever-Ready Co. (Gt. Britain) Ltd., Marshall St., Sydney. Educated Sydney Grammar School. With C. W. Stirling & Co., Chartered Accountants 4 years; Wilson Rattray & Co., 1 year; Starkey & Starkey, Chartered Accountants, 7 years. Joined Ever-Ready Co., present position, 7/1/33. Private address: 180 Forest Rd., Arncliffe. Recreations: Wrestling, Walking and Swimming. Born 30/1/1904.

AUSTEE, Alexander H.—Manager and Chief Announcer, North-Western Tasmania Broadcasters Ltd., Ulverstone, Tas. Entered Radio, 1925, Leviathan Ltd., Melbourne. Organised first series Community Singing, on North West Coast of Tasmania. Studied Radio Engineering. Musical Knowledge. Private address: Risby Street, Ulverstone. Recreation: Bowls. Born 1900.

AUSTIN, Ernest A.—Director, Essanay Pty. Ltd., Melbourne. Four years A.I.F. Entered Radio 1921. Works Manager, Radio Corporation, 1925-1928. Formed Essanay Ltd., with Mr. Sweeney, 1928. Born June, 1880.

BADGERY - PARKER, Ebb Richard.—Publicity and Sales Promotion Manager of Philips Lamps A/sia Ltd., 69-73 Clarence Street, Sydney. President of the Australian Association of National Advertisers. Served several years active service A.I.F. After the War appointed General Manager W.N.T. Avery Ltd., for New Zealand in 1927 joined Philips Lamps Ltd. Australian born, 1897. Private address: 34 Shirley Road, Roseville.

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BAIN, John Leonard.—Technical Editor, The Listener-In Dept. of The Herald and Weekly Times Pty. Ltd., Melbourne 62 Flinders Street, Melbourne, C1. Member I.R.E. (U.S.A.), B.Sc. (London). Engaged in Radio as marine operator before. and during the War. Took up technical journalism about 10 years ago. Private address: 48 Lincoln Road, Essendon, Melb. W.5. Born 7th February, 1891.

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BAIN, John Leonard.—Technical Editor, The Listener-In Dept. of The Herald and Weekly Times Pty. Ltd., Melbourne 62 Flinders Street, Melbourne, C1. Member I.R.E. (U.S.A.), B.Sc. (London). Engaged in Radio as marine operator before, and during the War. Took up technical journalism about 10 years ago. Private address: 48 Lincoln Road, Essendon, Melb. W.5. Born 7th February, 1891.

BAKER, Arthur W.—Director. Designing Engineer, Commonwealth Moulding Company Ltd., 240 Princes Highway, Arncliffe. N.S.W. Electrical and Mechanical Engineer. Private address: 5 Chandler Rd., Rockdale, N.S.W. Born 1893. Recreation: Fishing.

BAKER, Dr. William George, B.Sc., B.Eng., D.Sc. Eng. Radio research engineer, Amalgamated Wireless (A'sia) Ltd. Attended Broken Hill High School and entered University of Sydney, 1918. Gained Deas-Thomson Scholarship for Physics 1920. Graduated Bachelor of Science 1921 with University Medal for Mathematics and Honours in Mathematics and Physics. Graduated Bachelor of Engineering 1923 with first-class Honours and University Medal. Became demonstrator in Physics in 1923, and science research scholar 1923-4. Gained the Walter and Eliza Hall Engineering Travelling Fellowship 1924-27. Entered General Electric Co., U.S.A. Research Laboratory, and B.T.H. Coy's Research Laboratory, Rugby, Engand. Hon. Lecturer, Electrical Engineering, University of Sydney, 1927. Research Fellow, broadcasting station 2FC, 1927-8. Radio Research Officer, Council of Science and Industrial Research, 1928-31. Joined Amalgamated Wireless 1931. Graduated Doctor of Science and Engineering, Sydney University, 1932. Born 27th May, 1902, South Australia.

BARRY, Philp.—Partner of Majestic Radio Manufacturing Co., of 101 William Street, Sydney. Commenced in Radio 1915. Served apprenticeship in electrical and radio industry. Travelled extensively throughout some 39 countries for a number of years. Until recently he was engaged as sound engineer in Paris with the Metro-Goldwyn Mayer after several years' service with Western Electric. Founded the present company with Mr. Drummond on March 1st, 1934. Private address: Springfield avenue, Potts Point, Sydney. Born 1904.

BAYLEY, Ernest K.—Engineer, Radio and Electrical Department, Henry G. Small Co., Melbourne. B.E.E. Melbourne University. Junior Member Institute Engineers, Australia. Member Constitutional Club. Educated Wesley College, Melbourne, later obtained Degree Electrical Engineering after four years, Melbourne University. Associated with State Electricity Commission, Vic., 1923 to 1925. Spent two years with B.T.H., Rugby, England. Returned Australia, 1927, joined staff Johnson and Phillips as technical assistant until 1930, then present company. Private address: "Tintern," 2 Redan St., St. Kilda, Melbourne. Recreations: Tennis, golf.

BEAN, Leslie P. R.—Managing Director, Stromberg-Carlson (A/sia) Ltd., 72 William Street, Sydney. A.I.E.E., Mem.I.E.E. (U.S.A.), M.Inst.R.E. Aust. 1904-1919 Electrical Engineer on staff of P.M.G.'s Department. 1919, resigned from Public Service, visited America, returned 1920, founded L. P. R. Bean & Co. Ltd., visited overseas, 1922-23, again in 1926-27. Returned Australia 1927, formed Stromberg-Carlson (A/sia) Ltd. (incorporating L. P. R. Bean & Co. Ltd.). Vice-President of Institution of Radio Engineers, Australia. Born 1884.

BEARD, Ernest Gordon.—Director, Ace Amplifiers Ltd., Elizabeth St., Sydney. M.Inst.R.E. Aust. Past President, Wireless Institute of Australia, N.S.W. Division. Served in wireless in Royal Navy. Designer and constructor of Broadcasting Station 2KY and the original 2GB. Chief engineer, United Distributors Ltd. for several years. Founded Ace Amplifiers Ltd. Recreations: Reading. Private address: Tunk St., Northbridge, N.S.W. Born 1897.

BEARDSMORE, Gordon Charles.—Manager Radio, Electrical and Refrigeration Departments, David Jones Ltd. Post Office Store, George and Barrack Streets, Sydney. Councillor Lawn Tennis Association, Councillor Hard Courts Assn. Vice-President Western Suburbs Hard Courts Assn. Lieutenant 34th Battn. Signal Officer. Member Millions Club and Oatlands Golf Club. Started in electrical trade with F. S. Lee where first studied radio. Next appointed as manager Smith's Radio Stores, from there to Harringtons Ltd., where later became radio manager; then in business on own account for 2 years. Radio Manager David Jones Ltd. for past 5 years. Private Address: "Hearthbank," Pyrmont Street, Ashfield. Born 15/11/01. Recreations: Tennis, golf, football.

BEGG, Reginald H.—Proprietor, William Begg & Sons, 479 Little Collins Street, Melbourne. B.E., Diploma of Electrical Engineering; Associate Member, Institute of Engineers; Fellow S.A. School of Mines; Diploma of Applied Science, Adelaide University. Educated St. Peter's College and Adelaide University. Member of Electrical staff, Adelaide Tramways, 3 years. Assistant Engineer, Australian Metal Co., Melbourne, 2 years. Engineer and Manager, Electrical Machinery Business of Strachan, Murray & Shannon, Melbourne, 8 years. Director Lascelles Parrington Ltd., Melbourne, 5 years. Private address: 7 Henderson Ave., Maloeru, S.E.4, Victoria. Recreation: Golf and swimming. Born 31st March, 1889. Private address: 7 Henderson Avenue, Malvern, Victoria.

BELL, Ronald Albert.—Proprietor R.C.S. Radio, 12 City Rd., Sydney. Member of Royal Motor Yacht Club. Licensed Electrician, engaged in radio elec. eng. since 1919. Joined United Distributors 1919. Engaged in Electrical Fitting with Ferguson Pailin Ltd., Sydney, later with Stromberg Lab., then test department Airzone Ltd. Re-joined Stromberg-Carlson in designing, testing equipment, etc. Founded R.C.S. Radio in 1932. Private address: 29 Woodland St., Marrickville. Born 13/1/1902. Recreations: Angling, fish breeding and speed boat racing.

BENNETT, A. E.—Managing Director 2GB Broadcasting Station (Theosophical Broadcasting Co. Ltd.), 29 Bligh Street, Sydney. Commenced business in Sydney, 1922, as chartered accountant, A.C.A. (Aust.). Established 2GB Broadcasting Station, August 26th, 1926. Founder and President of "Who's For Australia League?" Took prominent part in New South Wales politics and occupied position of Vice-President of "All For Australia League." Contested Parliamentary election for Petersham electorate. Conducts broadcasting session each morning, 10 a.m., in the interests of better Australian citizenship. Vice-President, 1933-34, Australian Federation Broadcasting Stations. Born 28th September, 1899.

BLACKWELL, R. K.—Chief Technical Engineer, Ducon Condenser Pty. Ltd., Sydney; previously with A.G.E. Co., and Philips' Lamps Ltd., as Technical Commercial Manager. Associated with Radio Industry for past six years. Hobbies: Motoring and surfing.

BLUNDEN, Godfrey.—Editor, "Wireless Weekly," Wireless Newspapers Ltd., 60-66 Elizabeth St., Sydney.

BOLAND, Francis Hamilton.—Electrical Engineer, Technical Dept., Philips Lamps (A/sia) Ltd., 69-73 Clarence St., Sydney. 1915-1918 Dept. of Elec. Engr. & Physics, Sydney Technical College. 1918-1922, attached Dept. of Physics Royal Military College of Australia. Proprietor Electrical Business, Canberra, 1923. Joned Philips Lamps Ltd., 1927. Born 6/1/1888.

BLACK, Clifford.—General Manager Olympic Radio Ltd., William House, 101-111 William Street, Sydney. F 3358. Introduced the first Australian made all-wave superhet receiver with single dial control in October, 1933. Seven years' experience in U.S.A. with Western Electric Co., and Radio Corporation of America.

BOSTOCK, James Dundee.—Manager G. P. Embelton & Co., Brisbane. Educated at Ipswich College. Joined Queensland Civil Service. Active Military Service 1914-1916. Discharged wounded. Re-enlisted 1918. Transferred from State to Commonwealth Civil Service 1920. Resigned 1920 to take position with Kodak Ltd. Resigned this position to join staff of H. E. Harold Ltd., Brisbane. In 1933 took charge of Branch Office opened by G. P. Embelton & Co., Melbourne. A prominent leader of the R.S.S.I.L.A., Queensland, originally a State Councillor, he later became District Secretary to the Organisation. A first-class tennis player, keen amateur photographer, and a member of the Queensland Debating Society.

BOTTEN, Herbert William.—Radio Manager Mick Simmons Ltd., Sydney. Electrical test-room Adelaide Tramways, 1915. Served A.I.F., Palestine, Signals, 1915-1919. Joined wireless industry 1922, appointed present position 1924. Born 9/1/1895.

BOX, Arthur Kingston.—On the Technical Staff of "The Listener-in," of Flinders Street, Melbourne. Associated with radio journalism since 1925. Technical Staff "The Listener-in," 1926-30. Editor "Popular Hobbies," "Radio Trader," and "Modern Sets" from 1930-32. Rejoined "The Listener-in" June, 1933. Born January 8th, 1905.

BRASH, Alfred F.—Managing Director M. Brash & Co. Propy. Ltd., 108-110 Elizabeth Street, Melbourne, C.1. Chairman Victorian Radio Association. Clubs: Naval and Militarv Victoria Golf, Sorrento Golf. Educated Cumloden College & Melbourne University. Amateur Welterweight Boxing Champion of Victoria, 1906. Served with B.E.F., Italy, 1916-1919. Rank: Captain. Private address: "Lindfield," Mandeville Cr., Toorak. Born 2/8/81. Recreation: Golf.

BRIDGMAN, Stuart.—Manager, Broadcasting Station 3AW, Melbourne. A prominent personality in Melbourne Broadcasting circles.

BRITON, John Noel.—Assistant Radio Engineer, Breville Radio, 486 Elizabeth St., Sydney. Graduate of Sydney University. B.E. (First class honors in Electrical Engineering), B.Sc., Councillor and A.Inst.R.E. Aust. Born 1908.

BROKENSHA, Albert F.—General Manager R. S. Sampson Brokensha Co., of 971 Hay St., Perth, printers and publishers of "The West Australian Wireless News and Musical World." With printing and publishing industry past thirty years. Past fourteen, General Manager present position.

BROAD, Archibald Du Bourg.—Secretary Victorian Radio Association and Manager Electrical Federation (Victoria) since 1928. On discharge from A.I.F. in 1920 appointed Accountant Tasmanian Branch War Service Homes Commission. Then Private Secretary to Prime Ministers: The Hon. W. M. Hughes and The Rt. Hon. S. M. Bruce. Later, Managing Director Aurora Packing Co. Pty. Ltd. (Dried Fruit Packers & Exporters, Melbourne, Mildura, Sth. Australia, etc.).

BROADHURST, Benjamin.—Proprietor University Radio Co., 22 City Road, Sydney. Commenced own business with father, soft goods manufacturing, 1920. In 1927, commenced radio business. Private address: 17 Bruce St., Brighton-le-Sands. Born 5th October, 1904. Recreations: Motoring and swimming.

BROOKER, Vivian M.—Manager, Broadcasting Department, Amalgamated Wireless, M.Inst.R.E. (Aust.), M.Inst. Wireless Technology (London), A.I.R.E. (America). Joined staff Amalgamated Wireless, 1917, served 3 years Indian Service. 1920 long wave experimental station Koo-wee-rup international observation duty. Operated first commercial short wave station between London and Sydney, November, 1926. Joined Engineering staff, A.W.A., 1927. Manager and Chief Engineer, 7LA Launceston, 1931, to July, 1933. Transferred present position, July 1933. Private address: "Karingal," Long Bay, Maroubra, N.S.W. Recreation: Reading. Born 11th Feb., 1899.

BROWN, Andrew F. O.—Secretary, Electrical and Radio Association, N.S.W., Grace Bldg., Sydney. Assistant Secretary, Electrical Association, 1923. Appointed Secretary, 1928. Recreations: Tennis, golf. Born 25/6/1903.

BROWN, Harold Percival.—C.M.G., M.B.E., M.I.E.E., Director-General, Postmaster-General's Dept., Commonwealth of Australia, Treasury Gardens, Melbourne. As a youth on the staff of the superintending engineer, Newcastle, England (Post Office Department). Later he was attached to the engineer-in-chief's staff, London, in charge of cable designs and the undergrounding of telephone lines. In 1922 selected by the Commonwealth to act in an advisory capacity in carrying out a large works programme of the Postmaster-General's Department. Appointed present position, December, 1923. Born 28/12/1878.

BROWN, Stafford Meredith.—Sales Manager, Amalgamated Wireless (A'sia) Ltd., Melbourne. Graduated Marconi School of Wireless, Sydney, and joined A.W.A. Marine Staff in 1915. Served on Australian, New Zealand and overseas vessels until 1924. Transferred to Sydney Sales Department, and later Melbourne Sales Department. Born 20th January, 1896, Narrabri, N.S.W.

BUIK, Harold E.—Superintendent, Marconi School of Wireless. Joined Sydney branch of the M.I.M.C. Co. Ltd., in October, 1911, and appointed wireless officer on inter-State vessels. Transferred A.W.A. Marine Service in 1913. Joined R.A. Navy 1915, served on H.M.A. Fleet Auxiliary ship "Aorangi," in West Indian and European waters, also on transports "Port Lincoln" and "Armadale" engaged in Dardanelles campaign. 1918 appointed instructor at Marconi School of Wireless. 1921 Chief Instructor and 1926 Superintendent. Born 22nd February, 1889, Rose Park, Adelaide, S.A.

BURBURY, Eric Alfred.—Engineer, Patents Department, Amalgamated Wireless (A'sia) Ltd., Sydney. M.Inst.R.E. Aust. Joined A.W.A., 1914, Marine Service. Koo-wee-rup experimental station, 1920. Three months Marconi Works, Chelmsford, England, 1921. 2FC, 2SM and A.W.A. Laboratory since. Private address: 8 Norton Ave., Vaucluse. Born 20/4/94. Recreation: Tennis and swimming.

BURCHELL, Reginald John.—Manager-Secretary Radio Interests Ltd., Sydney. 16 years with West Australian Government Railways. 10 years member Commonwealth Parliament. Two years active service A.I.F. 12 years Commercial pursuits. Private address: 1 Cross Street, Mosman. Recreations: Golf. Born 20/5/1883.

BYRNE, Valentine Gerard.—Advertising Representative "The Listener-in," 62 Flinders St., Melbourne. Connected with publicity section of radio trade for last ten years. Was advertising manager of "Radio Trader and Popular Hobbies" for five years. Joined "The Listener-in" in 1931. Private address: 30 Forster Ave., East Malvern, Melbourne. Recreations: Tennis, motoring and fishing.

BUSHBY, T. R. W.—M.Inst.R.E. Aust., A.M.I.R.E. (U.S.A.). Born 1900, at Littlehampton, Eng. Educated, East Hove School, St. Georges College, London, and Regent Polytechnic, London. First interest in Radio, as a hobby in 1916, when associated with War Trade Dept., 1917-1918, City of London Volunteer Engineers, Wireless Division. 1919-1930 Dept. of Scientific Research, Radio Research Board, London. 1920-1927 followed non radio pursuits. During 1927 actively associated with amateur radio. 1929, Member, Wireless Institute of Australia. 1930-31, President W.I.A., N.S.W. Division. 1932, Member and Councillor Institution of Radio Engineers (Aust.). 1932 to date, Radio Engineer Raycophone Ltd.

CAMPBELL, Norman.—Editor "Radio News" — Bulletin Newspaper Co., 252 George St., Sydney. Commercial Travellers Club, Vic., Royal Automobile Club, Vic., Returned Soldiers' Club, Vic., Masonic Club, Sydney. Many years on Australian stage, producer for Nellie Stewart, J. C. Williamson, etc.; journalist Brisbane "Daily Mail"; Associate Editor "Aussie," Sydney; Sydney Editor Melbourne "Punch"; Editor "Shakespearean Quarterly"; Special article writer, Melbourne "Herald"; contributor to the press of Australia generally. Service of 1 year 232 days A.I.F. Private address: 5a Anzac Parade, Kensington, Sydney. Recreation: Motoring.

CANNING, Frederick Gerald.—M.Inst.R.E. Aust. Chief Radio Eng., Firth Bros. Pty. Ltd., 149 Little Lonsdale Street, Melbourne. Born in England. Educated at primary and secondary schools in England and Australia. 1917-18, W/T Telegraphist R.N.V.R. 1921-24 Marine Operator Amalgamated Wireless A/sia Ltd. 1924-29 Technician Radio Section, Victorian Police Dept. 1929-30 Chief Technician for Australasia Baird Television Ltd. 1930-31, Chief Radio Eng. Targan Electric Co., Melbourne. 1931 appointed Chief Radio Eng., Firth Bros. Pty. Ltd. Born 16/3/1900.

CARROLL, J. I.—General Manager New System Telephones Pty. Ltd., 276 Castlereagh Street, Sydney.

CAWTHORNE, Archibald—Director and chief engineer Colonial Radio Pty. Ltd., 136 a'Beckett St., Melbourne. Hobbies: Radio, cricket, shooting.

CHANDLER, John Beals—Born Norfold, England, in 1887, and arrived in Australia in 1907. For some years engaged in various occupations, mostly in North Queensland. In 1913 established the firm of J. B. Chandler & Co.; in 1915 moved to larger premises in Charlotte St. A further move was made 4 years later to larger and more convenient premises in Elizabeth Street. Up to this time the principal business was the sale of lighting systems in country districts, but in 1919 an electrical department was opened which developed very rapidly. Again the premises became too small and in 1923 a freehold was purchased in Adelaide Street. After extensive alterations the firm moved into its new home in August, 1924, and in the following November a radio department was opened. This was an immediate success and grew so rapidly that it is now one of the largest departments of the business. In addition to the present building the firm owns a large block of land at the rear on which it is proposed to erect buildings. The staff now numbers over 100 employees. While Mr. Chandler spends most of his time in his business office, his spare hours are generally devoted to his hobbies—golf and motoring. Mr. Chandler is keenly interested in radio and it is his intention that Station 4BC shall always be one of the most up-to-date and progressive broadcasting stations in the Commonwealth.

CHESTERFIELD, Eric Lindsay, B.C.—Accountant G. P. Embelton & Co. Educated Wesley College, Melbourne, and Melbourne University. Graduated B.Com. (Melb.) and winner of C.T.A. Scholarship. Private address: 7 Allenby Road, Canterbury, E.7. Recreations: Tennis, motoring. Born November 12th, 1908.

CHEONG, Clifford H.—Member of the Editorial Staff of "The Listener-in," Melbourne. The eldest son of a State School teacher, he joined the staff of the Victorian Railways in 1924 and graduated to the advertising division and later to the Betterment and Publicity Board. Was a member of the V.R. Magazine literary staff until the withdrawal of that publication. In 1931 he organised and directed a successful State campaign for the Commissioners on behalf of the Royal Victorian Institute for the Blind. Was a free lance journalist for many years; later joined "The Listener-in" Editorial Staff in July, 1933. Born at Shepparton, Victoria, Nov. 11th, 1907.

CHILTON, Robert Ralph.—Radio Laboratories, 22 City Rd., Sydney. A.Inst.R.E. (Aust.), Ph.C., M.P.S. Member Radio Society of G.B. Diploma W.I.A. Member A.R.R.L. Apprenticed to electrical engineering trade. Graduated in pharmacy, Sydney University. Practised two years in pharmacy then took up research work in television. Appointed chief-instructor Australian Radio College, 1931, and superintendent of same 1933. Private address: Chilton Ave., Wahroonga. Born 9/10/1907.

CLARKE, Alick Ryle.—Manager, Accessory Dept., A. G. Healing Ltd., 155 Pirie Street, Adelaide. Entered Radio trade S.A., 1925; 8 years manager Radio Dept., Harris Scarfe Ltd.; resigned to join A. G. Healing Ltd., in the present capacity of Wholesale and Retail Accessory Dept. Manager. Private address: 6 Staunton Ave., Rosefield, S.A. Recreation: Astronomy. Born 9/5/1904.

CLARKE, William G.—Supt. Coastal & Island Radio Services, Amalgamated Wireless (A/sia) Ltd., Sydney. Served O.I.C. Brisbane, Townsville and Perth Radio telegraph stations, 1912-1920. Radio Inspector, Territory of New Guinea, 1921. Completed change over, New Guinea Radio Service from Commonwealth Control to A.W.A., 1922, and remained in charge until 1927, when transferred to A.W.A. Head Office, Sydney, as Superintendent Radio Services. Private address: "Delmonte," 146 Carrington Road, Randwick. Born 5/6/84. Recreations: Motoring and Surfing.

COCHRANE, Arthur Stanley.—Senior Announcer, Council of Churches Broadcasting Station 2CH, 77 York Street, Sydney. Degrees, etc., Nil, except claim to being "The biggest story-teller" in the Commonwealth. Born at an obscure little town in Victoria, Violet Town, which can claim no distinction, except that Kelly Gang of Bushrangers operated around its peaceful glades. Educated at local school, and showed no great proficiency at anything except reading. Was always a shining example in this respect, and fostered it, probably by instinct knowing that he would be a Radio announcer when he grew to man's estate. The greater part of his life was spent in Melbourne. Came to Sydney in 1914, and joined Farmer & Co. Ltd., with whom he spent several years. When radio burst upon the astounded world, the company secured the first "A" class broadcasting license. An announcer was advertised for, and while 240 odd applicants were being sifted, he was used as a stop gap. Eventually the practically unknown position was offered him, and he accepted, with some misgivings, and so became wedded to the microphone. The union has been a very pleasant one, and in spite of the concentration and exacting nature of the work, he thoroughly enjoys it. It really does not matter about the date of his birth, for as long as he is allowed privilege of conducting his beloved Children's Storytime, he shall never grow old, for the little ones keep him young. Recreations: Radio announcers have no recreations, but the little breaks that he has between Studio Sessions, he spends with his favorite authors, amongst whom Dickens reigns supreme. At the same time he takes a keen interest in all sport, though not indulging in any of them. Was the first A class announcer, and completed 10 years' broadcasting in December last. Finds radio work still interesting, and has not grown weary of his work with the children at story time. Private address: 59 King's Cross Road, Darlinghurst.

COLES, H.—Managing Director A.Z. Radio Pty. Ltd. Formerly shareholder in Eclipse Radio, Melbourne. Later started Zenith Radio which was amalgamated with A.S.A. in 1933. forming A.Z. Radio Pty. Ltd. Private address: 4 Hampden Road, Armadale.

COLLOCOTT, Harold.—Branch Manager, Adelaide Dept., Eclipse Radio Pty. Ltd. Entered radio industry, 1923. 1926, joined Eclipse Radio Pty. Ltd. 1928, apptd. Sydney Mgr. 1930, apptd. Adelaide Manager.

COLVILLE, Sydney.—M.Inst.R.E. Aust. Proprietor Colville-Moore Wireless Supplies, Rowe Street, Sydney. Licensed operator (experimenter) since 1911. Call sign XQF. First started experiments in Q'ld. Founded Q'ld W.I.A. Honorary position in P.M.G.'s Dept. during war. Took up flying in 1927, for radio development work on 'planes. Appointed Radio Commissioner to Siamese Government in 1928. Carried out technical work for British Government and various other Governments in the Pacific. Radio Instructor, Aero Club, N.S.W., built Aero Club stations 2FA and 2FB. Honorary Lieutenant Instructor in Navy League. Business in Rowe St., for 11 years. Councillor 1934-5 I.R.E. Aust. Recreations: Flying, Navy League development.

CONLON, Samuel Matthew.—Sales Manager Lekmek Radio Labs., 75 Wiliam St., Sydney. Expert Electrical Engineer's Certificate, Melbourne Technical College. Bachelor of Science, Melbourne University. 10 years Telephone Engineer P.M.G.'s Dept., Melbourne. Turned attention to commercial side of Electrical Engineering. Went to U.S.A. and had nearly 4 years intensive experience in selling and salesmanaging in that country. Subsequently visited Leipzig Fair and Berlin and London Radio Exhibitions. Private address: Old South Head Rd., Rose Bay, Sydney. Born 2/8/1890. Recreations: Handball and golf.

COOK, Samuel Gordon Assistant Manager Radio Electrical & Refrigeration Dept., David Jones Ltd., Post Office Stores, George Street, Sydney. Mem. United Service Institute. Lieut. in Royal Aust. Naval Volunteer Reserve. Lieut. R.N.A.S. & R.A.F. during war. Mem. Australian Flying Corps Assn., also Master Mariner Cert. Served in Orient Steam Navigation Co. as 4th and 3rd officer, and then to New Zealand Shipping Co. as 2nd, then chief officer. During last three years with that Company was chief officer of cadet training ship. Left sea-going life to open radio business on own account at Townsville. From there to David Jones Ltd., as salesman. Later appointed Assistant Manager, Radio Dept. Seven years with David Jones Ltd. Born January, 1895.

CORFIELD, William Saxon.—Manager Harringtons Ltd., Melbourne, 260 Collins Street. Joined Harringtons 1920. Four years in N. Sydney Branch. Two years Manager Adelaide Branch, and 8 years Manager Melbourne Branch. Private address: "Kingsley," Hill St., Toorak, Victoria. Born 21/8/1897.

CRAWFORD, W. T. S.—M.Inst.R.E.Aust. Senior Radio Inspector, Sydney.

COURT, T. P.—Councillor & Member Institution Radio Engineers, Australia. President, Society of Radio Technicians, Australia. Design Engineer, Standard Telephones and Cables (A/sia) Ltd., Sydney. Commenced wireless experimenting 1910. Served R.A.N. Transport Service, 1915-1919. Designed and built 3UZ and 3AR (1923-1924). Joined S.T.C. 1925. Private address: 14 Boyle Street, Cremorne. Educated Prahran College and Melbourne Technical College. Born 2/12/1894.

DANIEL, Frederick Trevor.—Production Manager, Commonwealth Moulding and Electric Co., 240 Princes Highway, Arncliffe, N.S.W. B.Sc., A.M.I.Mech.E.F.C.L. Born 1903. Recreations: Tennis, surfing.

DARE, Eric.—General Manager, the Mullard Radio Company (Aust.) Limited, Head Office, 35 Clarence Street, Sydney. Educated Napier Boys' High School. Won Junior University Scholarship. Amateur radio transmitter, 1912-13. Left New Zealand at outbreak of War and enlisted A.I.F., 1915. Attached to General Headquarters for Wireless, British Army, 1916, transferred to A.I.F. Headquarters (Wireless), Commissioner Lieutenant Pilot A.F.C., 1918. Attached No. 4 Squadron, later with Army of Occupation in Germany. Joined Experimental Dept. (C.A.V.) C.A. Vandervell, Acton, London, 1920. Proprietor and Editor first broadcasting programme paper in Commonwealth—"Wireless Daily." With Philips, 1926 to June, 1930, as Technical-Commercial and Advertising Manager, taking over Mullard in August, 1930. Private address: 17 Streatfield Road, Bellevue Hill. Born N.Z., 17th Feb., 1897. Recreations: Swimming and amateur wrestling.

DAVIDSON, George Robert.—Sales Manager, Radio Department, H. Hecht & Co., 38 Carrington Street, Sydney. Educated at North Sydney High School. Six years in motor trade. Joined Radio Industry, 1928. Private address: 3 Thompson Street, Mosman. Born 7/7/03. Recreations: Tennis and swimming.

DAVIES, R. M.—New South Wales Manager New System Telephones Pty. Ltd., 276 Castlereagh Street, Sydney.

DAVIS, Albert George.—Sole Proprietor A. G. Davis & Co., Wembley House, George St., Sydney. Fellow Australian Institute of Secretaries. Associate—Chartered Institute of Secretaries (London). Associate—Association of Accountants of Australia. Justice of the Peace, N.S.W., Queensland, South Australia. 17 years practising as Accountant and Secretary. 5 years Distributor radio sets and accessories. Recreations: Motoring, literature and music.

DAVIS, Ross Raleigh.—Design Engineer, Amalgamated Wireless (A'sia) Ltd., Sydney. Diploma of Electrical Engineering, Sydney Technical College, 1926-1931. Educated Sydney Grammar School. Joined A.W.A. in 1925 as cadet engineer. Associated with Capt. P. P. Eckersley during his investigation of broadcast conditions in Australia in 1932. In conjunction with C. D. Maclurcan carried out experimental short wave tests between Australia and America, on R.M.S. "Tahiti," 1924. Private address: "Dumar Court," Dumaresq Road, Rose Bay. Born 19/9/1907. Recreation: Tennis and surfing.

DEARMAN, Reginald Vincent.—Chief Accountant, Amalgamated Wireless (A'sia) Ltd., Sydney. Associate Member, Commonwealth Institute of Accountants. Educated Fort Street High School. Accountancy, 1st place N.S.W. Institute, June, 1924, Final Accounts. Joined Amalgamated Wireless (A/sia) Ltd., January, 1924. 3½ years as Melbourne Accountant. War Service, Enlisted January, 1916. Active Service abroad with 9th Field Company Australian Engineers, A.I.F. (Awarded M.S.M.), July, 1916, to end of War. Private address: 20 Selwyn Street, Artarmon. Born 2/8/1897. Recreations: Tennis, fishing, swimming, gardening.

DICKIN, Albert Joseph.—Managing Director F. Dickin Ltd., 18 Lords Road, Leichhardt. 4 years President of Furniture Manufacturers Assoc., Justice of the Peace 10 years. Started business of F. Dickin Ltd., with the late Mr. Dickin, Senior, in Pitt St., Sydney, on Oct. 1st, 1889. Became Managing Director on March 13th, 1920. Toured world in 1928, investigating latest methods of cabinet manufacture. Private address: 213 Harrow Road, Bexley. Born 26/7/71. Recreations: Golf, motoring.

DOE, A. G.—Graduated B.Sc., 1923, B.E., 1925, Sydney University, with 1st class honours. For 4 years Assistant Electrical Engineer at Naval Dockyard, Garden Island, and assistant Electrical Overseer during building of H.M.A.S. "Albatross,' at Cockatoo Dockyard. In business for 4 years.

DUDMAN, Victor H.—Manager, Transmitting Department Philips Lamps (A/sia) Ltd., 69-73 Clarence Street, Sydney. Engaged with Royal Navy and Royal Australian Navy from 1919-1928. Has been with Philips Lamps since September, 1928. Private address: 52 Portland Street, Rose Bay. Born London, 2nd July, 1903. Recreations: Music and astronomy.

DUFFY, John.—Director & Chief Engineer, The Duffy Radio Co. Ltd., George Street, Redfern. Associate Institute Radio Engineers (U.S.A.). Member Society Radio Technicians (Aust.). President Harringtons Radio Club. Chief Engineer, Experimental Radio & Television Station VK2HR, Waverley. Commenced radio as hobby, June, 1920. Four years' Service Radio Manager, Home Recreations; 4 years Wholesale Radio Manager, Harringtons Ltd. Formed company, February, 1933. Private address: "The Towers," 45 Grafton St., Woollahra. Hobbies: Radio and photography. Born 3/6/1907.

DUNN, Charles.—Radio Manager, Noyes Bros. (Sydney) Ltd., Clarence St., Sydney. Born in England. Joined Union Cable Co. Ltd., Dagenham, 1901. Australasian Manager Union Cable Co. Ltd., 1910-1914. Returned England, appointed Secretary Union Cable Co. till 1920. Left for Australia, appointed Queensland Manager Noyes Bros. (Sydney) Ltd., 1921-1929. Then appointed Sydney Radio Manager. Prominent member trade association. Honorary Treasurer Electrical Radio Association, N.S.W.

DUKE, Alan S.—Proprietor Alan S. Duke Pty. Ltd., 486 Bourke Street, Melbourne. R.A.C.V. Commenced in Electrical Industry, Siemens, 1912. Considerable experience in Electrical and Radio Industry. Formed own Company March, 1931. Chairman Wholesale Radio Association, 1929-30. 1st President Victorian Radio Association, October, 1931 and 32. Chairman Exhibition Committee, 1930-31-32. Born January, 1897. Recreations: Tennis, swimming.

DWYER, Stanley G.—Secretary, Stromberg-Carlson (A/sia) Ltd., 72 William Street, Sydney. Trained in Accountancy, 1915. Present position, 1929. Born 3/6/96.

EARNEY, S. S.—Proprietor Peerless Metal Works, Brunswick East, Victoria. Started on own account as Peerless Metal Works in 1930.

EDWARDS, James Roy.—Chief Engineer Laboratory Department, Paramount Radio Manufacturing Co., 301 Castlereagh Street, Sydney. Bachelor of Engineering (Adelaide University). Consulting Engineer in South Australia until 1930, then to Sydney. Engineer for Custom Built Radio and Kriesler Radio Co. Private address: Ithaca Flats, Elizabeth Bay, New South Wales. Born December 11th, 1907. Recreations: Golf and swimming.

EGLON, George.—Factory Manager, Stromberg-Carlson (A/sia) Ltd., 86 Crown Street, East Sydney. Born March 18th, 1885, Leicester, England. Educated at Ald. Newton's School, Leicester, and Leicester Technical School. Apprenticed to tool-making at United Shoe Machinery Co's Works, Leicester. Came to Sydney in 1908 with special machinery. Later employed at Lithgow S. Arms Factory and Naval Wireless Works, Randwick. Repatriation School Instructor. Joined L. P. R. Bean & Co. in 1924. Appointed Factory Manager, Stromberg-Carlson (A/sia) Ltd., 1931. Private address: 17 Baroona Road, Northbridge. Recreations: Reading, gardening and surfing.

EGLON, George—Factory Manager, Stromberg-Carlson (A/sia) Ltd., 86 Crown Street, East Sydney. Born March 18th, 1885, Leicester, England. Educated at Ald. Newton's School, Leicester, and Leicester Technical School. Apprenticed to tool-making at United Shoe Machinery Co.'s Works, Leicester. Came to Sydney in 1908 with special machinery. Later employed at Lithgow S. Arms Factory & Naval Wireless Works, Randwick. Repatriation School Instructor. Joined L. P. R. Bean & Co. in 1924. Appointed Factory Manager, Stromberg-Carlson (A/sia) Ltd., 1931. Private address: 17 Baroona Road, Northbridge. Recreations: Reading, gardening and surfing.

ELLIOTT, Albert Arthur.—Proprietor Wendel Electric Co., St. Francis Street, Melbourne. Ten years experience radio engineering, always on own account. Born 18/11/98. Recreations: Shooting and fishing.

EMMELHAINZ, Albert Edward.—Chief Engineer, General Theatre Supplies. M.Inst.R.E.Aust. A.M.I.E.Aust. Councillor Institution of Radio Engineers, Aust., 1932-3-4. Private address: 93 Todman Ave., Kensington. Born 1873.

EMBELTON, George Pearson.—B.A. Proprietor G. P. Embelton & Co. Educated Wesley College, and Melbourne University. Graduated B.A. (Melb.). Joined Commonwealth Civil Service and held appointments of Secretary and Executive Member Defence Contract and Supply Board. Secretary and Executive Member Surplus War Stores Disposal Board. Commonwealth Supply Officer, London, 1921-24. Resigned Commonwealth Services to start firm abovementioned in 1925. Recreations: Golf and swimming.

EVANS, Clive Walter.—Director and General Manager, Widdis Diamond Dry Cells Pty. Ltd., 119 Hawke St., West Melbourne, since 1922. Treasurer, Victorian Division I.R.E., Aust. Visited overseas on three occasions in Diamond Battery interests. Served in A.I.F. Air Force. Previously trained in electrical engineering.

EVERITT, Arthur Raymond.—Manager Service Dept., Lekmek Radio Labs., 75 William Street, Sydney. Sydney Technical College Certificate A.Inst.R.E. Aust. Completed 5 year-indenture period with Amalgamated Wireless A/sia Ltd., 1923-28. Stromberg-Carlson Ltd., Chief Tester. New System Telephones Aust. Ltd., Assistant Engineer. Private address: "Merlan," Dunois St., Longueville. Recreations: Golf and tennis. Born 20/3/1908.

FACER, Reginald. — Director Efco Manufacturing Co. Ltd., Princes Highway, Arncliffe. Superintends radio side of business. Studied Analytical Chemistry, Sydney Technical College, six years. Metallurgist 1917-20. Commenced with father in business of Efco Manufacturing Co. Ltd., 1920. Born 12/4/1898. Recreations: Golf and motoring.

FACER, Richard.—Managing Director Efco Mfg. Co. Ltd., Princes Highway, Arncliffe. In business in England for many years. Came to Australia, and in company with two sons, Thomas and Reginald, founded the Efco Mfg. Co. Ltd., in 1920. Private address: 30 Clarence Road, Rockdale. Born 2/5/1860. Recreation: Gardening.

FACER, Thomas.—Director and Supervisor of hardware manufacturing side of Efco Mfg. Co. Ltd., Princes Highway, Arncliffe. Commenced with father and brother the business of Efco Mfg. Co. Ltd., in 1920. Private address: 12 Westminster St., Bexley. Born 12/1/1886. Recreations: Gardening, motoring and golf.

FINNEY, W.—National Radio, Brisbane. For many years a telegraphist in the P.M.G.'s Dept. First connected with wireless as Instructor of Wireless Telegraphy for Stott's College in Brisbane. Became a member of the Wireless Institute of Aust. (Q'land Division) and was elected President. Was appointed Acting Radio Inspector for Queensland when that office opened in 1924. Resigned from Commonwealth Service to take up commercial enterprise in the Wireless business in 1925, and has been connected with the radio business since, being now a partner in the firm of National Radio. Recreations: Motoring, fishing, music and gardening.

FISK, Ernest Thomas.—Chairman and Managing Director, Amalgamated Wireless (A'sia) Ltd., 47 York St., Sydney. F.Inst.R.E., A.M.I.E. (Aust.), F.Inst.R.E., Aust. Born at Sunbury-on-Thames, near London, 1886, joined Marconi Co., 1905. Trained and worked in all branches wireless engineering and operating in England, America, and other countries. 1909, went to Arctic icefields, demonstrated possibilities of wireless with Newfoundland Sealing Fleet. 1910, on board S.S. "Otranto," exchanged messages with H.M.S. "Powerful," in Sydney Harbour, when "Otranto" was 200 miles north-west of Fremantle, a distance of 1800 miles—a record in those days. Came to Australia, 1911, as representative of Marconi Wireless Telegraph Co. Amalgamated Wireless incorporated, 1913, appointed General Manager with a seat on the Board, three years later became Managing Director. In September, 1918, received first direct wireless telegraphic messages transmitted from England at his station at Wahroonga, N.S.W. August, 1920, gave first public demonstration of broadcasting at Royal Society of N.S.W., Sydney. The establishment of the Beam Wireless Service between Australia and England was largely due to his experimental work and his consistent advocacy with both British and Australian Governments for the adoption of his plans for the service. Wireless Telephone Service between Australia and Homeland mainly due to his experimental work. The prestige of Amalgamated Wireless as one of the foremost wireless companies of the world is due to the broad vision and high executive ability of Mr. Fisk who, during the past 20 years, has developed wireless in Australia and in the Pacific from a national point of view. Mr. Fisk is considered the foremost wireless authority in Australia. Visited England, U.S.A., and the Continent of Europe in 1933 investigating latest developments in wireless. Made a Chevalier of the Order of the Crown of Italy by the King of Italy. President, Institution of Radio Engineers (Aust.), 1932-33-34-35.

FORREST, Charles Eckersley.—Managing Director International Radio Co. Ltd., 254 Castlereagh Street, Sydney. Started the Radio business of International Radio Co. Ltd, in Wellington, N.Z., in 1922. International Radio Co. Ltd., Wellington, N.Z., were the first firm to broadcast in New Zealand in 1920 and 1921, with De Forest transmitter which was the birth of the Broadcasting system in New Zealand. A special Company named Wellington Broadcasters Ltd., was formed to carry on the broadcasting side of the business. The articles and memorandum of this Company were later adopted almost entirely by 2BL Sydney. Came over to Sydney, June, 1923, called trade meeting, supplied them with articles and memorandum to form 2BL. Established International Radio Co. Ltd., Sydney, in June, 1923. Private address: 79 Drumalbyn Road, Bellevue Hill. Born Sept. 27th, 1898.

FREEDMAN, Allan Harris.—Sales Manager, Stromberg-Carlson A/sia. Ltd., 72 William Street, Sydney. Yale University, B.Sc. Pilot Radio & Tube Mfg. Co. (U.S.A.) 5 years. 1929, present position. Born 23rd March, 1902. Recreation: Fishing.

GEE, William.—Manager and Attorney, Harringtons Ltd., 10 Rundle Street, Adelaide. Joined Harringtons in 1926 as Country Representative all lines in N.S.W. Appointed Manager Adelaide Branch, June, 1930. Private address: No. 4 Sixth Avenue, Helmsdale, S.A. Recreation: Golf. Born 16/10/1899.

GENDERS, E. B.—Managing Director W. & G. Genders Pty. Ltd., Hobart and Launceston. Address: "Glenwood," Relbia. Hobby: Farming and stock breeding.

GERBER, Eugene.—Chairman of Directors, Bloch & Gerber Ltd., 46-48 York Street, Sydney. Private address: 22 Eastbourne Avenue, Clovelly. Born July 10th, 1880.

GIDLOW, C.—Radio Parts Manager, Efco Mfg. Co. Ltd., Princes Highway, Arncliffe, N.S.W. Served in France with Imperial Army. Came to Australia and has been connected with Efco Company for 8 years. Private address: Port Hacking Road, Sylvania. Born 31/12/1895. Recreation: Poultry raising.

GILL, William Edward.—State Manager, Radio & Refrigeration Dept., Airzone (1931) Ltd., Central Chambers, Charles St., Adelaide, S.A. Opened wholesale warehouse for above firm in February, 1933, in Adelaide. Selling to the public in Perth two years previous. Private address: 40 Marlborough Street, Henley Beach, S.A. Recreations: Golf, tennis. Born 16/9/99.

GILMOUR, Norman Stanley. — Proprietor, Lekmek Radio Laboratories, 75 William St., Sydney. M.Inst.R.E. Aust., and Vice - President of the Institution, Millions Club. Amateur Experimenting 1910. Telegraph Branch P.M.G.'s Dept., till 1915, Engineer Post-Master - General's Department (N.S.W.), 1915-1922. 1922-1927 Director L. P. R. Bean & Co. Ltd.; 1927-31, Director Stromberg - Carlson A/sia Ltd.; 1931, founded Lekmek Radio Laboratories. Born 25/9/1890. Recreations: Swimming & tennis.

GITTOES, C. S.—Chanex Production Manager, Ducon Condenser Pty. Ltd. Age: 28. Hobbies: Gardening and tennis.

GODFREY, William.—Airzone (1931) Ltd., Sydney. First Chairman Wholesaler Section Erda. On leaving school, entered Admiralty Hydrographic Survey Branch, and as a cadet served four years surveying service in British Columbia. Followed by three years in North Queensland and two years in N.W. Australia. Later, a year was spent on Photographic Survey of countries around Mediterranean. Joined Harringtons Ltd., 1912, and had considerable executive experience. Following on country representation, was branch manager Adelaide four years, Brisbane two years and General Manager New Zealand, five years. Returned to Head Office as Sydney Manager in 1928. Resigned Feb., 1933. Joined B.G.E. Ltd. in N.Z. Returned Australia early 1934. Joined Airzone (1931) Ltd. Private address: 49 Tunstall Ave., Kensington. Born, January, 1882. Recreations: Photography, gardening, golf. Educated Tottenham Grammar School, London.

GOODE, Arthur Russell.—Editor "The Listener-In," 62 Flinders St., Melbourne. Diploma of Radio & Electrical Engineering. Telegraphist in Commonwealth Service, "free-lancing" as a sideline. Switched over to full time journalism with the inauguration of "The Listener-in." Had 12 books published in Australia, England and America. Was one of the founders of the Society of Australian Authors, and is a life member of the Bunyips Club. Private address: "Korong," 22 Rubens Grove, Canterbury, Vic. Recreations: Reading and writing. Born 22/7/1889.

GORDON, F. A.—Manager Electrical Supply Dept., Noyes Bros., Melbourne. Associated with this firm for many years. Has held executive positions in electrical and trade federations, and, in 1930 was chairman of the executive committee of the Melbourne Radio Show. Private address: 17 Denman Avenue, East St. Kilda, S.2. Phone L 1335. Recreation: Golf.

GOULDER, Francis.—A.S.T.C., A.A.C.I. Factory Manager, The Ever Ready Co. (Great Britain) Ltd., Marshall Street, Sydney. Educated at Sydney Technical College. Joined the organisation 1906; appointed assistant Factory Manager 1914 and present position 1929. Enlisted 1915 and served on active service with Australian Engineers. Visited England on the Company's behalf 1932-33. Private address: Cheltenham Avenue, Cheltenham. Born 15/11/1891. Recreations: Gardening, fishing and photography.

GRABER, Jack J.—Joint proprietor Graber Electric Co. Radio experience commenced with Crystal-Clear Radio Co., in early days of radio. Later asociated with New System Telephones and S.T.C. as Sales Manager and in charge of radio department of Bruce Small Pty. Ltd., from which he resigned to commence business on own account. Private address: 205 Dangenong Road, Windsor, Vic. Sport: Golf.

GRAHAM, Lancelot Beaven.—Sales Manager and Secretary University Radio Company, 22 City Road, Sydney. Commenced radio 1925, actively concerned in the industry since that date. Joined Amplion (A/sia) Ltd., at the commencement of that Company. Later with Philips Lamps (A/sia) Ltd. Private address: 20 Inglethorpe Avenue, Kensington. Born 23rd October, 1907.

GREENLEES, Robert James.—Works Manager, Don Electrical Co., 112-16 Salisbury Road, Camperdown. 1909 assistant electrician. Operating until 1915. Active service, 1915, as signaller Australian Field Artillery. Wounded France, 1918. While convalescent, 1919, studied at Regent St. Polytechnic College, London, Telegraphy and telephony. 1920, secured electrical fitters' certificate, Sydney Technical College. In employ of O'Donnell, Griffin & Co. till 1930, first as fitter, then leading hand, and later shop foreman. Appointed present position, 1930. Obtained radio mechanic Certificate, Marconi School, 1931. Private address: 4 Rheims Street, Fivedock. Born 17/12/1895. Recreations: Billiards and cricket.

GREENWOOD, J. Russell.—Electrical Manager, Anthony Hordern & Son, Limited, Sydney. Chairman, Electrical and Radio Development Association, N.S.W.

GRIERSON, Robert.—Joint proprietor, Graber Electric Co., Melbourne. 13 years associated with New System Telephones, portion of which time he was engineer. Has had expert experience in all telephone systems. Resigned and joined as partner in Graber Electric Co.

GRIFFITHS, G. W.—Proprietor Mica & Insulating Supplies Company, Melbourne.

GRIFFITHS, J. Western.—Proprietor Mica & Insulating Supplies Co., 562-4 Bourke St., Melbourne. Commodore of Victorian motor-boat club.

HALE, John Palmer.—Manager Radio Department, Newton, McLaren Limited, 17 Leigh Street, Adelaide. Associated with Company since early part of 1917. Inaugurated Radio Section and in charge of same from 1922. Private address: Elderslie Avenue, Fitzroy. Born October, 1900.

GRIME, Stanley M.—Assistant Manager, Amalgamated Wireless (A'sia) Ltd., 47 York Street, Sydney. A.M.I.E. (Aust.), M.Inst.R.E. (Aust.). Apprenticed to electrical engineering, connected with private electric light companies; 1909, appointed City Council Worshops; 1916, appointed Works Manager, A.W.A.; 1922, visited large works in England & on Continent; 1928 appointed Assistant Manager, A.W.A.; 1931-2, visited U.S.A. as preliminary to establishment of valve manufacturing industry in Australia. President Radio & Telephone Manufacturers Association; Chairman of Radio Panel, Standards Association of Australia; Chairman of Examinations Board, Institution of Radio Engineers (Aust.).

HARCOURT, Victor John.—Secretary Radio Finance Company Ltd., 11 Sturt St., Sth. Melbourne, Vic. Saw active service during War as signalman and wireless operator—invalided in 1919. Interest in wireless on a commercial basis first started with Ogden Smith in 1921. Introduced wireless to Hartley's Sports Store in 1922. Joined Louis Coen Wireless at the commencement of business, handling retail side until the demand made a wholesale department necessary. Continued in charge of wholesale until 1929, when the demand for goods on hire purchase made it necessary for a Finance Company to be formed. Private address: 20 Melrose St., Mordialloc, Vic. Recreations: Fishing and duck shooting. Born 1901.

HAYMAN, Myles Fletcher.—Director and engineer Colonial Radio Pty. Ltd., 136 a'Beckett St., Melbourne. Director Gossard's Pty. Ltd., 136 Bridge Road, Richmond. Educated Brighton and Melbourne Grammar School. Hobby: Fishing.

HARDY, Walter R.—Proprietor W. R. Hardy & Co., Hurstville, Sydney. In the radio trade since 1921. One of first to obtain amateur operator's certificate of proficiency and owned and operated station 2RD. Past President Kensington Radio Club and past Hon. Sec. Wireless Institute of Australia. Born 24/12/1900. Educated Tamworth District High School and three years' training in mechanical and electrical engineering and science, University of Sydney. Three years engineer Economic Radio Stores, Managing partner Hardy's Radio Stores, Royal Arcade, Sydney, 1930-1933. Private address: 4 Woniora Road, Hurstville. Recreations: Journalism, tennis, surfing, and shooting.

HARGRAVE, Dan W.—Radio Sales Manager, Noyes Bros., Melbourne. Joined firm 14 years ago and at inception of radio department, was assistant to Mr. William Hill. He took over the department when Mr. Hill started in business on his own. Private address: 20 Rosedale Road, Glen Iris, S.E.6. Born 3/7/1904.

HARRINGTON, John E.—Retail Sales Manager, Raycophone Radio Sets, Harringtons Ltd., 386 George St., Sydney. Educated Sydney University. Interested in radio since the earliest days, both on experimenting and merchandising sides. Made an extensive post-war visit to America, England, and Continent on Radio and other business activities of Harringtons Ltd. Born 20th June, 1902. Recreations: Literature, music, golf.

HARRIS, David Thomas.—Manager D. Harris & Co., 140 Rundle Street, Adelaide. After varying periods with S. Hoffnung & Co. Ltd., Norman L. Burnell & Co. Ltd., G. H. Horton & Co. Ltd. (later appointed manager Adelaide Branch), commenced on own account in Radio, July, 1929. Entered into partnership with brother S. D. Harris, 1930, who has charge of technical and manufacturing section. Private address: 6 Fortrose Street, Dunbath, Glenelg. Recreations: Yachting, swimming, golf.

HAWORTH, Stanley R. E.—Sales Representative, Amalgamated Wireless Valve Co. Ltd., Melbourne. For several years in West Australian State Government Service. Joined A.W.A. Marine Service in 1921 and transferred to Sales Department, Sydney, in 1924. Joined Amalgamated Wireless Valve Co., in 1932. Recreations: Tennis, aerodynamics, bridge.

HAYMAN, Brian Sanders.—Director Gossard's Pty. Ltd., 136 Bridge Road, Richmond, also Colonial Radio Pty. Ltd., 136 a'Beckett Street, Melbourne. Educated Geelong Grammar School; joined Wills & Paton Pty. Ltd., as accountant in 1920. Formed Gossard's Pty. Ltd., with M. F. Hayman, in 1927. Promoted Colonial Radio Pty. Ltd., in 1933, with A. Cawthorne. Hobbies: Camping and swimming.

HEALY, Clarence P.—Radio Engineer, Raycophone Ltd., Sydney, N.S.W. Bachelor of Electrical Engineering, Melbourne. Graduate Electrical Engineering, Melbourne Technical School and Melbourne University. Engineering assistant Victorian Railways, Engineering Instructor in Victorian Senior Technical Schools, Head of Engineering Department, Collingwood Technical School, Examiner Radio Patents, Commonwealth Patents Office, for 12 months prior to joining Airzone Ltd., 1930. Joined Raycophone 1933. Twelve months' active service with Australian Flying Corps. Private address: 7 Merley Road, Strathfield, N.S.W. Born 7th Oct., 1898. Recreation: Tennis.

HELE, Joseph Alexander.—25 Currie Street, Adelaide. Accountant and Trustee, Director of Savery's Pianos Ltd., Hume Broadcasters Ltd., Radio Wholesalers Ltd., and of some Pastoral Companies.

HERRING, George Ken.—Sales Manager, The Ever Ready Co. (Great Britain) Ltd., Marshall Street, Sydney. Educated Sydney Grammar School; early Commercial training in Accountancy; 8 years. Practised for 5 years as Public Accountant. Joined organisation April, 1931, as Accountant and Secretary. Appointed present position November, 1931. Private address: 14 Manning Road, Edgecliff. Born 16/12/99. Recreations: Golf and surfing.

HENDERSON, Frederick J.—M.Inst.R.E. (Aust.). Director and Manager, Howard Radio Pty. Ltd., Vere St., Richmond, Vic. Educated at All Hallows Grammar School, England. April, 1911, obtained British Post Office Certificate of Proficiency in

Radio Telegraphy. Joined staff Marconi Telegraph Co., England, Marine Installation. September, 1913, joined Balfillie's staff, Melbourne. September 13, joined S.S. "Aurora," Mawson Expedition ship to Antarctic. 1914-1916 in charge of Macquarie Island Radio Station. February 16th, returned to P.M.G.'s staff, Melbourne. 1916-17 joined R.A.N. Radio Service, instructor, inspector, also supervisor Randwick workshops. 1917-20 engaged designing, testing, supervising and erecting numerous radio installations in Australia and New Guinea for R.A.N.R.F. 1928, appointed Director Howard Radio Pty. Ltd. Born 26/6/1891. Private address: South Lodge, Were St., Brighton Beach, S.5., Victoria.

HERTOG, A. den.—Managing Director, Philips Lamps (A'sia) Ltd., 69 Clarence Street, Sydney. Director Electric Lamp Manufacturers (Australia) Ltd., Clyde St., Hamilton, N.S.W.

HILL, William C.—191 Queen Street, Melbourne. Connected with radio since the War, prior to which he served in the Army having been invalided back to Australia. After several years at sea as a Wireless Operator, joined the Commercial staff of A.W.A. in Melbourne. Organised and managed 7LA, Launceston. Joined Noyes Bros. (Melb.) Pty. Ltd., a year or two ago. Last year started in business on own account as Factory Representative for Victoria and Tasmania.

HILLS, A. H.—Queensland Representative of Philips Lamps (A/sia) Ltd. Company address: Perry House, Elizabeth Street, Brisbane. Has represented the interests of Philips Lamps (A/sia) Ltd. in Queensland since 1927.

HOBDEN, Hillstead Inigo. — Radio Manager, Eastern Trading Co. Ltd., 155 Clarence St., Sydney. Member Millions Club. Private address: 9 Denman Street, Hurstville. Born 1893. Recreations: Golf, motoring.

HOLDSWORTH, J.—Chanex Resistor Production Manager, Ducon Condenser Pty. Ltd. Associated with Company from its inception. Age: 26.

HOMBERG, S. G.—Born in Gippsland. Early in life interested in experimental wireless. After roving for a while returned to Melbourne 1919, and became a tram conductor. Studied radio operators' course, obtained experimental licence, and operated experimental station 3RG. Given job as salesman by P. McElroy. Became floor manager, and three years later, Melbourne manager of Harrington's. 2½ years later selected as Manager of Veall's new store. Now director of A. J. Veall's Pty. Ltd. Recreations: Psychology, ancient history, golf.

HOMEWOOD, Walter B. — Director and Sales Manager, Airzone (1931) Ltd., 16 Australia Street, Camperdown, Sydney.

HOOKE, Lionel Alfred. Deputy General Manager, Amalgamated Wireless (A'sia) Ltd., 47 York St., Sydney. M.I.R.E. (America), M.Inst.R.E. (Aust.), M.S.B.M. Joined Amalgamated Wireless, 1913, and in 1914 joined Shackleton's Polar Expedition. On return, commissioned in New Zealand Royal Naval Volunteer Reserve, served as commissioned officer in submarine chasers and armed rescue tug patrol. Transferred as pilot to Air Force, subsequently commanding Air Station at Bude. On return to Australia appointed Melbourne Office, A.W.A., and later became Melbourne Manager. Transferred to Sydney as Assistant Manager and became Deputy General-Manager A.W.A. 1925. 1930-32 travelled Europe and America for A.W.A. investigating world's development in radio. Councillor Institution Radio Engineers, Australia. Born 31/12/1894.

HORNER, Ernest Albert.—Manager Radio-Electric Works, Amalgamated Wireless (A'sia) Ltd., Parramatta Rd., Ashfield. Born Auburn, N.S.W., apprenticed electrical fitting Tramway Workshops, Randwick, March, 1908. Employed by various firms as armature-winder, electrical and mechanical fitter. Later rejoined R. & T. Dept., as electrical, loco. steamshed and mechanical fitter. Two years in testing division of Dept. Joined A.W.A. 1918, later Assistant Manager of Works. Appointed Works Manager, 1923. Visited England and United States in 1926, to study manufacture and again visited England in 1932-3 on A.W.A.'s behalf.

HORTON, George Harry.—Managing Director G. H. Horton & Co. Ltd., 66 City Road, Sydney. Member Rotary and Tattersalls Clubs. Director E. F. Wilks & Co. Ltd. Private address: "Roycroft," 20 New South Head Road, Vaucluse. Born 1886. Recreation: Golf.

HOSKING, A. P.—Sales Manager, Amalgamated Wireless Valve Co. Ltd., 47 York Street, Sydney. M.Inst.R.E. (Aust.). Dept. Posts & Telegraphs, South Africa, 1906. Beira, Mashonaland and Rhodesian Railways, 1911. Dept. of P. & T., Rhodesia, 1913. Joined South Africa Field Telegraph & Postal Corps at outbreak of war, 1914, engaged war service. Australian Coastal Radio Service, 1916. R.A.N. Service, 1916. Coastal Radio, 1922. A.W.A. 1922 Interstate Sales Manager. A.W. Valve Co. on formation, 1932. Recreation: Golf, fishing, swimming.

HUCKELL, Edward Dean.—Proprietor Huckell Radio, 285 Military Road, Cremorne, N.S.W. Member I.R.E., Aust. (Member Official Radio Service Mens' Assn., U.S.A.). Vice-President Radio Retailers' Association, N.S.W. Director "Radio Merchants Ltd.," Sydney. Beale & Co. Ltd., Queensland. 1926, organised Picton Lakes T.B. Settlement Scheme, Marrickville. 1927, established and managed Guille & Co. Ltd., Radio Dept. 1928, established "Huckell Radio," Cremorne. Private address: 285 Military Rd., Cremorne, N.S.W. Born November 24th, 1897. Recreations: Literature, travel.

HULL, Allan Galbraith.—Technical Editor "Wireless Weekly," Wireless Newspapers Ltd., 60 Elizabeth Street, Sydney. Associated with brother Ross A. Hull since 1920, in general radio activities. Technical Editor "Wireless Weekly" since July, 1930. Private address: 69 Baroona Road, Northbridge. Born 5/4/05.

HUNT, George.—General Manager E.S.M. Co. Ltd. Extensive Commercial and Accountancy experience in three Eastern States. Joined Radio Industry, 1932. Manager Darelle Products. Private address: 4 Mitchell Street, Marrickville. Born 15/10/04. Recreations: Tennis and motoring.

IRVINE, Charles T.—Radio Sales Manager, Radio Department, A. G. Healing Ltd., 167 Franklin Street, Melbourne. Commenced in Radio 1927. Appointed Sales Manager, 1929. Born 26/7/04.

JACK, James Paterson.—Station Engineer, Sport Radio Broadcasting Co. Ltd., 99 Currie Street, Adelaide, S.A. 2nd Class Washington Certificate. Commenced study radio, 1916. Employed by Marconi Company, London, 1917. Left Marconi Company, 1925, to continue radio engineering in New Zealand, 1925 to 1932 interested in short wave work and broadcasting. Appointed present position, January, 1932. Private address: Box 709F, G.P.O., Adelaide, S.A. Born 3/6/1900.

JAMES, Clause E. W.—M.H.A. Director W. & G. Genders Pty. Ltd., Tasmania. Address: Frankland St., Launceston. Fellow Federal Institute Accountants. Chief Secretary for Tasmania and an ex-Alderman of the City of Launceston, having occupied the Mayoral Chair for two years.

JEACOCKE, Norman Reginald.—Advertising representative of Wireless Newspapers Ltd., of 60 Elizabeth Street, Sydney. Recreations: Golf and swimming.

JEWELL, Albert.—General Manager and Australian Attorney, The Ever-Ready Co. (Great Britain) Ltd., Marshall St., Sydney. Appointed Melbourne Manager in November, 1931; present position, June, 1933. Private address: 31 Hopetoun Avenue, Vaucluse. Born 21/8/93. Recreations: Fishing and art.

JENNINGS, R. H. J.—Sales Manager, Thom & Smith, 55 Dowling St., East Sydney. Engaged in electrical industry many years and with British General Electric Co.; Radio Manager and later Engineering Representative. Visited Continent and England, 1926. Joined Thom & Smith, November, 1932. Private address: 42 Bradley's Head Road, Mosman. Recreations: Golf, tennis and yachting. Born 27/7/03.

JOHANSSON, Nils Alfred.—Radio Engineer, Beale & Co. Ltd., Trafalgar Street, Annandale. Bachelor Science, A.Inst.R.E. (America), M. Swedish Inventors Society. M. Radio Technical Society (Sweden). Formerly of Western Electric Radio Research Department (Bell Telephone Laboratories), Swedish Telefunken Co. and allied organisations. Private address: "Trearne," Mitchell St., Bondi. Born 25/9/1895.

JOHNSON, J. Murray.—Maintenance Engineer, Coastal Radio, Amalgamated Wireless (A'sia) Ltd., 47 York Street, Sydney. M.Inst.R.E. (Aust.). Served apprenticeship with Morris Bros., General Engineers, Sydney. 1911, joined Australasian Wireless Company, engaged erectional work high power stations Sydney and Perth. 1912, joined Commonwealth Radio Service, engaged erectional work at Geraldton and Broome Stations to end of 1913. 1914, transferred to operating staff and stationed at Esperance, Geraldton, Darwin and Adelaide stations. 1923, transferred to Engineering Department, A.W.A., Sydney. 1932, appointed present position. Visited England on behalf of A.W.A. 1932, and again in 1934. Born 24/11/89.

KENDALL, A. W.—Managing Director Kendall Knight & Co. Ltd., of 59 York Street, Sydney. Member Institute of Engineers, Aust. Private address: Dilecta Avenue, Mosman. Recreation: Golf.

KENNELL, Richard J. W.—Chief Engineer and Manager James Manufacturing Co. Ltd., Parramatta Road, Leichhardt, Sydney; also Chief Engineer New System Telephones Pty. Ltd. Councillor and M.Inst.R.E. (Aust.). Chairman of Directors, Radio Interests Ltd. Born 1894.

KERR, William.—Factory Manager, Eclipse Radio Pty. Ltd. Company address: 216-222 City Road, South Melbourne, Vic. Hon. Secretary, Brighton Radio Club. Private address: 211 North Road, Caulfield. Born 23rd January, 1904.

KINGSTON, Frederick Charles.—Director Musgrove's Ltd., in charge Radio, Phonographs and Electrical Depts., also Director W.A. Broadcasters' Ltd. Born in England Feb., 1892. Entered Music Trade in Australia, 1912. Served four years with A.I.F. Signals. Returned to Australia 1920 and re-entered music trade. In 1923 joined with Mr. D. O. Musgrove, A. T. Gray and R. D. Scott in founding Musgrove's Ltd., which firm commenced business as music warehousemen in November, 1923. In 1929 secured sole W.A. distribution for Magnavox Speakers and Stromberg-Carlson Radio Products. In March, 1930, established 6ML, W.A.'s first class "B" station, and in 1933 supervised building and establishing of Station 6IX. Now holds position as Station Director of 6ML and 6IX. President, 6ML Cheerio Club. Private address: 19 Suburban Road, South Perth.

KNIGHT, O. M.—Partner of Kendall Knight & Co. Ltd., of 59 York Street, Sydney. Associate Member Institute of Civil Engineers, and Associate Member Institution of Engineers Australia. Private address: Killara. Recreation: Golf.

KNOCK, Donald Brader.—Technical Editor Australian Radio News. Bulletin Newspaper Co. Ltd., 252 George St., Sydney. Member Flying Corps Assn. of Australia. 4th Russian Order St. George. Deniken's White Army, 1919. Born Manchester, England, 10/10/99. Educated Wigan Grammar School. Apprenticed Mech. Engineer and studied radio as hobby. Served with Royal Naval Air Service, Observation and Transport in Southern Russia, middle East and Bulgarian Front. Engineer afloat P. & O. Co. 1921-23. Tech. Sales Rep. British Empire Exhibition, Wembley, 1924. Engineer with British Broadcasting Co., 1925, Leeds-Bradford Relay Station. Sales Engineer Amplion (A/sia) Ltd., Sydney, 1927. Technical Editor "Wireless Weekly" & "Radio In Australia and New Zealand," 1928-29. Radio Engineer i/c S.W. Telephony installation Wyndham Meatworks, North-West Australia, 1930. Foundation Technical Editor "Radio Monthly," 1932. Short-wave radio consultant. Owner-operator exp. radio station VK2NO. Private address: 102 Nelson Bay Road, Bronte. Recreations: Swimming and motoring. Born 10/10/99.

LARKINS, Albert John.—Radio Sales Manager, Efco Mfg. Co. Ltd., Princes Highway, Arncliffe. With United Distributors 1922-27, then in business on own account for 5 years building "Rheola" radio receivers. Joined Efco early 1932. Private address: 50 Gray St., Kogarah. Born 19/10/1898. Recreations: Fishing and motoring.

LARKINS, Frederick William.—Publicity Manager, Amalgamated Wireless (A'sia) Ltd., 47 York Street, Sydney. Associate of Commonwealth Institute of Accountants. Associate of the Chartered Institute of Secretaries, Holder of Diploma in Economics & Commerce (Sydney University). Joined Australasian Wireless Co. Ltd., as Accountant July, 1912, appointed Accountant to Amalgamated Wireless (A'sia) Ltd., on formation, July, 1913, until 1923, when he took over duties of Publicity and Advertising Manager on the creation of that section of A.W.A. activities.

LEEMAN, John.—Branch Manager, The Ever Ready Co. (Great Britain) Ltd., 360 Collins Street, Melbourne. Joined organisation as country representative March, 1932; appointed present position June, 1933. Previously with J. L. Newbigin and Brooks, Robinson & Co. Ltd., of Melbourne. Born 2/7/1901. Recreations: Tennis and swimming. Private address: "Carngham," 38 Frederick Street, West Brunswick, Victoria.

LEVENSON, Joseph.—Proprietor Levenson's Radio, Pitt St., Sydney. 27 years in business in Pitt St., 7 years in radio. Private address: 36 Allison Road, Kensington. Born April, 1882. Recreations: Business literature.

LEVINGS, Stanley B.—Workshop Manager, Werring Radio Co., 213-215 Queensberry St., Carlton, N.3. In radio trade for five years. Private address: 5 Verdun Grove, Regent. Born 24/2/12. Recreations: Radio and television experiments.

LITTLE, H. L.—Radio Sales Manager, William Buckland Pty. Ltd. Formerly associated with Louis Coen Wireless, New Systems Telephones and Noyes Bros. Joined William Buckland about two years ago at the inception of radio department. Private address: 16 Gavan St., Burwood, Vic. Recreation: Swimming.

LINCOLN, Reginald.—General Manager, Sport Radio Broadcasting Co. Ltd. (Station 5KA), Currie St., Adelaide, S.A. Associated with Radio since 1924, in Eastern States. Appointed Manager Station 5KA in June, 1932. Private address: 81 Fifth Avenue, Joslin, Adelaide. Born June, 1893.

LONG, Henry Charles.—Proprietor United Radio Distributors, 73 York Street, Sydney. Associated with Radio since 1926. Manager of Latimer's Wireless Supplies Ltd. Retail Radio Branch Manager for United Distributors Ltd. Formed United Radio Distributors September, 1932. Present address: "Blanerne," Wybalena Road, Hunter's Hill. Born 1910.

LOVE, H. Kingsley.—Managing Director Teleradio Construction Pty. Ltd., Spring St., Melbourne. Associated in the amateur field since the earliest days. Organised first long-distance communication between England and America in 1922. Associated with Mackay expedition to Central Australia as radio technician. Flight-Lieutenant and organiser of amateur reserve for Australia. Private address: 1 Tollington Avenue, East Malvern. Sports: Shooting, flying.

LOVETT, Leonard.—Proprietor and manager Radio and Electric Department, L. Lovett, 81 Bathurst St., Hobart. Served apprenticeship with Hutchinson & Co., Hobart. Enlisted for active service August, 1914. Returned December, 1918. Employed at Electrolytic Zinc Co.'s works 12 months, then commenced own business in Electrical Business. One of the first to enter the Radio field in Hobart. Hon. Sec. Contractors' Section Federation of Tas. Private address: "Birkroyd," Alexander St., Hobart. Born 1894. Recreations: Tennis, fishing.

MACLURCAN, Charles Dansie.—Aust. Representative A. C. Cossor Ltd. (Great Britain), 26 Jamieson Street, Sydney. Assoc. I.R.E. (America). Foundation Member Wireless Institute Australia, 1910. President 5 years. Original pioneer experimenter, 1910. Founder and President of N.S.W. Figure Skating Club. President of National Ice Skating Association. Commenced regular Sunday Broadcasts, experimental nature, 1400-400-250 and ultimately down to 20 metre wave length. Transmitted Josie Melville's Broadcast, 1923. By arrangement with A.W.A. as a result of experimental activities sailed on S.S. "Tahiti," 1924, to investigate possibilities of low power transmission on 200 metres between Australia and America, results entirely satisfactory. Continued further experiments in short waves and in 1925, proved the success of 20 metre daylight transmission to England on low power. In 1926 and 1927 communicated with all countries on low power short wave amateur apparatus. Visited England and the Continent, 1927-8, and again in 1929. Appointed Australian Representative for Cossor Valves, 1929. Recreations: Ice skating, ski-ing and sailing. Private address: Agnes Street, Strathfield, N.S.W. Born 1891.

MACDOUGALL, R. K.—Director and Sales Manager A. J. Veall & Co., Swanston Street, Melbourne. Entered electrical business in 1920 with the Metropolitan Electric Co. Joined A. J. Veall as traveller 1923. Promoted to Directorship 1930. War service 2½ years in France with the 37th Battalion as Lieutenant. Private address: 11 Nepean St., Glen Iris. Recreations: Golf, bridge.

MACGRATH, James Herbert.—Managing Director and founder of Regent Radio Pty. Ltd., 288 Bourke Road, Camberwell, E.6., Victoria. Was with the Myer Emporium radio department. Managed G. & M. Radio for two years and in 1926 went to England and the Continent. On returning formed Regent Radio Company which in 1933 was re-formed into Regent Radio Pty. Ltd. Private address: 4, The Ridge, Canterbury, E.7., Vic. Recreation: Golf. Born 1905.

MALONE, James J.—M.Inst.R.E. Vice-Chairman I.R.E., Melbourne Division. Chief Inspector Wireless, Postmaster-General's Department, Treasury Gardens, Melbourne.

MANLEY, Patrick Joseph.—Managing Director, Amplion (A/sia) Ltd., 70 Clarence Street, Sydney. Member Institution of Radio Engineers Australia. Commenced Victorian Railways, Telegraph and Telephone Division. 2nd Lieut. Signal Engineers, 1912-14. A.I.F. Signals 1915-19. Captain Commanding Divisional Artillery Signals. 1919 Marine Wireless Officer. 1923, Sales Department Amalgamated Wireless. General Manager and Director, Amplion (Australasia) Limited, 1927. Formed Speakers (Australasia) Limited 1930, with position of Managing Director. Made careful study of Radio Manufacturing and merchandising abroad on several occasions. Private address: "Lindisfarne," Edgecliff Road, Woollahra. Born 11th September, 1894. Member Legacy Club. Recreations: Army Signals (Captain 1st Cav. Signals).

MARKS, Ted.—The Southport School, Queensland. St. Paul's College. Sydney University. B.E., A.M.I.E. (Aust.). N.S.W.G.R. Signal Branch, 1923. Southern Railway Company Electrification. England, 1924. Joined McKenzie & Holland (Aust.) Pty. Ltd., Chief Engineer, Melbourne, in 1924; in England and after experience with the Westinghouse Brake & Saxby Signal Co. in office work and field work, returned as Assistant Engineer. Appointed Chief Engineer in 1933. Interested in rowing, coached The King's School Eight to victory in 1920 Head of the River; also coached Sydney University crew in Adelaide 'Varsity race in 1923, but was "not quite so successful."

MARTIN, Albert Frederick.—B.E.E. Radio Receiver Development Engineer, A.W.A. Radio-Electric Works, Ashfield. Entered Wesley College, Melbourne, 1916, attended University of Melbourne 1920-23. Associated with Melbourne Electric Supply Co., 1924, and later with Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa., U.S.A. Joined A.W.A. in 1928. Born Ballarat, Victoria, 30th June, 1902. Recreations: Gardening and surfing.

MARTIN, Charles J.—Managing Director, Radio Maintenance Pty. Ltd., Swanston St., Melbourne. Formerly associated with Eclipse Radio. Now specialising in development of car radio. Recreation: Golf.

MARSHALL, Herbert A.—Chief Engineer of 2UW Broadcasting Station. Company address: State Shopping Block, Market Street, Sydney. Member of the I.R.E. (Aust.), also Member of the R.A.A.F. Reserve. Born in Punjab, India, 1888. Received Primary education in India and Secondary education in England. Trained as Power Electrical Engineer. Arrived in Australia 1907. Served B.H.P. Co., Broken Hill and Port Pirie. Built and exhibited a Wireless Transmitter and Receiver at S.A. School of Mines in 1901. Engineer in charge Waddington's Theatre Circuits, Sydney. Contractor Electrical installations 15 Theatres, Sydney and Suburbs. Founder City of Armidale Electric Power Company Ltd. Managing Director and Superintending Engineer, Armidale, for 5 years. One of pioneers Bakelite moulding industry in Australia, originator of Bakelite domestic wares—Nally Ware. Sound Engineer Union Theatres Ltd. right through initial installations in all theatres. Built and installed ½ K.W. Broadcasting Transmitter 2XC Broken Hill. Barrier Broadcast Ltd. One of pioneer band Experimental Wireless Stations VK2HM. Present Engineer in charge Commonwealth Broadcasting Corporation, Station 2UW. Private address: 94 Francis Street, Bondi. Born in India in 1888. Recreation: Radio.

MASKALL, Donald.—Managing Director Paramount Radio Manufacturing Co. Ltd., 301 Castlereagh Street, Sydney. Commenced radio with Messrs. Grose & Daniels and later on own account. Founded "Paramount Radio Mfg. Co.," May, 1932. Formed into Limited Company, April, 1934. Experimenting since age of 12. Private address: Carlingford. Born 16/4/11. Recreations: Tennis, motoring, flying.

MASHFORD, Rupert Leslie.—Liverpool Electric Cable Co. Ltd., Sydney. Technical, Publicity & Sales. Received early training in Electrical Engineering under late Professor Oxlade, of Sydney Technical College and Federal Electric Works, Sydney. Engaged in electrical activities until outbreak of war. One of the pioneers of radio in Australian experimental licences, dating back to 1910, when owned and operated experimental station XRL, Sydney. During the war served with Signal Section 13th and 45th Battalions, and later with Wireless Section of Signal Engineers. Eventually assumed command as O.C. Wireless, Australian Corps in France, and technical advisor to Chief of Signals. After Armistice was sent to London to superintend purchase and supply of radio equipment for the Australian Defence Forces. On the inception of broadcasting in Australia, engaged in the manufacture and sale of radio receivers, components, and in 1928 joined up with The Liverpool Electric Cable Co. Ltd.

MATTHEWS, Thomas John. — Manager Radio & Television Mfrs. Ltd., York House, 101 William Street, Sydney. Connected with radio since 1924. Associated with Edison Swan Electric Co. Ltd. and Harringtons. Then in charge of sales for Mullard and Ferranti, A. Beal Pritchett Ltd. Joined Speakers Ltd. 1932; with present Company marketing chassis and complete sets. Studies—Advertising and Sales Promotion. Private address: Bruce Flats, 93 Mount St., Coogee. Recreations: Fishing, swimming, billiards and reading. Born 14th November, 1903.

MINGAY, Oswald Francis.—Managing Editor and Proprietor "Radio & Electrical Merchant," and "Radio Trade Annual," "Radio Review of Aust.," 15 Castlereagh St., Sydney. M.Inst.R.E. Aust. Honorary Secretary Institution Radio Engineers Australia, M.Inst.R.E. (America), Millions Club. Telephone Dept. 10 years. Served A.I.F. Signals 4½ years. In charge reconstruction Charleroi Telephone System (Belgium), after Armistice. Nine months attached British P.O. Resigned from P.O. 1922, appointed Radio Manager, later Director, Burgin Electric Co. Ltd. till 1925. Radio Manager (N.S.W.) Harringtons Ltd., 1925-26. Managing Director Mingay's Wireless Mfg. Ltd., 1926-27. Radio Manager Suttons Ltd. (N.S.W.), 1928-29. Founded Australian Radio Publications, 1930. Principal Australian Radio College, 1930-1933. Private address: 19 Woodside Ave., Lindfield, N.S.W. Born 1/7/1895.

MEAD, Maxwell.—Proprietor Mead Manufacturing Co., 1 Crown Lane, Sydney. Attended Sydney University for LL.B. Degree. Associated with 2FC and 2BL orchestras and A.B.C. for a number of years. Member of Melba Williamson Grand Opera Co., 1928. Commenced Radio Manufacture, 1931. Private address: Shelley Beach, Manly. Born 27/12/05. Recreations: Swimming and tennis.

MILLINGEN, Arthur Clarence.—Managing Director, Eastern Trading Company Ltd., Keep House, 155 Clarence Street, Sydney.

MITCHELL, George.—Manager Radio Section Martin de Launay Ltd., Sydney and Newcastle. Marconi School of Wireless. Associated with Martin de Launay Ltd., fourteen years. Private address: Hall Street, Bondi.

MITCHELL, Stanley Cyril.—Managing Director Commonwealth Moulding Company Ltd., 240 Princes Highway, Arncliffe, N.S.W. Alderman of Rockdale Municipal Council. Electrical Engineer by profession. 12 years master builder. Alderman, Rockdale Municipal Council. Private address: 240 Princes Highway, Arncliffe, N.S.W. Born 1892. Recreation: Fishing.

MOORE, Eric J. T. — Chief Engineer, Stromberg-Carlson (A/sia) Ltd., 72 William Street, Sydney. M.Inst.R.E. Aust. (Chairman of Standards Committee of I.R.E.). Educated at Armidale College and Sydney High School. Qualified Royal Naval Examination Electrical Engineering, 1917. 1910, 1911, with Telefunken Company, erecting station AAA. 1911-14, P.M.G. Telephone Department. 1914-16, Wireless Operator, Australian Transport 1916-19, Lieutenant, Royal Naval Air Service. 1923-26, Manager Farmer and Company Ltd., Radio Section; 1926-32, Stromberg-Carlson & Company, Rochester, U.S.A. 1932, returned Australia, present position. Born 12/7/1894.

MOORE, Joseph Sheridan.—General Manager, Hazell & Moore Ltd., 36 Campbell Street, Sydney. Articled in Accountancy profession since schooldays. Practised as Chartered Accountant, F.C.A. (Aust.), now on retired list, until 1924, when with brother Mr. E. R. Moore and partner, Mr. E. J. Hazell, founded present Company, Hazell & Moore Ltd. Private address: 24 Paradise Avenue, Roseville. Born 27th Dec., 1895. Recreations: Golf, swimming and motoring.

MORGAN, Sydney.—Managing Director 3KZ Broadcasting Co. Pty. Ltd., 64 Elizabeth Street, Melbourne Member Victorian Institute of Advertising. Associated with advertising activities in Melbourne since 1917. Dec., 1930, one of founders and Director of 3KZ station. Appointed Managing Director June, 1932. Private address: 19 Nirvana Avenue, East Malvern. Born, 1900. Recreations: Tennis, swimming.

MORSE, Noel Percy.—Registered Proprietor Creela Radio Products—Transformer Specialists and Fertilizer Manufacturers Technician, Designer and Factory Manager for above firm. Marconi School Qualifications. Private address: 48 Kareela Rd., Cremorne. Recreation: Trout fishing. Hobbies: Amateur wireless and public speaking.

MORAND, Daniel Francis. — General Business Manager, Harringtons Ltd., 386 George Street, Sydney. Tattersalls Club 14 years System expert, W. C. Penfold Ltd., 1912-26. General Manager in Australia for N.Z. Redwood Forests Ltd., 1926-28. Appointed General Sales Manager, Western Electric Co. Ltd., 1930. And later in charge of credits and sales. Appointed present position, February, 1933. Private address, Hercules St., Chatswood. Recreations: Golf, surfing. Born 25/1/1887.

MUIR, David Temple.—Secretary Wireless Newspapers Ltd., 60-66 Elizabeth Street, Sydney. Associate Federal Institute of Accountants.

MULHOLLAND, John Leonard.—Melbourne Manager, Amalgamated Wireless (A'sia) Ltd., Melbourne. Rotary Club, Melbourne. President Victorian Radio Association (1932-33). M.Inst.R.E. (Aust.), Wireless Officer, s.s. "Katoomba," 28th August, 1911, also served in other ships until appointed Sydney Inspector, A.W.A., February, 1914. N.Z. Manager, July, 1915, until July, 1920. Traffic Manager, Marine Dept., 1920-22. Assistant Manager, A.W.A. Head Office, 1922. Melbourne Manager since April, 1928. Private address: Kensington Road, South Yarra, Victoria. Born, 19/4/91. Recreations: Golf, tennis, bridge.

MURRAY, Gilbert Lang.—Managing Director The Mullard Radio Company (Aust.) Ltd., 35 Clarence St., Sydney. Royal Automobile Club. Tattersall's Club. Australian Golf Club. Appointed Managing Director Mullard Radio Company (Aust.) Ltd., at inception of company, May, 1931. Managing Director of Scott & Holladay Ltd., 35 Clarence Street, Sydney. Has travelled throughout Australia and New Zealand on numerous occasions and made business trips abroad in 1915, 1920, 1921, 1929 and 1932. Private addres: Royal Automobile Club of Australia, 89 Macquarie Street, Sydney. Born 13th April, 1889. Recreations: Golf and Tennis.

McBRIDE, Frederick Robinson.—Director and Engineer, Colonial Radio Pty. Ltd., 136 a'Beckett Street, Melbourne. Hobbies: Shooting and Tennis.

McCUBBIN, Hugh Montgomery.—Sales Manager Radio Corporation Pty Ltd., 11-21 Stuart Street, South Melbourne, Vic. Served A.I.F. 1914-16. G.E.C. London 1916-22. Noyes Bros. (Melb.) Pty. Ltd., Manager Lamps and Radio Departments, 1923-28. Philips Lamps (A/sia) Ltd., Melbourne Manager, 1928-30. Radio Corporation Pty. Ltd., Sales Manager, 1930 onwards. Private address: "Leny Manor," Davidson St., South Yarra, Melbourne, Vic. Born 1894. Recreations: Swimming, Tennis, Fishing.

McEWIN, George Augustus.—Indoor Manager, C. Winkworth & Son Ltd., 337 George St., Sydney. Member Dee Why Golf Club. Educated Randwick High School. Spent 3 years in S. Australia in piano trade. Continental Player Co., Sydney, for 3 years. Joined Winkworth's, Manager Gramophone Dept., 1923. 1926, took charge radio dept. Private address: Mowbray Rd., Chatswood. Born, 29/6/1900. Recreations: Golf, motoring, swimming.

McDONALD, Arthur Stephen.—Chief Engineer & Assistant Manager, Amalgamated Wireless (A'sia) Ltd., 47 York Street, Sydney. M.Inst.R.E. (America) and M.Inst.R.E. (Aust.). Chairman, Qualifications Committee of I.R.E., Aust. Born Castle Donnington, now Swan Hill, Vic. Educated at Public School and Melbourne Technical College. Served apprenticeship in Melbourne engineering firm. Joined Electrical Engineers' Branch, P.M.G.'s Dept., 1909. 1911, transferred to Radio Section, and for some years engineer-in-charge of installation of Coastal Radio Stations throughout Australia. On outbreak of War transferred to R.A.N. and engaged in engineering designs. Later appointed inspector R.A.N. Workshops, Randwick. The War over, transferred to old position in P.M.G.'s Dept. On transfer of Coastal Radio Stations to Amalgamated Wireless, 1922, appointed Chief Engineer of A.W.A. Following year went to England and Continent, made intensive study of broadcasting and trans-ocean telegraphy, visiting the principal broadcasting and high-power stations in England, France and Germany. Since return, in charge of technical activities of A.W.A., including experimental short wave telegraph-telephone working and overseas telephony. Councillor Institution of Radio Engineers Australia.

McEWAN, Reginald.—Sales and Service Dept., P. & K. Williams Ltd., 74 Wentworth Avenue, Sydney, N.S.W. 13th Battn. A.I.F., 1916-1919. Born 29th November, 1899. Recreations: Short wave fan, surfing.

McLEAN, Eric Archibald.—Sales Manager of Radio Dept., Smith Sons & Rees Ltd. Company address: 30-32 Wentworth Avenue, Sydney. Educated Public Schools, South Australia. Entered Postal Department 1912. During 1917 and 1918 served as telegraph operator at Alice Springs, Central Australia. In 1919 transferred to Federal Taxation Department, Adelaide, as Assistant Cashier. Commenced commercial activities with Smith Sons & Rees Ltd., 1922, and in 1923 went for a tour of New Zealand, America, England and France—absent from Australia 3½ years. On return commenced radio business on own account in Adelaide. In August, 1931, transferred business to Messrs. A. G. Healing Ltd., and managed the then new retail department for them. In March, 1933, retired from Healings and transferred to Sydney, linking up again with Smith, Sons & Rees Ltd., in September of the same year. Address: Cambridge Avenue, Vaucluse. Born 4th February, 1897. Recreations: Literature, gardening, tennis.

McNEILL, Thomas Albert Edward.—Chief Engineer, Council of Churches Broadcasting Co., 2CH, 77 York St., Sydney. 1st Class P.M.G. Certificate, 1918. With Marconi Co., London, Nov., 1918-July, 1927, marine operator. With 2BL Broadcasters Sydney Ltd., and N.S.W. Broadcasting Co., operator, Nov., 1927, to July, 1929. With P.M.G. Dept. (Broadcasting Division) supervisor 2BL studio, July, 1929-Oct., 1931. Appointed Chief Engineer 2CH Oct., 1931. 2CH successfully opened Feb., 1932. Private address: 80 Glenayr Ave., Bondi. Born Feb., 1901. Recreations: Tennis, cricket.

McPHEE, Stuart Duncan.—Works Manager, Standard Telephones & Cables A'sia Ltd., 71 York Street, Sydney. Born and educated in Melbourne. After three years with the Electrolytic Zinc Co., Tasmania, went to U.S.A. Spent three years there with various manufacturing companies joining the Western Electric Co., in 1922. Has been with this company and Standard Telephones since above date in U.S.A., London, Paris and Sydney. Connected with the manufacture of telephone and radio equipment. In 1926 came to Sydney to start up and operate a manufacturing branch of Standard Telephones & Cables A/sia Ltd. M.Inst.R.E. (Aust.). Born 1899.

McQUILLAN, Cecil John.—Chief Radio Systems Engineer Standard Telephones & Cables Ltd., 71 York St., Sydney. B.Sc. (Engineering) Honors London University. D.I.C. (Diploma of the Imperial College, London), Whitworth Exhibition. M.I.R.E. (America). Private address: "Cheddington," Elizabeth Bay Rd., Sydney. 1923, Joined Standard Telephones & Cables Ltd., London. 1923-1925, Engaged in Transatlantic radio telephony research. 1925-1926, Took responsible part in the development design and installation of the 200 kilowatt Transatlantic radio telephone transmitter constructed by Standard Telephones & Cables Ltd., for the British Post Office at Rugby, and was one of the small group of engineers and scientists who, at 4 a.m. on February 7th, 1926, held the first two-way radio telephone conversation across the Atlantic Ocean—from Rugby, England, to New York. 1926-1928, Responsible for development and design of radio broadcast transmitters for Standard Telephones and Cables Ltd., London, including 50 kilowatt broadcaster which, at that time, was the largest in the world. 1928-1930, Chief Engineer to African Broadcasting Co., operating stations in Johannesburg, Durban, Cape Town, Pretoria and Bloemfontein. Installed 10 kilowatt broadcaster at Johannesburg. 1930, Re-joined Standard Telephones & Cables Ltd., London, and came to Australia to carry out contract for supply and installation of National Broadcasting Stations at Newcastle, Rockhampton, Corowa and Crystal Brook. 1933, Visited England and the Continent to study latest technique and returned to Australia to carry out contract with Postmaster General's Department for the manufacture, supply and installation of seven new Regional Stations to be erected at Launceston, Townsville, Grafton, Sale, Dubbo, Murtoa and Katanning.

NEWMAN, Sydney Moreton.—Radio Engineer, Amalgamated Wireless (A'sia) Ltd., Sydney. M.Inst.R.E. (Aust.). Joined A.W.A. Engineering and Research Staff, 1920; associated with following developments: First regular broadcasting service in Australia, 1921. First telephony tests to New Zealand, 1922. First S/W telegraph tests between England and Australia, 1923. First S/W telegraph tests between Australia and England, 1924. First S/W telephony tests between England and Australia, 1925. First S/W telegraph tests between Sydney and Pacific Islands, 1926. First S/W Empire broadcast tests, 1927. First S/W telephony tests between Australia and England, 1928. First S/W telephony service between Australia and England, 1930. First S/W telephony service between Australia and New Zealand, 1930. Private address: 11 Kissing Point Rd., Turramurra, Sydney. Born, 1898. Recreations: Golf, tennis, motor competitions.

NEWMAN, S. W. H.—Works Superintendent, The Ever-Ready Co. (Gt. Britain) Ltd., Marshall St., Sydney. Joined organisation 1916; appointed present position, 1930. Private address: "Wilga," Forsyth St., Sth. Kensington. Born 13/7/1900. Recreations: Cricket, golf and fishing.

NICHOLS, Walter G.—Proprietor, Walter G. Nichols Advertising Service, 160 Castlereagh Street, Sydney. Phone: MA 4375. Has executed Technical Drafting for many leading Radio Journals in Australia and N.Z. President and Life Member Leichhardt Radio Society. Commenced radio experimenting in 1921. Private address: 35 Albert St., Leichhardt. Recreations: Tennis, dancing and surfing.

NICHOLLS, Keith Trewhella.—Branch Manager of Philips Lamps (A/sia) Ltd. Company address: 590 Bourke Street, Melbourne. Entered the Radio field in the early days of broadcasting as a manufacturer of Radio parts in Melbourne, later joining the sales staff of Philips Lamps (A/sia) Ltd., Sydney. In 1930 transferred to Philips, Melbourne, as Sales Manager, and was appointed Manager of that Branch in 1932. Private address: 29 New Street, Hampton, S.7.

NORTHOVER, Geoffrey Haigh.—Advertising Dept., Bulletin Newspaper Co. Ltd., 252 George St., Sydney. Born 10/3/1903 at Bath, England. Educated at Royal Naval Colleges Osborne & Dartmouth. Served Royal Navy, 1915-1920, specialising in engineering. Took Civil Engineering course at the City & Guilds Engineering College, London. Came to Australia in 1923. Engaged in commercial activities until 1931 in Victoria, N.S.W. and Q'ld. Advertising Manager, Radio Monthly, 1932-33. Joined Australian Radio News staff in May, 1913. Private address: "St. Mervyns," Elizabeth Bay Road, Sydney. Recreations: Motoring and swimming.

NORVILLE, Charles Henry.—Partner and Chief Engineer, Breville Radio, 486 Elizabeth Street, Sydney. M.Inst.R.E. (Aust.). A.I.R.E. (America). Cadet Engineer, N.S.W. Railways, 1917-1922. Testing Engineer, N.S.W. Railways' Laboratories, 1922-1931. Radio Engineer, Philips Lamps (A/sia) Ltd., 1931-32. Co-partner Breville Radio, 1932-33. 4 years Councillor Wireless Institute of Australia. Hon. Treasurer Institution of Radio Engineers, Australia. Private address: 11 Hollywood Crescent, Willoughby. Born 20th Feb., 1902.

O'BRIEN, William J.—Partner and Sales Manager Breville Radio, 486 Elizabeth Street, Sydney. Commenced study of Wireless at Marconi School, Melbourne, in 1918. Obtained Wireless Operator's Certificate and went to sea for about six years on British and American ships. Spent 5 years in America, Sales Manager for wholesale Radio houses. Returned Australia, 1929. Manager, Radio Dept., Suttons Ltd., and later Sales Manager for Thom & Smith. Commenced above business in November, 1932. Private address: "Talofa," Ravenswood Avenue, Randwick. Born 2nd August, 1899.

OLLE, John Durrant.—A.Inst.R.E. (Aust.). Junior Radio Telegraphist Beam Wireless, Amalgamated Wireless (A/sia) Ltd., Sydney. Educated at Ashfield Grammar School and Newington College. 1926-27 Cadet Trainee Eastern Extension Telegraph Co., Adelaide. 1927, joined Beam Wireless Service. November, 1929, Amateur Operator's Certificate of Proficiency. Owner-operator VK2OZ. February 18th, 1921, Second Class Commercial Operator's Certificate of Proficiency in Radio Telegraphy. May 21st, 1931, First Class Commercial Operator's Certificate. Councillor and A.Inst.R.E. (Aust.) 1933-34.

OSWIN, G. L.—Proprietor Salonola Radio Sales & Service, 389 George St., Sydney. Born Tasmania. Private address: 52 Awaba Street, Mosman. Recreations: Snooker and general sport.

ORR, George Nicholson.—Proprietor Consolidated Advertising Services, Mabro House, 42 Market Street, Sydney. Ex-State Public Service, Qld. Compiling Draughtsman, 1911-1912. Federal Public Service, Electrical Engineers Branch, Brisbane, 1913-1916. Copy writer, Production Manager and Art Director, Myer Brothers Ltd., 1917-1919. Advertising Agent, Brisbane, 1919-1926. Importer and overseas representative German Novelties. Advertising consultant and artist, Sydney, 1927-1930. Established Consolidated Advertising Services, 1930. Activities cover newspaper, journal and Radio Broadcast Advertising, Sales promoter and merchandising, Advertising Illustrations in all mediums, poster design, modern photography, copper engraving and photo engraving and associated advertising crafts. Born 22/11/96. Recreations: Music, motoring and fishing.

OVERDIEP, Jelte Atze.—Assistant General Manager of Philips Lamps (A/sia) Ltd. Company address: 69-73 Clarence St., Sydney. Awarded D.H. (Rotterdam). Associated with Philips Company for many years. Two years in Holland and Czechoslovakia; 4 years in British India, Ceylon, Burma, Siam and Java, and Straits Settlements. Has been connected with the Australian organisation of Philips for four years and has recently returned from a business tour abroad. Private address: "Ashcroft," Bogota Avenue, Cremorne. Born 17th October, 1901.

OXFORD, Reginald Henry.—Governing Director Radiette Radio Ltd., Triumph House, 187 William St., Sydney. Member Society of Radio Technicians. Five years with International Radio Ltd. Since then operating on own behalf. Private address: "Tancreedi," Yarranaby Rd., Darling Point. Recreations: Golf and surfing. Born 8th August, 1902.

PARKER, Philip S.—Works Manager, Airzone (1931) Ltd., Australia St., Camperdown, N.S.W. Ashfield Technical School and private tutorship. Member Society Automotive Engineers, U.S.A. Conducted own business of automotive electric repairs 1923-25. Manufacture of radio 1925-27. Visited U.S.A. and England and had experience in various factories manufacturing automotive electric equipment and radio apparatus 1927-28. Joined Philips A/sia Ltd., Service Manager 1928. Appointed Factory Manager to Philips, laid down new plans, and in charge of all manufacturing activities 1930-32. Joined Airzone as Works Manager, 1932. Born 22/9/1903.

PARKINSON, Ernest Collins.—Works Production Superintendant, Amalgamated Wireless (A/sia) Ltd. Born Dec. 28th, 1898, Keighley, Yorkshire, England. Educated Salt High Schools, Saltair, Yorkshire, apprenticed J. Parkinson & Son, machine tool makers, Shipley. 5 years Bradford Technical College. Jig and tool machine tool designer, J. Parkinson & Son, 1919-23. Sub-Lieut. R.N., Kit Balloon Section. Active service on convoy work North Sea and Mediterranean. Arrived Australia, 1923. 9 months machine tool designer, Purcell Eng. Co.; Auburn. 9 months mechanical draughtsman, Commonwealth Portland Cement Co., Portland, N.S.W. 1924-1929, in charge water meter Department and special machine design, Clyde Eng. Co., Granville. 1929, joined A.W.A. as Works Production Superintendent. Private address: 28 Birnam Grove, Strathfield. Born 28/12/1898. Recreation: Cricket.

PALMER, E. F.—Managing Director, Melbourne Broadcasters Pty. Ltd. Owners of 3AK and 7UV.

PARMITER, Ernest Albert.—Governing Director, Acorn Pressed Metal Co. Ltd., 46 Mathieson St., Camperdown, N.S.W. Arrived in Australia, 1909; served First Light Horse, A.I.F., and Indian Mule Corps, Warrant Officer. Joined Ausmetoy Ltd., 1920, as Works Manager. Founded present company, September, 1930. Private address: 27 Thorn St., Ryde. Recreations: Motoring, shooting, surfing. Born 27/1/1891.

PARRAMORE, Harold Arthur.—Director of Regent Radio Pty. Ltd., 288 Bourke Road, Camberwell, E.6., Vic. Formerly employed by Radiovision Pty. Ltd. Private address: 4 The Ridge, Canterbury, E.7., Vic. Recreation: Tennis. Born 1913.

PATON, John Alston.—Factory Manager, Lekmek Radio, 75 William Street, Sydney. Five years apprenticed Electrical engineering. One year in charge test room, Ferguson Palin Ltd. Four years with Stromberg-Carlson as design and production engineer. Thom & Smith, design section, and two years with Lekmek Radio as Factory Manager and in charge of design section. Private address: 103 Essex St., Epping. Recreations: Swimming and fishing. Born 18th March, 1907.

PERSSON, Andrew Rudolf. — A.Inst.R.E. (Aust.). Manager, Ducon Condenser Pty. Ltd., and H. Hecht & Co., 38 Carrington St., Sydney. Born 1892.

PERSSON, O.—Factory Manager, Ducon Condenser Pty. Ltd., Sydney.

PHILLIPS, William H. C.—Marine Superintendent, Amalgamated Wireless (A'sia) Ltd., Sydney. M.Inst.R.E. (Aust.). Appointed telegraphist Queensland railways, later transferring to Postal Dept. Joined A.W.A., December, 1911, as marine operator. During war served on s.s. "Katoomba." Returned to Australia, 1919, later becoming Marine Inspector for A.W.A., appointed Marine Superintendent, 1924. Private address: 9 Ocean Street, Kogarah. Born, Cairns, N.Q., 12/3/92.

PHILLIPS, J. B., Proprietor Crown Radio Mfg. Co., 55 Bourke Street, Sydney.

PINKERTON, Harold Richard, Managing Director Savery's Pianos Ltd., Managing Director, Radio Wholesalers Ltd., General Manager, Hume Broadcasters Ltd. (5DN). Music and radio business twenty-six years. Broadcasting for past two years.

PITCHER, W. C., Proprietor Mica and Insulating Supplies Company, Melbourne.

PLOWMAN, Claude Mng. Dir. Airzone (1931) Ltd., 16 Australia St., Camperdown, Sydney. Vice-president Radio & Telephone Mfrs. Assn. of N.S.W.; Director, Radio Interests Ltd.

POGONOWSKI, Louis Alexander. Manager of Electrical & Radio Department of W. Adams Ltd., of Collins Street, Melbourne. 1928-9, Advertising Manager Amplion A/sia Ltd.; 1930, Advertising Manager and Assistant Sales Manager of Interstate Sales Ltd; 1931, Represented several large Radio houses in U.S.A.; 1932-33, Managing Director, Mulite Signs Ltd.; 1934, Sales Promotion Philips Lamps Ltd. Born Feb. 5th, 1906. Recreations: Golf and swimming.

PRENTICE, John M.—Chief Announcer and Controller of Copy Dept., Australian Broadcasting Co. Ltd., 49 Market Street, Sydney. Graduated Carnegie Institute of Technology, Pittsburgh, Pa., in psychology. Twice decorated in the Great War (order of the Crown of Belgium, Croix de Guerre), and twice mentioned in despatches. Prior to enlisting did a great deal of free-lance journalism and lecturing. Served in A.I.F. for four and a half years. Spent a year in U.S.A. and returned to Australia to join Federal Public Service. Joined 2BL in October, 1924. and has been in radio ever since. Spent 8 months with national service in New Zealand. Private address: 15 Hepburn Court, Lavender Bay, Sydney. Recreations: Reading memoirs, studying origins of the Great War and current International events. Born 10/3/1866.

PRICE, Aubrey Frederick.—Proprietor of Price's Radio Service, 5, 6 Angel Place, Sydney. Member of Royal Motor Yacht Club and Aero Club. Private address: 105 Hopetoun Avenue, Vaucluse. Recreations: Motor-boat racing.

POLL, Albert Edward.—Branch Manager, Philips Lamps (Australasia) Ltd. Company address: Hayward Building, Charles Street, Adelaide. Became a member of the staff of Marconi Co. during the War, in the capacity of wireless operator. In 1926 joined the National Electrical Engineering Co. of N.Z., and resigned in 1929 in favour of Philips Lamps (A/sia) Ltd., on the staff of their Adelaide office. Since 1932 has been in charge of Philips activities in South Australia.

POOLE, L.—Chief Engineer, Efco Mfg. Co. Ltd., Princes Highway, Arncliffe, N.S.W. In business on own account in England, then later with the Enfield Small Arms Coy. Served with Staffordshire Regiment in France during War. Joined Efco Co. nine years ago. Private address, 12 Flora Street, Arncliffe. Born 14/1/1898. Recreations: Surfing and motoring.

PRICE, John Clarey.—Proprietor own business, Perry House, Elizabeth Street, Brisbane. A.M.I.E. (Aust.). Commenced radio in Brisbane, 1922. Telephone Engineer P.M.G's. Dept., 1913. Studied Electricity City and Guilds, London. Born, October 5th, 1884. Recreations: Fishing, golf.

PRIOR, Herbert.—Managing Director A. J. Veall & Co. Left engineer's office of City Council to become accountant for A. J. Veall. Later appointed Manager. In 1931 appointed Managing Director. Recreations: Football, tennis and golf.

PRIOR, Henry Kenneth.—Managing Director and Chairman of Directors Bulletin Newspaper Co. Ltd., Sydney, publishers of "Australian Radio News." Joined the Bulletin as Assistant Financial Editor in 1910. Served in Egypt and France during the Great War as Major Commanding 113th Howitzer Battery, Aust. Field Art. T. Manager of the Bulletin 1919. Succeeded the late S. H. Prior as Chairman and Managing Director of Bulletin Newspaper Co. in June, 1933. Also Director Australian Radio News Ltd. Private address: 44 Bradleys Head Road, Mosman. Born 13/3/1893.

PURVES, Bartholomew.—Manager Brisbane Branch Eclipse Radio Pty. Ltd., 156 Creek Street, Brisbane. Joined W. H. Eutrope and Sons, Melbourne, in 1921, as City and Suburban Representative. Transferred to Radio Corporation, 1931. Joined Eclipse Radio Pty. Ltd., Melbourne, 1932. Opened Brisbane branch in September, 1933. Private address, "Retherway" Hotel, North Quay, Brisbane. Born 3/10/1898. Recreations: Tennis and swimming.

QUEALE, William.—Member Aust. Inst. Mining and Metallurgy. Member American Society of Refrigerating Engineers. Managing Director Mechanical Products Ltd., Manufacturers of Kelvinator for Australia. President Constitutional Club. Representative (Hon.) of Commonwealth Government on Commonwealth Employment Council and Employment Promotion Council.

RAZ, Otto.—Director, Bloch & Gerber Ltd., 46-48 York Street, Sydney. Private address: 14 Russell Ave., Lindfield.

READ, Leonard Leo (Uncle Ben 4QG).—Managing Director Printers and Stationers Dept., The Read Press (Pty.) Ltd., Adelaide Street, Brisbane. Served eight years apprenticeship, W. H. Wendt & Co., Printers, Brisbane. Salesman, Jackson & O'Sullivan, two years, 1918-1919. In business on own account over twelve years. Entertained children at 4QG for seven years, most of that period in an honorary capacity. Private address: Robinson Road, Eagle Junction. Born, 18/10/1894. Recreations: Golf, fishing and reading.

REED, Joseph Griffiths, A.M.I.E. (Aust.).—Design Engineer, Amalgamated Wireless (A'sia) Ltd. Transferred from Professional Division, P.M.G. Radio Service, 1912. Carried out experimental radio telegraph transmissions in association with R.A.N. Reserve at Newcastle, in 1914. Served as assistant to Radio Inspector, R.A.N. Radio Service at Garden Island during 1917-1918. Transmitted first experimental C.W. signals from Melbourne to Sydney 1921, and responsible for technical details 100 watt radio concert transmissions 1922. Engaged on experimental duplex radio-telephone transmission between mainland and Tasmania 1921. Engaged in design of numerous transmitters built by A.W.A. for Australian and New Zealand broadcasting services. Built short wave transmitters (500 watt) for first commercial trans-Pacific telegraph traffic between Sydney Radio and R.M.S. "Niagara," 1925. Recreations: Model making and photography. Born 30th June, 1897.

REES, M. W.—Managing Director Smith Sons & Rees, 30-32 Wentworth Ave., Sydney. Royal Automobile of Aust. C.T.A. Founded own business under name of M. W. Rees Ltd., 1917. August, 1920, a fusion of interests with S. Smith & Sons (M.A.) London was effected and Mr. Rees became Managing Director of the combined concern. Private address: 37 Bundarra Road, Bellevue Hill, Sydney. Recreations: Motoring and golf.

RENSHAW, Phil.—Supervising Engineer, State Monier Pipe Works, Bond Street, Sydney. A.M.I.E.Aust., M. Inst.R.E. Aust. Vice-president I.R.E., 1932-3-4; Councillor, 1934-5, Educated Fort Street Model School. Commenced wireless experimenting, 1910. Joined W.I.A., 1911. Held office continuously for twenty-one years. Hon. Secretary for twelve years. Radio experimenter 2DE. Has never professionally associated with Radio but engaged in Civil Engineering since 1907, when he started as a lad with Gummow Forrest & Co. Ltd. Private address: "Waimea,' 6 Lord Street, Roseville. Born, 3/11/1891. Recreations: Motoring, surfing, bridge, fishing.

REYNOLD, J. Howard.—Sales Manager R. W. Reynolds Ltd., 200 Chalmers Street, Sydney. Club, C.T.A. Private address: 46 Beresford Road, Strathfield. Born, 11/6/1910. Recreations: Swimming and tennis.

REYNOLDS, Robert W.—Managing Director R. W. Reynolds Ltd., 200 Chalmers Street, Sydney. Studied Electrical Engineering and Chemistry Perth University. 1923 joined Sir George Julius' Laboratory. Founded firm of R. W. Reynolds, 1924. Private address: 8 Moore Street, Strathfield. Born, 1895. Recreations: Motor driving, golf and wireless.

ROSE, Cecil John.—Manager, Reg. Rose & Co. Ltd., 58 Margaret Street, Sydney. Member Western Suburbs Hard Court Tennis Association. Sales Manager present company since inception, 1924. In April, 1934, appointed Attorney for Mr. Reg. Rose interests during the latter's absence on world tour. Private address: 12 Forest Street, Haberfield. Born 4/9/1888. Recreations: Tennis, cricket, football, motoring.

ROSE, Reginald James.—Governing Director, Reg. Rose & Co. Ltd., Kembla Buildings, 58 Margaret Street, Sydney. Member N.S.W. Aero Club, Royal Automobile Club, Bowral Golf Club, National Ice Skating Club. Educated Fort Street High School. Joined Amalgamated Wireless 1915. Appointed Departmental Manager, 1920. Started in business on own account 1923. Born, December, 1897. Recreations: Flying, golf, motoring, ice skating, and gardening.

RICHARDSON, E. B., B.Mech.E., B.E.E.—Director H. C. Richardson Pty. Ltd., Footscray, Melbourne.

RICHARDSON, Harold C.—Managing Director H. C. Richardson Pty. Ltd., Plastic Moulders, Footscray, Melbourne. After experience in radio merchandising, formed H. C. Richardson Pty. Ltd., two and a half years ago. Also Director Richardson Gears Pty. Ltd. Private address: 49 Moreland Street, Footscray.

RYAN, Albert John.—Engineer and Manager, A. J. Ryan Broadcasters Ltd., Lawson Street, Kingston, Canberra, F.C.T. Proprietor Commercial Broadcasting Station 2CA. Educated at

public school, Chiltern, Victoria. 1913-1919, Mechanic Electrical Engineer's Branch P.M.G.'s Dept. 1918, served in A.I.F. Wireless Training School. 1922-24, Electrical Engineer in charge at Municipality of Coraki. 1925-27, Willard Storage Battery representative for A.G.E. Co. Ltd. 1928-32, Radio Engineer on own account at Canberra. 1931, designed and constructed 2CA Broadcasting Station. M.Inst. R.E., Aust. Born 30/5/1897.

SANDEL, Otto.—Proprietor Sandel Radio, 248 Oxford Street, Woollahra. Member of Royal Automobile Club of Australia, N.S.W. Light Car Club and Sydney Bicycle & Motor Club. Commenced in Radio 1922 in Brisbane. Took course at Marconi School in 1923. Secured Amateur Operator's License 1923, call sign 2UW. Later changed to "B" class broadcasting licence—owned and operated 2UW for about six years . (Three years as an amateur station, three years as B class.) Designed and built 500 watt transmitter used by 2UW as B class station. Broadcasted the first political speeches in Australia while 2UW was only an amateur station (arranged by Mr. Archdale Parkhill who was the main speaker). Formed 2UW into Limited Company in 1927, called Sandel Radio Ltd. Later sold 2UW to Palings. Started at present address in Woollahra on February 1st, 1928, as retailer and manufacturer. Won Wakefield Cup (motoring) for 1931 together with over thirty other motor contest trophies. Private address: No. 8 St. Helens, Victoria Road, Bellevue Hill. Born 2/10/1905.

SAUNDERS, George Ambrose, M.B.A., J.P. (popularly known as Uncle George) manager and chief engineer Station 2GB, 29 Bligh Street, Sydney. Educated Cleveland Street School, Narrabri District School and Sydney Grammar School. Enlisted for active service with first contingent of first battalion 1914. Commenced broadcasting with Station 2BL at its inception, November, 1922, until 1927. Joined Station 2GB. Commenced Saturday morning entertainment for children. Established first bedtime story session, and commenced community singing at 2BL in King's Hall, Sydney. One of the early pioneer announcers in radio broadcasting. Recreations, motoring and golf. Hobbies, coin collection. Member Tattersall's Club. Born 16th May, 1896.

SCHLIESMAN, George.—Director and Chief Radio Engineer E.S.M. Co. Ltd. In radio since 1913. Was Electrical Contractor for number of years, later attached to Electrical Staff of Royal Agricultural Society. Joined staff Electricity Meter Mfg. Co. Ltd., in 1922, and was Assistant Chief Engineer to O. C. Turner, with whom he started E.S.M. Co. Ltd. Private address: 91 Arthur Street, Moore Park. Born 11/4/85. Recreations: Fishing, motoring, and E.S.M.

SCOVELL, Alexander J. W.—Chairman of Directors, Widdis Diamond Cells Pty. Ltd., 119 Hawke Street, West Melbourne.

SCHULTZ, L. N.—Chief Engineer 2GB Broadcasting Station. Company address: 29 Bligh Street, Sydney. Councillor and member of Institute of Radio Engineers, Aust. Vice-president Society of Radio Technicians, Australia. Commenced radio 1920. Joined staff of United Distributors Ltd., 1921. Employed on construction of original 2KY and 2GB, went to U.S.A. and England 1928-29 study technical side of broadcasting, returned and joined 2GB where he has been employed as Chief Engineer for last five and a half years. Is responsible for the design and construction of 4BH, Brisbane. Private address: Billabong Lagoon Street, Narrabeen. Recreation: Flying. Born 24th September, 1906.

SEARSEN, Edward Michael.—Sales Manager, Electricity Meter Manufacturing Co. Ltd., Joynton Ave., Waterloo. Graduated from marine service to radio sales. Private address: 63 Henrietta Street, Waverley. Born, 16/2/1901.

SHAW, Ernest Heywood.—Founder and editor of "The W.A. Wireless News." Joined staff of R. S. Sampson Brokensha Co., prior to 1929. Published the "West Australian Wireless News and Musical World,' 'Sept., 1929. Mr. Shaw is editor. Technical Editor, and Advertising Manager. An experienced radio experimenter, dating back to days of old "Quench Gap Spark Transmitters." Enlisted at Blackboy Hill, W.A., 1914, saw service on Gallipoli as an original Anzac, thence to France, where later he was detailed to special service, returning to Australia in 1920.

SLADE, Charles William.—Radio Engineer, Proprietor Croydon Radio, Lang Street, Croydon. Holds English P.M.G. Certificate 1st Class. Fifteen years radio experience in British Navy. 1909 to 1924. Three years Technical Editor of "Wireless Weekly," 1925 to 1928. Radio and Technical Editor Daily Telegraph, 1928-29. Radio Engineer Keogh Radio Ltd., 1929-1930. Commenced business at home, speciality, Superheterodynes. Private address: Lang St., Croydon. Born 22/5/1894.

SCOVELL, Alexander McKenzie.—Man., N.S.W., Widdis Diamond Dry Cells Pty. Ltd., Dalgety Rd., Millers Point, Sydney. Joined Widdis Organisation, 1927. Appointed Manager Sydney Factory, 1932. Born June 22nd, 1910.

SMALL, Bruce.—Governing Director of Bruce Small Pty. Ltd., is best introduced as the "Malvern Star" bicycle chief. In 1931 he decided to conquer further fields in the commercial world, hence the successful activities of his progressive firm in the marketing of wireless. Commencing by producing "Malvern Star" sets, he subsequently concentrated on S.T.C. and Airzone products. Still on the right side of forty, Mr. Bruce Small is the head of probably the largest wholesale and retail cycle business in the Commonweath, and, as such, his time is divided between the various States. In the immediate future he will embark upon another world tour, the fruits of which will be reflected in the firm's marketing campaign.

SMALL, Charles A.—Chief Technician, Radio & Service Dept., Henry G. Small & Co., 374 Post Office Place, Melbourne, C.1. Experience, Engineering Course, Swinburne Technical College, Metropolitan Vickers Elec. Co., Carroll & Grunden, Auto and Electrical Engineers, Electric Equipment Manufacturers, South Melbourne. Private address: 313 Riversdale Road, Camberwell, Victoria.

SMALL, Frank.—Managing Director Bruce Small Pty. Ltd., is the possessor of a pleasing personality, while his genius as business controller of "Malvern Star" cycles and S.T.C. and Airzone sets, has much to do with the firm's wireless business in line with modern ideas. Mr. Small recently made a world tour during which he availed himself of the opportunities of conferring with leading wireless authorities in England and on the Continent. One of Mr. Small's missions while abroad was the study of the development of the English business in Radio Broadcast apparatus.

SMALL, Henry G.—Manager, Henry G. Small & Co., 374 Post Office Place, Melbourne, C.1. A.M.I.E., Aust., A.S.T.C., Lic. A.S.E.C.V. Educated Kalgoorlie. West Australian School of Mines, Swinburne Technical College. Experience Kalgoorlie Municipal Electric Light Station, Kalgoorlie Light and Power Corporation, Melbourne Electric Supply Co., British Insulated & Helsby Cables, Electric Railway Dept., Metropolitan Vickers Electrical Co. Ltd. Private address: 16 Rathmines Road, Auburn, E.3., Victoria.

SMITH, Colin W.—Melbourne Manager Australian Radio Publications, Ltd., B.A., A.Inst.R.E. (Aust.). Associate Editor "New Zealand Radio Record," 1927-31. Editor N.Z. "Radio Times," 1932-33. Hon Secretary N.Z. Radio Institute, 1932-33. Joined Australian Radio Publications Ltd., July, 1933. Recreations: Golf and photography.

SMITH, F. Langford, B.Sc., B.E., A.M.I.E. (Aust).—Development Engineer, Amalgamated Wireless Valve Co. Ltd. Educated Trinity Grammar School, Sydney. Entered Sydney University, 1923, graduating with First-class Honours in Science and Engineering. Engaged two years with Metropolitan-Vickers

Electrical Co. Ltd., Manchester. Three years with Cosmos Lamps Works, Middlesex. During 1931-2 with Mazda Valves—during three years on valve manufacture was in charge of testing and design of factory equipment and testing apparatus, and also development engineer with technical supervision of all factory processes. Returned to Australia in 1932 and joined Amalgamated Wireless Valve Co. Ltd. Born, 1904, Waitara, N.S.W.

SMITH, Frederick Charles Noel.—Engaged in the Laboratory of Raycophone Ltd., of Booth and Trafalgar Streets, Annandale. Received secondary education at Maitland High School from 1919-1923. Joined N.S.W. Government Railways as Cadet in Testing Laboratory, Locomotive Branch. On leave 1927-30 to attend University as "Eddy Memorial" and P.N. Russell Scholar. Graduated B.E. 1931 with honours, and Kolling prize. Resumed duties with Railways as Assistant Engineer. Joined Raycophone staff in 1933. Private address: "Dobroyd," Dobroyd Parade, Haberfield. Date of birth: 14th January, 1908. Recreations: Reading, swimming.

SMITH, John Edwin. — Partner, Thom & Smith, Ltd. (Tasma), 55 Dowling Street, East Sydney. 1912-16, apprentice electrical instrument maker Western Electric, London; 1916-23, telephone experimental shop Siemens Bros., London; 1924-29, foreman toolroom, Stromberg-Carlson (Sydney); 17/12/29, founded Thom & Smith with Mr. Fred Thom. Private address: Jamieson Ave., Manly. Recreations: Golf, fishing and surfing.

SOLOMONS, Leopold M.—Interstate Sales Manager, Sales Department Radio Corporation Pty. Ltd., 11-21 Stuart Street, South Melbourne, Victoria. Joined present firm eight years ago. Private address: 68 Riversdale Road, Hawthorn, E2, Victoria. Born 2/11/03. Recreations: Tennis, golf and fishing.

SOUTHEY, Reginald V., M.Inst.R.E., Aust.—Radio and Recording Engineer, Columbia Graphophone Aust. Ltd. Educated Alleyn's College, Dulwich, England, Morley College, London, 1920, and G.E. Company Exam. 1922. 1919-23, General Electric Co. of London, radio and general electric work. 1923-32, Columbia Graphophone Co., London and Sydney, as Radio and Recording Engineer. Part of time spent in Research Labs. of above company, Standard Telephones, London, and Bell Telephone Labs., New York, studying sound engineering mainly on behalf of Columbia. Operated Stations G2TQ and VK2CO. Born 4/8/1903.

SOUTHWELL, Clifford Lindsay.—Radio Manager, Radio Dept. Associated General Electric Industries Ltd., 93 Clarence Street, Sydney. Member United Service Institute. Private address: 21 Narooma Road, Northbridge. Recreations: Military activities; Captain-Signals. Born 1897.

STEWARD, Alan.—Radio Sales Manager Hartley's Sports Stores, 270 Flinders Street, Melbourne, C.1., Victoria.

STEWART, Frederick Harold, M.P.—Governing Director 2CH Broadcasting Co., 77 York Street, Sydney. Won Federal Parramatta Election, 1930, promoted to Cabinet rank within eight months. Twenty years an officer of N.S.W. Railways. Resigned to undertake subdivisional and transport activities culminating in development of the Metropolitan Omnibus & Transport Co., of which founder and Governing Director. Director Associated Newspapers Ltd. A founder and Chairman of Australian National Airways. Chairman N.S.W. Woollen and Felt Mills. Private address: 223 Burwood Road, Burwood. Born 14/8/84. Recreation: Bowls and music.

STOKES, Robert Keith.—Man. Dir. Metropolitan Electric Co. Ltd., George and Cleveland Streets, Redfern. Radiokes firm was originally Keith Stokes Pty. Ltd. Established in 1923.. When the firm commenced manufacturing honeycomb coils it was formed into the Metropolitan Electric Co. Ltd., in Sussex St., Sydney. Gradually increased in personnel until reconstruction was undergone in 1930. It was then reformed and moved from Sussex St. to the present modern factory, and as far as can be ascertained it is now one of the most up-to-date radio part manufacturing concerns in Australia. Private address: "Dungowan," Manly. Recreations: Golf and surfing. Born 1893.

STEVENSON, Murray H.—Chief Engineer, Broadcasting Station 2UE, 296 Pitt Street, Sydney. Educated Sydney Technical High School (Leaving Certificate). 1/1/22 to 31/12/31, Electrical Utility Supply Co., 617 George Street, Sydney; electrical apprentice, licensed electrician, construction and maintenance of original 2UE. Appointed present position 1/1/32. Private address: 12, "Elgin," 89 Mount Street, Coogee. Born 17/4/1905.

SWEENEY, Walter.—Director, Essanay Pty. Ltd., Melbourne. M.I.R.E., U.S.A. Engineer Marconi Co., 1907-1912. W./T. P.M.G.'s Dept., 1912-1916 W/T. Inspector Navy, 1916-1917. A.I.F., 1917. Representative in Australia for Radio Communication Co., 1924-5. Formed Essanay 1928. Born Jan., 1887.

TAIT, J. M.—Radio Manager, British General Electric Company Ltd., 104 Clarence Street, Sydney. Member I.R.E. (Aust.). Educated Sydney Grammar School. Five years Dalgety's Ltd. Joined British General Electric Co., Jan., 1920, as assistant and later in charge of telephone section. Sent to England, 1925, for general experience at Peel Conner Telephone Works, Coventry. Returned Sydney, 1926. 1931, in charge of Radio and Telephones Dept. Born 11/12/1899.

TATHAM, Sydney Ernest.—Merchant. Company address, 95 William Street, Sydney. Started radio experimenting in 1910. Joined A.W.A. in 1914, served five years mercantile marine, thence transferred head office, Sydney. Opened Marconi School Wireless, Melbourne, 1919. Organised first British newspaper service in Pacific, 1922. Resigned A.W.A. 1924 entered business for self. Represented American and Continental manufacturers, including Allen Bradley Company and Atwater Kent Radio. Since then manufactured and distributed many radio and electrical lines. Designed and built Theatre Talking Picture Equipment, sold and installed in over fifty Australian theatres. Also manufactured and sold public address systems on a large scale. Now specialising in radio and automotive electrical specialities. Private address: Elizabeth Bay, Sydney. Born, 4th April, 1896. Recreations: Swimming, golf and motoring.

TAYLOR, John Peebles.—Sales Manager, Commonwealth Moulding Company Ltd., 240 Princes Highway, Arncliffe, N.S.W. Served in A.I.F. Engaged in radio selling and advertising for past fourteen years. Private address: 7 Poate Road,

Centennial Park, Sydney, N.S.W. (Major Army Signals.) Born, 1895. Recreations: Tennis and surfing.

THOM, Frederick William Parkes. — Partner Thom & Smith Ltd. (Tasma), 55 Dowling Street, East Sydney. Mem. Inst. R.E.Aust., Assoc.I.R.E. (U.S.A.). Councillor Institution Radio Engineers, Australia. Apprentice electrical fitter 27/1/20-25/3/25, A.W.A.; 1925-1929, production and radio engineer Stromberg-Carlson, Aust., Ltd.; 17/12/29, founded with Mr. J. E. Smith, the firm Thom & Smith. Private address: 9 Bancroft Ave., Roseville. Recreations: Golf, surfing, fishing. Born 11/7/1904.

TAYLOR, John T.—General Manager 2CH Broadcasting Co., 77 York Street, Sydney. Commercial experience with H. J. Heinz Co., U.S.A., in different States of Australia. Joined present company at inception (Feb., 1932), as Advertising Manager; appointed General Manager October, 1932. Private address: 18 Kulgoa Road, Bellevue Hill. Born 1904. Recreations: Golf, surfing.

TAYLOR, Thomas George, A.Inst.R.E., Aust.—Proprietor Taylor's Radio Service, Cessnock, N.S.W. Constructing, operating and servicing radio and amplifying equipment, 1923. I.C.S. student radio engineering. Born 1905.

THOMAS, Oscar.—Manager Radio Dept. F. Tritton Pty. Ltd., 260 George Street, Brisbane, Q. Manager McDowell's Radio Dept. Left that firm to take charge of Radio Sales at Bloch & Gerber. Left B. & G. for present position. Private address: Bryant Street, Ashgrove, Brisbane, Q. Recreation: Tennis.

THOMPSON, Derrick Albert, Managing Director Thompson's Radio Ltd., of 74 Oxford Street, Sydney. Started business in November, 1926, floated into a limited company in April, 1932. Inventor of Velona Sound Board with Floating Speaker. and Theatle Cabinets. Private address: 571 Forest Road, Bexley . Born, June 24th, 1892. Recreations: 'Cellist.

THORRINGTON, Albert Leonard. —Proprietor Express Universal Instrument Company, 50 Parramatta Road, Petersham. M.Inst.R.E., Aust. Commenced radio in 1923. In June, 1932, founded a partnership with A. J. Simpson under the name of Express Universal Instrument Company. Became sole proprietor, 5th February, 1934. Private address: 14 Harrington Street, Marrickville.. Recreations: Photography and motoring. Born 15/8/1906.

TISBURY, Frederick H.—Branch Manager, The Ever Ready Co. (Great Britain) Ltd., Perry House, Elizabeth Street, Brisbane. Formerly with Messrs. S. Hoffnung & Co. Ltd., for a period of thirteen years. Joined organisation in November, 1931, as Despatch Manager. Appointed present position May, 1932. Private address: Grove Crescent, Toowong, Brisbane. Born, 25/12/1895. Recreations: Tennis and motoring.

TOWNSEND-SMITH, Roy Victor.—General Manager, Sydney branch, Eclipse Radio Pty. Ltd., 137 Clarence Street, Sydney. Twelve years with Messrs. Arkell & Douglas, Inc., one of the largest indenting exporting houses in Australia, and who, as a result of this experience, joined Eclipse Radio, 1932. Was soon after sent to Sydney to take over the duty of General Manager, Sydney Branch. Born 3/4/1894. Private address: "Gwyder Court," 235 Raglan Street, Balmoral, N.S.W. Recreations: Tennis, bridge, literature.

TRACKSON, Philange S.—Managing Director Trackson Bros. Ltd., 157-159 Elizabeth Street, Brisbane. Assoc. M.I.R.E (Aust.), Assoc. M.I.E.E., London. Private address: "Norvie," 102 Racecourse Road, Ascot, Brisbane.

TREE, Ernest E.—Proprietor, Tree Radio-Electric Co., 128 Willoughby Road, Crow's Nest. Councillor and Inst. R.E. ,Aust. Captain Singer Car Club, N.S.W. President Radio Retailers Association of N.S.W. Associate of Illuminating Engineering Society. Born 1904.

TRENAM, Harold C.—Managing Director, Standard Telephones & Cables (A/sia) Ltd., 71 York Street, Sydney. Educated Manchester Technical College. M.Inst.R.E. (Aust). Qualified City and Guilds, London. Up to 1906, Engineer British Post Office. To 1926 Superintendent of Installations, Western Electric Co. Ltd.; 1925-28, General Sales Manager, Western Electric Co. Ltd.; 1928-30, Deputy Manager, Standard Telephones & Cables Ltd., London. To 1932, Managing Director Creed & Co. Ltd., Telegraph Engineers, London. Director Standard Telephones & Cables Ltd., London: Director International Telephone & Telegraph Co. Ltd. 1933, came to Australia in present position. Born Leeds, England, 11/10/1884.

TRICKEY, Ray E.—Manufacturers' representative, Melbourne. Has been identified with Melbourne radio trade for many years, commencing as representative of H.N.H. radio in 1924. Later with the A.G.E. and Tilbury & Lewis as general sales manager. Last year commenced business on own account as manufacturers' representative. Private address: 6 Heathfield Road, Brighton Beach. Telephone X3436.

TURNER, Arthur Rex.—Manager Radio Dept., E. F. Wilks & Co. Ltd., 124 Castlereagh Street, Sydney. R.A.C.A. Aust. Motor Yacht Squadron, R.M.Y.C. Thirteen years in E. F. Wilks & Co. Early 1926 went to England and Continent (9 months), returning as manager Radio & Phonographs Dept. Private address: 16 Buena Vista Ave., Clifton Gardens. Born, 1/3/02. Recreations: Motoring, golf and speed boat racing.

TURNER, Oliver Clive, I.R.E. of Aust, A.M.I.R.E. of U.S.A. —Director and Chief Electrical Engineer, E.S.M. Co. Ltd. Had electrical training under tutelage of Ramsay Sharpe & Co., later in charge of testing division of Electric Light & Power. Joined staff Electricity Meter Mfg. Co. Ltd. in 1926 as Foreman, later was Chief Engineer until 1933, when he started out with G. Schliesman in E.S.M. Co. Ltd. Private address: "Clynel," Rectory Avenue, Ashfield. Born 29/9/01. Recreations: Tennis, swimming and E.S.M.

TUIT, Percy George.—Chairman of Directors of Kriesler (Australasia) Ltd., Myrtle Street, Chippendale. Member of Millions Club and City Tattersalls Club. Born 1896. Commenced business in the retail softgoods, was founder and financier of several businesses in the silk and rubber indutries. Reconstructed the old Kriesler Radio Co. in October, 1933, and has been instrumental in placing this business on a sound and financial and profitable basis. Home address: Latimer Road, Bellevue Hill. Born 1896.

TYLER, Herbert Murray.—Radio Engineer, Service Department of Anthony Hordern & Co., Brickfield Hill, Sydney. Member of I.R.E. (Aust.) and has gained Diploma W.I.A. W.L.A. Trade Certificate. Educated at Technical High School. For five years studied Electrical Engineering at Sydney Technical College. Has been connected with O'Donnell Griffin, B.G.E., and has been in charge of technical and servicing side of radio at Anthony Horderns for the last five years. Private address: Rosedale Road, Gordon. Born 18/4/06.

TYRRELL, Charles W.—Engineer Philips Lamps (A'sia) Ltd., Sydney. Assoc. M.Inst.R.E., Aust. Appointed Technical Manager Harringtons, 1926. Manager Technical and Service Departments, Australian General Electric Co., 1927-30. Joined Philips, 1930. Private address: "Carlisle," Baden Street Coogee. Born 8/11/1905. Lieutenant Army Signals (2nd Divisional Signals.)

VAUGHAN, Clifford Walter,—Manager, Don Electrical Co., 112-16 Salisbury Road, Camperdown. Joined O'Donnell, Griffin & Co., 1921, apprenticed as electrical fitter in 1922, technical representative from 1927 till 1928, assistant to Works Manager, 1928 till 1930, transferred to Don Electrical Co. in 1930 as Manager. Private address: 182 Queen Street, Ashfield. Born 21/7/07. Recreations: Tennis and billiards.

VEALL, Arthur J.—Governing Director, A. J. Veall & Co., Swanston Street, Melbourne. Entered retail electrical business in Chapel Street, Prahran, opening business in city 1923. In 1928 bought Robotham's radio business and inaugurated purely cash trading basis. Now owns five retail houses. Recreations: Racing and shooting.

VOIGT, Emil Robert.—General Manager Station 2KY, Trades Hall, Sydney. Born Manchester, England. Trained as mechanical engineer. Founded engineering firm of Voigt & King, Melbourne, 1911. Returned to England in 1914, and founded the firm of the Power Engineering Company, Ltd., Trafford Park, Manchester, and Manchester Welding Co. Ltd., taking positions of Managing Director in each firm. Returned to Sydney in 1921 and established the Labour Research and Information Bureau. Visited U.S.A. in 1923 and 1924 and became associated with radio manufacture and development. Returned to Sydney and founded Station 2KY, the world's first Labour Broadcasting Station, being elected Chairman of the Board of Management, a position he has held ever since. Five years ago took over the position of general manager of the station. Founded the Australian Radio Manufacturers' Association, and officiated as President for several years. Became first President of the Australian Federation of Broadcasting Stations, and to-day is executive member. Presents the news service and daily commentary each morning over Station 2KY, and also gives ringside running descriptions of the heavyweight wrestling and boxing contests each week. Recreations: Held world's amateur five mile running championship, for Great Britain, Olympic Games, 1908. Interested in swimming, athletics, fishing and most forms of sport.

WADHAM, Kevin.—Manager Radio Dept. and Electrical Dept. A. G. Healing Ltd., 151-159 Pirie Street, Adelaide. Member W.I.A., VK5KW. Civil Service (three years). Production department Paroso Ltd., Radio Manufacturers and Dealers, Adelaide. Later transferred to Melbourne branch as country organiser and general sales work. Returned to Adelaide when Melbourne branch sold out to Louis Coen. Left this company after two years and commenced with H. C. McKenzie & Co., radio dealers, leaving after period of two years to enter business on own account. Joined present company, March, 1927, in capacity of Manager of Radio Dept. Recently taken over new Electrical Dept. Private address: 83 Mosley Street, Glenelg, S.A. Born October, 1904.

WATTS, H. C. — Born 1885. Since the early days of moving pictures when associated with Spencers and J. D. Williams has been actively connected with many new developments in Australia. 1910 was responsible for the introduction into Australia of Kinema-colour. 1912 introduced Kinetophone to this country at Lyceum Theatre. 1916 Engineer-in-Charge Waddington circuit of thirteen theatres. 1917 Chief Electrical Engineer, Paramount Co. 1920 Engineer-in-Charge and later Manager, Haymarket Theatres Ltd., until absorbed by Greater Union Theatres. 1921 to date, General Manager, General Theatre Supplies Ltd., Sydney.

WALKER, H.C.—Managing Director, H. C. Walker & Co. Associated Factories, 73-5 George Street, Redfern. Associate of the Commonwealth Institute of Accountants; was one of the first to engage in the radio trade in Australia as General Manager Harringtons Ltd. Took prominent part in early organisation of trade, Chairman of Radio Interests Ltd., 1927. Assisted materially in securing royal commission re radio and settling royalty question satisfactorily. Visited America 1929-30. On return appointed Managing Director Harringtons Ltd. and Raycophone Ltd. Resigned 1932 to organise several radio manufacturing activities. Feb., 1933, established Peerless Mfg. Co. Ltd., moulders, Duffy Radio Co. Ltd., short wave specialists, Motion Picture Supplies Ltd., Cinema Supplies, and Cummings Bros. Ltd., talkie and cinema manufacturers. Recreation: Golf.

WEBB, H. L. C.—Managing Director Rola Co., Aust., Pty Ltd., 359 Little Lonsdale Street, Melbourne, C.1., Victoria.

WEINGOTT, Rae.—Technical Director of Sales and Technical Depts. of Kriesler (Australasia) Ltd., Myrtle Street, Chippendale. Experimented last fourteen years. Had commercial interest in radio since 1924, managing the Airmaster Radio Co., later "Electric Trading Co." "Invettes Ltd.," "Vocalion Ltd." and founder of Kriesler Radio Co. Inventor of many efficient circuits, all-wave coil devices and a new vario coupled I.F. transformer. Home address: 15 Nelson Bay Road, Bronte. Date of birth, 12th Dec., 1904. Recreations: Movie picture photography.

WELSH, Charles O.—Director since 1931, Eclipse Radio Pty. Ltd. Born March, 1892.

WERRING, Oscar Carl.—Proprietor, Radio Dept. Werring Radio Co., 213-215 Queensberry Street, Carlton, N.3. Private address: 874 Burke Road, South Camberwell, S.E.6. Phone, Haw. 4875. Born 3/8/1906. Recreation: Billiards.

WETLESS, A. P. J.—Proprietor, Wetless Electric Manufacturing Co., 281 King Street, St. Peters. Electrical Engineer, specialised in condenser manufacture since 1923.

WHIGHT, C.J.—Managing Director Acme Radio Laboratories, Pty. Ltd. An old identity in radio, having been associated with the science as experimenter since about 1920. Associated with A. G. Healing Ltd. as engineer until 1931, when formed present company. Private address: 22 Orange Grove, East St. Kilda. Recreation: Deep sea fishing.

WILKINSON, Bruce, B.E., A.M.I.E. (Aust).—Engineer-in-charge, Research and Standards Laboratory, Amalgamated Wireless (A'sia) Ltd. After leaving Sydney Church of England Grammar School, apprenticed to the Australian Aircraft and Engineering Co., 1921-2. Graduated Bachelor of Mechanical and Electrical Engineering, University of Sydney, 1928. Appointed Efficiency Engineer, Australian Estates and Mortgage Co., 1929, and joined A.W.A. Engineering Department 1930. Captain 1st Medium Artillery Brigade, A.G.A. Born 8th November, 1903. Recreations: Cricket, tennis, swimming.

WILLIAMS, Percy Harold.—Managing Director P. & R. Williams Ltd., and Williams, Dredge & Haydon Ltd. Been in cycle and motor business since 1907. Australian Flying Corps. Abroad 1917-1918. Commenced business with brother, D. R. Williams, April, 1920. Member Royal Automobile Club of Australia. Private address: 17 Village High Road, Vaucluse. Born 21/8/1893. Recreations: Motoring, golf and music.

WILLIAMS, Sturt Milne.—Director of P. & R. Williams, Ltd., and Williams, Dredge & Haydon Ltd. Joined company of P. & R. Williams Ltd., 1920. Represented Australia Isle of Man Tourist Trophy Cycle Races, 1925, 1930 and 1931. Private address: 19 Kings Road, Vaucluse. Born 19/7/1904. Recreations: Tennis, motoring, swimming and music.

WILSON, John Francis.—Secretary and Assistant Manager, Amalgamated Wireles (A'sia) Ltd., 47 York Street, Sydney. A.C.I.S., Member Inst.R.E., Aust. Educated St. James College and Sydney University. Joined M.W.T. Co. in 1909 as marine operator. Engaged on construction work and ship fitting in Brazil, South Africa and Canada. Joined Australian branch in 1911, and been with A.W.A. since inception of company. Appointed Secretary A.W.A. in 1917, and Assistant Manager in 1918. Recreations: Tennis, swimming.

WING, William, J. J.—Sales Manager Amalgamated Wireless (A'sia) Ltd., 47 York Street, Sydney. Born and educated in England. Joined Marconi School, England, 1911. Operator s.s. "Empress of Ireland," and a number of White Star and Allan Liners. Joined Commonwealth Radio Service, 1913, served in Melbourne, Perth, Sydney, Thursday Island, and Cooktown Radio Stations. Joined commercial side of A.W.A. 1923, and appointed Sales Manager 1924. Has been prominently associated with radio trade organisations.

WINTER, William Francis.—Director Herberholds Dry Batteries Pty. Ltd., Melbourne. Entered radio in 1922. 1931 visited Great Britain and Europe to investigate battery situation 1932 formed Herberholds. Born 1903.

WINKWORTH, Leslie Herbert.—Director C. Winkworth & Son Ltd., 337 George Street, Sydney. Committee Carnarvon Golf Club, Hon. Secretary Barrier Reef Big Game Fishing Club; Life Member Haberfield Rowing Club, also Union Old Oarsmen; Associate Member Royal Zoological Society, Marine Life Section; Haberfield Music Club Committee. Educated Sydney Boys High School. Commenced business career with Makower McBeath Pty., Silk Merchants. Joined father in business, 1912, as Piano Importers. 1919, entered into control of business on retirement of C. R. Winkworth (father) with brother Herbert C. Winkworth as partner. Traded as C. Winkworth & Son Ltd., Pianos, players, gramophones. In 1924 became Director of new company, C. Winkworth & Son Ltd. Nominal capital £50,000. In 1925 opened 337 George Street. Extended also Annandale premises twice. Increased capital to £100,000. Travelled America, Europe, England, Canada, 1926, for new agencies. Private address: "Kowong," Crescent Street, Dobroyde Point, Haberfield. Born 1892. Recreations: Music, game fishing, marine life, zoology, golf, flying, shooting, boxing, Australian art, rowing.

WODELL, Frank E.—Balgowlah Golf Club. Six years wholesale leather business, 20 years motor-car business, ten years of which were as employee of General Motors, 3 of which were as Australasian representative. About 4½ years in Sydney radio, with 3½ years Interstate Sales Ltd. as Managing Director, 2 years Departmental Manager of Hazell & Moore Ltd. Private address: "Clybucca," Wanganella St., Balgowlah. Born 8/3/1883. Recreations: Golf, motoring, trout fishing, and camping.

KEARNEY, Cecil Reay.—Manager Harringtons W.A. Ltd., 660 Hay St., Perth. Served 6 years with A.W.A. from 1918. Then joined Standard Telephones until advent talkies. Resigned and joined Western Electric. Installation supervisor 1929-1932. Merchandise supervisor 1932-33. Joined Harringtons 1933. Private address: 232 St. George's Terrace, Perth. Born 14/6/02. Recreations: Swimming, golf and football.

WOOLF, Barnet.—Assistant Manager Sydney Branch Eclipse Radio Pty. Ltd., 137 Clarence Street. Joined Eclipse Radio about 1928. Transferred to Sydney, 1932. During 1933 had eight months world tour. Born 22/4/06. Private address: Hartford Hall, Fletcher Street, Bondi. Recreations: Tennis, bridge and literature.

WYLES, David G.—Manager Technical and Commercial Dept. Philip Lamps (A'sia) Ltd., 69 Clarence St. M.Inst.R.E., Aust., Mem. I.R.E. (U.S.A.). Served engineering apprenticeship Forward Down & Co. Ltd., joined Amalgamated Wireless 1914. Visited Europe, Great Britain 1922-23, investigating radio on behalf A.W.A. Appointed Chief Engineer Station 2BL, 1925. Later appointed engineer National Electric Co. N.Z. Joined Philips Lamps (A'sia) Ltd., Sydney, as technical manager, 1929. Visited England, Europe, and the U.S.A. on behalf of Messrs Philips Lamps. Councillor I.R.E. (Aust.). Private address: 36 Burra Road, Artarmon. Born 20/7/94.

WYNYARD-JOSS, Major A., O.B.E.—National Radio, Brisbane, Q. Has been a keen experimenter in radio since 1920. Much travelled. Associated with motoring in Queensland from almost its inception in that State, and was a Director in the C.C.M. up to that business going into voluntary liquidation in 1929. Purchased right out the C.C.M. Radio Department, carrying on the business as National Radio, of which he is senior member, in partnership with Mr. W. Finney.

YEND, R. H.—Manager Rola Co. (Aust.) Pty. Ltd., 359 Little Lonsdale Street, Melbourne, C.1, Victoria.

YELLAND, Francis Edward.—Sales Manager of Grand Opera Radio, Glen Eira Road, Ripponlea. Associated with his brother for three and a half years in manufacturing radio sets and accessories. Born 26/7/06. Recreation: Cricket.

YELLAND, Leslie J.—Proprietor Grand Opera Radio, Glen Eira Road, Ripponlea. Certified electrical engineer (Australia). For seven years in electrical trade with S. J. Fraser, St. Kilda. Took interest in radio experimentally in 1922. Entered business in 1927 as Grand Opera Radio. Born 24/8/03.

Manufacturers' Directory

Most of the information contained in this Directory section has been obtained direct from the manufacturers and wholesalers concerned, and although every care has been taken to prevent inaccuracies or errors, no responsibility is assumed by the Publishers.

Omissions or inaccuracies should be notified to the Editor so that the next edition can be revised.

A

Acme Radio Laboratories Pty. Ltd., 73 Queen Street, Melbourne, Vic. F 6850. Managing Director, C. J. Whight.

ACORN PRESSED METAL CO., 6 Mathieson Street, Camperdown, N.S.W. L 2977—L 2381. Chassis and Metal Spinners, Pressed Metal Goods Manufacturers. Governing Director, E. A. Parmiter.

AIRZONE (1931) LTD., 16 Australia Street, Camperdown, Sydney, N.S.W. L 2851. Telegrams and Cables, "AIRZONE". Managing Director, Claude Plowman. Sales Manager, W. B. Homewood. Manufacturers "AIRZONE" Radio Receivers and component parts. Branches: Arco House, Cole's Place, Melbourne; 886 Hay Street, Perth; Charles and Rundle Streets, Adelaide; Q.P.I. Buildings, 129 Adelaide Street, Brisbane, Qld.

AMALGAMATED WIRELESS (A/SIA) LTD., 47 York Street, Sydney. BW 2211. G.P.O. 2516 BB, Sydney. 167-9 Queen Street, Melbourne. F 4161. G.P.O. 1272 L, Melbourne. Interstate Distributors, J. B. Chandler & Co., Brisbane; Newton McLaren Ltd., Leigh Street, Adelaide; Phonographs Ltd., 671 Hay Street, Perth; Findlay's Pty. Ltd., 67 Brisbane Street, Launceston. Amalgamated Wireless prepare specifications and manufacture and install all manner of wireless equipment, all of which is designed and manufactured at Radio Electric Works, Ashfield, Sydney.

AMALGAMATED WIRELESS VALVE CO. LTD. Head Office, 47 York Street, Sydney. G.P.O. 2516 BB. BW 2225. F 4161. Representatives: S. R. E. Haworth. Agents in all States (Aust. valves now available.)

AMPLION (AUST.) LTD., 70 Clarence Street, Sydney. BW 1114 (3 lines). B 3683 (silent line). Telegrams and Cables, "AMPLION" Sydney. Managing Director, P. J. Manley. Sales Manager, E. Cox. Manufacturers of "AMPLION" Loud Speakers. (Previous to April, '34, known as Speakers (A/sia) Ltd.) Interstate Distributors: Queensland, Edgar V. Hudson Ltd., 47 Charlotte Street, Brisbane; Victoria, Australasian Engineering Equipment Co. Ltd., 415 Bourke Street, Melbourne; South Australia, Newton McLaren Ltd., Leigh Street, Adelaide; Western Australia, Carlyle & Co., 915 Hay Street, Perth; Tasmania, W. & G. Genders Pty. Ltd., 53 Cameron Street, Launceston; 69 Liverpool Street, Hobart; New Zealand, R. Harold Court, P.O. Box 1331, Wellington, N.Z.

ANDERSEN & FRANTZEN, cnr. Johnson & Queen Streets, Alexandria, N.S.W. Mascot 284. Cabinet makers. Manager, Victor Frantzen.

ARNOLD & NUNN, 62 Pine Street, Chippendale, N.S.W. MA 1132. Metal Spinners.

Aristone Radio Co. (Aust.) Pty. Ltd., 230 Chapel Street, Prahran, S.1, Victoria. Windsor 7282. Box 1622 M, Melbourne. Managing Director, Chas. Jordan. Manufacturers of Aristone Radio Receivers.

AUSTRALASIAN ENGINEERING EQUIPMENT PTY. LTD., 415-419 Bourke Street, Melbourne, Vic. Telegrams and Cables, "ENIQUIP". C1.11315. T.C.C. Products, Fixed and Electrolytic Condensers. Managing Director, D. G. Doughton. Director, W. M. Hipgrave. Interstate Representatives: N.S.W., Wm. J. McLellan; Qld., Trackson Bros.; W.A., Carlyle & Co.

Australian Condenser & Electric Co. Pty. Ltd., 25 Leichhardt Street, Melbourne, Vic. Manager, N. Hanger. Distributors, Kendall Knight & Co. Pty. Ltd. Lomil Condensers.

B

Beale & Company Ltd., 41-47 Trafalgar Street, Annandale. L 2791. Telegrams and Cables, "Beale". Box 1621 BB., Sydney. Managing Director, Ronald M. Beale. Sales Manager, J. M. Davis. Interstate Representatives: Maples Ltd., Melbourne and Prahran, Vic.; Maples, Wagga, Albury, and Cootamundra; Maples, Launceston, Tas.; Maples, Hobart, Tas.; G. J. Grice Ltd., 90-92 Queen Street, Brisbane, Qld.; Savery's Pianos Ltd., 29 Rundle Street, Adelaide, S.A.; Thompson's Ltd., 209 Murray Street, Perth, W.A.

BREVILLE RADIO, 486 Elizabeth Street (near Cleveland Street), Sydney, N.S.W. Telegrams, "Breville." M 6391-2. Proprietors, C. H. Norville and W. J. O'Brien. Chassis manufacturers.

C

CARR, JAMES & VAUTIN, 661 George Street, Sydney. MA 1420. Cables, "Jaycar". Trade name, "CJV", "Pertinax". Insulating Products. Proprietors: John Carr, W. H. James, C. Vautin. Sales Manager, John Carr. Interstate, Vic., Blake Eilbeck, 403 Bourke Street, Melbourne.

Clyde Engineering Co. Ltd., Granville, N.S.W. UW 8881 Battery Service Station, 106-110 Goulburn Street, Sydney (M 6738). Accumulators.

Colonial Radio Pty. Ltd., 136-138 A'Beckett Street, Melbourne, Vic. F 5655. Director and Secretary, Brian Hayman. Interstate Representatives, Sample & Wilson Pty. Ltd., all States and N.Z. O. H. O'Brien, Sydney, N.S.W. Manufacturers of "Melbourne" Superheterodyne Kits, Coils, etc., "Master Made" (M.M.) Potentiometers, Wire-wound Resistors, etc., "Operatic" Radio Receivers.

COLVILLE MOORE WIRELESS SUPPLIES, 4 Rowe Street, Sydney. B 2261. Short Wave and Aeroplane Transmitters and Receivers. Proprietor, Syd. Colville.

Manufacturers' Directory—(Continued).

COMMONWEALTH MOULDING CO. LTD., 240 Princes Highway, Arncliffe. LW 3876. Telegrams and Cables, "Commould". Trade name, "Marquis" Products, Marquis Mouldings. Managing Director, S. C. Mitchell. Sales Manager, J. P. Taylor. Interstate Representatives: G. P. Embelton & Co., 579 Bourke Street, Melbourne; P. H. Phillips, 195 Elizabeth Street, Brisbane, Qld.; A. G. Healing Ltd., Pirie and Pulteney Streets, Adelaide, S.A.; Carlyle & Co., 915 Hay Street, Perth, W.A.; W. & G. Genders Ltd., 53 Cameron Street, Launceston.

Creela Radio Products, 486 Elizabeth Street, Sydney. M 3172. Power transformers and line filters.

CROWN RADIO MFG. CO., 155 Bourke Street, Sydney, N.S.W. FL 1323. Interstate Representatives: Henry G. Small & Co., 374 Post Office Place, Melbourne, Vic.; Newton McLaren & Co. Ltd., Leigh Street, Adelaide, S.A.; J. G. Pritchard, William Street, Perth, W.A. Wire-wound products, testing equipment.

D

Dalton, H. & Co., 85 Eveleigh Street, Redfern, N.S.W. MA 5580. Moulded formers, sockets, etc.

Davies & Co., 938 Hay Street, Perth, W.A. Set manufacturers. Manager, R. P. Davies.

Dickin, F. Ltd., 18-34 Lords Road, Leichhardt. P.O. Box 18, Leichhardt. Products, "Dickin" cabinets. Managing Director, A. J. Dickin. Sales Manager, T. H. Dickin. Pet. 839.

DOE, A. G., 59-60 Beecroft Road, Epping, N.S.W. Epping 1. "Arion" radio products.

DON ELECTRICAL CO., Mallett Street, Camperdown. L 2839. Proprietor, F. T. O'Donnell. Sales Manager, J. C. W. Vaughan.

DUCON CONDENSER PTY. LTD., 46 Carrington Street, Sydney. Telegrams, "Ducon"; Cables, "Esoxur". Products: "Dulytic", "Chanex". Manager, A. R. Persson. B 6541-2. 450 Little Collins Street, Melbourne, Vic. CL 8700.

DUFFY RADIO CO. LTD., 73-5 George Street, Redfern, N.S.W. MA 3933. Box 1055. Telegrams, "Cinema", Sydney. Managing Director, H. C. Walker. Chief Engineer, J. Duffy. Specialists in short-wave and television equipment.

DUNLOP-PERDRIAU RUBBER CO. LTD., Flinders Street, Melbourne, C.1. Rubber manufacturers and plastic moulders. Dept. Manager, E. Hine.

E

ECLIPSE RADIO PTY. LTD., 212 City Road, South Melbourne, Vic. M 4681. 137 Clarence Street, Sydney (B 6937). Telegrams and Cables, "Eclipse". Products: "Croyden" sets, "Univox" sets, "Alpha" parts, "Saxon" parts. Directors: Albert Aarons, Saul C. Aarons, Charles O. Welsh. Sales Manager, Arch. McPhee. Interstate Branches: Adelaide, Manager, H. Collocott, 43 Austin Street, Adelaide (C1 929); Brisbane, 88 Adelaide Street, Manager, —. Pervis; Sydney Manager, R. V. Smith.

EFCO MFG. CO. LTD., 108 Rocky Point Road, Arncliffe, N.S.W. Telegrams and Cables: "Efco", Arncliffe. LW 1105. All types of dials, gang variable condensers. Trade name, "Efco". Managing Director, Richard Facer; Sales Manager, A. J. Larkin. Dials available all wholesalers.

ELECTRICAL SPECIALTY MANUFACTURING CO. LTD., 19 Glebe Street, Glebe. MW 2608-9. Telegraphs and Cables, "Essemco", Sydney. Directors: O. C. Turner and G. Schliesman. General Manager, G. Hunt. Set Manufacturers. Distributors: P. & R. Williams Ltd., Wentworth Avenue, Sydney; United Radio Distributors, 73 York Street, Sydney; Edgar V. Hudson Pty. Ltd., 47 Charlotte Street, Brisbane; C. S. Baty & Co., Murray Street, Perth.

Essanay Mfg. Co. Pty. Ltd., 54 Buckhurst Street, South Melbourne, Vic. M 3169. Set and Parts Manufacturer. Directors: E. A. Austin and W. M. Sweeney.

EVER-READY CO. (GT. BRIT.) LTD., Marshall Street, Surry Hills, N.S.W. FL 4639, 4640. Telegrams and Cables, "Readyworks", Sydney. General Manager and Aust. Attorney, Albert Jewell. Sales Manager, G. K. Herring. Factory Manager, F. Goulder. Works Supt., S. W. H. Newman. Melbourne: 360 Collins Street, C1 4417. Manager, John Leeman. Brisbane: Perry House, Elizabeth Street. B 9811. Manager, F. H. Tisbury. Dry battery manufacturers. Ever-Ready Batteries and torches distributed by all wholesalers.

EYELETS PTY. LTD., 44-6 Green Street, Windsor, S.1. Windsor 7084-7085. Telegrams and Cables, "Eyelets". Proprietor, F. W. and J. W. Deannett. Interstate Representatives: C. H. R. Johnston, cnr. Cleveland and Buckingham Streets, Sydney; P. G. Lavers, 125 Adelaide Street, Brisbane, Qld.; F. L. Runge, Edments' Buildings, Rundle Street, Adelaide, S.A.

Exide Batteries, Grace Buildings, York Street, Sydney. Distributors: Deering Engineering Co. Ltd., 8 Hunt Street, Sydney; A. P. Sutherland, 2 Maffra Street, South Melbourne; Unbehaun & Johnstone Ltd., 97 Currie Street, Adelaide, S.A.; M. J. Bateman Ltd., 12 Milligan Street, Perth, W.A.; Medhurst & Sons Pty. Ltd., 95 Collins Street, Hobart, Tas.; Exide Battery Service (Q'land) Pty. Ltd., Adelaide Street, Brisbane, Qld.

EXPRESS UNIVERSAL INSTRUMENT CO., 50 Parramatta Road, Petersham, N.S.W. L 3036. Makers of Radio Testing Equipment. Interstate Representatives: A. G. Healing Ltd., 167 Franklin Street, Melbourne, and Pirie Street, Adelaide, S.A.; Harringtons Ltd., 212 Queen Street, Brisbane, 28 King Street, Perth, 32 Elizabeth Street, Hobart, Tas., and 134 Queen Street, Auckland, N.Z.

F

Fallshaw, D. & Sons, 1 Boundary Road, North Melbourne, Vic. F 4636. Director, F. Fallshaw. Manufacturers of radio cabinets.

Federal Insulating Products Pty. Ltd., 130 Church Street, Richmond, E.1. J 4069. Mica manufacturers.

FIRTH BROS. PTY. LTD., 149 Little Lonsdale Street, Melbourne, Vic. F 4127. Telegrams and Cables, "Firbro". Managing Director, B. G. Firth. Director, E. G. Firth. Interstate Representatives:

Manufacturers' Directory—(Continued).

N.S.W., P. A. Morse, Bradbury House, 55 York Street, Sydney. BW 6803. S.A.—D. Harris & Co., 140 Rundle Street, Adelaide. C 1733. Manufacturers of radio receivers and parts, principally speakers. Trade name, "Precedent" and "Monitor".

G

Gage, H., Tempany Street, Fitzroy, Vic. Manufacturers of Radio Cabinets. JW 1138.

Genkay Electric Co., 379 Kent Street, Sydney, N.S.W. M 4921. Manufacturers of soldering irons.

GENERAL THEATRE SUPPLIES LTD., 298 Pitt Street, Sydney. MA 2093. Telegrams and Cables, "Gentheatre". Box 3191 P. General and Sales Manager, H. (Bert) Watts. Branches: 178A Flinders Street, Melbourne (Manager, W. Lyall); 169 Eliabeth Street, Brisbane (Manager, H. R. Wright); Henley Street, Adelaide (Manager, P. Harmer); Film House, Perth (Manager, A. B. Neilson); 15 Courtney Place, Wellington, N.Z. (Manager, R. Grant); 129 Albert Street, Auckland, N.Z. (Manager, F. Mumford). Manufacturers of theatre supplies.

Gladiola Co., 241 Waymouth Street, West, Adelaide, S.A. (C.1 6585). Manufacturers of wireless sets. Proprietor, W. Black.

H

Hardy, W. R. & Co., Woniora Road, Hurstville. Box 1033 H G.P.O. LW 4519. Proprietor, W. R. Hardy. Queensland Representatives: T. H. Martin & Son, Wilson House, Charlotte Street, Brisbane.

HAZELL & MOORE LTD., 36 Campbell Street, Sydney. MA 6091. Telegrams and Cables: "Hazelmore," Sydney. "Red Seal" Receivers. Distributors Airzone and Radiola radio sets. Manager, J. S. Moore; Sales Manager, W. D. S. Taylor. Q'land Representatives: R. W. Hislop, 232 Queen Street, Brisbane, Qld.; 328 Hunter Street, Newcastle.

Healing, A. G. Ltd., 167-173 Franklin Street, Melbourne, C.1, Vic. F 5171 (10 lines). Telegrams and Cables, "Healing". Box 870 J. Products: Healing Golden Voiced Radio Receivers and Healing Refrigerators. Managing Director, N. Broomhall, Radio Manager, C. J. Irvine. Interstate Branches: S.A., 155 Pirie Street, Adelaide (C1.4635); N.S.W., 164 Goulburn Street (FL 2601), Sydney; Q'ld., R. J. Rose, Fairfield Road, Yeerongbilly, Brisbane; W.A., Australian Radio Supply Co., 804 Hay Street, Perth.

Henderson, P. A. & Co., 409 Pacific Highway, Crows Nest (X 1214), N.S.W. Trade name, "Henderson". Products, Henderson power equipment. Manager, P. A. Henderson.

HERBERHOLDS DRY BATTERIES (AUST.) PTY. LTD., 562-566 Spencer Street, Melbourne, Vic. F 5225. Manufacturers of dry batteries. Trade name, "Impex". Telegrams and Cables, "Parwin", Melbourne. Managing Director, W. F. Winter. Interstate Representatives: R. C. Willard, Adelaide; W. J. Griffiths, Exton House, Queen Street, Brisbane; Masse Batteries Sales Co., Nield Avenue, Rushcutter's Bay, N.S.W.; W. & G. Genders Pty. Ltd., Cameron Street, Launceston, Tas.; G. M. Martin, King Street, Perth, W. A.

Hilco Products Proprietary Ltd., 207-9 Latrobe Street, Melbourne, C.1. M 2563. Telegrams and Cables, "Hilcoy", Melbourne.

HOELLE, J. J. & CO., 47 Alma Street, Darlington, N.S.W. MA 5672. Manufacturers of lugs, terminals, and electrical goods. Trade name, "Utilux". Sales Manager, J. J. Hoelle. Interstate Representatives: Q'land, Brownlow, Jarman & Co., 318 Elizabeth Street, Brisbane; Vic., G. P. Hordern, 499 Little Collins Street, Melbourne; N.S.W., D. Beston, Kent Street, Sydney (M 3926); W.A., M. J. Bateman Ltd., 12 Milligan Street, Perth.

Howard Radio Pty. Ltd., Vere Street, Richmond, Vic. 'Phone, J 5149.

I

Invincible Radio Co., 12 Castlereagh Street, Sydney. B 1746. Trade name, "Invincible". Products, Radio chassis. Manager, E. C. R. Wolridge.

J

James Mfg. Co. Ltd., 573 Parramatta Road, Leichhardt, N.S.W. (Pet. 4101—2071). Manufacturers of N.S.T. receivers and components.

Jansen, H. E. C., Eudunda, S.A. 'Phone, 58. Radio equipment manufacturers. P.O. Box 23.

Jardyne, J., 28 Wyndham Street, Alexandria, N.S.W. MA 5325. Variable condensers.

Jensen Radio Mfg. Co., 254 Castlereagh Street, Sydney. MA 1387. Manufacturers of dynamic speakers. Manager, Charles Forrest.

K

Kemp, A. W. & Co., 32 Market Street, Sydney, N.S.W. MA 5270. General Manager, G. F. Mann. Manufacturers, Rotary Converters.

KRIESLER (A/SIA) LTD., Pine, Myrtle and Beaumont Streets, Chippendale, Sydney. M 4430. Makers of sets and components. Trade name, "Kriesler". Chairman of Directors, P. G. Tuit. Technical Director, Rae Weingott.

L

LEKMEK RADIO LABORATORIES (N. S. Gilmour), 75 William Street, Sydney. FL 2626-7. Telegrams and Cables, "Nogil". Box 2971 NN G.P.O., Sydney. Proprietor, N. S. Gilmour. Sales Manager, S. M. Conlon. Works Manager, J. Paton. Service Manager, A. Everitt. Representatives: W. A., H. C. Little & Co. Ltd., 858 Hay Street, Perth; Q'land, Warburton, Franki (Bris.) Ltd., 233-35 Elizabeth Street, Brisbane; N.S.W., A. & S. McCrum, 352 Hunter Street West, Newcastle; W. G. Watson & Co. Ltd., 279 Clarence Street, Sydney; Lawrence & Hanson Electric Co. Ltd., 33 York Street, Sydney. Manufacturers of radio sets, kits and components.

M

Magnavox (Australia) Ltd., 61 Dowling Street, East Sydney, N.S.W. FL 4174. Managing Director, D. T. Hinchen. Makers of dynamic speakers.

Majestic Radio Mfg. Co., York House, 101 William Street, Sydney, N.S.W. FL 4005. Proprietors, J. K. Drummond and Barry Philp. Manufacturers, "Majestic" receivers.

Manufacturers' Directory—(Continued).

McColl Electric Works Pty. Ltd., 104 Moor Street, Fitzroy, N6, Vic. J 3197. Generators and eliminators.

Mead Mfg. Co., Crown St., East Sydney. F 3879. Products: "Mead" chassis, "Airmead" Short Wave Superheterodyne. Proprietor, Max Mead.

METROPOLITAN ELECTRIC CO. LTD., Corner George & Cleveland Streets, Redfern, N.S.W. M 6108. Telegrams & Cables: "Radiokes." P.O. Box 10, Redfern. Mng. Dirs., R. K. and G. M. Stokes. Secretary, Miss E. Gawthorne. Interstate Distributors: A. J. Veall Pty. Ltd., 243 Swanston Street, Melbourne, Vic.; Newton McLaren Ltd., Leigh Street, Adelaide, S.A.; Carlyle & Co. Ltd., 915 Hay St., Perth, W.A.; W. & G. Genders Pty. Ltd., 59 Liverpool St., Hobart, and 53 Cameron Street, Launceston; E. V. Hudson Pty. Ltd., 47 Charlotte Street, Brisbane, and Trackson Bros. Pty. Ltd., 157 Elizabeth Street, Brisbane, Qld.; F. J. W. Fear & Co., 63 Woollett St., Welington, N.Z. Trade Names: "Radiokes" and "Kit Sets." Mfrs. of all kinds of radio accessories.

McKenzie & Holland (Aust.) Pty. Ltd., Electrical and Mechanical Engineers, Newport, W.15, Vic. Williamstown 429. Telegrams: "Holland-Spotswood," Vic. Cables: "Schwirren." Branch Office: McKenzie & Holland, Northgate, Brisbane, Qld. Phone M 6001. Telegraphic address: "Nundah," Brisbane. J. B. Jacobson, Mng. Dir. Melb. Mgr., A. W. Beauchamp; Brisbane Mgr. Distributors: E. V. Hudson Pty. Ltd., Brisbane, Qld.; Amplion A/sia Ltd., Sydney, N.S.W.; Alan S. Duke Pty. Ltd., Melbourne, Vic.; Newton McLaren Ltd., Adelaide, S.A.; Carlyle & Co., Perth, W.A. Manufacturers of "Westector" rectifiers, "Holanite" plastic moulding, "Westric" metal rectifiers, battery chargers, etc.

Mica Insulating Supplies Co., 562-4 Bourke Street, Melbourne, Vic. Cl. 3669, F 5307. Telegraphic address: "Mandisco." S.A. Rep.: A. A. Ralph, 31 Gilbert Place, Adelaide, S.A. (Cl. 4803). Telegrams: "Ralph," Adelaide. Proprietors, J. W. and G. W. Griffiths and W. C. Pitcher. Manufacturers of micanites and insulating materials.

Micanite and Insulating Manufacturers, 31 Guildford Lane, Melbourne, Vic. Cl. 5479. Proprietor, P. J. O'Hanlon (Electrical Manufacturer). Mica, micanite, tube and section manufacturers. General moulders of radio and electrical trade.

Moulded Products (A/sia) Pty. Ltd., 37-41 Scotchmer Street, North Fitzroy, N.7, Vic. JW 1144-5. Tel. & Cables: "Vocal-Gramo." Bentley's Code. Mng. Dir.: L. A. Herman. Sydney Representatives: Dobson Agency Co., 142 Clarence Street; Adelaide, Lodge & Hill, 91 Grenfell Street; Melbourne, Aust. Moulding Corp. Pty. Ltd., 302 Flinders Lane.

N

Nally Ltd., 5 Queen Street, Glebe, N.S.W. MW 1370 Victoria, Frank Hooper, 197 Elizabeth Street, Melbourne; Qld., E. J. M. Watson, Ryan House, Charlotte Street, Brisbane; S.A., A. E. Stephen, 15 Cranbrook Chambers, Bentham Street, Adelaide; W.A., Chas. Harris, 117 Barrack Street, Perth.

NOYES BROS. (SYDNEY) LTD., 115 Clarence Street (Radio Dept., 78 Clarence St.), Sydney, N.S.W. B 7581. Telegrams and Cables: "Noyes," Sydney. Box 1587 H, G.P.O., Sydney. Makers of Seyon radio sets. Branches: 11 Watt St., Newcastle; Burton House, Elizabeth Street, Brisbane, Qld. General Manager, Malcolm Ritchie. Radio Manager, C. Dunn.

NOYES BROS. (MELBOURNE) PTY. LTD., 569 Lonsdale Street, Melbourne, C.1, Vic. Cl. 6723. Manager Electrical Supplies Dept., F. A. Gordon. Radio Dept., D. Hargrave. Interstate Branches: Grenfell Street, Adelaide; 36 Argyle Street, Hobart, Tas.; 59 George Street, Launceston, Tas.; 138 Murray Street, Perth, W.A. Manufacturers of Seyon Radio Receivers.

O

Orpheus Radio Co. Pty. Ltd., 294 Little Lonsdale St., Melbourne, Vic. F 2649. Manufacturers of radio receivers.

P

Paramount Radio Mfg. Co., 301 Castlereagh Street, Sydney. MA 3875. Trade name: "Paramount." Products: Resistors, Coils, Coil Kits, Dials, etc. Manager, D. Maskall.

PEERLESS MANUFACTURING CO. LTD., 73 George Street, Redfern, N.S.W. MA 3933. Telegrams & Cables: "Cinema." P.O. Box 1055 H. Trade name: "Peerless." Managing Director, H. C. Walker. Sales Manager, H. E. Gould. Representatives: Vic., Aucher Pty. Ltd.; Qld., Eric Welsh; S.A., T. G. Buteman; W.A., D. Henderson; N.Z., H. Goodwin.

Peerless Metal Works, 12 Rathdown Street, Brunswick East, Melbourne, Vic. Bruns. 842. Proprietor, S. Earney. Manufacturers of coil cans, valve cans, electric canopies, etc.

PHILIPS LAMPS (AUST.) LTD., 69-73 Clarence Street, Sydney. BW 2121. Telegrams & Cables: "Argenta." Box 2703 C. Trade name: "Philips." Managing Director, A. den Hertog. Assistant General Manager, J. Overdiep. Interstate Branches: Philips Lamps (Aust.) Ltd., 590 Bourke St., Melbourne, Vic.; Perry House, Elizabeth Street, Brisbane, Qld.; Hayward Buildings, Adelaide, S.A. (Manager,—. Poll); J. R. W. Gardam, Murray St., Perth, W.A. Valves and Lamps available from all wholesalers in all States.

Precision Engineering Co., 25 Little Collins Street, Melbourne, Vic. Proprietors, C. A. O'Halloran and C. H. Lane. Cl. 4930. Telegrams: "Peco," Melbourne. Manufacturers of general radio apparatus and special gear for transmitting stations.

PYROX PTY. LTD., 264 Latrobe Street, Melbourne, Vic. F 4157. Telegrams: "Pyrox." Managing Director, A. Hoette. Sales Manager, G. Miller. Sydney Office: 405 Castlereagh Street, Manager F. J. Hill. Phone MA 1941. Specialists in car radio. Importers of American-Bosch car radio and American-Bosch accessories. Manufacturers of Pyrox car radio.

R

Radiette Radio Ltd., 187 William Street, Sydney, N.S.W. FL 1020. Governing Director, R. H. Oxford. Manufacturers of Radiette Receivers.

Manufacturers' Directory—(Continued).

RADIO CORPORATION PTY. LTD., 21 Sturt Street, South Melbourne, Vic. M 4711 (10 lines). Telegrams & Cables: "Schuh," Melbourne. P.O. Box 845 J. Managing Directors, A. G. Warner and L. Abrahams. Interstate Representatives: H. E. Read, Hay Street, Perth, W.A.; W. Whitley, Alfred Chambers, Currie Street, Adelaide, S.A.; F. W. Koochew, The Quadrant, Launceston, Tas.; L. Pucke, 163 Goulburn Street, Hobart, Tas. Interstate Distributors: N.S.W., Smith Sons & Rees Ltd., 20 Wentworth Avenue, Sydney; Qld., Trackson Bros. Ltd., 157 Elizabeth Street, Brisbane.

Radio Maintenance Pty. Ltd., 407 Swanston Street, Melbourne, Vic. F 1869. Managing Director, C. J. Martin. Interstate Representatives: Vic. and Tas., C. H. Simpson & Co. Pty. Ltd.; N.S.W., Leo Regaly & Lewis, 119 York Street, Sydney. Manufacturers of radio receivers.

RADIO & TELEVISION MANUFACTURERS LTD., 101 William Street, Sydney, N.S.W. F 3735. Telegrams & Cables: "Ravision," Sydney. Manager, T. J. Mathews. Manufacturers of radio receiver chassis.

Radiovision (Aust.) Pty. Ltd., Margaret Street, Richmond, E.1, Vic. Phone J 2209.

Radix Power Supplies, 64 Lawler Street, Subiac, W.A. Proprietor, H. J. Dix. Australian Distributors: J. G. Pritchard, 18 William Street, Perth. Phone: B 4711 and B 4812.

RAYCOPHONE LTD., Booth & Trafalgar Streets, Annandale, N.S.W. MW 1834-1874. Telegrams: "Raycophone." Managing Director, G. D. Cree. Director and Chief Engineer, Ray Allsopp. Radio sets, components and talking picture equipment. Distributors, Harringtons Ltd. (all States).

R. C. S. RADIO, 12 City Road, Sydney. MA 2226, MA 4276. Trade name: "R.C.S." Proprietor, Ronald A. Bell. Sales Manager, R. A. Kelsey. Interstate Representatives: Vic., Henry G. Small Pty. Ltd., 374 Post Office Place, Melbourne; S.A., A. G. Healing Ltd., Pirie Street, Adelaide; Qld., J. C. Price, Perry House, Elizabeth Street, Brisbane; W.A., Carlyle & Co., 915 Hay Street, Perth. Products: Wire-wound components.

Regent Radio Pty. Ltd., 288 Bourke Road, Camberwell, E.6, Vic. Hawthorn 905. Directors: Messrs. Paramoor & McGrath. Manufacturers of radio receivers.

REYNOLDS, R. W. LTD., 200 Chalmers Street, Sydney, N.S.W. M 6879. Telegrams & Cables: "Renrade." General Manager, R. W. Reynolds. Sales Manager, J. H. Reynolds. Interstate Representatives: Scott & Holladay Ltd. (W.A., Tas., N.Z., Qld., Vic.); Newton McLaren Ltd., Adelaide, S.A. Products: Resistors, condensers (mica), voltage dividers, etc.

Richardson, H. C. Pty. Ltd., 52 Moreland Street, Footscray, Vic. Phone Footscray 1099. Directors: E. R. and H. C. Richardson and J. R. Callow. Interstate Representatives: N.S.W., O. H. O'Brien, Sydney; Qld., Edgar V. Hudson Ltd., Brisbane; W.A., Radio Shop, 842 Hall Street, Perth; Vic., Balwyn & Slattery, Flinders Lane, Melbourne; N.Z., P. D. Trickett & Co., Wellington, N.Z.

Ricketts & Thorp Ltd., Kimpton Street, Rockdale, N.S.W. LW 2641. Manager, F. E. Thorp. Interstate Representative: W. O. Barker, Q.P.I. Buildings, Adelaide Street, Brisbane, Qld. Cabinet makers.

ROLA CO. (AUST.) PTY. LTD., 359 Little Lonsdale Street, Melbourne, Vic. F 3852, F 5726. Telegrams & Cables: "Rola." Managing Director, A. L. C. Webb. Manager, R. H. Yeend. Products: Dynamic speakers.

S

SIMPLEX RADIO, 716 Parramatta Road, Petersham, N.S.W. Pet. 3100. Proprietor, H. H. J. Hankin. Manager, G. Rich. Victorian Representatives: R. E. Trickey & Co., 403 Bourke St., Melbourne. Moulded condensers, tone controls, sockets.

Slade Radio, Lang Street, Croydon, N.S.W. UJ 4576. Proprietor, C. W. Slade.

Standard Telephones & Cables (A/sia) Ltd., 71 York Street, Sydney, N.S.W. BW 1226. Telegrams & Cables. "Relay," Sydney. Box 525 B. Trade name: S.T.C. Managing Director, H. C. Trenam. Sales Manager, James Clarke. Radio Manager, H. F. Pearce. Interstate Representatives: C. R. Foster, 588 Bourke Street, Melbourne, Vic. Distributors: Vic., Noyes Bros. (Melb.) Ltd., 597 Lonsdale St. (Cl. 10105), Bruce Small Pty. Ltd., 283 Elizabeth Street (F 5195), Melbourne; Qld., Edgar V. Hudson Ltd., 47 Charlotte Street, Brisbane (B 3733); S.A., Noyes Bros. (Melb.) Ltd., 119 Pirie Street, Adelaide; Tas., W. & G. Genders Pty. Ltd., 53 Cameron Street, Hobart; W.A., M. J. Bateman, 12 Milligan Street, Perth. Products: Sets and components.

Stan-Mor Dry Cell Co., 212 Bay St., Brighton, S.5, Vic. Phone: X 1423. Proprietor, Stanley Morgan. Manufacturers of Stan-Mor Dry Cells.

STROMBERG-CARLSON (A/asia) LTD., 72-6 William Street, Sydney, N.S.W. FL 4184. Telegrams & Cables, "Strom," Sydney. Trade names: "Stromberg Carlson," "Audiola," "Roamer." Managing Director, L. P. R. Bean. Sales Manager, A. Freedman. Victorian and Tasmanian Representative, W. C. F. Hill, 191 Queen Street, Melbourne, Victoria. Makers of Radio Receivers, Auto Radio, variable gang condensers and volume controls. Distributors: N.S.W., Noyes Bros. (Sydney) Ltd. (B7581), 78 Clarence Street, Sydney; 11 Watt Street, Newcastle; Keen Street, Lismore. Wagga Wireless Distributors, Box 93, Wagga. Victoria. M. Brash and Co. Pty. Ltd., Elizabeth Street, Melbourne; 146 Ryrie Street, Geelong; A. J. Veall and Co., Pty., Ltd., 243 Swanston Street, Melbourne. Queensland: Noyes Bros. (Sydney) Ltd., Burton House, Elizabeth Street, Brisbane; Lawrence and Hanson Electrical Co. Ltd., 87 Elizabeth Street, Brisbane. Tasmania: Findlay's Pty. Ltd., 80 Elizabeth Street, Hobart, and George Street, Launceston; Wills and Co. Pty. Ltd., 7 The Quadrant, Launceston; Findlay and Wills Pty. Ltd., Devonport. South Australia: Radio Wholesalers Ltd., James Place, Adelaide; Savery's Pianos Ltd., 29 Rundle Street, Adelaide. West Australia: Musgroves Ltd., Lyric House, Murray Street, Perth.

Manufacturers' Directory—(Continued).

Superheterodynes Pty. Ltd., 90 Chapel Street, Melbourne, Victoria. Windsor 7944. Managing Director, Alan H. Burch. Manufacturers of radio receivers and accessories. Interstate Agents, Lazarus and Co., Murray Street, Perth, W.A.

Syme, W. A., & Co., Braefield Buildings, corner Bourke and Liverpool Streets, Sydney, N.S.W. F2730, FL2463. Manager, W. A. Syme. Trade name, "Symphona." Manufacturers of receivers and chassis.

T

TARGAN ELECTRIC CO. PTY. LTD., 131 Brunswick Road, Brunswick, Victoria. F8857. Telegrams, "Airmaster." Trade name, "Airmaster."

Tatham, S.E., 95 William Street, Sydney. Phone FL1767. Box 3182P, Sydney. Proprietor, S. E. Tatham. Trade name, "Reprovox" (sound reproducing equipment).

Teleradio Construction Pty. Ltd., 249-51 Spring Street, Melbourne, Vic. Phone: Cl. 8461. Directors: H. Kingsley Love, M. Malone.

THOM & SMITH, LTD., 55 Dowling Street, East Sydney, N.S.W. F2117-8. Radio manufacturers. Directors: J. E. Smith and F. W. P. Thom. Sales Manager, R. H. Jennings. Design Engineer, E. M. Fanker. Distributors—Queensland: G. J. Grice Ltd., 90 Queen Street, Brisbane (B1674); F. P. Moody, 34 Lake Street, Cairns (Phone 242, auto. B2480); S. W. Davids & Sons, 82 Flinders Street, Townsville (Phone 1271); Rosenstengels Pty. Ltd., Ruthven Street, Toowoomba (Phone 45). Victoria: Noyes Bros. (Melb.) Pty. Ltd., 597 Lonsdale Street, Melbourne (Cl.10105); John Hollway & Sons, 40 Armstrong Street, Ballarat (Phone 89), Box 71. Tasmania: Noyes Bros. (Melb.) Pty. Ltd., 36 Argyle Street, Hobart (Cl. 457), Box 263, and at 69 George Street, Launceston (Cl. 121), Box 228. South Australia: Noyes Bros. (Melb.) Pty. Ltd., 89 Grenfell Street, Adelaide (Cl. 2357), Box 9414. W.A.: Unbehaun & Johnstone (W.A.) Ltd., 381 Murray Street, Perth (B3131), Box D169. British Radios Ltd., 108 Armagh Street, Christchurch, New Zealand.

THOMPSONS RADIO LTD., 74 Oxford Street, Sydney. FL2264. Manager, J. Thompson. Manufacturers of cabinets and receivers, also patented sound board.

TILBURY & LEWIS PTY. LTD., 45 Wangaratta Road, Richmond, Victoria. J5171. Telegrams and Cables, "Lewbury." Managing Director, Reg. Lewis. Radio Sales Manager, Norman Lewis. Manufacturers of "Van Ruyten" Radio and general radio lines.

TRIUMPH RADIO LTD., 86 Anzac Parade, Kensington, N.S.W. FX 1986. Telegrams & Cables: "Triumph," Sydney. Joint Man. Directors: Thomas J. Sheedy and Leon Weingott. Manufacturers of Triumph Radio Receivers and Chassis. Distributors—N.S.W. Ronn Shafto & Co., Clarence Street, Sydney. MA 6141. Tasmania: W. & G. Genders Pty., Ltd., 52 Cameron Street, Hobart. Radio Supply Co. Ltd.

U

University Radio Co., 22 City Road, Sydney, N.S.W. MA2419. Manager, B. Broadhurst. Sales Manager and Secretary, L. B. Grahame. Manufacturers of radio receivers. Trade names, "University," "Chancellor," "Dean," and "Librarian."

V

Vesta Battery Co. (Aust.) Ltd., 14 George Street, Leichhardt. Pet. 1844. Accumulators. Service Station, 71 Macquarie Street, Sydney. BW5218.

VOLTA DRY BATTERIES PTY. LTD., 123 Thistlewaite Street, South Melbourne, Victoria. M 3913. Cables and Telegrams, "Voltabatts," Melbourne. Interstate Distributors—N.S.W.: Amplion (A/sia) Ltd., 70 Clarence Street, Sydney. South Australia: Harris Scarfe Ltd., Grenfell Street, Adelaide. Tasmania: Noyes Bros. (Melb.), 36 Argyle Street, Hobart; Noyes Bros. (Melb.), 59 George Street, Launceston. New Zealand: Brown & Paul Ltd., 58-60 Queen Street, Auckland. West Australia: J. R. W. Gardam & Co., 138 Murray Street, Perth. Queensland: Edgar V. Hudson Ltd., 47 Charlotte Street, Brisbane.

W

Wendel Electric Co., 14 St. Francis Street, Melbourne C1, Victoria. Cl. 76917. Proprietor, A. A. Elliott.

Werring Radio Co., 213 Queensberry Street, North Carlton, N3, Victoria, and 285 High Street, Prahran, Victoria. F5843 and Windsor 55. Proprietor, Oscar C. Werring. Manufacturers of radio receivers and chassis, power transformers, wire-wound products and special amplifiers.

Wetless Electric Manufacturing Co. Ltd., 281 King Street, St. Peters, N.S.W. L2263. Trade name, "Wetless." Manager, J. Wetless. Interstate representatives, Alan S. Duke Pty. Ltd., 486 Bourke Street, Melbourne, Victoria; T. W. Egan, Perth; Trackson Bros., Brisbane; National Radio, Brisbane, Queensland. Manufacturers of Tubular paper, mica (receiving transmitting) and midget variable condensers.

WIDDIS DIAMOND DRY CELLS PTY. LTD. (Head Office), 119 Hawke Street, West Melbourne, Victoria. F1175. Telegrams and Cables, "Diamoncel." Trade name, "Diamond." Branch office, Dalgety Road, Millers Point, Sydney (B3004). Managing Director, Alex J. Scovell. Manager and Director, Clive Evans. Sales Manager, Cliff Swift. Sydney Branch Manager, Alex. McK. Scovell. Interstate Distributors—Queensland: J. B. Chandler & Co., 43-45 Adelaide Street, Brisbane. South Australia: Newtown McLaren Ltd., Leigh Street, Adelaide. West Australia: Carlyle & Co., 915 Hay Street, Perth. Tasmania: W. & G. Genders Pty. Ltd., 52 Cameron Street, Hobart, and Launceston.

Y

YELLAND, L. J., 44-50 Glen Eira Road, Ripponlea, S4, Victoria. L3130. Manager, L. J. Yelland. Interstate Representatives, Robert Bryce & Co., Adelaide; Paramount Stores, Hay Street, Perth, W.A. Products: Radio receivers, condensers, transformers. Trade name, "Grand Opera."

Z

Zenith Radio Co. Ltd., 37 Oxford Street, Paddington, N.S.W. FL2248. Trade name, "Zenco." Managing Director, Jose Alberti. Sales Manager, Ray Evans. Radio receivers and components.

Directory of Trade Names

Inclusion of a trade name in this section of the Directory does not necessarily mean the name is registered. No responsibility is accepted for omissions or errors, but any of these should be advised to the Editor. Letter D. or M. after the name indicates, Distributor or Manufacturer. W. indicates Wholesale. Refer to Manufacturers or Wholesalers list for full address.

A

ACORN—(M.) Acorn Pressed Metal Co. Ltd. (Aluminium chassis, coil cans, sockets, etc.).
ACCURATE—(D.) Amplion (A/sia) Ltd. (Electric Clocks).
ACCURATUNE—(M.) W. R. Hardy & Co. (Receiver Kits).
A.G.D.—(M.) A. G. Davis & Co. (Chassis and components).
A.G.E.—(M.D) Associated General Electric Industries Ltd. (Receivers).
A.G.E.I.—(M.D.) Associated General Electric Industries Ltd. (Receivers).
A.W.A.—(M.D.) Amalgamated Wireless (A/sia) Ltd.
ALPHA—(M.) Eclipse Radio Pty. Ltd. (Components).
AIR-CELLS—(D.) Amplion (A/sia) Ltd. (Batteries).
AEGIS—(D.) Embelton & Co. (Radio Equipment).
AIR-MASTER—(M.) Targan Electric Co. Pty. Ltd. (Receivers).
AIRMEAD—(M.) Mead Manufacturing Co. (Chassis).
AIRWAY—(D.) Lawrence & Hanson Electric Co. (Receivers).
AIRZONE—(M.) Airzone (1931) Ltd. (Radio Receivers and Component parts).
AMPLION—(D.) Amplion (A/sia) Ltd. (Loud Speakers, Microphones and Dynamic Units).
ASTOR—(M.) Radio Corporation Pty. Ltd. (Receivers).
ARION—(M.) A. G. Doe (Analyzers and Transformers).
ATWATER-KENT—(D.) A. G. Healing Ltd. (Auto Radio).
AUDIOLA—(M.) Stromberg-Carlson (A/sia) Ltd. (Receivers).

B

BELDAS—(D.) O. H. O'Brien (Components).
BELDON—(F.R.) O. H. O'Brien (Wire).
BOSCH—(D.) Pyrox Pty. Ltd. (Auto Radio).
BRADLEYOMETERS—(D.) Eastern Trading Co. Ltd. (Variable Resistors).
BRADLEYUNITS—(D.) Eastern Trading Co. Ltd. (Resistors).
BREVILLE—(M.) Breville Radio (Receivers).
BRISTOL—(D.) Warburton, Franki (Melb.) Ltd. (Recording Instruments).
B.T.H.—(D.) Associated General Electric Industries Ltd. (Pick-ups).

C

CARBONCEL—(D.) Amplion (A/sia) Ltd. (Air depolarising Primary Batteries).
CATKIN—(F.R.D.) British General Electric Co. (Valves).
C.B.R.—(M.) Customs Built Radio (Receivers).
CETRAN—(D.) H. G. Small & Co. (Photo-Electric Cells).
CHANCERY—(D.) H. Hecht & Co. (Potentiometers).
CHANEX—(M.) Ducon Condenser Pty. Ltd. (Condensers).
C.J.V.—(M.) Carr, James & Vautin (Synthetic resin, coil formers).
CLARITONE—(M.) Dobbie, A. W. & Co. Ltd.
CLEFONIE—(M.) Bardsleys Ltd. (Receivers).
CLYDE—(M.) Clyde Batteries (Accumulators).
COLMO—(M.) Colville Moore Wireless Supplies (Receivers).
CONLEY LEE—(D.) Cooke Bros. Ltd.
CONCOURSE—(D.) Small, H. G. & Co. (Resistors and Rheostats).
COSSOR—(D.) W.G. Watson & Co. Ltd. (Valves).
CREELA—(M.) Creela Radio Products (Power Transformers line filters).
CROWN—(M.) Crown Radio Manufacturing Co. (Receivers).
CROYDEN—(M.) Eclipse Radio Pty. Ltd. (Receivers).
COLTON—(M.) J. Colton. (Power transformers).
CHALLENGE—(M.) Arnold & Nunn. (Pressed metal work).

D

DIAMOND—(M.) Widdis Diamond Dry Cells Pty. Ltd. (Batteries).
DICKIN—(M.) F. Dickin Ltd. (Cabinets).
DON—(M.) Don Electrical Co. (Receivers).
DUFFY—(M.) Duffy Radio Co. (Sets and Components).
DULYTIC—(M.) Ducon Condenser Pty. Ltd. (Electrolytic Condensers).
DUPERITE—(M.) Dunlop Perdriau (Mouldings).
DURHAM—(D.) Wm. J. McLellan (Resistors).
DALTON—(M.) H. Dalton & Co. (Moulded products).

E

EDISON—(D.) Associated General Electric Industries Ltd. (Lamps).
EFCO—(M.) The Efco Manufacturing Co. Ltd. (Dials Escutcheons and Variable Condensers).
EMMCO—(M.) Electricity Meter Manufacturing Co. Ltd. (Receivers).
E.S.M.—(M.) Electrical Specialty Manufacturing Co. Ltd. (Receivers).
E.T.C.—(M.) Eastern Trading Co. Ltd. (Mica condensers).

Trade Names—(Continued).

ETHER EAGLE—(M.) Davies & Co. (Receivers).
EVER-READY—(M.) Ever-Ready Battery Co. Ltd. (Dry batteries).
EXIDE—(W.) Exide Batteries of Australia Ltd. (Accumulators).
EXPRESS UNIVERSAL—(M.) Express Universal Instrument Co. (Service Equipment).
EYELETS—(M.) Eyelets Pty. Ltd. (Eyelets).

F

FERRANTI—(D.) Noyes Bros. Pty. (Meters).

G

G.E.—(M.D.) Associated General Electric Industries Ltd. (Receivers).
GENALEX—(M.) British General Electric Co. Ltd. (Radio).
GENKAY—(M.) Genkay Manufacturing Co. (Soldering irons).
GRAND OPERA—(M.) L. J. Yelland (Receivers and Components).

H

H.C.R.—(M.) H. C. Richardson (Condensers and Moulded Products).
HART SPORT—(M.) Hartleys Pty. Ltd. (Batteries).
HARLEQUIN—(M.) Moulded Products (A/sia) Pty. Ltd. (Mouldings).
HEALING GOLDEN VOICED—(M.) A. G. Healing Ltd. (Receivers).
HENDERSON—(M.) P. A. Henderson & Co. (Power Equipment).
HILCO—(M.) Hilco Products Pty. Ltd. (Transformers)
HOELLE—(M.) J. J. Hoelle & Co. (Metal work terminals).
HOLANITE—(M.) McKenzie & Holland Pty. Ltd. (Plastic Mouldings).
HOLLINGSWORTH—(D.) New Systems Telephones Pty. Ltd. (Receivers).
HYDRA—(D.) Eastern Trading Co. Ltd. (Condensers).
HYGRADE SYLVANIA—(D.) Tyme Ltd. (Valves).

I

IMPERIA—(M.) Harringtons Ltd. (Receivers).
IMPEX—(M.) Herberholds Dry Batteries (Aust.) Pty. Ltd. (Batteries).
IMPERITE—(M.) Moulded Products (A/sia) Pty. Ltd. (Mouldings).
INVINCIBLE—(M.) Invincible Radio Co. (Chassis).
I.R.C.—(D.) J. C. Price (Resistors).
I.R.C.—(D.) Wm. J. McLellan (Resistors).

J

JENSEN—(M.) Jensen (Aust.) Ltd. (Speakers).
JEWELL—(D.) Warburton, Franki Ltd. (Measuring Instruments).
J.R.C.—(M.) Small, H. G. & Co. (Valves).
JUBILEE—(D.) H. Hecht & Co. (Speakers).

K

KELVIN—(D.) Henry G. Small & Co. (Receivers, Components).
KENRAD—(D.) Eastern Trading Co. Ltd. (Valves).
KRIESLER—(M.) Kriesler (A/sia) Ltd. (Receivers).
KIT-SETS—(M.) Metropolitan Electric Co. Ltd.

L

LEKMEK—(M.) Lekmek Radio Laboratory (Kits and Receivers).
LEWCOS—(M.) Liverpool Electric Cable Co. (Wire).
LION—(M.) Amplion (A/sia) Ltd. (Land Microphones).
LINCONOLA—(W.) M. Brash & Co. (Receivers).
LOMEL—(D.) Kendall Knight & Co. (Electrolytic condensers).

M

MAGNATONE—(D.) Musgrove Ltd. (Electric Gramophones).
MAGNAVOX—(M.) Magnavox (Aust.) Ltd. (Speakers).
MAGNUM—(D.) Philips Lamps (Aust.) Ltd. (Speakers).
MAJESTIC—(M.) Majestic Radio Manufacturing Co. (Receivers).
MARQUIS—(M.) Commonwealth Moulding Co. Ltd. (Coil Formers and Potentiometers).
MASTER—(W.) General Theatre Supplies Ltd. (Film Phonograph).
MASTERMADE—(M.) Colonial Radio Pty. Ltd. (Resistors).
MASTERTINE—(W.) General Theatre Supplies Ltd. (Theatre Sound Equipment).
MAZDA—(D.) Associated General Electrical Industries Ltd. (Lamps).
MEAD—(M.) Mead Manufacturing Co. (Chassis).
MELODAIRE—(M.) P. & R. Williams Ltd. (Receivers).
MELBOURNE—(M.) Colonial Radio Pty. Ltd. (Coil Kits).
MULLARD—(M.D.) Mullard Radio Co. (Valves).
MU-F-ER—(D.) McLellan, Wm. J. (Testing Instruments).
MONITOR—(M.) Firth Bros. Pty. Ltd. (Speakers).

N

NALLY—(M.) Nally Ltd. (Plastic Mouldings).
NATIONAL UNION—(D.) International Radio Co. Ltd. (Valves).
NIGHT HAWK—(M.) Newton McLaren Ltd. (Receivers).

O

OCEANIC—(M.D.) Mick Simmons Ltd. (Receivers).
OSRAM—(M.D.) British General Electric Co. Ltd. (Valves).
OPERATION—(M.) Colonial Radio Pty. Ltd. (Receivers).
OHIOHM—(F.R.) International Radio Co. Ltd. (Resistors).
OLYMPIC—(M.) Olympic Radio Co. (All Wave Receivers).

P

PAILLARD—(D.) W. J. McLellan (Pick-ups and Motors).
PANCHROMATIC—(M.D.) Beale & Co. Ltd. (Receivers).
PARAMOUNT—(M.D.) Paramount Manufacturing Co. (Resistors, Coil Kits, etc.).
PEERLESS—(M.) Peerless Manufacturing Co. Ltd. (Coil Formers, Valve Sockets, Speaker Plugs).
PERTINAX—(M.) Carr, James and Vautin (Insulating Material).
PHILIPS—(M.D.) Philips Lamps (A/sia) Ltd. (Valves and Lamps).

Trade Names—(Continued).

POLLOCK—(M.D.) Pollock Electric Manufacturing Co. (Potentiometers, coils).
POLYMET—(M.D.) Eastern Trading Co. (Electrolytic Condensers).
PRECEDENT—(M.D.) Firth Bros. Pty. Ltd. (Receivers and Speakers).
PYROX—(M.) Pyrox Pty. Ltd. (Auto Radio).

R

RADIETTE—(M.) Radiette Radio Ltd. (Receivers).
RADIOKES—(M.) Metropolitan Electric Co. Ltd. (Coils and Kits).
RADIOLA—(M.) Amalgamated Wireless (A/sia) Ltd. (Receivers).
RADIOLETTE—(M.) Amalgamated Wireless (A/sia) Ltd. (Receivers).
RADIO MASTER—(M.) Efco Manufacturing Co. Ltd. (Dials, Variable Condensers).
RADIOTRON—(M.) Amalgamated Wireless Valve Co. Ltd. (Valves).
RADIOVISION—(M.) Radiovision (Aust.) Pty. Ltd. (Receivers).
RAVISION—(M.) Radio and Television Manufacturers Ltd. (Radio Receiver Chassis).
RAYCOPHONE—(M.) Raycophone Ltd. (Sets and Components).
RAYTHEON—(D.) Standard Telephones and Cables (Aust.) Ltd. (Valves).
R.C.S.—(M.) Receiver Components Sydney. (Components).
RED SEAL—(M.) Hazell & Moore Ltd. (Receivers).
RELIANCE—(M.) Reliance Radio Co. (Receivers and Chassis).
RENRADE—(M.) R. W. Reynolds Ltd. (Resistors, Condensers).
REXONOLA—(D.) Jackson & Macdonald (Sets, Cabinets).
RICHMOND—(M.) Richmond Products (Power Equipment).
ROADMASTER—(M.) Regent Radio Pty. Ltd. (Auto Radio).
ROAMER—(M.) Stromberg-Carlson (A/sia) Ltd. (Auto Radio Sets).
ROTARY—(M.) Simplex Radio (Tone Controls).
ROLA—(M.) Rola Co. (Aust.) Pty. Ltd. (Speakers).
READRITE—(F.R.D.) W. G. Watson & Co. Ltd. (Meters and Testing Equipment).

S

SANGAMO—(D.) Warburton, Franki Ltd. (Fixed Condensers and Components).
SAXON—(M.D.) Eclipse Radio Pty. Ltd. (Components).
SECURA—(M.) Moulded Products (A/sia) Pty. Ltd. (Mouldings).
SEYON—(M.D.) Noyes Bros. Ltd. (Receivers).
SILVATONE—(M.) Hartleys Pty. Ltd. (Receivers).
SIMPLEX—(M.) Simplex Radio (Condensers).
SLADE—(M.D.) Croydon Radio (Receivers and Analysers).
SOLAR—(D.) Eastern Trading Co. Ltd (Electrolytic Condensers).
SPRAGUE—(D.) International Radio Co. Ltd. (Electrolytic Condensers).
SPEED—(M.) Small, H. G. & Co. (Valves).
S.T.C.—(M.D.) Standard Telephones & Cables Ltd. Receivers).
STANMORE—(M.) Stanmore Batteries (Dry Batteries).
STEWARD WARNER—(D.) Machin, F. A. & Co. Pty. Ltd. (Auto Radio).
STROMBERG-CARLSON—(M.) Stromberg-Carlson (A/sia) Ltd. (Receivers).
SUPERHETERODYNE—(M.) Superheterodynes Pty. Ltd. (Receivers).
SOLAR—(D.A.F.R.) Eastern Trading Co. Ltd. (Condensers).
SIMPSON—(D.) Noyes Bros. Ltd. (Electric Record Turntable).
SIEMENS-ELLIOTT—(F.R.) Siemens (Aust.) Ltd. (Meters).

T

TASMA—(M.) Thom & Smith Ltd. (Receivers—All kinds of fixed condensers).
T.C.C.—(M.) Australasian Eng. Equipment Co. Pty Ltd. (Components).
THEATLE—(M.) Thompsons Radio Ltd. (Receivers).
THEATROLA—(M.) Thompsons Radio Ltd. (Receivers.
TIGER WARE—(M.) Moulded Products (A/sia) Pty. Ltd. (Mouldings).
TRAVELTONE—(D.) Simpson, C. H. & Co. Pty. Ltd. (Auto Radio).
TRIUMPH—(M.) Triumph Radio Ltd. (Receivers).
TROUBADOUR—(M.) Electricity Meter Manufacturing Co. (Receivers).
TUFNOL—(M.) Guthridge Ltd. (Resin).

U

UNIVERSITY—(M.) University Radio Co. (Receivers).
UNIVOX—(M.) Eclipse Radio Pty. Ltd. (Receivers).
UTILUX—(M.) J. J. Hoelle & Co. (Earthing Clips and Adapters).
UTILITY—(D.) McLellan, Wm. J. (Switches).

V

VELCO—(D.) A. J. Veall & Co. Ltd. (Receivers).
VELONA—(M.) Thompsons Radio Ltd. (Patented Sound-board).
VESTA—(M.) Vesta Battery Co. (Aust.) Ltd. (Accumulators).
VOLMAX—(M.) R. J. Ray (Wire Wound Components).
VOLTA—(M.) Volta Dry Batteries Pty. Ltd. (Batteries).
VOXADEON—(M.) Denford, H. W. (Converters).

W

WARD LEONARD—(D.) Warburton, Franki Ltd. (Resistors).
WATES—(D.) Amplion Ltd. (Radio Meters).
WELDON—(M.) Bloch & Gerber Ltd. (Receivers and Components).
WERRING—(M.) Werring Radio Co. (Sets, Components).
WESTINGHOUSE—(D.) Amplion (A/sia) Ltd. (Metal Rectifiers).
WESTON—(D.) Warburton, Franki Ltd. (Measuring instruments).
WETLESS—(M.) Wetless Manufacturing Co. (Paper mica fixed, midget variable condensers).
WHITING—(D.) Noyes Bros. Ltd. (Pick-ups).

Z

ZENITH—(M.) Zenith Radio Co. (Chassis, Receivers, Tone & Volume controls).
ZEVA—(D.) Warburton, Franki (Melb.) Ltd. (Soldering irons).

Company or Ownership Particulars

AMALGAMATED WIRELESS (A/sia) LTD., Head Office, 47 York Street, Sydney. Nominal Capital, £1,000,000. Paid up Capital, £744,282. Directors: E. T. Fisk, Esq. (Chairman), C. P. Bartholomew, Esq., The Rt. Hon. W. M. Hughes, P.C., K.C., LL.D., Senator J. D. Millen, T. J. Parker, Esq, Hon. J. F. Coates, M.L.C., F. Strahan, Esq., C.B.E., LL.B. Secretary: J. F. Wilson. Managing Director: E. T. Fisk. Auditors: Yarwood Vane & Co. with Sir G. Mason Allard.

AMPLION (AUST.) LTD., 70 Clarence Street, Sydney. Nominal Capital, £10,000. Paid up Capital, £7,000. Managing Director, P. J. Manley. Directors: K. S. Kopsen. Secretary, J. Armstrong. Auditors: Perry, Johnson, Challis House, Martin Place, Sydney. Registered 19/9/30.

ANDERSEN, H. C. & FRANTZEN, Johnson St., Alexandria. Proprietors: Hans Christian Andersen and Victor Franztsen. Registered, April, 1916.

BLOCH & GERBER LTD., Head Office, 46-48 York Street, Sydney. Nominal Capital, £50,000. Paid up Capital, £26,200. Directors: Eugene Gerber, Otto Raz. Secretary: H. Lederman. General Manager: Eugene Gerber. Bankers: English, Scottish & Australian Auditors: John Stewart & Co. Registered—1/4/1926.

3KZ BROADCASTING CO. PTY. LTD., Head Office, 64 Elizabeth Street, Melbourne. Directors: M. G. Sloman, W. V. Morgan, S. Morgan. Secretary: M. B. Duffy. General Manager: S. Morgan. Bankers: Bank of Australasia. Auditors: Sloman & Mogg.

BREVILLE RADIO, 486 Elizabeth Street, Sydney. Proprietors: W. J. O'Brien and C. H. Norville. Registered, November, 1932.

CHANDLER, J. B. & CO., Head Office, 43 Adelaide Street, Brisbane. Directors: J. B. Chandler (General Manager). Secretary and Accountant, W. G. Duncan. Sales Manager, V. F. Mitchell. Branch Manager, A. L. Prince. Branch Director, E. Gold. Branch Sales Manager, R. A. Sears.

COLONIAL RADIO PTY. LTD., 136-138 A'Beckett Street, Melbourne. Nominal Capital, £5000. Directors: Archibald Cawthorne, Frederick Robinson, McBride, Myles Fletcher Hayman, Brian Sanders Hayman, and Secretary. Auditors: Taxation Services of Australia Ltd. Bankers: Commercial Bank of Aust. Ltd., Elizabeth Street, Melbourne.

THE DUFFY RADIO CO. LTD., Head Office, 73-75 George Street, Redfern. Nominal Capital, £2,000. Issued Capital, £1,000. Directors: H. C. Walker (Managing Director), J. Duffy (Secretary), H. C. Walker, A.I.C.A. (Chief Engineer). Solicitor: Emil J. Ford. Bankers: Bank of New Zealand. Registered, 9/2/33.

ELECTRICAL SPECIALTY MANUFACTURING CO. LTD., 17-19 Glebe Street, Glebe, N.S.W. Directors: O. C. Turner and G. Schliesman. Secretary: R. V. Bridekirk. Registered Office, 4 Bridge Street, Sydney. Nominal capital, £10,000. Auditors: Robertson, Rudder and Watt. Bankers: E. S. & A., Sydney.

EMBELTON, G. P. CO., Head Office, 579 Bourke Street, Melbourne. Proprietor: G. P. Embelton.

ENFIELD CABLE WORKS (A/sia) Ltd., Head Office, 337 Kent Street, Sydney. Directors: A. E. Flaskett (Managing Director), G. H. Murphy, H. Brown. Secretary: H. J. Perry.

EVER-READY COMPANY (GREAT BRITAIN) LTD., Marshall Street, Sydney. Branch of English Company. No local Directors. General Manager and Australian Attorney, Albert Jewell. Auditors: Starkey and Starkey, Sydney. Bankers: Bank of N.S.W.

EXPRESS UNIVERSAL INSTRUMENT CO., 50 Parramatta Road, Petersham. Proprietor: A. L. Thorrington. Registered, June 26th, 1932.

GENDERS, W. & G. Pty. Ltd., Head Office, 53 Cameron Street, Launceston. Nominal Capital, £250,000, Paid up Capital, £110,914. Directors: E. B. Genders (Managing Director), Mr. Claude James, M.H.A., F.F.I.A. Secretary: P. C. Thompson. Auditors: Messrs. Cruikshank, Creasy, Gow and Layh. Bankers: Bank of Australia.

GENERAL THEATRE SUPPLIES LTD., Head Office, 298 Pitt Street, Sydney. Nominal Capital, £20,000. Director: H. Y. Russell. General Manager: H. Watts. Secretary: W. Sale. Auditors: Messrs. Smith, Johnson. Bankers: E.S. & A. Solicitors: Messrs. Sly & Russell.

HARTLEYS PTY. LTD., Head Office, 270 Flinders Street, Melbourne. Directors: J. R. Hartley, F. Hartley, F. H. Hartley. Secretary, H. W. Joseph. Radio Sales Manager: A. Steward.

HAZELL & MOORE LTD., Head Office, 36-38 Campbell Street, Sydney. Nominal Capital, £30,000. Paid up Capital, £24,378. Directors: E. J. Hazell (Managing Director), A. W. Booth, R. A. Patrick, E. R. Moore, J. S. Moore. Secretary: J. S. Moore. Bankers: E.S. & A. Ltd. Auditors: P. J. G. McGrath. Registered, 26/6/1924.

HEALING, A. G. LTD. Head Office, 167-173 Franklin Street, Melbourne. Directors: A. G. Healing (Governing Director), N. Bromhill (Managing Director), W. W. Devling, V. R. Powell. Secretary: C. Forbes. Authised Capital, £412,500. Subscribed Capital, £233,905. Solicitors: L. S. Lazarus. Auditors: Holmes & McGrindle. Bankers: English Scottish & Australian Bank Ltd.

HERBERHOLDS DRY BATTERIES (AUST) PTY. LTD., Head Office, 562 Spencer Street, Melbourne, also Utrecht, Holland. Nominal Capital, £20,000. Directors: Gasper Herberhold, W. F. Winter, W. Parry. Secretary: W. F. Winter. General Manager: W. Parry. Bankers: National Bank of Australasia Ltd. Solicitors: O'Donuhue & Brew. Registered, September, 1931.

KENDALL KNIGHT & CO., Head Office, 59 York Street, Sydney. Directors: A. W. Kendall (Managing Director), O. Le M. Knight. Secretary: T. M. Casey. Bankers: Commercial Banking Co. of Sydney Ltd.

KRIESLER (A/SIA) LTD., Head Office, Corner Pine, Myrtle & Beaumont Streets, Chippendale. Nominal Capital, £10,000.

LEKMEK RADIO LABORATORIES, Head Office, 75 William Street, Sydney. Proprietor: N. S. Gilmour. Auditor: S. J. Walton. Bankers: Union Bank of Australia Ltd.

METROPOLITAN ELECTRIC CO. LTD., Tracey House, Corner Cleveland & George Streets, Redfern, N.S.W. Directors: R. K. Stokes, G. M. Stokes, Secretary: Miss E. Gawthorne. Nominal Capital, £10,000. Auditors: Joiner & Harding, Wingello House, Angel Place, Sydney. Bankers: Commercial Banking Co. of Sydney, Redfern.

McKENZIE & HOLLAND (AUST.) PTY. LTD., Newport, Melbourne, W.15. Chairman of Directors: H. G. Brown. Managing Director: J. B. Jacobson. Directors: W. R. C. Forster and W. H. Craig. Secretary: B. J. Waddick. Registered office, Newport, Melbourne, W.15. Nominal Capital, £110,000, paid up capital, £100,000. Auditors: Troup Harwood & Co. Bankers: Bank of Australasia.

McLELLAN, Wm. J., Bradbury House, 55 York St., Sydney. Proprietor: Wm. J. McLellan. Registered.

MUSGROVE LTD., Head Office, Lyric House, Murray Street, Perth. Directors: M. D'O. Musgrove (Managing Director), H. B. Jackson, K.C., F. C. Kingston. Secretary: R. Peart. Accountant: R. Peart. Auditors: Flack & Flack.

NALLY LTD., Registered Office, 15 Castlereagh St., Sydney. Nominal Capital, £30,000. Directors: T. P. Dowd (Chairman of Directors), A. A. Kelly (Managing Director). Secretary: H. R. Griffiths. Auditors: S. H. Jackson & Co. Bankers: Commercial Banking Co. of Sydney Ltd.

NOYES BROS. (SYDNEY) LTD., Head Office, 115 Clarence Street, Sydney. Nominal Capital, £100,000. Paid up Capital, £99,993. Directors: Messrs. E. F. Moates, E. C. Holroyde, I. Cureton and Mrs. C. C. Noyes. General Manager: Mr. T. Malcom Ritchie. Secretary: Mr. H. L. Tuckerman. Bankers: The Commercial Bank of Australia Ltd. Solicitors: Stephen, Jacques and Stephen. Auditors: H. B. Allard, Way and Hardie. Registered, 3/9/1907.

PEERLESS MANUFACTURING CO LTD., Head Office, 73-75 George Street, Redfern. Nominal Capital, £10,000. Paid up Capital, £2,000. Directors: H. C. Walker (Managing Director), H. E. Gould (Secretary), H. C. Walker, A.I.C.A. (Chief Engineer). Solicitor: Emil J. Ford. Bankers: Bank of New Zealand. Registered, October, 1932.

PRICE, J. C. Head Office, Perry House, Elizabeth Street, Brisbane. Proprietor: J. C. Price. Secretary: Miss Beryl Bowen. Accountant: J. A. McIntyre. Bankers: Commercial Bank of Australia.

RADIO CORPORATION PROP. LTD., Head Office, 21 Sturt Street, South Melbourne. Nominal Capital, £100,000. Directors: A. G. Warner and L. Abrahams (Joint Managing Directors). Secretary: J. Breen. Bankers: National Bank of Australasia Ltd. Auditors: Geo. Wright.

R.C.S. RADIO, Head Office, 12 City Road, Sydney Proprietor: Ronald A. Bell. Registered 28/7/32.

REYNOLDS, R. W. LTD., Head Office, 200 Chalmers Street, Sydney. Directors: R. W. Reynolds (Managing Director), A. Gosling. Secretary: Miss V. Reynolds. Sales Manager: J. H. Reynolds. Advertising Manager and Buyer: J. Hardy. Bankers: The Commercial Bank of Australia. Auditors: Messrs. Joiner and Harding Co.

SAVERY'S PIANOS LTD., Head Office, 29 Rundle Street, Adelaide. Directors: A. D. Young (Chairman), J. A. Hele, W. Queale and H. R. Pinkerton (Managing Director), A. J. Carvosso (Secretary). Nominal Capital, £100,000. Paid up Capital, £81,250. Auditors: Messrs. Counsell, Booth & Hunwick. Bankers: Bank of New South Wales.

SMALL, H. G. & CO., Head Office, 374 Post Office Place, Melbourne. Proprietor: H. G. Small. Registered, 1932.

STANDARD TELEPHONES & CABLES (A/sia) LTD., Head Office, 71 York Street, Sydney. Nominal Capital, £100,000. Paid up Capital, £100,000. Directors: H. C. Trenam, J. Clarke, R. S. Beckwith, E. H. McInnes, T. N. Bore. Secretary: H. A. Hack. General Manager: H. C. Trenam. Bankers: Bank of Australasia. Solicitors: Minter Simpson & Co. Auditors: Bowes & Craig. Registered, 12/4/1912.

THOM & SMITH LTD., Head Office, 55 Dowling Street, East Sydney. Directors: J. E. Smith and F. W. P. Thom. Secretary: S. T. Lindsay.

TRIUMPH RADIO CO. LTD., 86a Anzac Parade, Kensington, N.S.W. Nominal Capital: £10,000 in £1 shares. Chairman: E. A. Kingsbury. Directors: Leon Weingott and Thomas J. Sheedy (joint Managing Directors). Secretary: T. M. Foster. Auditors: T. M. Foster & Co. Bankers: Commonwealth Bank of Australia.

UNITED RADIO DISTRIBUTORS, 73 York Sts., Sydney. Proprietor: H. C. Long. Registered, 27/9/1932.

UNIVERSITY RADIO CO., 22 City Road, Sydney. Proprietor: Benjamin Broadhurst. Registered, 11th January, 1933.

VEALL, Arthur J., PTY. LTD., Head Office, 243-249 Swanston Street, Melbourne. Directors: A. J. Veall, Mrs. C. E. Veall, H. V. Prior, S. G. Humberg, R. K. McDougall. Secretary: Andrew Brown.

WARBURTON FRANKI, LTD., Head Office, 307-315 Kent Street, Sydney. Nominal Capital, £200,000. Paid up Capital, £100,000. Directors: F. J. Carrick (Chairman), G. S. Warburton, R. J. N. Franki. Secretary: H. J. Rodgers. Auditors: Allard, Way and Hardie. Bankers: Commercial Banking Co. of Sydney Ltd.

WENDEL ELECTRIC CO. PTY. LTD., Head Office, 14-16 St. Francis Street, Melbourne. Proprietor: A. A. Elliott.

WETLESS ELECTRIC MFG. CO., 281 King Street, St. Peters. Proprietor: A. P. J. Wetless. Registered, 24th April, 1929.

WILLIAMS, P. & R., Head Office, 74-78 Wentworth Avenue, Sydney. Directors: P. H. Williams, S. M Williams, W. A. Williams, H. J. Williams. Secretary: C. B. Williams. Nominal Capital, £45,600. Paid up Capital, £23,400. Auditors: N. B. Stewart. Bankers: National Bank of Australasia Ltd.

Wholesale Distributors

A

AIRZONE (1931) LTD., 16-22 Australia Street, Camperdown, N.S.W. L2851. Telegrams and Cables, "Airzone." Managing Director, Claude Plowman. Sales Manager, W. B. Homewood. Branches: Arco House, Coles Place, Melbourne (Manager, E. Dial); Central Chambers, Rundle Street, Adelaide (Manager, W. E. Gill); Q.P.I. Buildings, Adelaide Street, Brisbane (W. O. Barber); 886 Hay Street, Perth (H. L. Smith).

AMALGAMATED WIRELESS (A/SIA) LTD., 47 York Street, Sydney. BW2211. G.P.O. Box 2516, Sydney. 167-169 Queen Street, F4161, G.P.O. Box 1272L, Melbourne. Interstate Distributors: J. B. Chandler & Co., Brisbane; Newton McLaren Ltd., Leigh Street, Adelaide; Wyper & Howard, Ltd., 671 Hay Street, Perth; Findlay's Pty. Ltd., 67 Brisbane Street, Launceston. Amalgamated Wireless prepare specifications and manufacture and install all manner of wireless equipment, all of which is designed and manufactured at Radio Electric Works, Ashfield, Sydney.

AMALGAMATED WIRELESS VALVE CO. LTD., 47 York Street, Sydney. BW2225. G.P.O. Box 2516BB. Sales Manager, A. P. Hosking. Melbourne, 167-9 Queen Street, G.P.O. Box 1273L. Phone 4161. Representative, S. R. E. Haworth. Agents in all States. (Australian valves now available.)

AMPLION (AUST.) LTD., 70 Clarence Street, Sydney. BW1114 (3 lines), B3683 (silent line). Telegrams & Cables, "Amplion," Sydney. P. J. Manley, Managing Director; E. Cox, Sales Manager. Interstate Distributors—Queensland: Edgar V. Hudson Pty. Ltd., 47 Charlotte Street, Brisbane. Victoria: Australasian Engineering Equipment Co. Ltd., 415 Bourke Street, Melbourne. S.A.: Newton McLaren Ltd., Leigh Street, Adelaide. W.A.: Carlyle & Co., 915 Hay Street, Perth. Tasmania: W. & G. Genders Pty. Ltd., 53 Cameron Street, Launceston, and 69 Liverpool Street, Hobart. New Zealand: R. Harold Court, P.O. Box 1331, Wellington, N.Z. Distributors Amplion loudspeakers, microphones, etc., Westinghouse metal rectifiers, Lekmek coil kits, transformers, etc., Volta batteries, accurate electric frequency clocks, carbon cell batteries, Lion microphones, Wates radio meters, Block plate-less accumulators.

Associated General Electric Industries Ltd., 95 Clarence Street, Sydney. BW2261. G.P.O. 2517, Sydney. Melbourne: Corner Queen and Little Collins Streets. Cl. 7900; G.P.O. 538, Melbourne. Brisbane: Kelvin House, 252 Adelaide Street; B2151; G.P.O. 487. Adelaide: 25-27 Grenfell St.; Cl. 8210; G.P.O. 1324. Newcastle: 53 King Street; 'phone, Newcastle 1310; Box 447 P.O. Lismore, N.S.W.: Keen Street; 'phone, Lismore 260; P.O. Box 282. Rockhampton, Q.: 158 East Street; 'phone 1571; P.O. Box 358. Townsville, Q.: Flinders Street East; 'phone, 1407, P.O. Box 29. Agents—W.A.: Atkins, W. A., Ltd., 894 Hay Street, Perth; B3151; G.P.O. 147. Tasmania: Oliver & Oliver Pty. Ltd., 33 Elizabeth Street, Hobart; 'phone 3036; Box 1. Launceston: 15 The Quadrant; 'phone Launceston 504; Box 227.

Atkins (W.A.) Ltd., 894 Hay Street, Perth; B3151, B1901; G.P.O. D147. Telegrams, "Calcolim," Perth. Sales Manager, J. J. Nathan. Branches, Fremantle and Kalgoorlie. N.S.W. Representative, Atkins McLean Ltd., 301 Castlereagh Street, Sydney.

AUSTRALASIAN ENGINEERING EQUIPMENT CO. PTY. LTD., 415-419 Bourke Street, Melbourne. Cl. 11315. Telegrams, "Eniquip," Melbourne. Managing Director, D. Doughton. Secretary, W. M. Hipgrave. Australasian distributors for T.C.C. condensers, Durham I.R.C. resistors, Harley microphones and pick-ups.

A.Z. Radio Pty. Ltd., 52 Buckhurst Street, South Melbourne, SC5; M3169. Sole distributors Essanay radio and wholesalers of radio equipment. Managing Director, H. Coles. Directors, W. M. Sweeney, E. A. Austin.

B

Bateman, M.J., Ltd., 12 Milligan Street, Perth, W.A. Manager, F. Beames. B9346. Branch, 119 High Street, Fremantle (FM2630).

Baty, C. S., & Co., 357 Murray Street, Perth. B5219. Box A33. Telegrams and Cables, "Batycoy," Perth. Manager, —. Langoulant.

Beale & Co. Ltd., 41-47 Trafalgar Street, Annandale. G.P.O. 1621BB. Telegrams, "Beale," Sydney. L2791.

Begg, William, & Co., 499 Little Collins Street, Melbourne, C1. M1835. Telegrams, "Begansons," Melbourne. Proprietor, Reginald H. Begg. Interstate Representative, William Begg & Son, Hayward Buildings, Charles Street, Adelaide.

Bell, Norman, & Co., Adelaide Street, Brisbane, Queensland. Agent for British General Electric Co., Ltd.

Bland Radio, 57 Allinga Avenue, Knoxville, S.A. F5581. Telegrams, "Blandradio." Proprietor, W. J. Bland.

Bloch & Gerber Ltd., 47-48 York Street, Sydney. G.P.O. 2282M. Telegrams, "Lesab," Sydney. M2675. General wholesalers all radio lines. Managing Director, Eugene Gerber. Director, Otto Raz. Sales Manager, H. Kefford.

Brash, M., & Co. Pty. Ltd., 108-110 Elizabeth Street, Melbourne, C1. Cl. 3729. Cables, "Brash Piano," Melbourne. Managing Director, A. G. Brash. Sales Managers, J. E. Rowson and C. R. Graham. Distributors for Stromberg-Carlson and Radiola.

BRITISH GENERAL ELECTRIC CO. LTD., Magnet House, 104 Clarence Street, Sydney. BW 2941. Telegrams and Cables, "Osram," Sydney. G.P.O. 1594BB. Managing Director, E. E. Hirst. Sales Manager, W. R. Caithness. Melbourne Manager, T. E. Morgan. "Genalex" and "Osram," "Geco-

Wholesalers & Distributors—(Continued).

phone," 388 Bourke Street, Melbourne; Cl. 9940. Perth branch, 370 Murray Street; B5141. ..Adelaide branch, 35 Grenfell Street; Cl. 782. Newcastle branch, 141 Scott Street; 'phone 1259. Agents—Tasmania: Electrical Agencies Ltd., 55 Elizabeth Street, Hobart, and 117 Charles Street, Launceston. Brisbane: Norman Bell & Co., 403 Adelaide Street; B3561.

Brooklands Accessories Pty. Ltd., 150 Lonsdale Street, Melbourne; Cl. 7142. Telegrams, "Brookparts," Melbourne. G.P.O. 2030S. Sales Manager, J. A. Champion.

Brooks, Robinson & Co. Ltd., 59 Elizabeth Street, Melbourne, C1. Cl. 8800. Radiola, and Croyden distributors. Mackintosh cables.

Bruce Small Pty. Ltd., 283 Elizabeth Street, Melbourne. F5195. P.O. Box 497. Telegrams, "Smalstar," Radio Manager, F. Small. Branches: Forrest Place, Perth; Malvern, Footscray; Sydney Road, Brunswick; Point Nepean Road, Gardenvale; Glenhuntly Road, Elsternwick. Interstate Representatives, Hazell and Moore, Sydney. New System Telephones, Adelaide; Morgan and Wacker, Brisbane.

Buckland, Wm., Pty. Ltd., 139-41 Frankland Street, Melbourne. F1188. Telegrams, "Willbuck." Managing Director, William M. Buckland. Radio Manager, H. Little. Interstate agents—Tasmania: William L. Buckland Pty. Ltd., Charles and Cameron Streets, Launceston; C. C. Boag & Co., 158 Collins Street, Hobart. Queensland: N. Lawler, Lutwyche Road, Woolowom, Brisbane. Sole Victorian representatives for Airmaster Radio Receivers and Australian distributors of Celebrity radio.

C

Carlyle & Co., 915 Hay St., Perth, W.A. B 9371. Box J716. Telegrams, "Lylecar," Perth. Manager, C. Cohen. General wholesalers all radio components.

CARR, JAMES & VAUTIN, 661 George Street, Sydney. MA1420. Cables, "Jaycar," Sydney. Proprietors, J. Carr, W. H. James, Claude S. Vautin. Sales Manager, John Carr. Interstate Representative, Blake Eilbeck, 403 Bourke Street, Melbourne. Insulating materials, moulded products.

Chandler, J. B., & Co., 43-45 Adelaide Street, Brisbane. Telegrams and cables, "Chandlerco," Brisbane. B2041. G.P.O. 883L. General Manager, John Beale Chandler. Branch Offices: Rockhampton Broadcasting Co. Pty. Ltd., William Street, Rockhampton, 'phone No. 9; Gold Radio Service Ltd., Ruthven Street, Toowoomba, 'phone No. 88. Distributors for Radiotron, Radiola, Diamond Batteries.

Chandler, D. & W., Ltd., 276 Brunswick Street, Fitzroy, N6, Melbourne. J4145.

Colton, Palmer & Preston Ltd., Currie Street, Adelaide. Cl. 3580 (10 lines). Cables, "Palmprest," Adelaide. P.O. Box 583D. Managing Director, A. H. Preston. London office, Australia House, Strand.

Cooke Bros. Ltd., 7 Hamilton Street, Sydney. BW5008-9. G.P.O. 2451MM. Telegrams and cables, "Otago." Managing Director, A. C. Cooke. Director, E. C. Cooke. Queensland branch, 35 Charlotte Street, Brisbane. B 5250. Box 555J. Telegrams and Cables, "Octago," Brisbane.

Custom Built Radio, 254 Castlereagh Street, Sydney. MA1308. Proprietor and Manager, E. A. Park. General wholesaler parts and sets.

D

Davis, A. G., & Co., Wembley House, Railway Square, Sydney. MA2866. Proprietor, A. G. Davis. General wholesaler.

Dobbie, E., Ltd., Rundle Street, Adelaide, S.A. Cl. 6170. G.P.O. 70A. Telegrams, Cables, "Dobrico," Adelaide. Proprietor and Manager, A. H. Dobbie. General wholesaler.

DUKE, ALAN PTY. LTD., 486 Bourke Street, Melbourne. Phone Cl. 1255. Representative of: D. Fallshaw & Sons, Gerard Electric Manufacturers Ltd., Australian Westinghouse Electric Co., Wetless Electric Manufacturing Co. Ltd., Mackenzie & Holland (Aust.) Pty. Ltd., Mullard Radio Co., Jensen (Aust.) Ltd.

E

EASTERN TRADING CO. LTD., 155 Clarence Street, Sydney. B6305-7. Telegrams and Cables, "Quietando," Sydney. G.P.O. 2920NN. Melbourne office, McEwan House, Little Collins Street. F2528. G.P.O. 1771. Managing Director, Arthur C. Millingen. Radio Sales Manager, Hillstead I. Hobden. Melbourne Sales Manager, K. Stevenson. Interstate Distributors; Edgar V. Hudson Pty. Ltd., 47 Charlotte Street, Brisbane, Queensland, B3733; Newton McLaren Ltd., Leigh Street, Adelaide, S.A., Cl. 8341; Carlyle & Co., 915 Hay Street, Perth, W.A., B2017; Tasmania Territory handled by Melbourne branch.

ECLIPSE RADIO PTY. LTD., 216-22 City Road, South Melbourne. M4681. Telegrams, Cables, "Eclipse," Melbourne. Directors, Albert Aarons, Saul C. Aarons, Charles O. Welsh. Sales Manager, Arch. McPhee. Adelaide branch, 43 Austin Street, Adelaide. Cl. 929. Manager, H. Collocott. Sydney Manager, R. V. Smith, 137 Clarence Street, Sydney. B6937. Queensland branch, 88 Adelaide Street, Brisbane. Manager, —. Pervis. Distribution of parts, chassis, sets and valves.

Eddys Ltd., 12 Rundle Street, Adelaide, S.A. Cl. 6353.

EFCO MANUFACTURING CO. LTD., Princes Highway, Arncliffe, N.S.W. LW1105. Telegrams, "Efco," Arncliffe. Manager, Richard Facer. Sales Manager, A. J. Larkin. "Efco" dials all types, condensers, remote controls, and electric irons.

Enfield Cable Works (A/sia) Ltd., 337 Kent Street, Sydney. B5708. Telegrams and Cables, "Enfelcama," Sydney. Managing Director, A. E. Flaskett (Head Office). G. H. Murphy, Director New Zealand Branch Office, 8 Ballance Street, Wellington, New Zealand. Interstate distributors: Harris, Scarfe & Sandovers Ltd., Perth, W.A.; Dankel & Co., Adelaide, S.A.; W. G. Watson & Co. Ltd., Melbourne; W. G. Watson & Co. Ltd., Newcastle, N.S.W.; W. E. Peterman, Brisbane, Queensland, H. Brown Director, H. J. Perry Secretary. Manufacturers and distributors of insulated and uninsulated wires, cables and flexibles.

Wholesalers & Distributors—(Continued).

Embelton, G. P., & Co., 579 Bourke Street, Melbourne. Cl. 9133. Telegrams and Cables, "Notlebme," Melbourne. General Manager, G. P. Embelton. Branch, Perry House, Elizabeth Street, Brisbane. Brisbane Manager, J. Bostock. Victorian distributors "Radiokes," "Marquis."

F

Farm & Pastoral Supplies Pty. Ltd., 500 Bourke Street, Melbourne, Victoria. Cl. 8049. Australasian distributors for Regent radio.

FOX & MacGILLYCUDDY LTD., Merino House, 57 York Street, Sydney. G.P.O. 2144LL. B2409. Telegrams, "Fox Radio," Sydney. Managing Director, A. R. Fox. General Manager, G. T. Swanson. Wholesalers and distributors of all radio lines.

Findlay Bros. Pty. Ltd., 80 Elizabeth Street, Hobart, and distributors Stromberg-Carlson, Audiola and George Street, Launceston. Cl. 718. Tasmanian distributors Stromberg - Carlson, Audiola and Radiola.

FIRTH BROS., 149 Little Lonsdale Street, Melbourne. F4127. Distributors and manufacturers of Precedent radio products and Monitor speakers. Sydney Representative, P. A. Morse, Bradbury House, 55 York Street, Sydney. BW6803.

G

Gardam, J. R. W., & Co., 138 Murray Street, Perth, W.A. B9241-2. G.P.O. L903. Telegrams and Cables, "Gardam," Perth. Sales Manager, Mr. Murray. Distributors Philips, Volta Igranic, Ferranti, Jensen.

Genders, W. & G. Pty. Ltd., 53 Cameron Street, Launceston, Tasmania. Phone 1140. Box B98. Telegrams and Cables, "Genders Limited." Branch, 69 Liverpool Street, Hobart. Managing Director, E. B. Genders. Radio and Electrical Manager, H. W. Hallet. Distributors S.T.C. sets.

GENERAL THEATRE SUPPLIES LTD., 298 Pitt Street, Sydney. Telegrams and Cables, "Gentheatre." Box 3191P. MA 2093. General and Sales Manager, H. (Bert.) Watts. Branches: 178A Flinders Street, Melbourne (Manager, W. Lyall); 169-71 Elizabeth Street, Brisbane (Manager, H. R. Wright); Henley Street, Adelaide (Phil. Harmer, Manager); Film House, Perth (Manager, A. B. Neilson); 15 Courtenay Place, Wellington, New Zealand (Manager, R. Grant); 129-31 Albert Street, Auckland, N.Z. (Manager, F. Mumford).

Gerard & Goodman Ltd., 14-16 Synagogue Place, Adelaide (Cl. 5040), and 132 Rundle Street, Adelaide, Box X2. Managing Director, A. E. Gerard. Manager and Director, A. Hubert Gerard. Telegrams, "Gerard-Goodman," Adelaide.

Graber Electric Co., London Stores Buildings, Elizabeth Street, Melbourne, Victoria. F2281. Proprietors, J. J. Graber and R. Grieson. Distributors Essanay, Airmaster and Airzone receivers.

Grice, G. J., Ltd., 90 Queen Street, Brisbane, Queensland. B1674. Telegrams and Cables, "Symphony." Box 231D. Branches: Maryborough, Rockhampton, Townsville, Mackay, Cairns and Toowoomba. Distributors Tasma radio sets and Beale Panchromatic radio sets. Managing director, Arthur Baynes.

H

HARRINGTONS LTD., 386 George Street, Sydney. BW2181. G.P.O. 4146X. Telegrams, Cables, "Harringtons," all States. Managing Director, G. D. Cree. Katoomba, 507 (Manager, H. Fawcett), and 88 Hunter Street, Newcastle, 1994 (Manager, J. Comrie). Interstate branches: 226 Collins Street, Melbourne, J2186 (Manager, W. C. Corfield); 212 Queen Street, Brisbane, B1438 (Manager, E. G. Radford); 10 Rundle Street, Adelaide, Cl. 8412 (Manager, W. G. Gee); 28 King Street, Perth, B7725 (Manager, C. R. Kearney); 32 Elizabeth Street, Hobart (Manager, O. Good); 134 Queen Street, Auckland, N.Z., and 44-48 Victory Street, Wellington, N.Z. (Manager, C. Grounsell). Distributors of Kaycophone sets, Pilot parts and all standard lines.

Harris, D., & Co., 140 Rundle Street, Adelaide. Cl. 1733. General radio and electrical merchants.

Harris, Scarfe Ltd., Rundle Street, Adelaide. Cl. 3300 (13 lines). Box 385A. Telegrams and Cables, "Harriscarf." Radio Manager, E. J. Opie. Radio wholesalers and distributors.

Harris, Scarfe & Sandovers Ltd., Hay Street, Perth, W.A. B8131.

Harrold, A. E., 123-25 Charlotte Street, Brisbane, Q. B2729. Box 593J. Telegrams and Cables, "Harrold." Proprietor, A. E. Harrold. Wholesaler of radio and components.

HARTLEYS PTY. LTD., 270 Flinders Street, Melbourne, Victoria. Cl. 4970 (10 lines). Cables, "Hartsport," Melbourne. Managing Director, J. R. Hartley. Radio Sales Manager, A. Steward. Secretary, H. W. Josephs. Victorian distributors Radiola, general distributors Silvertone and general wholesalers. Branches: 148 Swanston Street, Melbourne (Manager, G. R. Robertson); 407 Bourke Street, Melbourne (Manager, C. Priestley).

HAZELL & MOORE LTD., 36 Campbell Street, Sydney. MA 6091. Telegrams, "Hazelmore," Sydney. Manager, J. S. Moore. Radio Sales Manager, W. Taylor. Interstate Representatives, R. W. Hislop, 232 Queen Street, Brisbane, Q.; Hazell & Moore, Ltd., 328 Hunter Street, Newcastle, N.S.W.

HEALING, A. G., LTD., 167-73 Franklin Street, Melbourne, Victoria. F5171 (10 lines). Box 870J. Managing Director, N. Broomhall. Radio Manager, C. J. Irvine. Interstate Branches—S.A.: 155 Pirie Street, Adelaide; C4635; Radio Manager, K. Wadham. N.S.W.: Goulburn Street, Sydney; Manager, E. M. Dumbrell. Queensland: R. H. Rose, Fairfield Road, Yeerongpilly, Brisbane. W.A.: Australian Radio Supply Co., 604 Hay Street, Perth.

HECHT, H. & CO., Australia House, 38 Carrington Street, Sydney, N.S.W. B6541. Telegrams, "Hech," Cables "Esoxur,' Sydney and Melbourne. Trade names, "Chancery," "Chanex," "Dylytic," "Jubilee." Manager, A. R. Persson. Sales Manager, Geo. R. Davidson. Melbourne office, Hecht & Co., 450 Little Collins Street; S.A., W. T. Mathew, 95 Grenfell Street, Adelaide; W.A., Carlyle & Co., 856 Hay Street, Perth; Queensland, J. C. Price, Perry House, Elizabeth Street, Brisbane; Tasmania, W. & G. Genders Pty. Ltd., 53 Cameron Street, Hobart.

Wholesalers & Distributors—(Continued).

Hilco Products Pty. Ltd., 207-209 Latrobe Street, Melbourne. Cl. M2563. Telegrams and Cables, "Hilcoy," Melbourne.

Hill, William, Law Court Chambers, Queen Street, Melbourne. Cl. 4155. Representing Stromberg Carlson (Aust.) Ltd.

Hoffnung, S., & Co. Ltd., 165 Pitt Street, Sydney. BW2921. Distributors Ever-Ready Batteries.

Hudson, Edgar V. Pty. Ltd., 45 Charlotte Street, Brisbane. B3733. Box 522H, G.P.O. Telegrams and Cables, "Qupee." Distributors for Mullard, Radiokes, Emmco, S.T.C., Paillard, T.C.C., Magnavox, Marquis, Impex, Ken-Rad, Polymet, Hydry, Amplion, Westinghouse, Ever-Ready, Diamond, Clyde, Philips, Cossor, Osram. General wholesalers.

I

International Radio Co. Ltd., 254 Castlereagh Street, Sydney. MA1387, MA5792. Branches: 403 Bourke Street, Melbourne, Cl., F2858; 71 Hindmarsh Square, Adelaide, S.A.; Brunswick Buildings, Queen Street, Auckland, N.Z. Managing Director, C. Forrest. Distributors National Union Valves, Jensen Speakers, Sprague Electrolytic Condensers.

J

Jackson & MacDonald, 360-362 Kent Street, Sydney. M2226. Telegrams, "Jayondem," Sydney.

K

Keep Bros. & Wood Pty. Ltd., 200 Latrobe Street, Melbourne, C1. F1155. Distributor "Astor" sets.

Kohn Bros., 116 York Street, Launceston, Tasmania. Distributors for New System Telephones Ltd.

Kendall, Knight & Co. Ltd., 59 York Street, Sydney, B7441. Telegrams and Cables, "Hitension." Branch at 114 King Street, Melbourne; F2932. Managing Director, A. W. Kendall. Interstate Representatives: Adelaide Electric Co., Adelaide, S.A.; J. R. W. Gardam, Perth, W.A.; Electrical Agencies, Brisbane, Queensland.

L

Lawrence & Hanson Electrical Co. Ltd., 33 York Street, Sydney. B6476. Box 2551. Telegrams and cables, "Lawhanson" (all States). Branches: 172-6 William Street, Melbourne, Cl. 10394; 87 Elizabeth Street, Brisbane, B1407; 120 Collins Street, Hobart; 20 Leigh Street, Adelaide. Cl. 2106; 26 Hunter St., Newcastle. Managing Director, A. J. Hanson. Directors, A. E. Kaleski and A. R. Hanson. Wholesalers and distributors Glovers C.M.A. wires and cables; Smith's synchronous electric clocks; Record electrical company's instruments; Philips electric lamps; Lekmek radio sets; Phoenix telephone material. Distributors Philips valves.

LEKMEK RADIO LABORATORIES (N. S. Gilmour), 75 William Street, Sydney. FL2626. Sets and kits.

Lenroc Limited, 211-15 Pulteney Street, and 123-5 Flinders Street, Adelaide, S.A. Cl. 8770 (4 lines). Telegrams and Cables, "Lenroc," Adelaide. Box 1119K. Managing Director, P. Moody. S.A. distributors for S.T.C.

Little, H. C., & Co. Ltd., 858 Hay Street, Perth. B7148. Box D154. Telegrams and Cables, "Litelectra." Managing Director, H. C. Little. Distributors Lekmek Radio Products.

LIVERPOOL ELECTRIC CABLE CO. LTD., Lewcos House, 233 Clarence Street, Sydney. Box 1296J, M3821. Manager, A. Maughan. Interstate Representatives—Victoria: Warburton Franki Ltd., 380-382 Bourke Street, Melbourne. W.A.: Carlyle & Co., 915 Hay Street, Perth. Queensland: Intercolonial Boring Co., Ann Street, J. C. Price, Perry House, Elizabeth Street, Brisbane. Telegrams and Cables, "Concentric," Sydney. Wholesalers for all kinds of wires.

Lovetts Radio, 81 Bathurst Street, Hobart, Tasmania.

M

Machin & Co. Pty. Ltd., 535 Elizabeth Street, Melbourne, Victoria. F1691. Victorian distributors Emmco, Troubadour and Stewart-Warner auto radio.

Maclurcan, Charles D., Pratten Building, 26 Jamieson Street, Sydney. Cables, "Zincite," Sydney. Australasian Representative, Cossor Valves. Distributors, W. G. Watson & Co. Ltd., all States.

Martin, G. G., 26 King Street, Perth, W.A. B2012. Distributor Impex Batteries.

Martin de Launay Ltd., 289 Clarence Street (M 4268), Sydney, and Newcastle. Cables, "Martindel," Sydney. Managing Director, E. de Launay. Sales Manager, E. P. Logan. General wholesalers.

Masse Batteries Sales Co., Neild St., Rushcutter's Bay, N.S.W. FL2418. Distributors of Impex batteries.

McLELLAN, WM. J., Bradbury House, 55 York Street, Sydney, N.S.W. B1255. Telegrams and Cables, "Normac." Proprietor, Wm. J. McLellan. Secretary, Maxwell Walker. Interstate Distributors—Queensland: Edgar V. Hudson Ltd.; J. C. Price. S.A.: Newton McLaren. W.A.: Atkins, W.A., Ltd.; Carlyle and Co. Tasmania: W. & G. Genders Pty. Ltd. Sole agents in Victoria Australasian Engineering Equipment Co. Pty. Ltd.

MICK SIMMONS LTD., Haymarket, Sydney. G.P.O. 18B, Haymarket. M6311. General Radio Wholesalers. Metropolitan distributors for Airzone, Radiola sets.

MULLARD RADIO CO. (AUST.) LTD., 35 Clarence Street, Sydney. BW 1278. Telegrams and Cables, "Mulvalve." G.P.O. 2118L. Managing Director, G. L. Murray. General Manager, Eric Dare. Secretary, E. A. Richards. Sub-Distributors—Victoria: Scott & Holladay Ltd., Melbourne; Alan S. Duke Pty. Ltd., Melbourne. S.A.: R. C. Woollard, Gerard & Goodman, Adelaide. Queensland: V. J. Griffiths, E. V. Hudson Pty. Ltd., Brisbane. W.A.: Carlyle & Co.; Harris, Scarfe & Sandovers Ltd., Perth.

Musgrove's Ltd., Lyric House, Murray Street, Perth B1971. G.P.O. Box 195. Telegrams, "Pianoforte," Perth. Manager Radio and Electrical Departments, F. C. Kingstone. Branches: Atwell's Arcade, Fremantle (FM2829); Victoria Street, Bunbury (Phone 151); Albany Road, Victoria Park. W.A. distributors Stromberg Carlson receivers.

N

National Radio, corner Queen and Wharf Streets, Brisbane, Queensland. B4289.

Neals Motors Pty. Ltd., 140 Exhibition Street, Melbourne, C1. Cl. 7550. Telegrams and Cables, "Nealautos." Distributors of "Traveltone" radio.

NEW SYSTEM TELEPHONES PTY. LTD., 276-278 Castlereagh Street, Sydney. M6425. Telegrams, "Newsysaust," all States. Branches: 276 Flinders Street, Melbourne, Victoria (M3191), Box 512J; 155 Rundle Street, Adelaide, S.A. (Cl. 6676). General Manager, J. I. Carroll. N.S.W. Manager, R. M. Davies. Victorian Manager, D. E. Williams. S.A. Manager, F. A. Pennington. Interstate Distributors: Kohn Bros. Pty. Ltd., 118 York Street, Launceston, Tasmania; McCann Bros., 180-184 Elizabeth Street, Hobart, Tasmania; Howards Ltd., 317-27 Adelaide Street, Brisbane, Queensland.

Newton McLaren Ltd., Leigh Street, Adelaide, S.A. G.P.O. 1339H. Telegrams, "Newton McLaren." Cables, "Generator." Cl. 8341. Managing Director, E. Eardley McLaren. Radio Sales Manager, J. P. Hale. S.A. distributors for Radiola sets, Radiotron, Diamond batteries.

Nicholsons Ltd., Barrack Street, Perth. B6131. Branch, 85 High Street, Fremantle (FM2266).

Nilsen, O. J., & Co. Pty. Ltd., 45-47 Bourke Street, Melbourne, Victoria. Cl. 572; and 35 King William Street, Adelaide, S.A. Telegrams, "Nilseno," Melbourne. Manager, Oliver J. Nilsen. Sales Manager, C. T. Cromie. Manager Adelaide Branch, Lawford.

NOYES BROS. (SYDNEY) LTD., 115 Clarence Street; Radio Department, 78 Clarence Street, Sydney. B7581. Telegrams and Cables, "Noyes," Sydney. G.P.O. 1587B. General Manager, Malcolm Ritchie. Manager, Charles Dunn. Branches: 197 Elizabeth Street, Brisbane, Queensland (B3186); 11 Watt Street, Newcastle ('Phone 525); Keen Street, Lismore. Distributors Seyon, Stromberg-Carlson and Radiola radio sets, and general wholesalers of practically all lines.

NOYES BROS. (MELB.) LTD., 597-603 Lonsdale Street, Melbourne, C1. Cl. 10105. G.P.O. 779H. Telegrams and Cables, "Noyes," Melbourne. General Manager, A. F. Keegan. Manager Electrical Department, F. A. Gordon. Interstate Branches: 89 Grenfel Street, Adelaide (Cl. 2357); 138 Murray Street, Perth (B9241); 36 Argyle Street, Hobart, Tasmania; 59 George Street, Launceston. Distributors for Tasma and S.T.C. sets.

O

O'BRIEN, O.H. (SYDNEY), 37-39 Pitt Street, Sydney. BW1034. Telegrams and Cables, "Beldas," all States. Branch, 654-64 Bourke Street, Melbourne (Cl. 2179). Proprietor, O. H. O'Brien. Sales Manager, E. R. Tidswell. Interstate Representatives, W. E. Peterman, 160 Edward Street, Brisbane (B5704).

Oliver & Oliver Pty. Ltd., Hobart, Tasmania.

OLYMPIC RADIO CO., 101 William Street, Sydney, N.S.W. F3358. All wave receivers.

Ord Radio Co. Pty. Ltd., 294 Little Lonsdale Street, Melbourne, Victoria. F2649. Distributors Orpheus Radio.

P

PARISH, HAYWARD C., State Shopping Block, Market Street, Sydney. M3531. Australian Agent General Radio Testing and Laboratory equipment.

PHILIPS LAMPS (A/SIA) LTD., 69-73 Clarence Street, Sydney. G.P.O. Box 2703C. BW2121. Telegrams and Cables, "Argenta," Sydney. Managing Director, A. den Hertog. Assistant General Manager, J. Overdiep. Branches: 390 Bourke Street, Melbourne (F3191), (Manager, —. Nichols); 11 Elizabeth Street, Brisbane, Queensland (B 7462), (Manager, —. Hills); Hayward Buildings, Charles Place, Adelaide, S.A. (Manager, —. Poll); Unbehaun & Johnstone Ltd., Wm. Adams Ltd., Perth, W.A.

Price, J. C., Perry House, Elizabeth Street, Brisbane, Queensland. B7635. Proprietor, John Clarey Price. General wholesaler.

Pritchard, J. G., 18 William Street, Perth. B4711. Manufacturers' Agent, Emmco, Alpha. Distributors Radix Power Supplies.

PYROX PTY. LTD., 264 Latrobe Street, Melbourne, Victoria. F4157. Telegrams, "Pyrox." Specialists in car radio. Importers of American-Bosch car radio and accessories. Managing Director, A. Hoette. Sales Manager, G. Miller. Sydney Office, 405 Castlereagh Street. Manager, F. J. Hill. MA1941.

R

RADIO CORPORATION PTY., LTD., 11-21 Sturt Street, South Melbourne, SC4. M4711 (10 lines). Telegrams and Cables, "Schuh." Box 845J. Managing Directors, A. G. Warner and L. Abrahams. Interstate Representatives—N.S.W.: Smith Sons & Rees Ltd., Wentworth Avenue, Sydney (M2631). W.A.: H. E. Pead, 905 Hay Street, Perth (B8459). S.A.: W. Whitley, Alfred Chambers, Currie Street, Adelaide. Tasmania: F. W. Koochew, The Quadrant, Launceston; L. Pucke, 163 Goulburn Street, Hobart.

Radio Industries Ltd., Joynton Avenue, Waterloo, N.S.W. MA6043. Sales Manager, E. Searson. Distributors of Emmco radio products.

Radio Limited, Commerce Buildings, 1 Anzac Avenue, Auckland, N.Z. Phones 45-186, 41-186. Box 1166. Telegrams and Cables, "Broadcast," Auckland. Branches: Wellington, Christchurch and Dunedin.

Radio Merchants Ltd., 5th Floor, Australia House, Carrington Street, Sydney, N.S.W. BW6673. Secretary, John Sessions.

Radio Wholesalers, James Place, Adelaide, S.A. Cl. 8000. Distributors Stromberg-Carlson and Audiola.

Rhodes Motors Pty. Ltd., 401-411 Elizabeth Street, Melbourne, Victoria. F2111. Box 61A. Managing Director, J. H. Rhodes. Radio Manager, A. S. Strauss. Distributors Rhodes radio and Philco Transitone car radio.

Rickards Bros. Pty. Ltd., 567-615 Elizabeth Street, Melbourne, Victoria. F3114. Distributors Philco Transitone auto radio.

Rose, Reg & Co. Ltd., Kembla Buildings, Margaret Street, Sydney. BW2114. Cables, etc., "Esor," Sydney. Governing Director, Reg. Rose. Sales Manager, C. J. Rose. Wholesalers of radio and electrical goods.

S

Savery's Pianos Ltd., 29 Rundle Street, Adelaide, S.A. Cl. 8000, Cl. 284. Box 660F. Cables, "Saverys." Distributors Stromberg-Carlson, Audiola and Beale Panchromatic radio sets. Manager, H. R. Pinkerton.

Wholesalers & Distributors—(Continued).

Shafto, Ronn & Co., Clarence Street, Sydney. MA4161. General wholesalers.

Siemens (Aust.) Pty. Ltd., 257 Clarence Street, Sydney. M4161. Riverside Avenue, Queens Bridge, South Melbourne, SC4. M1103. Measuring instruments.

Simpson, C. H., & Co. Pty. Ltd., 34 Little Latrobe Street, Melbourne, C1. F4444. Managing Director, C. H. Simpson. Distributors Traveltone auto radio.

Small, H. G., & Co., 374 Post Office Place, Melbourne. Telegrams and Cables, "Hengsmall," Melbourne. Cl. 11455. Manager, Henry G. Small. Trade name, "Kelvin." Wholesaler of sets and components, electrical and radio engineers and manufacturers' agent.

Smart, H., & Co., Commerce House, Flinders St., Melbourne, Victoria. Cl. 7997. Indent agents for wire cables, flexes, sheet metal condensers, resistances and insulating material.

SMITH, SONS & REES LTD., 30-32 Wentworth Avenue, Sydney. M2631. Telegrams, "Speedomet," Sydney. Managing Director, M. W. Rees. Sales Manager, —. McLean. N.S.W. "Astor" distributors.

South Australian Phono-Radio Co. Ltd., 71 Hindmarsh Square, Adelaide, S.A.

Standard Telephones and Cables (A/sia) Ltd., 71 York Street, Sydney. Box 525B. Telegrams and Cables, "Relay." 588 Bourke Street, Melbourne, Vic. Cl. 8336. S.T.C. Receivers, Raytheon Valves. Managing Director, H. C. Trenam. Sales Manager, James Clarke.

Stokoe Motors Pty. Ltd., 559 Elizabeth Street, Melbourne, Victoria. F4181. Distributors Vanguard radio.

Sutherland, A. P., 2 Maffra Street, South Melbourne, Victoria. M2291. Exide distributor.

T

THOM & SMITH LTD., 55-57 Dowling Street, East Sydney. F2117. Telegrams and Cables, "Teaness." Directors, J. E. Smith and F. W. P. Thom. Sales Manager, R. H. Jennings. Design Engineer, E. M. Fanker. Manufacturers of Tasma radio sets. Distributors—Queensland: G. J. Grice Ltd., 90 Queen Street, Brisbane; F. P. Moody, Cairns; S. W. Davids and Sons, Townsville; Rosenstengels Pty. Ltd., Toowoomba. Victoria: Noyes Bros. (Melb.) Pty. Ltd., 597 Lonsdale Street, Melbourne; John Hollway & Sons, Ballarat. Tasmania: Noyes Bros. (Melb.) Pty. Ltd., 36 Argyle Street, Hobart, and 69 George St., Launceston. S.A.: Noyes Bros. (Melb.) Pty. Ltd., 89 Grenfell Street, Adelaide. W.A.: Unbehaun & Johnstone Ltd., 381 Murray Street, Perth. N.Z.: British Radios Ltd., 108 Armagh Street, Christchurch. Newcastle Representative, Eric Cupit, Hamilton.

Thomsons Ltd., 209 Murray Street, Perth, W.A. B9571. Managing Director, Alan L. Thomson. Sole W.A. distributors Beale Panchromatic Radio.

Trackson Bros., Ltd., 157-59 Elizabeth Street, Brisbane, Q. B2804. Telegrams and Cables, "Trackson," Brisbane. Electrical Engineers and Radio Merchants.

TYME LTD., 280 Castlereagh Street, Sydney. MA3796. Telegrams and Cables, "Amsta." Distributors Hygrade Sylvania Valves.

Trickey, R. E., Danks Building, 403 Bourke Street, Melbourne, Victoria. Cl. 7263. Radioke components and kit sets.

U

Unbehaun & Johnstone Ltd., 58 Gawler Place, Adelaide, S.A. Cl. 3900.

UNITED RADIO DISTRIBUTORS, 73 York Street, Sydney. B3639. Proprietor, H. C. Long. General radio wholesalers.

Unbehaun & Johnstone (W.A.) Ltd., 381 Murray Street, Perth, W.A. B3131. Distributors Tasma receivers and Philips valves.

V

Veall, Arthur J., Pty. Ltd., 243-9 Swanston Street, Melbourne, Victoria. C2058 (2 lines). Telegrams and Cables, "Artveall," Melbourne. Governing Director, A. J. Veall. Manager, H. V. Prior. Sales Manager, R. K. McDougall. Branches: 172 Swanston Street, Melbourne; 301 Chapel Street, Prahran; 5 Riverdale Road, Camberwell. Representatives: Atkins Maclean Ltd., 301 Castlereagh Street, Sydney, N.S.W.; Geo. Procter, 40 Pirie Street, Adelaide, S.A.; T. H. Martin & Son, Box 1708V, G.P.O. Brisbane, Q.; G. G. Martin, Hay Street, Perth, W.A.

W

Wagga Wireless Distributors, Box 93, Wagga, N.S.W. Phone Wagga 191. Proprietor, H. Gissing. Riverina distributors for Stromberg-Carlson and Audiola.

WARBURTON FRANKI LTD., 307-15 Kent Street, Sydney, N.S.W. BW1251 (5 lines). Cables and Telegrams, "Booster." Box 1523DD.

WARBURTON FRANKI (MELB.) LTD., 380-82 Bourke Street, Melbourne, Victoria. Cl. 8888. Cables "Ignition." Telegrams, "Warburton Franki." G.P.O. 487.

WARBURTON FRANKI (BRIS.) LTD., 233 Elizabeth Street, Brisbane, Q. B3907. Telegrams, "Warburton Franki," Brisbane. Cables, "Booster," Brisbane. G.P.O. 190C.

WATSON, W. G., & CO., LTD., 279 Clarence Street, Sydney. M4331. 31 Hunter Street, Newcastle; 200 Queen Street, Melbourne, Cl. 1525; 74 Pirie Street, Adelaide, S.A.; 45 King Street, Perth, W.A.; 73, Murray Street, Hobart, Tasmania. Telegrams and Cables, "Switchon," Sydney. Managing Director, W. G. Watson. Sales Manager, D. J. Miles. Distributors Cossor Valves, Lekmek sets.

Westcott Hazell & Co. Ltd., 225 Castlereagh St., Sydney, N.S.W. M 2711. Branches at Newcastle and Lismore. Managing Director, E. J. Hazell. Radio Sales Manager, C. H. Jensen. Distributors S.T.C. receivers and wholesalers.

WILLIAMS, P. & R., 74-8 Wentworth Avenue, Sydney. M 4660, 8, 9. Telegrams & Cables: "Ajayess," Sydney. Box 311 Haymarket, Sydney. Branches: 316-18 Hunter Street West, Newcastle; 247 Adelaide Street, Brisbane, Qld. Managing Director, P. H. Williams.

Wills & Co. Pty. Ltd., 7, The Quadrant, Launceston, Tas., and at Devonport, Tas. Distributors for Stromberg-Carlson & Audiola.

Wyper, Howard Ltd., 671 Hay Street, Perth, W.A. B 4697. General Manager, H. R. Howard. N.S.W. Representatives: R. B. Wyper Ltd., Grace Buildings, Sydney. Radiotron Valve and Radiola distributors.

BUYERS' GUIDE

Addresses and Telephone Numbers of Names listed will be found in the Green Directory Section.

ACCUMULATORS

AMALGAMATED WIRELESS
AMPLION (A/SIA) LTD.
Assoc. General Elec.
Atkins (W.A.) Ltd.
A.Z. Radio Pty. Ltd.
Bateman, M. J., Ltd.
Baty, C. S., & Co.
BARDSLEYS, LTD.
Bennett & Wood, Ltd.
Bloch & Gerber, Ltd.
Brandts, Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks, Robinson & Co.
Bruce Small Pty. Ltd.
Buckland, Wm. L.
Carlyle & Co.
Chandler, J. B., & Co.
Clyde Battery Service
Colville-Moore Wireless
Cooke Bros., Ltd.
Custom Built Radio
Davis, A. G., & Co.
Dobbie, E., Ltd.
DUKE, ALAN, PTY. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P., & Co.
Erg Batteries Ltd.
Exide Batteries
Farm and Pastoral Supplies
Findlay Bros. Pty. Ltd.
FIRTH BROS. PTY. LTD.
FOX & MacGILLICUDDY LTD.
Gage, H.
Gardam, J. R. W., & Co.
Genders, W. & G.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
HARRINGTONS LTD.
Harris, D., & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold, A. E.
HARTLEYS PTY. LTD.
HAZELL MOORE LTD.
Healing, A. G., Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V., Ltd.
Jackson & MacDonald
Keep Bros. & Wood
Kohn Bros.
Lawrence & Hanson
LEKMEK RADIO
Little, H. C., & Co. Ltd.
Machin & Co. Pty. Ltd.
Majestic Radio Mfg. Co.
Martin de Launay Ltd.
Martin, G. C.
Masse Batteries Sales
McLELLAN, Wm. J.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Nicholsons Ltd.
Nilson, O. J., Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
Price, J. C.
Pritchard, J. G.
PYROX PTY. LTD.
Radiette Radio Ltd.
Radio Maintenance
Radio Merchants Ltd.
Radio Wholesalers Ltd.
RADIO CORPORATION
Reliance Radio Co.
Rhodes Motors
Rickards Motors
Rose, Reg. & Co., Ltd.
Savery's Pianos Ltd.
Shafto, Ronn Ltd.
Siemens Ltd.
Simpson, C. H., Pty. Ltd.
Small, H. G., & Co.
SMITH SONS & REES
S. Aust. Phono-Radio
Standard Telephones
Stokoe Motors Pty. Ltd.
Sutherland, A. P.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
THOMPSONS RADIO LTD.
TILBURY & LEWIS
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone, (W.A.)
United Radio Distributors
VEALL, A. J., PTY. LTD.
Vesta Battery Co.
Wagga Wireless Dist.
WARBURTON FRANKI LTD.
Watson, W. G., & Co. Ltd.
Wendel Electric Co. Ltd.
Werring Radio Co.
Westcott Hazell & Co.
WILLIAMS, P. & R., LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.

ACCUMULATOR CHARGING EQUIPMENT

AMPLION (A/SIA) LTD.
Assoc. General Elec.
Atkins (W.A.) Ltd.
Bateman, M. J., Ltd.
Bennett & Wood Ltd.
BRITISH GENERAL ELECTRIC
Carlyle & Co.
Chandler, J. B., & Co.
Don Electrical Co.
Embelton, G. P., & Co.
Erg Batteries Ltd.
FOX & MacGILLICUDDY LTD.
Genders, W. & G.
HARRINGTONS LTD.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G., Ltd.
Hudson, Edgar V., Ltd.
Keep Bros. & Wood
Lawrence & Hanson
LEKMEK RADIO LABORATORIES
Martin de Launay Ltd.
Masse Batteries Sales
McKenzie & Holland
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
PHILIPS LAMPS (A/SIA)
Pritchard, J. G.
Rose, Reg. & Co., Ltd.
Shafto, Ronn & Co.
SMITH SONS & REES LTD.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distributors
VEALL, A. J., PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G., & Co., Ltd.
Westcott Hazell & Co. Ltd.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.

ADAPTORS
(See Electrical Accessories)

AERIAL AND EARTH ACCESSORIES

Acme Radio Laboratories
AIRZONE (1931) LTD.
AMALGAMATED WIRELESS
Aristone Radio Pty. Ltd.
Assoc. General Electric
Atkins (W.A.) Ltd.
A.Z. Radio Pty. Ltd.
Bateman, M. J., Ltd.
Baty, C. S., & Co.
BARDSLEYS LTD.
Beale & Co. Ltd.
Begg, Wm., & Sons.
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
Bland Radio
Brandts Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks Robinson & Co.
Bruce Small Pty. Ltd.
Buckland, Wm. L.
Carlyle & Co.
Chandler, J. B., & Co.
Colton, Palmer & Preston
Colville-Moore Wireless
Cook & Williams Pty. Ltd.
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G., & Co.
Dobbie, E., Ltd.
DUFFY RADIO CO. LTD.
DUKE, ALAN, PTY. LTD.
ECLIPSE RADIO PTY. LTD.
Electricity Meter
Embelton, G. P., & Co.
Enfield Cable Works
Essanay Mfg. Co.
Farm & Pastoral Supplies
Findlay Bros. Pty. Ltd.
FIRTH BROS. PTY. LTD.
FOX & MacGILLICUDDY LTD.
Gage, H.
Gardam, J. R. W., & Co.
Genders, W. & G.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
Grice, C. J., Ltd.
HARRINGTONS LTD.
Harris, D., & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold, A. E.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G., Ltd.
Henley Telegraph Works
HOELLE, J. J., & CO.
Homecrafts Pty. Ltd.
Hudson, Edgar V., Ltd.
International Radio Co.
Invincible Radio Co.
Jackson & MacDonald
Keep Bros. & Wood
Kohn Bros.
Lawrence & Hanson Elec.
LEKMEK RADIO
Little, H. C., & Co. Ltd.
LIVERPOOL ELECTRIC CABLES
Machin & Co. Pty. Ltd.
Majestic Radio Mfg. Co.
Martin de Launay Ltd.
Martin, G. C.
McLELLAN, Wm. J.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
Neal's Motors Pty. Ltd.
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Nicholsons Ltd.
Nilson, O. J., Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
Ord Radio Pty. Ltd.
PHILIPS LAMPS
Price, J. C.
Pritchard, J. G.
PYROX PTY. LTD.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
RADIO CORPORATION
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
Shafto, Ronn & Co.
Siemens Ltd.
Slade's Radio
Small, H. G., & Co.
Smart, H., & Co.
SMITH SONS & REES
S. Aust. Phono-Radio
Standard Telephones
Sutherland, A. P.
THOM & SMITH LTD.
THOMPSONS RADIO LTD.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distributors
VEALL, A. J., PTY. LTD.
Wagga Wireless Distrib.
WARBURTON, FRANKI LTD.
Watson, W. G., & Co. Ltd.
Werring Radio Co.
Westcott Hazell
WILLIAMS, P. & R., LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.

AERIAL INTERFERENCE FILTERS.

Creela Radio Products
Jansen, H. E. C.
Lawrence & Hanson
Musgrove's Ltd.
NOYES BROS. (SYDNEY)
Savery's Pianos
STROMBERG-CARLSON.

AEROPLANE RADIO EQUIPMENT.

AMALGAMATED WIRELESS
Colville-Moore Wireless
National Radio
NEW SYSTEM TELEPHONES
NOYES BROS. (MELB.)
PHILIPS LAMPS
Rose. Reg., & Co. Ltd.
Standard Telephones

ALUMINIUM SHEET AND CHASSIS.

ACORN PRESSED METAL CO.
Bloch & Gerber Ltd.
Carlyle & Co.
Chandler, J. B., & Co.
DUFFY RADIO CO. LTD.
FOX & MacGILLICUDDY LTD.
Genders, W. & G.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
HARTLEYS PTY. LTD.
Healing, A. G., Ltd.
MEAD MFG. CO.
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
RADIO & TELEVISION MFRS.
RAYCOPHONE LTD.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J., PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G., & Co. Ltd.
Zenith Radio Co. Ltd.

AMPLIFIERS

(See Public Address Equipment)

ANALYSERS

Acme Radio Laboratories
DOE, A. G.
EASTERN TRADING CO. LTD.
EVER READY CO.
Exide Batteries
EXPRESS UNIVERSAL
Kendall, Knight & Co. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Slade's Radio
WARBURTON FRANKI LTD.
Watson, W. G., & Co. Ltd.

ANTI-STATIC KIT

Bloch & Gerber Ltd.
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
HARTLEYS PTY. LTD.
MICK SIMMONS LTD.
Musgrove's Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
RADIO & TELEVISION MFRS.
R.C.S. Radio
Rose, Reg., & Co. Ltd.
Savery's Pianos Ltd.
STROMBERG-CARLSON.
Trackson Bros. Pty. Ltd.
TYME LTD.
United Radio Distributors
VEALL, A. J., Pty. Ltd.
Westcott Hazell & Co.

AUTO RADIO EQUIPMENT

Acme Radio Laboratories
AIRZONE (1931) LTD.
AMALGAMATED WIRELESS
Aristone Radio Pty. Ltd.
Assoc. General Electric
Atkins (W.A.) Ltd.
A/sian Engr. Equipment Co.
Aust. Condenser & Elec. Co.
A.Z. Radio Pty. Ltd.

Bateman, M. J., Ltd.
Baty, C. S., & Co.
BARDSLEYS, LTD.
Beale & Co. Ltd.
Begg, Wm. & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
Bland Radio
Brandts Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks Robinson & Co. Ltd.
Bruce Small Pty. Ltd.
Buckland, Wm. L., Pty. Ltd.
Carlyle & Co.
Chandler, J. B., & Co.
Colonial Radio Pty. Ltd.
Colville-Moore Wireless
COM'WEALTH MOULDING CO.
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G., & Co.
Dobbie, E., Ltd.
Don Electrical Co.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
EFCO MFG. CO. LTD.
ELECTRICAL SPECIALITY CO.
Electricity Meter Mfg. Co.
Embelton, G. P., & Co.
Findlay Bros. Pty. Ltd.
FIRTH BROS. PTY. LTD.
FOX & MacGILLICUDDY LTD.
Gage, H.
Gardam, J. R. W., & Co.
Genders, W. & G., Pty. Ltd.
GENERAL THEATRE SUPPLIES
Genkay Electric Co.
Gerard & Goodman Ltd.
Gladiola Ltd.
Graber Electric Co.
Grice, G. J., Ltd.
HARRINGTONS LTD.
Harris, D., & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold, A. E.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G., Ltd.
Homecrafts Pty. Ltd.
Howard Radio Pty. Ltd.
Hudson, Edgar V., Ltd.
International Radio Co.
Invincible Radio Co.
KRIESLER (A/SIA) LTD.
Lawrence & Hanson
LEKMEK RADIO
Little, H. C., & Co. Ltd.
Machin & Co. Pty. Ltd.
Martin de Launay Ltd.
Martin, G. C.
MICK SIMMONS
National Radio
Neal's Motors Pty. Ltd.
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Nilson, O. J., Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Price, J. C.
PYROX PTY. LTD.
Radiette Radio Ltd.
RAYCOPHONE LTD.
Rhodes Motors Pty. Ltd.
Rickards Motors Pty. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
SMITH, SONS & REES
S. Aust. Phono-Radio
Stokoe Motors Pty. Ltd.
STROMBERG-CARLSON
Syme, W. A., & Co.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
TILBURY & LEWIS PTY. LTD.
Trackson Bros. Pty. Ltd.
VEALL, A. J., PTY. LTD.
Wagga Wireless Distributors
Watson, W. G., & Co. Ltd.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.

BATTERIES DRY, "A," "B," "C"

AMALGAMATED WIRELESS
AMPLION (A/SIA) LTD.
Assoc. General Electric
Atkins (W.A.) Ltd.
Bateman, M. J., Ltd.
Baty, C. S., & Co.
BARDSLEYS LTD.
Beale & Co., Ltd.
Begg, Wm., & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
Brandts Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks Robinson & Co. Ltd.
Bruce Small Pty. Ltd.
Buckland, Wm. L., Pty. Ltd.
Carlyle & Co.
CARR, JAMES & VAUTIN
Chandler, J. B., & Co.
Colton, Palmer & Preston
Colville-Moore Wireless
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G., & Co.
Dobbie. E., Ltd.
DUFFY RADIO CO. LTD.
DUKE, ALAN, PTY. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P., & Co.
Ever Ready Co.
Exide Batteries
Farm & Pastoral Supplies
Findlay Bros. Pty. Ltd.
FOX & MacGILLICUDDY LTD.
Gage, H.
Gardam, J. R. W., & Co.
Genders, W. & G., Pty. Ltd.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
Grice, G. J., Ltd.
HARRINGTONS LTD.
Harris, D., & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold, A. E.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G., Ltd.
HERBERHOLDS (IMPEX)
Hoffnung, S., & Co. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V., Ltd.
International Radio Co.
Invincible Radio Co.
Jackson & MacDonald
Keep Bros. & Wood Pty. Ltd.
Kohn Bros.
Lawrence & Hanson Elec.
LEKMEK RADIO
Little. H. C., & Co. Ltd.
Machin & Co. Pty. Ltd.
Martin de Launay Ltd.
Martin, G. C.
Masse Batteries Sales Coy.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Nicholsons Ltd.
Nilson, O. J., Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
Price, J. C.
Pritchard, J. G.
PYROX PTY. LTD.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
RADIO CORPORATION LTD.
REGENT RADIO PTY. LTD.
Rhodes Motors Pty. Ltd.
Rose, Reg & Co. Ltd.
Savery's Pianos Ltd.
Siemens Ltd.
Slade's Radio
Small, H. G., & Co.
Smart, H., & Co.
SMITH SONS & REES LTD.
S. Aust. Phono-Radio
Standard Telephones
Stan-Mor Dry Cell Co.
Superheterodyne Pty. Ltd.
Sutherland, A. P.
TARGAN ELECTRIC CO.
THOMPSONS RADIO LTD.
TILBURY & LEWIS PTY. LTD.
Tracksons Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distributors
VEALL, A. J., PTY. LTD.
VOLTA DRY BATTERIES
Wagga Wireless Distributors
WARBURTON, FRANKI LTD.
Watson, W. G.
Werring Radio Co.
Westcott Hazell
WIDDIS DIAMOND DRY CELLS
WILLIAMS, P. & R., LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.

BATTERIES (IGNITION DRY CELLS)

Stan-Mor Dry Cell Co.
VOLTA DRY BATTERIES
WIDDIS DIAMOND DRY CELLS

BOBBINS (LOUD SPEAKER AND TRANSFORMERS)

COM'WEALTH MOULDING CO.
Embelton, G. P., & Co.
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
PEERLESS MFG. CO. LTD.
Price, J. C.
Standard Telephones
Trackson Bros. Pty. Ltd.
VEALL, A. J., PTY. LTD.
Wendel Electric Co.
Westcott Hazell & Co. Ltd.

BOLTS AND NUTS.

ACORN PRESSED METAL CO.
Assoc. General Electric
Bloch & Gerher Ltd.
Carlyle & Co.
Chandler, J. B., & Co.
Custom Built Radio
ECLIPSE RADIO PTY. LTD.
Electricity Meter Mfg. Co.
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold. A. E.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G., Ltd.
Homecrafts Pty. Ltd.
Howard Radio Pty. Ltd.
Hudson, Edgar V., Ltd.
Iinvincible Radio Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Orpheus Radio Pty. Ltd.
Price, J. C.
RAYCOPHONE LTD.
Rose, Reg., & Co. Ltd.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J., & CO. LTD.
Watson, W. G., & Co. Ltd.
Westcott Hazell & Co. Ltd.

BOOKS (RADIO)

Angus & Robertson Ltd.
AUST. RADIO PUBLICATIONS
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
MICK SIMMONS LTD.
NOYES BROS (MELB.)
NOYES BROS. (SYDNEY)
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J., PTY., LTD.

BRACKETS (PANEL AND BASEBOARD)

Bloch & Gerber Ltd.
Carlyle & Co.
Chandler, J. B., & Co.
ECLIPSE RADIO PTY. LTD.
EFCO MFG. CO. LTD.
Embelton, G. P., & Co.
FOX & MacGILLICUDDY LTD.
Genders. W. & G., Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G., Ltd.
Invincible Radio Co .
MICK SIMMONS LTD.
National Radio
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Price, J. C.
Rose, Reg., & Co. Ltd.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J., PTY. LTD.

BRASSWORK

ACORN PRESSED METAL CO.
EFCO MFG. CO. LTD.
Genders, W. & G., Pty. Ltd.
Gerard & Goodman Ltd.
Harris Scarfe Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Trackson Bros. Pty. Ltd.

BROADCASTING STATIONS

AMALGAMATED WIRELESS
PHILIPS LAMPS
Standard Telephones

BULBS (TORCH)

Assoc. General Electric
Atkins (W.A.) Ltd.
Bateman, M. J., Ltd.
Baty, C. S., & Co.
BARDSLEYS LTD.
Beale & Co. Ltd.
Begg, Wm. & Sons
Bennett & Wood, Ltd.
Bloch & Gerber Ltd.
Brandts Ltd.
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks Robinson & Co. Ltd.
Bruce Small Pty. Ltd.
Buckland, Wm. L., Pty. Ltd.
Carlyle & Co.
Chandler, J. B., & Co.
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G., & Co.
ECLIPSE RADIO PTY. LTD.
EVER READY CO.
FOX & MacGILLICUDDY LTD
Gage, H.
Gardam, J. R. W., & Co.
Genders, W. & G., Pty. Ltd.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
Grice, G. J., Ltd.
HARRINGTONS LTD.
Harris, D., & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold. A. E.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G., Ltd.
Hoffnung, S., & Co. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V., Ltd.
Invincible Radio Co.
Jackson & MacDonald
Keep Bros. & Wood Pty. Ltd.
Kendall, Knight & Co. Ltd.
Kohn Bros.
Lawrence & Hanson Elec.
Little, H. C., & Co. Ltd.
Machin & Co. Pty. Ltd.
Martin de Launay Ltd.
Martin, G. C.
McLELLAN, Wm. J.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Nicholsons Ltd.
Nilson, O. J., Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
PHILIPS LAMPS (A/SIA)
Price, J. C.
Pritchard, J. G.
Rose, Reg., & Co. Ltd.
Savery's Pianos Ltd.
Shafto, Ronn & Co.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distributors
VEALL, A. J., PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G., & Co., Ltd.
Westcott Hazell & Co. Ltd.
WILLIAMS, P. & R., LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.

BUZZERS.

Assoc. General Electric
Atkins (W.A.) Ltd.
A/sian Engr. Equipment Co.
AMALGAMATED WIRELESS
Bateman, M. J., Ltd.
Baty, C. S., & Co.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Price, J. C.
Standard Telephones
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J., PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G., & Co. Ltd.

CABINETS (LEATHER AND WOOD)

Custom Built Radio
EXPRESS UNIVERSAL
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
Harris Scarfe tLd.
Jackson & MacDonald
Martin de Launay Ltd.
MICK SIMMONS LTD.
NOYES BROS. (MELB.)
Rose, Reg. & Co. Ltd.
Trackson Bros. Pty. Ltd.
United Radio Distributors

CABINETS (WOOD)

ANDERSON & FRANTZEN
Beale & Co. Ltd.
Beard Watson Ltd.
Begg, Wm., & Sons
Bloch & Gerber Ltd.
BREVILLE RADIO
Brash & Co. Pty. Ltd.
Carlyle & Co.
Chandler, J. B., & Co.
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G., & Co.
Dickin, F., Ltd.
DUKE, ALAN PTY. LTD.
ECLIPSE RADIO PTY. LTD.
Fallshaw, D., & Sons
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
Gerard and Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G., Pty. Ltd.
Howard Radio Pty. Ltd.
Invincible Radio Co.
Jackson & MacDonald
Martin, G. C.
MICK SIMMONS LTD.
Moulded Products (A/sia)
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Ricketts & Thorp Ltd.
Rose, Reg., & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
THOMPSONS RADIO LTD.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J., PTY. LTD.
Westcott Hazell & Co. Ltd.

CARBON CELLS

AMPLION (A/SIA) LTD.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC
Carlyle & Co.
Chandler, J. B. & Co.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G., Ltd.
Hudson, Edgar V., Ltd.
LEKMEK RADIO
Little, H. C., & Co. Ltd.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Price, J. C.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J., PTY. LTD.
Westcott Hazell & Co. Ltd.

CASTINGS.

EFCO MFG. CO. LTD.
Electricity Meter Mfg. Co.
Genders, W. & G., Pty. Ltd.
Harris Scarfe Ltd.
NOYES BROS. (MELB.)
Trackson Bros. Pty. Ltd.

CATHODE RAY TUBES.

BRITISH GENERAL ELECTRIC
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
HARRINGTONS
Martin de Launay Ltd.
NEW SYSTEM TELEPHONES
Price, J. C.
RAYCOPHONE LTD.
Standard Telephones
TYME LTD.
United Radio Distributors
Westcott Hazell & Co. Ltd.

CHASSIS METAL.

ARNOLD & NUNN
Begg, Wm., & Sons
Bloch & Gerber Ltd.
BREVILLE RADIO
Cooke Bros. Ltd.
CROWN RADIO MFG. CO.
Davis, A. G., & Co.
Electricity Meter Mfg. Co.
Embelton, G. P., & Co.
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G., Ltd.
HOELLE, J. J., & CO.
Howard Radio Pty. Ltd.
James Mfg. Co. Ltd.
Lawrence & Hanson Elec.
LEKMEK RADIO
Little, H. C., & Co. Ltd.
METROPOLITAN ELECTRIC CO
MICK SIMMONS LTD.
National Radio
Newton McLaren Ltd.
NOYES BROS. (MELB.)
Price, J. C.
RADIO & TELEVISION MFRS.
RAYCOPHONE LTD.
Syme, W. A., & Co.
TARGAN ELECTRIC CO.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J., PTY. LTD.
YELLAND, L. J.
Zenith Radio Co. Ltd.

CHOKES (FILTERS).

ACORN PRESSED METAL CO.
AIRZONE (1931) LTD
AMALGAMATED WIRELESS
AMPLION (A/SIA) LTD.
Assoc. General Electric
Begg, Wm., & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
Bland Radio
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Carlyle & Co.
Chandler, J. B., & Co.
Cooke Bros. Ltd.
Creels Radio Products
CROWN RADIO MFG. CO.
Custom Built Radio
Davis, A. G., & Co.
Don Electrical Co.
DUFFY RADIO CO. LTD.
Denford, H. W.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY CO.
Electricity Meter Mfg. Co.
Embelton, G. P., & Co.
Essanay Mfg. Co. Pty. Ltd.
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G., Ltd.
HENDERSON, P., A.
Hudson, Edgar V., Ltd.
Invincible Radio Co.
James Mfg. Co. Ltd.
KRIESLER (A/SIA) LTD.
Lawrence & Hanson Elec.
LEKMEK RADIO
Little, H. C., & Co. Ltd.
Martin de Launay Ltd.
McLELLAN, Wm. J.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
Newton McLaren Ltd.
Nilson, O. J., Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
PARAMOUNT RADIO
PEERLESS MFG. CO. LTD.
Price, J. C.
Pritchard. J. G.
Radio Merchants Ltd.
RADIO & TELEVISION MFRS.
Radix Power Supplies
RAYCOPHONE LTD.
R.C.S. RADIO
Rose, Reg. & Co. Ltd.
Standard Telephones
STROMBERG-CARLSON
Superheterodyne Pty. Ltd.
Syme, W. A., & Co.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
TILBURY & LEWIS PTY. LTD.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J., PTY. LTD.
Wagga Wireless Distrib.
Watson, W. G., & Co.
Wendel Electric Co.
Westcott Hazell & Co. Ltd.
YELLAND, L. J.
Zenith Radio Co. Ltd.

CHOKES (R.F.).

AIRZONE (1931) LTD.
AMPLION (A/SIA) LTD.
Aristone Radio Pty. Ltd.
Bateman, M. J., Ltd.
Baty, C. S., & Co.
Bloch & Gerber Ltd.
Colonial Radio Pty. Ltd.
Colville-Moore Wireless
Cooke Bros. Ltd.
DUKE, ALAN, PTY. LTD.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY CO.
Embelton, G. P., & Co.
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G., Ltd.
Homecrafts Pty. Ltd.
Howard Radio Pty. Ltd.
Hudson, Edgar V., Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO
Little, H. C., & Co. Ltd.
Martin de Launay Ltd.
McLELLAN, Wm. J.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
Pritchard, J. G.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Shafto, Ronn & Co.
SMITH SONS & REES LTD.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G., & Co. Ltd.
Westcott Hazell & Co. Ltd.
WILLIAMS, P. & R. LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.

COPPER SHIELDING BRAID.

Assoc. General Electric
Bloch & Gerber Ltd.
Carlyle & Co.
Chandler, J. B., & Co.
Custom Built Radio
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
EFCO MFG. CO. LTD.
Embelton, G. P., & Co.
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G., Ltd.
Invincible Radio Co.
LEKMEK RADIO
LIVERPOOL ELECTRIC CABLES
Martin de Launay Ltd.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio
Newton McLaren Ltd.
NOYES BROS. (MELB.)
O'BRIEN, O. H.
Price, J. C.
RAYCOPHONE LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
SIMPLEX RADIO
Standard Telephones
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J., PTY. LTD.

CIRCUIT DRAWINGS.

COMMERCIAL COPYING CO.
FOX & MacGILLICUDDY LTD.
HARTLEYS PTY. LTD.
MICK SIMMONS LTD.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
VEALL, A. J., PTY. LTD.

CLOCKS (ELECTRIC).

AMPLION (A/SIA) LTD.
Assoc. General Elec.
Atkins (W.A.) Ltd.
Bateman, M. J., Ltd.
Baty, C. S., & Co.
Beale & Co., Ltd.
Begg, Wm. & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks Robinson & Co.
Carlyle & Co.
Chandler, J. B., & Co.
Colville-Moore Wireless
Cooke Bros. Ltd.
FOX & MacGILLICUDDY LTD.
Genders, W. & G., Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G., Ltd.
Invincible Radio Co.
LEKMEK RADIO
Little, H. C., & Co. Ltd.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES PTY.
Newton McLaren Ltd.
Nilson, O. J., Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
PHILIPS LAMPS (A/ASIA)
Pritchard, J. G.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Shafto, Ronn & Co.
SMITH SONS & REES LTD.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G., & Co. Ltd.
Westcott Hazell & Co. Ltd.
WILLIAMS, P. & R. LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.

COIL CANS.

ARNOLD & NUNN
Bloch & Gerber Ltd.
BREVILLE RADIO
Embelton, G. P., & Co.
Genders, W. & G., Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G., Ltd.
Howard Radio Pty. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
McLELLAN, Wm. J.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio
NEW SYSTEMS TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Peerless Metal Works
Price, J. C.
R.C.S. RADIO
STROMBERG-CARLSON
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J., PTY. LTD.
Watson, W. G., & Co. Ltd.

COIL FORMERS

AIRZONE (1931) LTD.
Bloch & Gerber Ltd.
CARR, JOHN, & CO.
COM'WEALTH MOULDING CO.
Cooke Bros. Ltd.
ECLIPSE RADIO PTY.
Embelton, G. P., & Co.
FOX & MacGILLYCUDDY LTD.
HARRINGTONS LTD.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
McLELLAN, Wm. J.
Moulded Products (A/sia)
Nally Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
PEERLESS MFG. CO. LTD.
R.C.S. RADIO
TARGAN ELECTRIC CO. LTD.
THOM & SMITH LTD.
TILBURY & LEWIS PTY. LTD.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distrib.
VEALL, A. J., PTY. LTD.
Watson, W. G., & Co. Ltd.
Westcott Hazell & Co., Ltd.
Wills & Co. Pty. Ltd.

COIL WINDING MACHINES.

Bloch & Gerber Ltd.
CARR, JOHN, & CO. LTD.
Electricity Meter Mfg. Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G., Pty. Ltd.
Martin de Launay Ltd.
MICK SIMMONS LTD.
NOYES BROS. (MELB.)
Standard Telephones
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
Wendel Electric Co.

COILS TUNING (ALL KINDS).

AIRZONE (1931) LTD.
AMPLION (A/SIA) LTD.
Atkins (W.A.) Ltd.
A/sian Engr. Equipment Co.
A.S.A. Equipment Co. Ltd.
Bateman, M. J., Ltd.
Baty, C. S., & Co.
Begg, Wm., & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
BREVILLE RADIO
Brooklands Accessories
Brooks Robinson & Co.
Carlyle & Co.
Chandler, J. B., & Co.
Colonial Radio Pty. Ltd.
Colville-Moore Wireless
Cooke Bros. Ltd.
CROWN RADIO MFG. CO.
Custom Built Radio
Davis, A. G., & Co.
DUFFY RADIO CO. LTD.
DUKE, ALAN PTY. LTD.
ECLIPSE RADIO PTY. LTD.
Electricity Meter Mfg. Co.
Embelton, G. P., & Co.
Essanay Mfg. Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G., Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G., Ltd.
Howard Radio Pty. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
McLELLAN, Wm. J.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
PARAMOUNT RADIO MFG. CO.
PEERLESS MFG. CO.
Price, J. C.
Radiette Radio Ltd.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
RAYCOPHONE LTD.
R.C.S. RADIO
REYNOLDS, R. W., LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Slades Radio
Small. H. G., & Co.
Standard Telephones
STROMBERG-CARLSON
Superheterodyne Pty. Ltd.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
TILBURY & LEWIS PTY. LTD.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distrib.
VEALL, A. J., PTY. LTD.
Watson, W. G., & Co. Ltd.
Wendel Electric Co.
Werring Radio Co.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.
Zenith Radio Co. Ltd.

COMPRESSED CORK.

Embelton, G. P., & Co.

CONDENSERS (Electrolytic).

Assoc. General Elec.
Atkins (W.A.) Ltd.
A/sian Engr. Equipment Co.
Aust. Condenser & Elec.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Beale & Co. Ltd.
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
BRITISH GENERAL ELEC. CO.
Carlyle & Co.
CARR, JOHN & CO. LTD.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G. & Co.
DUCON CONDENSER PTY. LTD.
DUFFY RADIO CO. LTD.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
Embleton, G. P. Co.
Farm & Pastoral Supplies.
Findlay Bros. Pty. Ltd.
FOX & MacGILLYCUDDY LTD.
Gage, H.
Gardam, J. R. W. & Co.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
Grice, G. J. Ltd.
HARRINGTONS LTD.
Harris, D. & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold, A. E.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Hecht, H. & Co.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
Invincible Radio Co.
Jackson & MacDonald.
Kendall, Knight & Co.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Little, H. C. & Co. Ltd.
Machin & Co. Pty. Ltd.
Martin de Launay Ltd.
McColl Elec. Works.
McLELLAN, WM. J.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
Nicholsons Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
Price, J. C.
Pritchard, J. G.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
Rose, Reg. & Co. Ltd.
Small, H. G. & Co.
Sth.-Aust. Phono-Radio.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.

CONDENSERS (Fixed Type).

A.S.A. Equipment Co.
Assoc. General Electric.
Atkins (W.A.) Ltd.
A/sian Engr. Equipment Co.
Aust. Condenser & Elec.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
CARR, JAMES & VAUTIN
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
DUCON CONDENSER PTY. LTD.
DUFFY RADIO CO LTD.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
Essanay Mfg. Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris, D. & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HECHT, H. & CO.
Homecrafts Pty. Ltd.
International Radio Co.
Invincible Radio Co.
Jackson & MacDonald.
Lawrence & Hanson Elec.
LEKMEK RADIO
Little, H. C. & Co. Ltd.
Martin de Launay Ltd.
McColl Electric Works.
McLELLAN, WM. J.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
Pritchard, J. G.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
Reliance Radio Co.
REYNOLDS, R. W. LTD.
Rose, Reg. & Co. Ltd.
Small, H. G. & Co.
Sth.-Aust. Phono-Radio.
Standard Telephones.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wetless Electric Mfg. Co.
Wills & Co. Pty. Ltd.
Zenith Radio Co. Ltd.

CONDENSERS (Midget Reaction)

AIRZONE (1931) LTD.
A.S.A. Equipment Co.
Bloch & Gerber Ltd.
Carlyle & Co.
CARR, JAMES & VAUTIN
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
Essanay Mfg. Co.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Howard, Radio Pty. Ltd.
Invincible Radio Co.
LEKMEK RADIO.
Martin de Launay Ltd.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEMS TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Wetless Electric Mfg. Co.
Zenith Radio Co. Ltd.

CONDENSERS (Padding).

AIRZONE (1931) LTD.
Bloch & Gerber Ltd.
FOX & MacGILLYCUDDY LTD.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Invincible Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Martin de Launay Ltd.
McColl Electric Works.
METROPOLITAN ELECTRIC.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.
Wetless Electric Mfg. Co.
Zenith Radio Co. Ltd.

CONDENSERS (Variable).

ACORN PRESSED METAL CO.
AIRZONE (1931) LTD.
A.S.A. Equipment Co. Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Begg, Wm. & Sons.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
CARR, JAMES & VAUTIN
Chandler, J. B. & Co.
Custom Built Radio.
Davis. A. G. & Co.
DUFFY RADIO CO. LTD.
DUKE, ALAN PTY. LTD.
ECLIPSE RADIO PTY. LTD.
EFCO MFG. CO. LTD.
Electricity Meter.
Embelton, G. P. & Co.
Essanay Mfg. Co.
FOX & MacGILLYCUDDY LTD.

Genders, W. & G. Pty. Ltd.
Gerard & Goodman, Ltd.
HARRINGTONS LTD.
Harris, Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Howard Radio Pty. Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
Invincible Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Martin de Launay Ltd.
McColl Electric Works.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEMS TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY.)
O'BRIEN, O. H.
Price, J. C.
RADIO & TELEVISION MFRS.
RAYCOPHONE LTD.
R.C.S. RADIO.
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Standard Telephones & Cables A/sia Ltd.
STROMBERG-CARLSON.
TARGAN ELECTRIC CO. PTY. LTD.
TILBURY & LEWIS PTY. LTD.
Trackson Bros. Pty. Ltd.
United Radio Distributors.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.
YELLAND, L. J.

CORD GRIP HOLDERS
(See Elec. Accessories)

CORDS (BATTERY, HEADPHONES, SPEAKERS, ETC.)

AIRZONE (1931) LTD.
AMALGAMATED WIRELESS.
AMPLION (A/SIA) LTD.
Assoc. General Electric.
Atkins (W.A.) Ltd.
A.Z. Radio Pty. Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Brooklands Accessories.
Brooks Robinson & Co.
Bruce Small Pty. Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
DUKE, ALAN PTY. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
EXPRESS UNIVERSAL.
FOX & MacGILLYCUDDY LTD.
Gardam, J. R. W. & Co.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Gladiola Co.
Grice, G. J. Ltd.
HARRINGTONS LTD.
Harris, D. & Co.
Harris Scarfe Ltd.
Harris Scarfe & Sandovers.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
LIVERPOOL ELECTRIC CABLE.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Price, J. C.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
Standard Telephones.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.

CRYSTALS (DETECTORS).

Bloch & Gerber Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
Standard Telephones.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.

CRYSTALS (Quartz Oscillating).

AMALGAMATED WIRELESS.
Bloch & Gerber Ltd.
Cooke Bros. Ltd.
DUFFY RADIO CO. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Newton McLaren Ltd.
NOYES BROS (MELB.).
NOYES BROS. (SYDNEY).
Standard Telephones.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.

DIALS (All Types).

ACORN PRESSED METAL CO.
AIRZONE (1931) LTD.
A.S.A. Equipment Co. Ltd.
A.Z. Radio Pty. Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
CARR, JAMES & VAUTIN
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
EFCO MFG. CO. LTD.
Electricity Meter.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HECHT, H. & CO.
Howard Radio Pty. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Martin de Launay Ltd.
MEAD MFG. CO.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
PARAMOUNT RADIO.
Price, J. C.
RADIO & TELEVISION MFRS.
RAYCOPHONE LTD.
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
Standard Telephones.
STROMBERG-CARLSON.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
Wendel Electric Co.
William, S. & Co.

DISTILLED WATER.

Bloch & Gerber Ltd.
Clyde Battery Service.
Erg Batteries Ltd.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Newton McLaren Ltd.
NOYES BROS (MELB.).
O'BRIEN, O. H.
WARBURTON FRANKI LTD.

DUCO-ING & SPRAYING.

ARNOLD & NUNN.
RAYCOPHONE LTD.

EARTH CLIPS (See Aerial & Earth Accessories).

ELECTRICAL ACCESSORIES.

ARNOLD & NUNN.
Assoc. General Electric.
Atkins (W.A.) Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Bloch & Gerber Ltd.
Boswell & Co.
BRITISH GENERAL ELECTRIC.
DUKE, ALAN PTY. LTD.
ELECTRICAL SPECIALITY CO.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Sandovers
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
Savery's Pianos Ltd.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Werring Radio Co.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.

ELECTRO PLATING.

Don Electrical Co.
EFCO MFG. CO. LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Healing, A. G. Ltd.
MICK SIMMONS LTD.
NOYES BROS. (MELB.).
RAYCOPHONE LTD.
Reliance Radio Co.
STROMBERG-CARLSON.
TARGAN ELECTRIC CO.
Trackson Bros. Pty. Ltd.

ELIMINATORS A, B, C.

Bateman, M. J. Ltd.
Baty, C. S. & Co.
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
Brandts Ltd.
Buckland, Wm. L.
Chandler, J. B. & Co.
Davis, A. G. & Co.
Don Electrical Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Electricity Meter.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jansen, H. E. C.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
McColl Electric Works.
MEAD MFG. CO.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
PHILIPS LAMPS.
Price, J. C.
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Slade's Radio.
SMITH SONS & REES LTD.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.
YELLAND, L. J.

ENGRAVING.

Bloch & Gerber Ltd.
CARR, JOHN & CO.
Electricity Meter.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
MICK SIMMONS LTD.
NOYES BROS. (MELB.).
Peerless Metal Works.
Price, J. C.
RAYCOPHONE LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.

EYELETS & RIVETS.

EFCO MFG. CO. LTD.
EYELETS PTY. LTD.
Genders, W. & G. Pty. Ltd.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
Price, J. C.
Reliance Radio Co.
Trackson Bros. Pty. Ltd.
United Radio Distrib.

FIBRE (Sheet Rod & Tube).

Assoc. General Electric.
BRITISH GENERAL ELECTRIC.
Genders, W. & G. Pty. Ltd.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
LIVERPOOL ELECTRIC CABLE.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
O'BRIEN, O. H.
Price, J. C.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

FILM PHONOGRAPHS.

GENERAL THEATRE SUPPLIES.

FILTERS (OUTPUT).

AIRZONE (1931) LTD.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
Chandler, J. B. & Co.
Creela Radio Products.
Don Electrical Co.
DUFFY RADIO CO LTD.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
HENDERSON, P. A.
Hudson, Edgar V. Ltd.
LEKMEK RADIO.
Martin de Launay Ltd.
McLELLAN, WM. J.
METROPOLITAN ELECTRIC.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Price, J. C.
RADIO & TELEVISION MFRS.
RAYCOPHONE LTD.
Rose, Reg. & Co. Ltd.
Standard Telephoens.
STROMBERG-CARLSON
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Wendel Electric Co.
YELLAND, L. J.

GENEMOTORS.

Harris Scarfe Ltd.
International Radio Co.

GENERATORS.

Assoc. General Electric.
Bloch & Gerber Ltd.
DUFFY RADIO CO. LTD.
Electricity Meter.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Healing, A. G. Ltd.
International Radio Co.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
McColl Electric Works.
MICK SIMMONS LTD.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
Rose, Reg. & Co. Ltd.
SMITH SONS & REES LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.

GROMMETS (Rubber).

Bloch & Gerber Ltd.
DUNLOP-PERDRIAU.
EFCO MFG. CO. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Invincible Radio Co.
Martin de Launay Ltd.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
Price, J. C.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
Standard Telephones.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.

HEADPHONES.

Begg, Wm. & Sons.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
DUFFY RADIO CO LTD.
ECLIPSE RADIO PTY. LTD.
Electricity Meter.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jackson & MacDonald.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
Price, J. C.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
Standard Telephones.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.

HOME TALKIE APPARATUS.

DUFFY RADIO CO. LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Healing, A. G. Ltd.
NOYES BROS. (MELB.).
Radiette Radio Ltd.
RAYCOPHONE LTD.
Rose, Reg. & Co. Ltd.
United Radio Distrib.
YELLAND, L. J.

HYDROMETERS.

Assoc. General Elec.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Buckland, Wm. L.
Carlyle & Co.
Chandler, J. B. & Co.
Davis, A. G. & Co.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
Price, J. C.
Rose, Reg. & Co. Ltd.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

INSULATING MATERIAL.

Assoc. General Elec.
A/sian Engr. Equipment Co.
Bloch & Gerber Ltd.
BRITISH GENERAL ELEC.
Carlyle & Co.
CARR, JOHN & CO. LTD.
Chandler, J. B. & Co.
COMMONWEALTH MOULDING.
Cooke Bros. Ltd.
Davis, A. G. & Co.
Dobbie, E. Ltd.
DUFFY RADIO CO. LTD.
DUNLOP-PERDRIAU
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Fowler, R. Ltd.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Guthridge Ltd.
HARRINGTONS LTD.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Henley Telegraph Works.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
Invincible Radio Co.
Lawrence & Hanson Elec.
LIVERPOOL ELEC. CABLE.
Martin de Launay Ltd.
McLELLAN, WM. J.
Mice Insulating Supplies.
Micanite & Insulating.
MICK SIMMONS LTD.
Nally Ltd.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
O'Hanlon, P. J.
PEERLESS MFG. CO. LTD.
Price, J. C.
RICHARDSON, H. C.
Rose, Reg. & Co. Ltd.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

INSULATORS (See Aerial & Earth Accessories).

JACKS (See Plugs and Jacks)

KITS (Coils and Condensers).

AMPLION (A/SIA) LTD.
Atkins (W.A.) Ltd.
A.Z. Radio Pty. Ltd.
Bloch & Gerber Ltd.
BREVILLE RADIO.
BRITISH GENERAL ELECTRIC.
Brooklands Accessories.
Brooks Robinson & Co.
Bruce Small Pty. Ltd.
Buckland, Wm. L. Pty. Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Davis, A. G. & Co.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Howard Radio Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
LEKMEK RADIO.
Little, H. C. & Co. Ltd.
Martin de Launay Ltd.
METROPOLITAN ELECTRIC.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
O'BRIEN, O. H.
Price, J. C.
R.C.S. RADIO.
Savery's Pianos.
STROMBERG-CARLSON
Trackson Bros. Pty. Ltd.
United Radio Distrib.
Watson, W. G. & Co. Ltd.
YELLAND, L. J.

KNOBS (See Mouldings).

LABORATORY INSTRUMENTS.

AMALGAMATED WIRELESS.
Assoc. General Electric.
EASTERN TRADING CO. LTD.
EXPRESS UNIVERSAL.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Kendall, Knight & Co.
LEKMEK RADIO.
Martin de Launay Ltd.
McColl Electric Works.
McLELLAN, W. J.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Parish, Hayward C.
PHILIPS LAMPS.
R.C.S. RADIO.
Standard Telephones.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

LAMPS (Hand & Pocket).

Assoc. General Electric.
Atkins (W.A.) Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Beard Watson Ltd.
Begg Wm. & Sons.
Bennett & Wood Ltd.
BRITISH GENERAL ELECTRIC.
Brooklands Accessories.
Brooks Robinson & Co.
Bruce Small Pty. Ltd.
Buckland, Wm. L.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
Dobbie, E. Ltd.
DUKE, ALAN PTY. LTD.
EVER READY CO.
FOX & MacGILLYCUDDY LTD.
Gardam, J. R. W. & Co.
Genders, W. & G. Pty. Ltd.
GENERAL THEATRE SUPPLIES.
Gladiola Co.
Graber Electric Co.
Grice, G. J. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Harris, D. & Co.
Harris Scarfe Sandovers.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
Lawrence & Hanson Elec.
Little, H. C. & Co. Ltd.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Musgrove's Ltd.
Newton McLaren Ltd.
Nilson, O. J. Pty. Ltd.
Nicholsons Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Radio Maintenance
Radio Wholesalers Ltd.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

LEAD IN TUBES (See Aerial & Earth Accessories).

LENZ (Connecting Rush Back Wire).

International Radio Co. Ltd.

LINE INTERFERENCE FILTERS.

Creela Radio Products.
Jansen, H. E. C.
METROPOLITAN ELECTRIC.
STROMBERG-CARLSON

LUGS (Tin & Tinned Copper).

ACORN PRESSED METAL CO.
Assoc. General Electric.
Bloch & Gerber Ltd.
COMMONWEALTH MOULDING.
Cooke Bros. Ltd.
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
EFCO MFG. CO. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
HOELLE, J. J. & CO.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
O'BRIEN, O. H.
PRICE, J. C.
REYNOLDS, R. W. LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wetless Electric Mfg. Co.

MAGNETS (Permanent).

AMALGAMATED WIRELESS.
AMPLION (A/SIA)LTD.
Embelton, G. P. & Co.
MARINE WIRELESS EQUIPMENT.
AMALGAMATED WIRELESS.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
PHILIPS LAMPS.
Standard Telephones.

MASTS (Aerial).

Genders, W. & G. Pty. Ltd.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
NOYES BROS. (MELB.).
Trackson Bros. Pty. Ltd.
VEALL, A. J. PTY. LTD.
Williams, S. & Co.

METALS (Rare).

Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
NOYES BROS. (MELB.).
NOYES (SYDNEY).
RAYCOPHONE LTD.
Standard Telephones.
Trackson Bros. Pty. Ltd.

METER FUSES.

Assoc. General Electric.
Bloch & Gerber Ltd.
EXPRESS UNIVERSAL.
Genders, W. & G. Pty. Ltd.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Kendall, Knight & Co.
Martin de Launay Ltd.
McColl Electric Works.
MICK SIMMONS LTD.
National Radio.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.
WARBURTON FRANKI LTD.

METERS & MEASURING INSTRUMENTS.

AMPLION (A/SIA) LTD.
Assoc. General Electric.
Atkins (W.A.) Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Begg, Wm. & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
Chandler, J. B. & Co.
Colville-Moore Wireless.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
DUKE, ALAN PTY. LTD.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
Electricity Meter.
EXPRESS UNIVERSAL.
FOX & MacGILLYCUDDY LTD.
Gardam, J. R. W. & Co.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Harris Scarfe Sandovers.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Kendall, Knight & Co.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Martin de Launay Ltd.
McColl Electric Works.
McLELLAN, WM. J.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
Price, J. C.
Siemens Ltd.
Slade's Radio.
Standard Telephones.
TARGAN ELECTRIC CO.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

METERS (Testing) REPAIRS

DOE, A. G.
EXPRESS UNIVERSAL
Slade's Radio
WARBURTON, FRANKI LTD.

MICROPHONE STANDS

AIRZONE (1931) LTD.
AMALGAMATED WIRELESS
PHILIPS LAMPS
Standard Telephones
Williams, S. & Co.

MICROPHONES

AMALGAMATED WIRELESS
AMPLION A/SIA LTD.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
DUFFY RADIO CO. LTD.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Martin de Launay Ltd.
McColl Electric Works
McLELLAN, WM. LTD.
MICK SIMMONS LTD.
National Radio
Newton McLaren Ltd.
NOYES BROS. (MELB.)
PHILIPS LAMPS
Price, J. C.
Rose, Reg. & Co. Ltd.
Standard Telephones
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.

MOTOR ALTERNATOR SETS

Associated General Electric
Don Electrical Co.
Harris Scarfe Ltd.
Lawrence & Hanson Elec.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.

MOTORS (Electric Phonograph)

Associated General Electric
Atkins (W.A.) Ltd.
A/sian Engr. Equipment
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Beale & Co. Ltd.
Begg, Wm. & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks Robinson & Co.
Bruce Small Pty. Ltd.
Buckland, Wm. L.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G. & Co.
Dobbie, E. Ltd.
DUKE, ALAN PTY. LTD.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
GENERAL THEATRE SUPPLIES
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris, D. & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Jackson & MacDonald
Lawrence & Hanson Elec.
Martin de Launay Ltd.
McColl Electric Works
McLELLAN, WM. J.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
STROMBERG-CARLSON
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.
WILLIAMS, P. & R. LTD.
Wyper Howard Ltd.

MOULDINGS

Begg, Wm. & Sons
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC
Carlyle & Co.
CARR, JOHN & CO.
Chandler, J. B. & Co.
COMMONWEALTH MOULDING
Cook & Williams
Dalton, H. & Co.
Davidson, G. R. & Co.
DUFFY RADIO CO. LTD.
DUNLOP-PERDRIAU
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY
Electricity Meter
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Hardy, Walter R. & Co.
Harris Scarfe Ltd.
HECHT, H. & CO.
Hudson, Edgar V. Ltd.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
McKenzie & Holland
MICK SIMMONS LTD.
Moulded Products A/sia
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
PEERLESS MFG. CO. LTD.
RICHARDSON, H. C.
SIMPLEX RADIO
TARGAN ELECTRIC CO.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.

NICKEL PLATINGS

RAYCOPHONE LTD.

OHMMETERS

EXPRESS UNIVERSAL
Kendall, Knight & Co.
WARBURTON, FRANKI LTD.

OSCILLATORS

AMALGAMATED WIRELESS
EASTERN TRADING CO. LTD.
EXPRESS UNIVERSAL
LEKMEK RADIO
McLELLAN, WM. J.
Parish, Hayward C.
STROMBERG-CARLSON
THOM & SMITH LTD.

PANELS (Relay)

AMALGAMATED WIRELESS
Standard Telephones
Williams, S. & Co.

'PHONE TERMINALS

Bloch & Gerber Ltd.
Davis, A. G. & Co.
EFCO MFG. CO. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
HOELLE, J. J. & CO.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio
Newton McLaren Ltd.
NOYES BROS. (MELB.)
Price, J. C.
REYNOLDS, R. W. LTD.
Rose, Reg. & Co. Ltd.
Standard Telephones
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wyper Howard Ltd.

'PHONE TIP NIPPLES

Cooke Bros. Ltd.
Healing, A. G. Ltd.

PHONOGRAPH ACCESSORIES

Bloch & Gerber Ltd.
Chandler, J. B. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
GENERAL THEATRE SUPPLIES
HARRINGTONS LTD.
Harris Scarfe Ltd.
Jackson & McDonald
McLELLAN, WM. J.
MICK SIMMONS LTD.
Moulded Products A/sia
NEW SYSTEMS TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Savery's Pianos Ltd.
Trackson Bros. Pty. Ltd.
United Radio Distributors
Wyper Howard Ltd.

PHOTO ELECTRIC CELLS

AMALGAMATED WIRELESS
AMALGAMATED WIRELESS VALVE CO.
AMPLION A/SIA LTD.
Associated General Electric
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC

Carlyle & Co.
Chandler, J. B. & Co.
DUFFY RADIO CO. LTD.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Healing, A. G. Ltd.
Howard Radio Pty. Ltd.
McLELLAN, WM. J.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
PHILIPS LAMPS
Reliance Radio Co.
Trackson Bros. Pty. Ltd.
TYME LTD.
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.

PICK-UPS

Associated General Electric
Beale & Co. Ltd.
Bloch & Gerber Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Callaghan & Co.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio
Columbia Graphophone
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
HECHT, H. & CO.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jackson & MacDonald
Lawrence & Hanson Elec.
LEKMEK RADIO
Martin de Launay Ltd.
McColl Electric Works
McLELLAN, WM. J.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
PHILIPS LAMPS
Price, J. C.
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
South Australian Phono-Radio
STROMBERG-CARLSON
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
TILBURY & LEWIS
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Jhonstone (W.A.)
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.

PLUGS AND JACKS

Bloch & Gerber Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
COMMONWEALTH MOULDING
Cooke Bros. Ltd.
Custon Built Radio
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HOELLE, J. J. & CO.
Hudson, Edgar V. Ltd.
Jackson & MacDonald
LEKMEK RADIO
Martin de Launay Ltd.
McLELLAN, WM. J.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
PHILIPS LAMPS
Radiette Radio Ltd.
RAYCOPHONE LTD.
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Standard Telephones
THOM & SMITH LTD.
TILBURY & LEWIS
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Wyper Howard Ltd.
YELLAND, L. J.

PUBLIC ADDRESS EQUIPMENT

AMALGAMATED WIRELESS
AMPLION A/SIA LTD.
BREVILLE RADIO
BRASH, M. & CO. PTY.
Chandler, J. B. & Co.
Colville-Moore Wireless
Don Electrical Co.
DUFFY RADIO CO. LTD.
EXPRESS UNIVERSAL CO.
FOX & MacGILLYCUDDY
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harsis Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Lawrence & Hanson Elec.
LEKMEK RADIO
Majestic Radio Mfg. Co.
MICK SIMMONS LTD.
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
PHILIPS LAMPS
Radiette Radio Ltd.
RAYCOPHONE LTD.
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Standard Telephones
THOM & SMITH LTD.
TILBURY & LEWIS
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Wyper Howard Ltd.
YELLAND, L. J.

POTENTIOMETERS

ACORN PRESSED METAL CO.
AIRZONE (1931) LTD.
Atkins (W.A.) Ltd.
A.Z. Radio Pty. Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Begg, Wm. & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC
Carlyle & Co.
Chandler, J. B. & Co.
Colonial Radio
COMMONWEALTH MOULDING
Cooke Bros. Ltd.
CROWN RADIO MFG. CO.
Custom Built Radio
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
Electricity Meter
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY
Genders, W. & G. Pty. Ltd.
GENERAL THEATRE SUPPLIES
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HECHT, H. & CO.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
Invincible Radio Co.
James Mfg. Co. Ltd.
Lawrence & Hanson Elec.
LEKMEK RADIO
Martin de Launay Ltd.
McColl Electric Works
McLELLAN, WM. J.
METROPOLITAN ELECTRIC
MICK SIMMONS LTD.
National Radio
New System Telephones
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
Price, J. C.
PARAMOUNT RADIO
PEERLESS MFG. CO. LTD.
Price, J. C.
RAYCOPHONE LTD.
R.C.S. RADIO
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
Standard Telephones
STROMBERG-CARLSON
TARGAN ELECTRIC CO.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co.

POWER PACKS

AIRZONE (1931) LTD.
AMPLION A/SIA LTD.
A.S.A. Equipment Co.
Bloch & Gerber
Chandler, J. B. & Co.
Creela Radio Products
Custom Built Radio
Davis, A. G. & Co.
Don Electrical Co.
Duffy Radio Co. Ltd.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY
Electricity Meter
Embelton, G. P. & Co.
Essanay Mfg. Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HENDERSON, P. A.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO
Martin de Launay Ltd.
McLELLAN, WM. J.
METROPOLITAN ELECTRIC
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
Price, J. C.
RAYCOPHONE LTD.
RICHARDSON, H. C.
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
Small, H. G. & Co.
South Australian Phono-Radio
Standard Telephones Ltd.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Westcott Hazell & Co.
YELLAND, L. J.

RADIO SCHOOLS AND COLLEGES

Australian Radio College
Australian School of Radio Eng.
International Correspondence Schools
Marconi School of Wireless

RECEIVERS (All-Wave Battery)

Associated General Electric
A.Z. Radio Pty. Ltd.
Beale & Co. Ltd.
Bloch & Gerber Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Colville-Moore Wireless
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ELECTRICAL SPECIALITY
Embelton. G. P. & Co.
Essanay Mfg. Co. Pty. Ltd.
Findlay Bros. Pty. Ltd.
FIRTH BROS. PTY. LTD.
Gardam, J. R. W. & Co.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris, D. & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jackson & MacDonald
James Mfg. Co. Ltd.
Keep Bros. & Wood
Lawrence & Hanson Elec.
LEKMEK RADIO
Majestic Radio Mfg. Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
OLYMPIC RADIO CO.
Radiette Radio Ltd.
RADIO & TELEVISION MFRS.
RAYCOPHONE LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
Small, H. G. & Co.
South Australian Phono-Radio
Standard Telephones
STROMBERG-CARLSON
Superheterodyne Pty. Ltd.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
THOMPSON'S RADIO LTD.
TILBURY & LEWIS PTY. LTD.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distributors
VEALL, A. J. PTY. LTD.
Wagga Wireless Distributors
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Werring Radio Co.
Westcott Hazell & Co. Ltd.
WILLIAMS, P. & R. LTD.
Willis & Co. Pty. Ltd.
Wyper Howard Ltd.
YELLAND, L. J.
Zenith Radio Co. Ltd.

RECEIVERS (All-Wave Electric)

Associated General Electric
Atkins (W.A.) Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
BARDSLEY'S LTD.
Beale & Co. Ltd.
Begg, Wm. & Sons
Bloch & Gerber Ltd.
Bland Radio
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks Robinson & Co. Ltd.
Bruce Small Pty. Ltd.
Buckland, Wm. L. Pty. Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Colville-Moore Wireless
Cooke Bros. Ltd.
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY
Electricity Meter
Embelton, G. P. & Co.
Farm & Pastoral Supplies
Findlay Bros. Pty. Ltd.
FIRTH BROS. LTD.
FOX & MacGILLYCUDDY
Gardam, J. R. W. & Co.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
Grice, G. J. Ltd.
HARRINGTONS LTD.
Harris, D. & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold, A. E.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.

Invincible Radio Co.
James Mfg. Co. Ltd.
Jackson & MacDonald
KRIESLER (A/SIA) LTD.
Lawrence & Hanson Elec.
LEKMEK RADIO
Little, H. C. & Co. Ltd.
Majestic Radio Mfg. Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Nicholsons Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
OLYMPIC RADIO CO.
Price, J. C.
Pritchard, J. G.
Radiette Radio Ltd.
Radio Industries Ltd.
Radio Maintenance
Radio Merchants Ltd.
Radiovision (A/sia)
Radio Wholesalers Ltd.
RADIO & TELEVISION MFRS.
RADIO CORPORATION
RAYCOPHONE LTD.
REGENT RADIO PTY. LTD.
Rose, Reg. & Co.
Reliance Radio Co.
Savery's Pianos Ltd.
Shafto, Ronn & Co.
Slade's Radio
Small, H. G. & Co.
South Australian Phono-Radio
Standard Telephones
STROMBERG-CARLSON
Superheterodyne Pty. Ltd.
Syme, W. A. & Co.
TARGAN ELECTRIC CO.
Teleradio Construction
THOM & SMITH LTD.
THOMPSON'S RADIO LTD.
TILBURY & LEWIS PTY. LTD.
TYME LTD.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distributors
University Radio Co.
VEALL, A. J. PTY. LTD.
Wagga Wireless Distributors
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Werring Radio Co.
Westcott Hazell & Co. Ltd.
WILLIAMS, P. & R. LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.
YELLAND, L. J.
Zenith Radio Co. Ltd.

RECEIVERS (Auto. Radio)

AIRZONE (1931) LTD.
AMALGAMATED WIRELESS
Associated General Electric
Atkins (W.A.) Ltd.
A.Z. Radio Pty. Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
BARDSLEY'S LTD.
Beale & Co. Ltd.
Beard Watson Ltd.
Begg, Wm. & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
Bland Radio
Brandts Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks Robinson & Co. Ltd.
Bruce Small Pty. Ltd.
Buckland, Wm. L. Pty. Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Colonial Radio Pty. Ltd.
Colton Palmer & Preston
Colville-Moore Wireless
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G. & Co.
Dickin, F. Ltd.
DUFFY RADIO CO. LTD.
DUKE, ALAN PTY. LTD.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY
Electricity Meter
Embelton, G. P. & Co.
Farm & Pastoral Supplies
Findlay Bros. Pty. Ltd.
FIRTH BROS. PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Gardam, J. R. W. & Co.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
Grice, G. J. Ltd.
HARRINGTONS LTD.
Harris, D. & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold, A. E.
HARTLEY'S PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jackson & MasDonald
Keep Bros. & Wood
KRIESLER (A/SIA) LTD.
Lawrence & Hanson Elec.
LEKMEK RADIO
Little, H. C. & Co. Ltd.
Majestic Radio Mfg. Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Nicholsons Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Radiette Radio Ltd.
Radio Maintenance
Radio Merchants Ltd.
Radio Wholesalers Ltd.
RADIO & TELEVISION MFRS.
Radix Power Supplies
RAYCOPHONE LTD.
REGENT RADIO PTY. LTD.
Rhodes Motors Pty. Ltd.
Rickards Motors Pty. Ltd.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
Shafto, Ronn & Co.
Small, H. G. & Co.
SMITH, SONS & REES LTD.
Standard Telephones
Superheterodyne Pty. Ltd.
STROMBERG-CARLSON
Syme, W. A. & Co.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
THOMPSON'S RADIO LTD.
TILBURY & LEWIS PTY. LTD.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distributors
VEALL, A. J. PTY. LTD.
Wagga Wireless Distributors
WARBURTON, FRANKI LTD.
Watson, W. G. & Co.
Wendel Electric Co.
Werring Radio Co.
Westcott Hazell & Co. Ltd.
WILLIAMS, P. & R. LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.
YELLAND, L. J.

RECEIVERS (Battery) SUPERHETERODYNE

AIRZONE (1931) LTD.
AMALGAMATED WIRELESS
AMALGAMATED WIRELESS VALVE CO.
Associated General Electric
Atkins (W.A.) Ltd.
Australian Radio College
A.Z. Radio Pty. Ltd.
A.S.A. Equipment
Bateman, M. J. Ltd.
Baty, C. S. & Co.
BARDSLEY'S LTD.
Beale & Co. Ltd.
Begg, Wm. & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
Brandts Ltd.
Bland Radio
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks Robinson & Co. Ltd.
Bruce Small Pty. Ltd.
Buckland, Wm. L. Pty. Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Colonial Radio Pty. Ltd.
Colville-Moore Wireless
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G. & Co.
Dickin, F. Ltd.
DUFFY RADIO CO. LTD.
DUKE, ALAN PTY. LTD.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY
Electricity Meter
Embelton, G. P. & Co.
Farm & Pastoral Supplies
Findlay Bros. Pty. Ltd.
FIRTH BROS. PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Gardam, J. R. W. & Co.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
Grice, G. J. Ltd.
HARRINGTONS LTD.
Harris, D. & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold, A. E.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jackson & MacDonald
James Mfg. Co. Ltd.
Keep Bros. & Wood
Kohn Bros.
KRIESLER (A/SIA) LTD.
Lawrence & Hanson Elec.
LEKMEK RADIO
Little, H. C. & Co. Ltd.
Majestic Radio Mfg. Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Nicholsons Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Radiette Radio Ltd.
Radio Industries Ltd.
Radio Maintenance
Radio Merchants Ltd.
Radiovision (A/sia)
Radio Wholesalers Ltd.
RADIO & TELEVISION MFRS.
RADIO CORPORATION
RAYCOPHONE LTD.
REGENT RADIO PTY. LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
Shafto, Ronn & Co.
Slade's Radio
Small, H. G. & Co.
Smart, H. & Co.
SMITH, SONS & REES LTD.
Standard Telephones
Stokoe Motors Pty. Ltd.
STROMBERG-CARLSON
Superheterodyne Pty. Ltd.
Syme, W. A. & Co.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
THOMPSON'S RADIO LTD.
TILBURY & LEWIS PTY. LTD.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distributors
University Radio Co.
VEALL, A. J. PTY. LTD.
Wagga Wireless Distributors
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Werring Radio Co.
Westcott Hazell & Co. Ltd.
WILLIAMS, P. & R. LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.
YELLAND, L. J.
Zenith Radio Co. Ltd.

RECEIVERS (A.C.) SUPERHETERODYNE

AIRZONE (1931) LTD.
AMALGAMATED WIRELESS
Associated General Electric
Atkins (W.A.) Ltd.
Australian Radio College
A.Z. Radio Pty. Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
BARDSLEY'S LTD.
Beale & Co. Ltd.
Begg, Wm. & Sons
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
Bland Radio
Brandts Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Brooklands Accessories
Brooks Robinson & Co. Ltd.
Bruce Small Pty. Ltd.
Buckland, Wm. L. Pty. Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Colonial Radio Pty. Ltd.
Colville-Moore Wireless
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G. & Co.
Dobbie, E. Ltd.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO CO. LTD.
ELECTRICAL SPECIALITY
Electricity Meter
Essanay Mfg. Co.
Farm & Pastoral Supplies
Findlay Bros. Pty. Ltd.
FIRTH BROS. PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Gardam, J. R. W. & Co.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
Grice, G. J. Ltd.
HARRINGTONS LTD.
Harris, D. & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers
Harrold, A. E.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Howard Radio Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jackson & MacDonald
Keep Bros. & Wood
Kohn Bros.
KRIESLER (A/SIA) LTD.
Lawrence & Hanson Elec.
LEKMEK RADIO
Little, H. C. & Co. Ltd.
Majestic Radio Mfg. Co.
Martin de Launay Ltd.
MEAD MFG. CO.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Nicholsons Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Ord Radio Pty. Ltd.
Orpheus Radio Pty. Ltd.
Pritchard, J. G.
Radiette Radio Ltd.
Radio Industries Ltd.
Radio Maintenance
Radio Merchants Ltd.
Radiovision (A/sia)
Radio Wholesalers Ltd.
RADIO & TELEVISION MFRS.
RADIO CORPORATION
RAYCOPHONE LTD.
REGENT RADIO PTY. LTD.
Rhodes Motors Pty. Ltd.
Rickards Motors Pty. Ltd.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
Shafto, Ronn & Co.
Slade's Radio
Small, H. G. & Co.
SMITH, SONS & REES LTD.
South Australian Phono-Radio
Standard Telephones
Stokoe Motors Pty. Ltd.
STROMBERG-CARLSON
Superheterodyne Pty. Ltd.
Syme, W. A. & Co.
TARGAN ELECTRIC CO.
Teleradio Construction
THOM & SMITH LTD.
THOMPSON'S RADIO LTD.
TILBURY & LEWIS PTY. LTD.
Trackson Bros. Pty. Ltd.
TYME LTD.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distributors
University Radio Co.

VEALL, A. J. PTY. LTD.
Wagga Wireless Distributors
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Werring Radio Co.
Westcott Hazell & Co. Ltd.
WILLIAMS, P. & R. LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.
YELLAND, L. J.
Zenith Radio Co. Ltd.

RECEIVERS (Wired Chassis Only)

AIRZONE (1931) LTD.
A.Z. Radio Pty. Ltd.
A.S.A. Equipment Co.
Begg, Wm. & Sons
Bloch & Gerber Ltd.
Boswell & Co.
BREVILLE RADIO
Colonial Radio Pty. Ltd.
Custom Built Radio
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY
Electricity Meter
Embelton, G. P. & Co.
Essanay Mfg. Co.
FIRTH BROS. PTY. LTD.
FOX & MacGILLYCUDDY LTD.
HARTLEYS PTY. LTD.
Howard Radio Pty. Ltd.
Invincible Radio Co.
Jackson & MacDonald
Lawrence & Hanson Elec.
LEKMEK RADIO
Martin de Launay Ltd.
MEAD MFG. CO.
MICK SIMMONS LTD.
National Radio
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
PARAMOUNT RADIO
Radiette Radio Ltd.
Radio Industries Ltd.
Radio Merchants Ltd.
Radiovision (A/sia)
RADIO & TELEVISION MFRS.
RAYCOPHONE LTD.
Slade's Radio
Small, H. G. & Co.
South Australian Phono-Radio
Superheterodyne Pty. Ltd.
Syme, W. A. & Co.
TARGAN ELECTRIC CO.
TILBURY & LEWIS PTY. LTD.
VEALL, A. J. PTY. LTD.
YELLAND, L. H.
Zenith Radio Co. Ltd.

RECEIVERS (D.C. Supply)

AIRZONE (1931) LTD.
AMALGAMATED WIRELESS
Beale & Co. Ltd.
Begg, Wm. & Sons
Bloch & Gerber Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Brash, M. Pty. Ltd.
Chandler, J. B. & Co.
Custom Built Radio
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY CO.
Electricity Meter
Embelton, G. P. & Co.
FIRTH BROS. PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G. Ltd.
Howard Radio Pty. Ltd.
Jackson & MacDonald
Lawrence & Hanson Elec.
LEKMEK RADIO
Little, H. C. & Co. Ltd.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Radiette Radio Ltd.
RAYCOPHONE LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio
Savery's Pianos Ltd.
Slade's Radio
Small, H. G. & Co.
SMITH, SONS & REES LTD.
STROMBERG-CARLSON
Syme, W. A. & Co.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
TILBURY & LEWIS PTY. LTD.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.
YELLAND, L. H.

RECEIVERS (Portable)

AIRZONE (1931) LTD.
Beale & Co. Ltd.
Bloch & Gerber Ltd.
BREVILLE RADIO
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Jackson & MacDonald
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
Radiette Radio Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
Small, H. G. & Co.
Syme, W. A. & Co.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
Westcott Hazell & Co. Ltd.
Zenith Radio Co. Ltd.

RECEIVERS BROADCAST 32V.

Begg, Wm. & Sons
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
Genders, W. & G. Pty. Ltd.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Jackson & MacDonald
LEKMEK RADIO.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
Radiette Radio Ltd.
RAYCOPHONE LTD.
Reliance Radio Co.
Savery's Pianos Ltd.
Small, H. G. & Co.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
TILBURY & LEWIS.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
Wescott Hazell & Co. Ltd.

RECEIVERS COMBINATION RADIO PHONOGRAPH.

AIRZONE (1931) LTD.
AMALGAMATED WIRELESS.
Assoc. General Electric.
Atkins (W.A.) Ltd.
A.Z. Radio Pty. Ltd.
Beale & Co. Ltd.
Bloch & Gerber Ltd.
BREVILLE RADIO.
BRITISH GENERAL ELECTRIC.
Duffy Radio Co. Ltd.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY CO.
FIRTH BROS. PTY. LTD.
HARRINGTONS LTD.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jackson & MacDonald
KREISLER (A/SIA) LTD.
LEKMEK RADIO.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Radiette Radio Ltd.
RADIO & TELEVISION MFRS.
RAYCOPHONE LTD.
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Slade's Radio
Small, H. G. & Co.
Syme, W. A. & Co.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
TILBURY & LEWIS.
Trackson Bros. Pty. Ltd.
THOMPSONS RADIO LTD.
Unbehaun & Johnstone Ltd.
United Radio Distribs.
University Radio Co.
VEALL, A. J. PTY. LTD.
Wagga Wireless Distribs.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Werring Radio Co.
Westcott Hazell & Co. Ltd.
WILLIAMS, P. & R. LTD.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.
YELLAND, L. J.
Zenith Radio Co. Ltd.

RECEIVERS UNIVERSAL A.C. & D.C.

AMALGAMATED WIRELESS.
Assoc. General Electric.
A.Z. Radio Pty. Ltd.
Beale & Co. Ltd.
Begg, Wm. & Sons.
Bloch & Gerber Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Davis, A. G. & Co.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY CO.
Essanay Mfg. Co. Pty. Ltd.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
James Mfg. Co. Ltd.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Majestic Radio Mfg. Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Radiette Radio Ltd.
RADIO & TELEVISION MFRS.
RADIO CORPORATION.
RAYCOPHONE LTD.
Savery's Pianos Ltd.
SMITH SONS & REES LTD.
Sth.-Aust. Phono-Radio.
Standard Telephones.
STROMBERG-CARLSON
Superheterodyne Pty. Ltd.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
THOMPSONS RADIO LTD.
TILBURY & LEWIS.
Trackson Bros. Pty. Ltd.
VEALL, A. J. PTY. LTD.
Wagga Wireless Distribs.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
WILLIAMS, P. & R. LTD.
Wyper Howard Ltd.

RECORD CHANGERS (Electric)

Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
MICK SIMMONS LTD.
NOYES BROS. (MELB.).
Savery's Pianos Ltd.
Trackson Bros. Pty. Ltd.
United Radio Distribs.

RECTIFIERS (Metal & Dry Contact)

AMPLION (A/SIA) LTD.
Bloch & Gerber Ltd.
Custom Built Radio
Davis, A. G. & Co.
Don Electrical Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Invincible Radio Co.
LEKMEK RADIO.
Martin de Launay Ltd.
McKenzie & Holland.
McLELLAN, Wm. J.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Trackson Bros. Pty. Ltd.
United Radio Distribs.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Westcott Hazell & Co. Ltd.

RECTIFIERS (Valve)

AMALGAMATED WIRELESS LTD.
AMALGAMATED WIRELESS VALVE CO.
Assoc. General Electric.
Atkins (W.A.) Ltd.
A.Z. Radio Pty. Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
BARDSLEYS LTD.
Beale & Co. Ltd.
Begg, Wm. & Sons.
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
Bland Radio.
Brandts Ltd.
BREVILLE RADIO.
BRITISH GENERAL ELECTRIC.
Brooklands Accessories.
Brooks Robinson & Co.
Bruce Small Pty. Ltd.
Buckland, Wm. L. Pty. Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
EASTERN TRADING CO.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
Farm & Pastoral Supplies.
Findlay Bros. Pty. Ltd.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
Grice, G. J. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
Invincible Radio Co.
Jackson & MacDonald.
Keep Bros. & Wood.
Kohn Bros.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Little, H. C. & Co.
Maclurcan, Chas. D.
Martin de Launay Ltd.
MICK SIMMONS LTD.
MULLARD RADIO CO.
Musgrove's Ltd.
Ord Radio Pty. Ltd.
PHILIPS LAMPS.
Price, J. C.
Pritchard, J. G.
PYROX PTY. LTD.
RADIO & TELEVISION MFRS.
RADIO CORPORATION.
RAYCOPHONE LTD.
REGENT RADIO PTY. LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Savery's Pianos Ltd.
Small, H. G. & Co.
SMITH SONS & REES LTD.
Sth.-Aust. Phono-Radio.
Standard Telephones.
STROMBERG-CARLSON.
Superheterodyne Pty. Ltd.
Syme, W. A. & Co.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
THOMPSONS RADIO LTD.
TILBURY & LEWIS.
Trackson Bros. Pty. Ltd.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Invincible Radio Co.
LEKMEK RADIO.
Martin de Launay Ltd.
McKenzie & Holland.
McLELLAN, Wm. J.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Trackson Bros. Pty. Ltd.
United Radio Distribs.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Westcott Hazell & Co. Ltd.

TYME LTD.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.).
United Radio Distrib.
University Radio Co.
VEALL, A. J. PTY. LTD.
Wagga Wireless Distrib.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.

REMOTE CONTROL UNITS.

Bloch & Gerber Ltd.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
EFCO. MFG. CO. LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Martin de Launay Ltd.
McColl Electric Works.
MICK SIMMONS LTD.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
O'BRIEN O. H.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.

REPAIRS (Coils, Headphones, Transformers, Etc.)

AMPLION (A/SIA) LTD.
Bloch & Gerber Ltd.
Chandler, J. B. & Co.
Davis, A. G. & Co.
Don Electrical Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
EXPRESS UNIVERSAL.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Invincible Radio Co.
LEKMEK RADIO.
Martin de Launay Ltd.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
Radio Power Supplies.
RAYCOPHONE LTD.
Savery's Pianos Ltd.
Teleradio Construction.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Wendel Electric Co.
Westcott Hazell & Co. Ltd.
YELLAND, L. J.

REPETITION WORK.

Acme Radio Laboratories.
A.S.A. Equipment Co. Ltd.
Begg, Wm. & Sons.
Colonial Radio Pty. Ltd.
EFCO MFG. CO. LTD.
Essanay Mfg. Co.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Howard Radio Pty. Ltd.
Martin de Launay Ltd.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
SIMPLEX RADIO.
TARGAN ELECTRIC CO.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Wendel Electric Co.

RESISTANCES (FIXED).

AIRZONE (1931) LTD.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
CROWN RADIO MFG. CO.
Custom Built Radio.
Davis, A. G. & Co.
Don Electrical Co.
DUCON CONDENSER PTY. LTD.
DUFFY RADIO CO. LTD.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HECHT, J. & CO.
Howard Radio Pty. Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
Invincible Radio Co.
Jackson & MacDonald.
Martin de Launay Ltd.
McColl Electric Works.
McLELLAN, Wm. J.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
PARAMOUNT RADIO.
Price, J. C.
Pritchard, J. G.
Radiette Radio Ltd.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
RAYCOPHONE LTD.
R.C.S. RADIO.
Reliance Radio Co
REYNOLDS, R. W. LTD.
Rose, Reg. & Co. Ltd.
Small, H. G. & Co.
STROMBERG-CARLSON
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
TILBURY & LEWIS.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.).
United Radio Distrib.
VEALL, A. J. PTY. LTD
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.

RESISTANCES (Variable)

Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Cooke Bros. Ltd.
CROWN RADIO MFG. CO.
Don Electrical Co.
EASTERN TRADING CO.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Martin de Launay Ltd.
McColl Electric Works.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
O'BRIEN, O. H.
Price, J. C.
RAYCOPHONE LTD.
R.C.S. RADIO.
Reliance Radio Co.
Savery's Pianos Ltd.
STROMBERG-CARLSON
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Westcott Hazell & Co. Ltd.
Zenith Radio Co. Ltd.

RHEOSTATS.

AIRZONE (1931) LTD.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
Chandler, J. B. & Co.
CROWN RADIO MFG. CO.
Custom Built Radio.
Davis, A. G. & Co.
Don Electrical Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Martin de Launay Ltd.
McColl Electric Works.
McLELLAN, Wm. J.
MEAD MFG. CO.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. J.
PARAMOUNT RADIO.
Price, J. C.
RAYCOPHONE LTD.
R.C.S. RADIO.
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Small, H. G. & Co.
Standard Telephones.
Trackson Bros. Pty. Ltd.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.

ROTARY CONVERTERS.

Assoc. General Elec.
Don Electrical Co.
Embelton, G. P. & Co.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Martin de Launay Ltd.
McColl Electric Works.
MICK SIMMONS LTD.
Newton McLaren Ltd.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.

SCREWDRIVERS.

FOX & MacGILLYCUDDY LTD.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Lawrence & Hanson Elec.
WARBURTON FRANKI LTD.

SCREWS.

Assoc. General Electric.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
Chandler, J. B. & Co.
Custom Built Radio.
Davis, A. G. & Co.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Howard Radio Pty. Ltd.
HUDSON, EDGAR V. LTD.
Jackson & MacDonald.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY)
Price, J. C.
RAYCOPHONE LTD.
Rose, Reg. & Co. Ltd.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Wescott Hazell & Co. Ltd.

SERVICE & REPAIRS (for Trade)

Colonial Radio Pty. Ltd.
DUFFY RADIO CO LTD.
EXPRESS UNIVERSAL.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
Radiette Radio Ltd.
RAYCOPHONE LTD.
Standard Telephones.
TARGAN ELECTRIC CO.
Trackson Bros. Pty. Ltd.
VEALL, A. J. PTY. LTD.

SHIELDS & SCREENS.

ACORN PRESSED METAL CO.
AIRZONE (1931) LTD.
ARNOLD & NUNN.
A.S.A. Equipment Co.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Bloch & Gerber Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Electricity Meter.
Embelton, G. P. & Co.
Essanay Mfg. Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Howard Radio Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
LEKMEK RADIO.
Martin de Launay Ltd.
Mick Simmons Ltd.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
RAYCOPHONE LTD.
R.C.S. RADIO.
Reliance Radio Co.
STROMBERG-CARLSON
TARGAN ELECTRIC CO.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.).
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

SOCKETS

AIRZONE (1931) LTD.
Associated General Electric
A.S.A. Equipment Co.
A.Z. Radio Pty. Ltd.
Bloch & Gerber Ltd.
Carlyle & Co.
CARR, JAMES & VAUTIN
Chandler, J. B. & Co.
COMMONWEALTH MOULDING CO. LTD.
Cooke Bros. Ltd.
Custom Built Radio
Dalton, H. & Co.
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
Essanay Mfg. Co. Pty. Ltd.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HECHT, H. & CO.
Howard Radio Pty. Ltd.
Hudson, Edgar V. Ltd.
Jackson & MacDonald
LEKMEK RADIO
Martin de Launay Ltd.
McCLELLAN, WM. J.
MICK SIMMONS LTD.
Nally Ltd
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
PEERLESS MFG. CO. LTD.
Price, J. C.
RAYCOPHONE LTD.
Reliance Radio Co.
REYNOLDS, R. W. LTD.

Rose, Reg. & Co. Ltd.
SIMPLEX RADIO
Standard Telephones
STROMBERG-CARLSON
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Westcott Hazell & Co. Ltd.

SOLDERING MATERIAL—IRONS, ETC.

Associated General Electric
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio
Davis, A. G. & Co.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio
Newton McLaren Ltd.
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
Price, J. C.
Rose. Reg. & Co. Ltd.
TARGAN ELECTRIC CO.
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, E. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.

SPARK SUPPRESSORS (Auto. Radio)

A/sian Engr. Equipment
Bloch & Gerber Ltd.
EASTERN TRADING CO. LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
International Radio Co.
Martin de Launay Ltd.
McColl Electric Works
McLELLAN, WM. J.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
Price, J. C.
PYROX PTY. LTD.
REYNOLDS, R. W. LTD.
Reliance Radio Co.
Savery's Pianos Ltd.
STROMBERG-CARLSON
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
Westcott Hazell & Co.

SPEAKERS (Dynamic)

AMALGAMATED WIRELESS
AMPLION A/SIA LTD.
Atkins (W.A.) Ltd.
Beale & Co. Ltd.
Begg, Wm. & Sons
Bloch & Gerber Ltd.
Brash, M. & Co. Pty. Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
Carlyle & Co.
Chandler. J. B. & Co.
Custom Built Radio
Davis, A. G. & Co
DUCON CONDENSER PTY. LTD.
DUFFY RADIO CO. LTD.
DUKE, ALAN PTY. LTD.
ECLIPSE RADIO PTY. LTD.
Electricity Meter
FIRTH BROS. PTY. LTD.
FOX & MacGILLYCUDDY
Gardam, J. R. W. & Co.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HECHT, H. & CO.
Hudson, Edgar V. Ltd.
International Radio Co.
Invincible Radio Co.
Jackson & MacDonald
Jensen Radio Mfg. Co.
LEKMEK RADIO
Magnavox (Aust.) Ltd.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Musgrove's Ltd.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
PHILIPS LAMPS
Price, J. C.
Radio Industries Ltd.
Radio Merchants Ltd.
Reliance Radio Co.
ROLA CO. AUST. PTY. LTD.
Rose, Reg. & Co. Ltd.
Savery's Pianos Ltd.
Small, H. G. & Co.
SMITH, SONS & REES LTD.
South Australian Phono-Radio
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.
Zenith Radio Co. Ltd.

SHORT-WAVE CONVERTERS

AMALGAMATED WIRELESS
Bloch & Gerber Ltd.
BREVILLE RADIO
Colville-Moore Wireless
COMMONWEALTH MOULDING
Custom Built Radio
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
Essanay Mfg. Co.
FOX & MacGILLYCUDDY
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO
Martin de Launay Ltd.
MEAD MFG. CO.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
Reliance Radio Co.
Savery's Pianos Ltd.
Standard Telephones
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.
YELLAND, L. J.
Zenith Radio Co. Ltd.

SHORT-WAVE COMPONENTS

AIRZONE (1931) LTD.
A.S.A. Equipment Co.
Bloch & Gerber Ltd.
BREVILLE RADIO
Carlyle & Co.
Chandler. J. B. & Co.
Colville-Moore Wireless
COMMONWEALTH MOULDING
Custom Built Radio
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
Essanay Mfg. Co.
FOX & MacGILLYCUDDY
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO
Martin de Launay Ltd.
MEAD MFG. CO.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (MELB.)
NOYES BROS. (SYDNEY)
O'BRIEN, O. H.
PARAMOUNT RADIO
PEERLESS MFG. CO. LTD.
Price, J. C.
Radiette Radio Ltd.
RAYCOPHONE LTD.
R.C.S. RADIO
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
Standard Telephones
Trackson Bros. Pty. Ltd.
United Radio Distributors
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.
YELLAND, L. J.
Zenith Radio Co. Ltd.

SPEAKERS (Permanent Magnet)

AMPLION A/SIA LTD.
Bloch & Gerber Ltd.
BREVILLE RADIO
BRITISH GENERAL ELECTRIC
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
FIRTH BROS. PTY. LTD.
FOX & Mac GILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Invincible Radio Co.
Jackson & MacDonald
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
Price, J. C.
ROLA CO. AUST. PTY. LTD.
Reliance Radio Co.
Trackson Bros. Pty. Ltd.
United Radio Distributors
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.
Zenith Radio Co. Ltd.

STAMPINGS

ACORN PRESSED METAL CO.
ARNOLD & NUNN.
CROWN RADIO MFG. CO.
EFCO MFG. CO. LTD.
EYELETS PTY. LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Healing, A. G. Ltd.
HECHT, H. & CO.
Howard Radio Pty. Ltd.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
REYNOLDS. R. W. LTD.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
Wendel Electric Co.

SUPERHET COMPONENTS.

AIRZONE (1931) LTD.
Bloch & Gerber Ltd.
BREVILLE RADIO.
Carlyle & Co.
Chandler. J. B. & Co.
Custom Built Radio.
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Howard Radio Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Little, H. C. & Co. Ltd.
Martin de Launay Ltd.
METROPOLITAN ELECTRIC.
MICK SIMMONS LTD.
Nattonal Radio.
Newton McLaren Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
RAYCOPHONE LTD.
R.C.S. RADIO.
Rose, Reg. & Co. Ltd.
SMITH SONS & REES LTD.
Sth.-Aust. Phono-Radio.
Standard Telephones.
STROMBERG-CARLSON
Superheterodyne.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.)
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co.
YELLAND, L. J.
ZENITH RADIO CO. LTD.

SUPPRESSORS (Diathermy)

Don Electrical Co.

SWITCHES (All-Wave)

Begg, Wm. & Sons.
Bloch & Gerber Ltd.
BREVILLE RADIO.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
Chandler, J. B. & Co.
COMMONWEALTH MOULDING.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
EFCO MFG. CO. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
LEKMEK RADIO.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Nally Ltd.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
R.C.S. RADIO.
Reliance Radio Co.
Rose, Reg. & Co. Ltd.
SMITH SONS & REES LTD.
Standard Telephones.
STROMBERG-CARLSON
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Westcott Hazell & Co. Ltd.
Zenith Radio Co. Ltd.

SWITCHES (ELECTRIC).
(See Electrical Accessories).

TENSION TESTERS.

PHILIPS LAMPS

TERMINAL BOARDS.

CROWN RADIO MFG. CO.

TERMINAL CONNECTORS & TAGS.

ACORN PRESSED METAL CO.
A.S.A. Equipment Co.
Bloch & Gerber Ltd.
Carlyle & Co.
CARR, JAMES & VAUTIN.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Davis, A. G. & Co.
ECLIPSE RADIO PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
Harris Scarfe Ltd.

Healing, A. G. Ltd.
HOELLE, J. J. & CO.
Hudson, Edgar V. Ltd.
Lawrence & Hanson Elec.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Price, J. C.
REYNOLDS, R. W. LTD.
Rose, Reg. & Co. Ltd.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wetless Electric Mfg. Co.

TONE CONTROLS.

Begg, Wm. & Sons.
Bloch & Gerber Ltd.
CROWN RADIO MFG. CO.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Martin de Launay Ltd.
McColl Electric Works.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Price, J. C.
RAYCOPHONE LTD.
Reliance Radio Co.
SIMPLEX RADIO.
Standard Telephones.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Wetless Electric Mfg. Co.
Zenith Radio Co. Ltd.

TORCHES.

Assoc. General Electric.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
EVER READY CO.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jackson & MacDonald.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Savery's Pianos Ltd.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.).
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.

TORCH REFILLS.

EVER-READY CO.
HERBERHOLDS (IMPEX).
VOLTA DRY BATTERIES.
WIDDIS DIAMOND DRY CELLS.

TRANSMITTING APPARATUS.

AMALGAMATED WIRELESS.
Chandler, J. B. & Co.
Colville-Moore Wireless.
DUFFY RADIO CO. LTD.
Genders, W. & G. Pty. Ltd.
MICK SIMMONS LTD.
Newton McLaren Ltd.
NOYES BROS.
PHILIPS LAMPS.
Radiette Radio Ltd.
Standard Telephones.
VEALL, A. J. PTY. LTD.

TRANSFORMERS (Audio)

ACORN PRESSED METAL CO.
AIRZONE (1931) LTD.
AMPLION (A/SIA) LTD.
A S A Equipment Co. Ltd.
Begg, Wm. & Sons.
Bloch & Gerber Ltd.
BREVILLE RADIO.
Carlyle & Co.
Chandler J. B. & Co.
Cooke Bros. Ltd.
Creela Radio Products.
Custom Built Radio.
Davis, A. G. & Co.
Don Electrical Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Electricity Meter.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HENDERSON, P. A.
Hilco Products Pty. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
James Mfg. Co. Ltd.
LEKMEK RADIO.
Martin de Launay.
McKenzie & Holland.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
Nally Ltd.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
Price, J. C.
Radio Industries Ltd.
Radio Merchants Ltd.
Radix Power Supplies.
RAYCOPHONE LTD.
Standard Telephones.
STROMBERG-CARLSON
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Westcott Hazel & Co. Ltd.
YELLAND, L. J.

TRANSMITTER FRAMES (Steel)

Williams, S. & Co.

TRANSFORMERS (Intermediate Frequency)

AIRZONE (1931) LTD.
AMPLION (A/SIA) LTD.
Atkins, (W.A.) Ltd.
Bloch & Gerber Ltd.
BREVILLE RADIO.
BRITISH GENERAL ELECTRIC.
CARLYLE & CO.
Chandler, J. B. & Co.
CROWN RADIO MFG. CO.
Davis, A. G. & Co.
Dobbie. E. Ltd.
DUFFY RADIO CO. LTD.
DUKE, ALAN PTY. LTD.
ECLIPSE RADIO PTY. LTD.
ELECTRICAL SPECIALITY CO.
Embelton. G. P. & Co.
FIRTH BROS. PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Harris Scarfe Sandovers.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Howard Radio Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Little, H. C. & Co. Ltd.
Majestic Radio Mfg. Co.
Martin de Launay Ltd.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
Nally Ltd.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
Radiette Radio Ltd.
RAYCOPHONE LTD.
R.C.S. RADIO.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Sth.-Aust. Phono-Radio.
Standard Telephones.
STROMBERG-CARLSON
Syme, W. A. & Co.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
TILBURY & LEWIS.
Trackson Bros. Pty. Ltd.
Unbehaun & Johnstone Ltd.
Unbehaun & Johnstone (W.A.).
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON, FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Westcott Hazell & Co. Ltd.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.
YELLAND, L. J.

TRANSFORMER LAMINATIONS.

AIRZONE (1931) LTD.
ARNOLD & NUNN.
Don Electrical Co.
EFCO MFG. CO. LTD.
Embelton, G. P. & Co.
Genders, W. & G. Pty. Ltd.
Harris Scarfe Ltd.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
Standard Telephones.
TARGAN ELECTRIC CO.
Trackson Bros. Pty. Ltd.
Wendel Electric Co.

TRANSFORMERS (POWER & CLASS B).

A.Z. Radio Pty. Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
Chandler, J. B. & Co.
Creela Radio Products.
Don Electrical Co.
Denford, H. W.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HENDERSON, P. A.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Little, H. C. & Co. Ltd.
Martin de Launay Ltd.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Price, J. C.
Radio Merchants Ltd.
Radix Power Supplies.
RAYCOPHONE LTD.
Sth.-Aust. Phono-Radio.
Standard Telephones.
STROMBERG-CARLSON
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.
Wendel Electric Co.
Westcott Hazell & Co. Ltd.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.
YELLAND, L. J.

TUBES—VACUUM.
(See Valves).

VALVE TESTERS.

Assoc. General Electric.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
EASTERN TRADING CO. LTD.
EXPRESS UNIVERSAL.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Hudson, Edgar V. Ltd.
Martin de Launay Ltd.
MICK SIMMONS LTD.
Newton McLaren Ltd.

VALVES (Thermionic-Vacuum, All Types

AMALGAMATED WIRELESS.
AMALGAMATED WIRELESS VALVE CO.
Assoc. General Electric.
Atkins (W.A.) Ltd.
A.Z. Radio Pty. Ltd.
Bateman, M. J. Ltd.
Baty, C. S. & Co.
Beale & Co. Ltd.
Begg, Wm. & Sons.
Bennett & Wood Ltd.
Bloch & Gerber Ltd.
Brandts Ltd.
BREVILLE RADIO.
BRITISH GENERAL ELECTRIC.
Brooklands Accessories.
Brooks Robinson & Co.
Bruce Small Pty. Ltd.
Buckland, Wm. L. Pty. Ltd.
Brash, M. & Co. Pty. Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
Dobbie. E. Ltd.
DUFFY RADIO CO. LTD.
DUKE, ALAN PTY. LTD.
EASTERN TRADING CO. LTD.
ECLIPSE RADIO PTY. LTD.
Farm & Pastoral Supplies.
Findlay Bros, Pty Ltd.
FIRTH BROS. PTY. LTD.
FOX & MacGILLYCUDDY LTD.
Gardam, J. R. W. & Co.
Genders, W. & G. Ltd.
Gerard & Goodman Ltd.
Gladiola Co.
Graber Electric Co.
Grice, G. J. Ltd.
HARRINGTONS LTD.
Harris, D. & Co.
Harris Scarfe Ltd.
Harris Scarfe Sandovers.
Harrold, A. E.
HARTLEYS PTY. LTD.
HAZELL & MOORE LTD.
Healing, A. G. Ltd.
Homecrafts Pty. Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
Invincible Radio Co.
Jackson & MacDonald.
Lawrence & Hanson Elec.
LEKMEK RADIO.
Little, H. C. & Co. Ltd.
Maclurcan, Chas. D.
Martin de Launay Ltd.
McLELLAN, Wm. J.
MICK SIMMONS LTD.
MULLARD RADIO CO.
Musgrove's Ltd.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
Nicholsons Ltd.
Nilson, O. J. Pty. Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
PHILIPS LAMPS.
Price, J. C.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
RADIO CORPORATION.
REGENT RADIO PTY. LTD.
Rose, Reg. & Co.
Reliance Radio Co.
Savery's Pianos Ltd.
Shafto, Ronn & Co.
Small, H. G. & Co.
SMITH SONS & REES LTD.
Sth.-Aust. Phono-Radio.
Standard Telephones.
Superheterodyne Ptl. Ltd.
Trackson Bros. Pty. Ltd.
TYME LTD.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Wagga Wireless Distrib.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Wills & Co. Pty. Ltd.
Wyper Howard Ltd.
Zenith Radio Co. Ltd.

VALVES (Transmitting)

AMALGAMATED WIRELESS.
AMALGAMATED WIRELESS VALVE CO.
BRITISH GENERAL ELECTRIC.
HARRINGTONS LTD.
MULLARD RADIO CO.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
PHILIPS LAMPS.
Standard Telephones.
TYME LTD.
VEALL, A. J. PTY. LTD.
Wyper Howard Ltd.

VIBRATORS.

EASTERN TRADING CO. LTD.
International Radio Co.

VISUAL TUNING METERS.

EFCO MFG. CO. LTD.
EXPRESS UNIVERSAL.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
MICK SIMMONS LTD.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
O'BRIEN, O. H.
Parish, Hayward C.
RAYCOPHONE LTD.
STROMBERG CARLSON.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Zenith Radio Co. Ltd.

VOLTAGE DIVIDERS.

Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Colonial Radio Pty. Ltd.
Cooke Bros. Ltd.
CROWN RADIO MFG. CO.
Davis, A. G. & Co.
Don Electrical Co.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Healing, A. G. Ltd.
Howard Radio Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jansen, H. E. C.
Martin de Launay Ltd.
McColl Electric Works.
McLELLAN, Wm. J.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS CO.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
O'BRIEN, O. H.
PARAMOUNT RADIO
Price, J. C.
RAYCOPHONE LTD.
R.C.S. RADIO
REYNOLDS, R. W. LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Small, H. G. & Co.
Standard Telephones
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Wendel Electric Co.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.
Zenith Radio Co. Ltd.

VOLUME CONTROLS

AIRZONE (1931) LTD.
Begg, Wm. & Sons
Bloch & Gerber Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
COMMONWEALTH MOULDING
CROWN RADIO MFG. CO.
Custom Built Radio
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HECHT, H. & CO.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jackson & MacDonald
Lawrence & Hanson Elec.
LEKMEK RADIO
Martin de Launay Ltd.
McColl Electric Works
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
PARAMOUNT RADIO.
Peerless Metal Works.
Price, J. C.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
RAYCOPHONE LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Standard Telephones.
STROMBERG-CARLSON.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Zenith Radio Co. Ltd.

WANDER PLUGS.

Bloch & Gerber Ltd.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.

WASHERS.

EYELETS PTY. LTD.
REYNOLDS, R. W. LTD.

WAVE METERS.

AMALGAMATED WIRELESS
HARRINGTONS LTD.
Harris Scarfe Ltd.
LEKMEK RADIO.
Martin de Launay Ltd.
McColl Electric Works.
MICK SIMMONS LTD.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Parish, Hayward C.
Standard Telephones.
Trackson Bros. Pty. Ltd.
VEALL, A. J. PTY. LTD.
Westcott Hazell & Co. Ltd.

WAVE TRAPS.

Beale & Co.
Bloch & Gerber Ltd.
BREVILLE RADIO.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
Chandler, J. B. & Co.
Custom Built Radio.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Jackson & MacDonald.
Martin de Launay Ltd.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
Price, J. C.
R.C.S. RADIO.
Rose, Reg. & Co. Ltd.
Slade's Radio.
Standard Telephones.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.
Zenith Radio Co. Ltd.

WIRE (Connecting)

Assoc. General Electric.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
CARR, JAMES & VAUTIN.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
Enfield Cable Works.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HECHT H. & CO.
Hudson, Edgar V. Ltd.
International Radio Co.
Jackson & MacDonald.
Lawrence & Hanson Elec.
LIVERPOOL ELECTRIC CABLE.
Martin de Launay Ltd.
McLELLAN, Wm. J.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
SMITH SONS & REES LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.

WIRE (Hook-up)

Cooke Bros. Ltd.
International Radio Co.
LIVERPOOL ELECTRIC CO.
O'BRIEN O. H.

WIRE (Resistance)

Assoc. General Electric.
Bloch & Gerber Ltd.
Boswell & Co.
BRITISH GENERAL ELECTRIC.
Don Electrical Co.
Enfield Cable Works.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
LIVERPOOL ELECTRIC CABLE.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
O'BRIEN, O. H.
Price, J. C.
Reliance Radio Co.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

WIRE (Screened)

Assoc. General Electric.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Enfield Cable Works.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
LIVERPOOL ELECTRIC CABLE.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
O'BRIEN, O. H.
Price, J. C.
Reliance Radio Co.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

WIRES (Winding Plain, Cotton, Enamel Silk, Etc.)

Boswell & Co.
Carlyle & Co.
Chandler, J. B. & Co.
Hudson, Edgar V. Ltd.
Lawrence & Hanson Elec.
LIVERPOOL ELECTRIC CABLE.
O'BRIEN, O. H.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

VALVES (Transmitting)

AMALGAMATED WIRELESS.
AMALGAMATED WIRELESS VALVE CO.
BRITISH GENERAL ELECTRIC.
HARRINGTONS LTD.
MULLARD RADIO CO.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
PHILIPS LAMPS.
Standard Telephones.
TYME LTD.
VEALL, A. J. PTY. LTD.
Wyper Howard Ltd.

VIBRATORS.

EASTERN TRADING CO. LTD.
International Radio Co.

VISUAL TUNING METERS.

EFCO MFG. CO. LTD.
EXPRESS UNIVERSAL.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
MICK SIMMONS LTD.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
O'BRIEN, O. H.
Parish, Hayward C.
RAYCOPHONE LTD.
STROMBERG CARLSON.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Zenith Radio Co. Ltd.

VOLTAGE DIVIDERS.

Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Colonial Radio Pty. Ltd.
Cooke Bros. Ltd.
CROWN RADIO MFG. CO.
Davis, A. G. & Co.
Don Electrical Co.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Healing, A. G. Ltd.
Howard Radio Pty. Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jansen, H. E. C.
Martin de Launay Ltd.
McColl Electric Works.
McLELLAN, Wm. J.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS CO.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
O'BRIEN, O. H.
PARAMOUNT RADIO
Price, J. C.
RAYCOPHONE LTD.
R.C.S. RADIO
REYNOLDS, R. W. LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Small, H. G. & Co.
Standard Telephones
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Wendel Electric Co.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.
Zenith Radio Co. Ltd.

VOLUME CONTROLS

AIRZONE (1931) LTD.
Begg, Wm. & Sons
Bloch & Gerber Ltd.
Carlyle & Co.
Chandler, J. B. & Co.
COMMONWEALTH MOULDING
CROWN RADIO MFG. CO.
Custom Built Radio
Davis, A. G. & Co.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
FOX & MacGILLYCUDDY
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HECHT, H. & CO.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Jackson & MacDonald
Lawrence & Hanson Elec.
LEKMEK RADIO
Martin de Launay Ltd.
McColl Electric Works
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio
NEW SYSTEM TELEPHONES
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
PARAMOUNT RADIO.
Peerless Metal Works.
Price, J. C.
Radio Merchants Ltd.
Radio Wholesalers Ltd.
RAYCOPHONE LTD.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
Standard Telephones.
STROMBERG-CARLSON.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.
Zenith Radio Co. Ltd.

WANDER PLUGS.

Bloch & Gerber Ltd.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.

WASHERS.

EYELETS PTY. LTD.
REYNOLDS, R. W. LTD.

WAVE METERS.

AMALGAMATED WIRELESS
HARRINGTONS LTD.
Harris Scarfe Ltd.
LEKMEK RADIO.
Martin de Launay Ltd.
McColl Electric Works.
MICK SIMMONS LTD.
Newton McLaren Ltd.
NOYES BROS. (MELB.).
NOYES BROS. (SYDNEY).
Parish, Hayward C.
Standard Telephones.
Trackson Bros. Pty. Ltd.
VEALL, A. J. PTY. LTD.
Westcott Hazell & Co. Ltd.

WAVE TRAPS.

Beale & Co.
Bloch & Gerber Ltd.
BREVILLE RADIO.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
Chandler, J. B. & Co.
Custom Built Radio.
DUFFY RADIO CO. LTD.
ECLIPSE RADIO PTY. LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
Hudson, Edgar V. Ltd.
Jackson & MacDonald.
Martin de Launay Ltd.
METROPOLITAN ELECTRIC CO.
MICK SIMMONS LTD.
National Radio.
NEW SYSTEM TELEPHONES.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
Price, J. C.
R.C.S. RADIO.
Rose, Reg. & Co. Ltd.
Slade's Radio.
Standard Telephones.
TARGAN ELECTRIC CO.
THOM & SMITH LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.
Zenith Radio Co. Ltd.

WIRE (Connecting)

Assoc. General Electric.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Carlyle & Co.
CARR, JAMES & VAUTIN.
Chandler, J. B. & Co.
Cooke Bros. Ltd.
Custom Built Radio.
Davis, A. G. & Co.
ECLIPSE RADIO PTY. LTD.
Embelton, G. P. & Co.
Enfield Cable Works.
FOX & MacGILLYCUDDY LTD.
Genders, W. & G. Pty. Ltd.
Gerard & Goodman Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
HARTLEYS PTY. LTD.
Healing, A. G. Ltd.
HECHT H. & CO.
Hudson, Edgar V. Ltd.
International Radio Co.
Jackson & MacDonald.
Lawrence & Hanson Elec.
LIVERPOOL ELECTRIC CABLE.
Martin de Launay Ltd.
McLELLAN, Wm. J.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
NOYES BROS. (SYDNEY).
O'BRIEN, O. H.
Price, J. C.
Rose, Reg. & Co. Ltd.
Reliance Radio Co.
SMITH SONS & REES LTD.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.

WIRE (Hook-up)

Cooke Bros. Ltd.
International Radio Co.
LIVERPOOL ELECTRIC CO.
O'BRIEN O. H.

WIRE (Resistance)

Assoc. General Electric.
Bloch & Gerber Ltd.
Boswell & Co.
BRITISH GENERAL ELECTRIC.
Don Electrical Co.
Enfield Cable Works.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Hudson, Edgar V. Ltd.
Invincible Radio Co.
LIVERPOOL ELECTRIC CABLE.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
O'BRIEN, O. H.
Price, J. C.
Reliance Radio Co.
Trackson Bros. Pty. Ltd.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

WIRE (Screened)

Assoc. General Electric.
Bloch & Gerber Ltd.
BRITISH GENERAL ELECTRIC.
Enfield Cable Works.
Genders, W. & G. Pty. Ltd.
HARRINGTONS LTD.
Harris Scarfe Ltd.
Hudson, Edgar V. Ltd.
International Radio Co.
LIVERPOOL ELECTRIC CABLE.
Martin de Launay Ltd.
MICK SIMMONS LTD.
National Radio.
Newton McLaren Ltd.
O'BRIEN, O. H.
Price, J. C.
United Radio Distrib.
VEALL, A. J. PTY. LTD.
Watson, W. G. & Co. Ltd.
Westcott Hazell & Co. Ltd.
Wyper Howard Ltd.

WIRES (Winding Plain, Cotton, Enamel Silk, Etc.)

Boswell & Co.
Carlyle & Co.
Chandler, J. B. & Co.
Hudson, Edgar V. Ltd.
Lawrence & Hanson Elec.
LIVERPOOL ELECTRIC CABLE.
O'BRIEN, O. H.
WARBURTON FRANKI LTD.
Watson, W. G. & Co. Ltd.

Prominent Radio Traders

This list comprises the trading name, address and 'phone of many prominent radio traders throughout Australia who have submitted their particulars for insertion. It is not intended that this list be taken as including all radio traders, and the publishers accept no responsibility for inserting these names, or for any omissions. A fee of 2/6 is charged for each insertion.

ACE AUTOS LTD., Port Lincoln, S.A. Phone 258.
AIR-ACE RADIO LABORATORY, 21 Meeks Rd., Marrickville, N.S.W.
AIRZONE (1931) LTD., 886 Hay St., Perth, W.A. B5726-B5808. Telegrams: "Airzone," Perth.
AMOS, O., 4 Fairfield Ave., Yallourn, Vic.
ANDERSON, E., 139 Oxford St., Sydney. FL 2382.
ANTHONY, MARK, George St., Belmont, N.S.W.
AUSTRALIAN RADIO SUPPLY CO., 804 Hay St., Perth, W.A. B 4000.
BAIRDS CO. LTD., THE, Murray St., Perth, W.A. B 2161.
BALRANALD RADIO CO., Balranald, N.S.W. Bal. 131.
BARNES, E. L., Cnr. Ryrie and Gheringhap Sts., Geelong, Vic. Gee. 1126.
BEALE & CO. LTD., 41-47 Trafalgar St., Annandale, N.S.W. L 2791. "Beale," Sydney.
BEST MOTORS LTD., Hunter St., Wickham, N.S.W. Newcastle 699.
BLAND RADIO, 57 Allinga Ave., Knoxville, S.A. 5581. "Blandradio."
BUHLER'S LIMITED, 178 Murray St., Perth, W.A. B 1646.
CLEARATONE RADIO CO., Stanley Terrace, East Brisbane. J 1051.
COLONIAL RADIO PTY. LTD., 136-138 A'Beckett St., Melbourne. F 5655.
COLTON PALMER & PRESTON LTD., Currie St., Adelaide, S.A. 3580 (10 lines).
CORNEY, E., 487 Hunter St., Newcastle. Newcastle 1664.
COURIER RADIO (A/SIA) LTD., 94a Percival Rd., Stanmore, N.S.W. LM 1056-LM 1062.
CRAFTSMAN RADIO, 185 Military Rd., Neutral Bay. X 4956.
CROYDON RADIO ELECTRIC CO., 46 The Strand, Croydon, N.S.W.
DAVIES, R., Brennan's Arcade, Perth, W.A.
DENFORD, H. W., 57 Milligan St., Perth, W.A. B 8784.
ELECTRIC LAMP HOUSE LTD., THE, 27 Manners St., Wellington, N.Z. 41-614. "Lamphouse," Wellington.
ELECTRICAL SERVICES PTY. LTD., Queen Street, Brisbane, Qld. B 8400.
EVANS, W. A., The Wireless Shop, Cooma, N.S.W. Phone 218.
FIELD CYCLE & MOTOR WORKS, 148-144 Victoria St., Mackay, Qld. Phone 118.
FITTELL, S. L., City Bldgs., Mary St., Gympie, Qld. Phone 264.
FLEMING, BRUCE, Mount Magnet, W.A.
FRICKER, N. M., 19 Moseley St., Glenelg, S.A., X 1619
FURNER, S. F., 164 Railway Parade, Kogarah, N.S.W. LW 5935.
GALLOWAYS RADIO SUPPLIES, Lang St., Kurri Kurri, N.S.W. K.K. 238.
GARRETT, J. H., 28 Whitby St., W. Brunswick, Vic. Brun. 700.
GIBSON, L., Alstonville, Richmond River, N.S.W. Al. 209.
GIBSON, R. S., 292 Sydney Rd., Balgowlah, N.S.W. YU 2203.
GILLAN, JAS., Craigilee House, Fitzroy St., Rockhampton. 1484.
GOLDFINCH, H. R., Dawson St., Strathalbyn, S.A. Phone 203.
GRIMWOOD, S., 10 Heygarth St., Echuca, Vic. Phone 226.
GUILLE & CO. LTD., 264 King St., Newtown, N.S.W. L 1227.
HANCOCK, D. M., 51 Taylor St., Kadina, S.A. Phone 202.
HARRIS, D. & CO., Rundle Chambers, 140 Rundle St., Adelaide, S.A. Phone C 1733.
HARROLD, A. E., 123-5 Charlotte St., Brisbane, Qld. Phone B 2729.
HAEBICH & CAVANAGH PTY. LTD., Belmore St., Yarrawonga, Vic. Phone 178.
HEALING, A. G. LTD., 151-159 Pirie St., Adelaide, S.A. Phone Cen. 4635. Telegrams: "Healing."
HILCO PRODUCTS PTY. LTD., 207 Latrobe St., Melbourne, Vic. Phone M 3563.
HITZKE BROS., Campbell St., Oakey, Qld. Phone 36.
HODGE, B., Argyle St., Camden, N.S.W. Phone Cam. 59.
HOLMES, P., 78 Whitehorse Rd., Deepdene, Melbourne, Vic.
HOLT, E. A., 747 Stanley St., South Brisbane, Qld. Phone J 4379.
HOSKINS, CHAS. H. & SONS PTY. LTD., 61 Firebrace St., Horsham, Vic. Phone 145.
HUCKELL, E. D., 285 Military Rd., Cremorne. Phone Y 5086.
HULL BROWN'S RADIO, Cressy Street, Deniliquin, N.S.W. Phone 203.
IRVING, G. W., Smith Street, Kempsey, N.S.W. Phone 114.
JAMES, CH. H. & CO., 4 Airways Arcade, George Terrace, Perth, W.A. Phone B 6025.
JENKIN, P., 69 Gilmour St., Wollongong, N.S.W.
JOHNSON, L. J., 32 Templar St., Forbes, N.S.W. Phone 38.
KAVANAGH, W. W., Pittwater Road, Dee Why, N.S.W. Phone Y 8275.

KING'S RADIO & ELECTRICAL SERVICE, 227 Canterbury Road, Punchbowl, N.S.W. Phone UL 1438.
KLOSE, H., Box No. 79, Loxton, S.A.
KRUGER RADIO, Armstrong Street, Charlton, Vic. Phone 125.
KUM CHONG YEK & CO., Cassilis, N.S.W. Phone 10.
LANGSDORF, K., Nobby, Qld. Phone 6.
LENROC LIMITED, 211 Pulteney Street, Adelaide, S.A. C 8770 (4 lines).
LITTLE, H. C. & CO. LTD., 858 Hay Street, Perth, W.A. B 7148. Telegrams: "Litelectra."
LONG & CO., Parker Street, Cootamundra, N.S.W. Phone 183.
LORD, H. M., McDowall Street, Roma, Qld. Phone 188.
LUSCOMBE, L. G., Yandilla St., Pittsworth, Qld.
MARTIN, JOHN & CO. LIMITED, 92-106 Rundle St., Adelaide. C 4400. Telegrams: "Tellmartin."
MEANEYS WIRELESS SUPPLIES, 103 Keen St., Lismore, N.S.W. Phone 921.
MID STATES RADIO, 610 Dean St., Albury, N.S.W. Phone 859.
MILTON'S RADIO & ELECTRICAL SERVICE, 100 Church St., Mudgee, N.S.W. Phone 282.
MITCHELL, L., "Border Post" Building, Stanthorpe, Qld. Phone 212.
MOODY, F. P., 34 Lake Street, Cairns, Qld. Phones 2480-2671.
MORGAN, C., Carp St., Bega, N.S.W.
MOSMAN RADIO SERVICE, Poullar's Chambers, 4a Spit Rd., Mosman, N.S.W. Y 3792.
MUSGROVES LIMITED, Lyric House, Murray St., Perth, W.A. B 1971. Cables: "Pianoforte."
McLEAN, A., Erica P.O., Gippsland, Vic.
McLEOD, A. K., East Street, Rockhampton, Qld.
NEILSON, A. E. A., Mount Larcom, Qld.
NEWTON McLAREN LTD., Leigh Street, Adelaide, S.A. Cen. 8341. Telegrams: "Newton McLaren."
NILSEN, O. J. & CO. PTY. LTD., 45 Bourke Street, Melbourne. Cen. 572.
NIXON'S EXCHANGE STORES PTY. LTD., Brook St., Inglewod, Vic.
O'BRIEN, P., 60 Irvine St., South Kensington, N.S.W FJ 1240.
O'BRIEN, R. K., RADIO & ELECTRICAL SERVICE, Blatchford St., Canowindra, N.S.W. Phone 255.
PARKER, M. J., 180 Nelson Bay Road, Bronte FW 3523.
PARR, A. K., 206 Pittwater Rd., Collaroy Beach Y 8230.
PATON, F. H., 90 Victoria St., Ashfield, N.S.W.
PELL, E. M. B., P.O. Box No. 28, Bega, N.S.W. Ph. 5.
PENNY, W. LANGFORD, 53 Dalmeny Rd., Northbridge.
PERCIVAL, W. G., 146 Hampden Rd., Artarmon, N.S.W. J 5004.
PETTETT, G. C., Dowling St., Dungog, N.S.W. Phone 165.
PIDGEON, A., 814 Hay Street, Perth, W.A. B 2576.
PREMIER RADIO, 11 Constitution Rd., Ryde, N.S.W.
PRICE, J. C., Perry House, Elizabeth St., Brisbane, Qld.
QUIRKE RADIO, 493 Willoughby Rd., Wiloughby. J 1876.
RADIETTE RADIO LTD., 187 William St., Sydney. FL 1020.
RADIO HOUSE, Morgan St., Mt. Morgan, Qld. Ph. 78.
RADIO LIMITED, 1 Anzac Ave., Auckland, N.Z. Phone 45-186.
RADIO SERVICES LTD., 74a Pirie Street, Adelaide, S.A.
RADIO TRADING CO., THE, 14 Pulteney St., Adelaide, S.A. Cen. 1903.
RAINES, E. A., Auburn St., Goulburn, N.S.W. Ph. 677.
RANDWICK RADIO ELECTRIC, 2 Belmore Road, Randwick, N.S.W. FX 2260.
RAPLEY, F. H., Tocumwal, N.S.W. Phone 108.
RAY, R. J., 14 Hedger Ave., Ashfield, N.S.W.
REID, A. J., 5 Temple St., Stanmore, N.S.W. LM1189.
REUSCH'S RADIO SERVICE, P.O. Box No. 63, Nuriootpa, S.A. Nur. 48.
REVILL, R., Central Arcade, Coolac, Vic. Phone 441.
RICHARDSON'S RADIO SERVICE STN., Houston St., Stawell, Vic. Phone 287.
ROBINS, J. W., 123 Griffiths St., Balgowlah, N.S.W. YU 1209.
ROGERS & KING, Boggabilla, N.S.W.
RYAN, A. J., Kingston, Canberra, F.C.T.
RYMOLA RADIOS, Hibernian Bdgs., Adelaide Street, Brisbane, Qld. B 6341.
S.A. PHONO RADIO CO. LTD., Griffith Bdgs., 71 Hindmarsh Square, Adelaide. Cen. 1932.
SALEEBA'S SERVICE STATION, Moora, W.A. Ph. Moora 60.
SANDEL, OTTO, 248c Oxford St., Woollahra, N.S.W. FW 2625.
SCHRADER, JOHN F., 1 Cowandilla Road, Cowandilla, S.A. L 5719.
SEAGRAVE, T. H., Main Road, Bulli, N.S.W. Phone Thirroul 257.
SHEARER, C. T., Maitland St., Narrabri, N.S.W. Phone 83.
SMITH, E. J., Harrietville Road, Bright, Vic. Phone 23. Telegrams: "Smith," Bright.
SMITH, E. H. C., Little Barber St., Gunnedah, N.S.W. Phone 142.
STAHL, H. H., 27 Rawson St., Mayfield, Newcastle, N.S.W. War. 292.
STEVENSON, JOHN, Main Street, Wallerawang, Vic. Phone 25.
SULLY, CH. H., Bourke St., Glen Innes, N.S.W. Phone 130.
SYMONS RADIO & ELEC. SERVICE, Burrowa St., Young, N.S.W. Phone 180.
TATHAM, S. E., 95 William St., Sydney. FL 1767.
"TELERADIO," 97 Queen Street, Brisbane, Qld.
THE RADIO SHOP, 842 Hay St., Perth, W.A. B 5608.
THOMPSON, N. S., Cowra Avenue, Irymple, Vic. Irymple 56.
THOMPSON'S RADIO LTD., 74 Oxford Street, Darlinghurst, N.S.W. **F 2264.**
TRACKSON BROS. PTY. LTD., 157-159 Elizabeth St., Brisbane, Qld. B 2804.
TREE RADIO ELECTRIC CO., Head Office, 128 Willoughby Road, Crow's Nest. X 5713.
TREE RADIO ELECTRIC CO., Branch: 204 Sydney Street, Willoughby Junction, N.S.W.

TREE RADIO ELECTRIC CO., Branch: 407 Pacific Highway, Lane Cove, N.S.W.

TREE RADIO ELECTRIC CO., Victoria Ave. & Victor St., Chatswood, N.S.W.

TRITTON, F. PTY. LTD., 260 George Street, Brisbane, Qld. B 3641. Telegrams: "Trittons," Bris.

TURNER'S RADIO SERVICE, Station Street, Weston, N.S.W.

VENNINGS' SERVICE STATION, Graves St., Kadina, S.A. Phone 94.

VINETTE RADIO, 412 High St., West Maitland, N.S.W. Phone 690.

WALFORD & SON, 89 New Canterbury Road, Petersham. Pet. 1791.

WANGARATTA BROADCASTING PTY. LTD., Reid St., Wangaratta, Vic. Wan. 355.

W.A. RADIO SERVICE, Prince of Wales Bdgs., Murray St., Perth, W.A. B 3629.

WATERS, L., Radio House, Rankin St., Innisfail, N.Q. Phone 79.

WATSON, C.L., Manuka Arcade, Canberra, F.C.T.

WATTS, R. J., Glenlyon Street, Gladstone, Qld.

WEDGNER, N. T., 353 Penshurst Street, Willoughby Junction. J 3729.

WENKE BROS., The Parade, Tumbarumba, N.S.W. Phone 21.

WEST, L., Dalton Street, Parkes, N.S.W.

WHATMUFF'S RADIO & ELECTRICAL SERVICE, 26 George St., Parramatta, N.S.W. Ph. UW 9601.

WILEY, H., York Street, Albany, W.A. Phone 61.

WILLIAMS MOTORS, P.O. Box No. 30, Kaniva, Vic. Kaniva 82.

WILLIAMS, P. & R. LTD., 74-78 Wentworth Ave., Sydney. M 4668-9. Telegrams: "Agayess," Sydney.

WINKWORTH, C. & SON LTD., 160-4 Parramatta Rd., Annandale, N.S.W. L 1441.

WINTERBURN & CO., 66 Clarence Street, Sydney. B 1196.

WINTON, G., Campbelltown, N.S.W. Cam. 1.

WIRELESS SHOP, THE, 6-8 Royal Arcade, Sydney. MA 5543.

WYPER BROS. LTD., Bourbong Street, Bundaberg, Qld. Phone 14.

WYPER HOWARD LTD., 671-3 Hay Street, Perth, W.A. B 4697.

Radio Magazines Published in Australia

AUSTRALIAN RADIO NEWS, 252 George Street, Sydney. Phone B 7971. Weekly programme and technical journal published every Friday by the Bulletin Newspaper Co. Ltd. Editor, Norman Campbell. Technical Editor, Don B. Knock. Advt. Representative, G. Northover. Price 2d. Advertising page size 9in. x 7¼in. Column 14 ems, 2¼in.; 3 columns per page. Overall size, 11in. x 8½in.

ERDA. Official organ of the Electrical and Radio Association of N.S.W., Grace Building, King Street, Sydney. Phone M 2531. Price 6d. per copy, 5/- per annum. Advertising page size 9in. x 7in. Column 13 ems; 3 columns per page. Overall size, 11in. x 8½in. Editorial Committee: Chairman, J. Russell Greenwood; Editor-Secretary, Andrew F. O. Brown; Members, Messrs. E. R. Badgery Parker, G. K. Dunbar, W. J. Wing, A. E. Pepper. Monthly publication circulating in N.S.W.

QUEENSLAND RADIO NEWS. Printed and published by Read Press Ltd., Douglas Chambers, Adelaide Street, Brisbane. Phone B 2781. Monthly programme and technical magazine. Price 6/- per annum. Advertising page size, 8in. x 6¼in.; column 18 ems (3in.); 2 columns per page. Overall size, 9⅜in. x 7¼in.

RADIO AND ELECTRICAL MERCHANT Published by Australian Radio Publications Ltd., 15 Castlereagh Street, Sydney. Phones: B 2549-BW 6098. National Weekly Trade newspaper circulating throughout Australia covering the whole of the Radio and Electrical industry. Dealing chiefly with the merchandising side of all radio and electrical domestic appliances and service problems. The only National trade magazine devoted entirely to the welfare of the radio and electrical trade. Price 1/- per copy, or by subscription 10/- per annum (52 issues), post free. Managing Editor, Oswald F. Mingay. Advertising Manager, Geo. W. Doyle. Technical Editor, Keith Denny. Victorian Branch Office, Colin W. Smith, 422 Little Collins St., Melbourne. Phone: Central 2805. Advertising page size, 9in. x 7in. Three 13 em columns (2 1-6in.) per page. Overall size 11in. x 7½in. Blocks—half-tone, 110 screen.

RADIO MONTHLY. Published by Amateur Radio & Broadcast Monthly, 84 Pitt Street, Sydney. Phone B 4142. Monthly radio publication catering chiefly for amateur constructors and experimenters. Editor, A. Alexander. Advt. Manager, F. A. Hankin. Price 6d. per copy. Advertising page size, 9½in. x 7in.; column 13 ems. (2 1-6in.); 3 columns per page. Overall size, 11in. x 8½in.

RADIO REVIEW OF AUSTRALIA. Published by Australian Radio Publications Ltd., 15 Castlereagh Street, Sydney. Phones: B 2549-BW 6098. Monthly technical journal incorporating the proceedings of the Institution of Radio Engineers, Australia, and covering advanced radio technical subjects. Circulating throughout Australia. Price 1/- per copy or by subscription, 10/- per annum, post free. Managing Editor, Oswald F. Mingay. Technical Editor, Keith Denny. Melbourne Office, Colin W. Smith, 422 Little Collins Street, Melbourne. Phone: Central 2805. Advertising page size, 9in. x 7in. Column 20 ems (3 1-3in.); 2 columns per page. Overall size, 11in. x 8¼in. Blocks—half tone, 110 screen.

RADIO TRADE ANNUAL OF AUSTRALIA. Published by Australian Radio Publications Ltd., 15 Castlereagh Street, Sydney. Phones: B 2549-BW 6098. A stiff covered, cloth bound year book, published for the first time in Australia in March, 1933. Contains over 300 pages covering all subjects allied to radio, including particulars of Broadcasting Station activities, Acts and Regulations, patents information, Trade Association data, company particulars, an extensive technical section, Who's Who in Radio, a complete directory of the industry throughout Australia and much other essential information. Circulating throughout the Commonwealth. Price 5/- per copy post free. Managing Editor, Oswald F. Mingay. Advertising Manager, Geo. W. Doyle. Technical Editor, Keith Denny. Melbourne Branch Office, Colin W. Smith, 422 Little Collins Street, Melbourne. Phone: Central 2805. Advertising page size, 9in. x 7in. Two columns, 20 ems (3 1-3 in.) per page. Overall size, 11in. x 8¼in.

THE BROADCASTER. Published by West Australian Newspapers Ltd., Newspaper House, St. George's Terrace, Perth. Phone: B 8161. Sydney Office, 30 Carrington Street, Sydney. Phone: B 4802. (Rep., D. W. Virtue). Melbourne Office, Newspaper House, Collins Street, Melbourne. (Rep., B. Rieusset). Published weekly every Saturday, containing programmes, technical features, wireless information and sporting. 64 pages selling at 3d. per copy. Overall size 12½in. x 9in. Advertising page size, 11in. x 7½in. 3 columns, 15 ems. Blocks—half-tone, 55-65 screen newsprint.

THE LISTENER IN. Published by United Press, Herald Buildings, 62-74 Flinders Street, Melbourne. Phone: Central 6853. Published every Saturday, containing technical and programmes. Deals with development of broadcasting, etc. Price 3d. per copy. Advertising page size, 9¼in. x 6¾in.; column 10 ems, four columns per page. Overall size , 11in. x 8in. N.S.W. Office, Geo. Snape, Manager, 30 Carrington Street, Sydney. Phone: B 4186.

WEST AUSTRALIAN WIRELESS NEWS AND MUSICAL WORLD. Published by R. S. Sampson-Brokensha & Co., 971-3 Hay Street, Perth. Phones: B 4435-B 7244. Published on 1st and 16th of each month. Full programmes of all stations and technical matters. Editor, Ernest H. Shaw. Subscription, 6/6 per annum; 3d. per copy. Advertising page size, 9¼in x 7in.; column 20 ems (3 1-3in.); 2 columns per page. Overall size, 11in. x 8¼in.

WIRELESS WEEKLY. Published by Wireless Newspapers, 60-66 Elizabeth Street, Sydney. Phone: B 0333. A weekly radio magazine containing technical and programme matter. Published on Friday of each week. Price 3d. per copy. Advertising page size, 9⅜in. x 7in. Column 13 ems (2 1-6in.); three columns per page. Overall size, 11in. x 8in. Member of Audit Bureau of Circulations.

Moulding Materials

For Electrical, Mechanical and Chemical Uses

THIS is well termed the day of creative chemistry. It has given us many new and better materials without which modern industry and our present-day standards of living would be impossible.

Among such new and better materials, all products of chemical research, are vulcanized rubber, coal-tar dyes, celluloid, commercial aluminium and its alloys, carborundum, stainless steel, rayon, cellophane, and phenol resinoid plastics, of which Bakelite products were the first and remain the foremost representatives.

Phenol resinoid plastics constitute an American achievement. They were invented, in 1907, by Dr. L. H. Baekeland, after exhaustive research. Doctor Baekeland gave the world an entirely new substance, phenol resinoid, a substance which has found extensive use in nearly every field of industry. It is a significant fact that those who were the first to take advantage of the distinctive qualities of the new plastic materials based on this new substance, are to-day among the largest users of these materials.

Thus they find application in such widely divergent uses as jewellery and dentures, dash pots and grinding wheels, pump valves and timing gears, refrigerator breaker strips and condenser explosion chambers, door knobs and wall panelling, low-loss radio insulation, and radio cabinets, carbon brushes and switchboard insulation, gear shift knobs and distributor heads, lighting insulation and lamp-basing cements, chemically resistant lacquers and water resistant flexible coatings for fabrics.

What Bakelite Resinoid Is

Like most products of creative chemistry, phenol resinoid bears no resemblance to the raw materials from which it is made. Principal among these raw materials are phenol or "carbolic acid," a white crystalline solid, and formaldehyde, a gas, which when dissolved in water is commonly known as formalin. Both are highly reactive substances. Under certain definite, controlled conditions they may be caused to combine chemically, forming a distinctly new and highly useful product, a product which is resin-like but superior in its properties to any natural resin.

In its raw, or primary state, phenol resinoid is quickly softened by moderate heat, and is soluble in certain solvents, notably alcohol. Further heating, however, causes it to harden, after which it cannot again be softened at any temperature. Furthermore, the solvents which served to dissolve it in its primary state now have little or no effect on it. This property of being first fusible and soluble, and then, under the influence of heat, becoming infusible and insoluble—of becoming, in fact, a material of pronounced hardness, strength, and resistance to deteriorating agents generally, has made phenol resinoid outstanding among organic plastic materials. It is called a resinoid to distinguish it from natural resinous substances.

Bakelite resinoid is produced by the Bakelite Corporation, employing processes perfected through a quarter century of research and manufacturing experience—BAKELITE being the trade-mark employed exclusively to designate the products of the Bakelite Corporation.

Cast Bakelite resinoid, which is produced in a wide variety of colours and used extensively in the manufacture of pipe stems, parasol handles, knobs, beads, bracelets and similar articles, is not fabricated by a pressure moulding process, but is cast roughly to shape and turned or otherwise machined to finished form. Such manufacture is a special art, entirely distinct from that of plastic moulding. Leaflets describing these so-called transparent materials are available.

The Moulding Materials

Bakelite moulding materials are prepared from primary Bakelite resinoid and various so-called filling agents. The all-important ingredient is the resinoid itself, which imparts to the moulding materials the property of quickly hardening in the heat which first renders them plastic, and which, as bonding and surfacing substance, imparts to the moulded products most of their distinctive properties.

The use of the filling materials, which include woodflour, asbestos, fabric, paper is for the added value given by the special properties of these materials—better moulding qualities, greater toughness and strength, and, in the case of mineral fillers, an increased degree of water and heat-resistance. In every case the hardened Bakelite resinoid remains unchanged in its many superior properties.

The Bakelite moulding materials are prepared in either powder or sheet form and are supplied to the trade ready for use. They are made according to well-established formulas, and under close laboratory control.

Five General Classes

The moulding materials are of five general classes: Woodflour-filled materials, mineral-filled materials, moulding sheet, impact materials, special materials.

There are a number of materials in each of these classes differing in their characteristics as may be necessary to meet the requirements of specific applications. The five classes are described briefly in the following paragraphs.

Woodflour-filled Materials

The following figures represent high and low values for moulded materials of the woodflour group:

Moulded Woodflour Materials

1. Specific Gravity, 1.34 to 1.52.
2. Weight per cubic inch, 0.78 to 0.88oz (22 to 25gms.)
3. Tensile Strength, 6,000 to 11,000lbs per sq. in.
4. Compressive Strength, 25,000 to 36,000lbs. per sq. in.
5. Impact Strength $\frac{\text{(Energy to break test piece)}}{bd^2*}$ 1.00 to 3.5 ft. lbs. for an inch sq.
6. Flexural Strength (transverse), 10,000 to 20,000lbs. per sq. in.
7. Modulus of Elasticity (by flexure) 1.0 to 2.5 x 10^5 lbs. per sq. in.
8. Distortion under heat (2½ kgm. load) 120° C. to 130° C.
9. Specific Heat .3 to .4 calories per gm. per °C.
10. Thermal Conductivity 0.0004 to 0.0006 calories per sq. cm. per second per °C per cm.
11. Co-efficient of Heat Expansion 0.00003 per degree C.
12. Dielectric Strength (Instantaneous 60 cycles) 300 to 500 volts per mil; (Step 60 cycles) 250 to 400 volts per mil.
13. Volume Resistivity (at 30° C) 10^4 to 10^6 megohm-centimetres.
14. Power Factor (10^3 cycles) .04 to .15 (4.0% to 15%)** (10^6 cycles) .035 to .10 (3.5% to 10%)**
15. Dielectric Constant (10^3 cycles) 4.5 to 8; (10^6 cycles) 4.5 to 8.
16. Water Absorption (Disc 2" diameter x ⅛" thick—24 hrs.) 0.2%—0.6%; Water Absorption (Disc 2" diameter x ⅛" thick—144 hrs.) 0.6%—2.0%.
17. Standard Colors—Black and Brown.
18. Colors made to order—a wide variety.

Values given under 3 to 16 inclusive, are from A.S.T.M. Standard Tests.

*b = width; d = thickness (measured in the direction of force application).

**The moulding material should be protected against absorption of moisture from the air if these values for power factor are to be maintained. Proper preheating before moulding gives improved electrical properties. For the best values in power factor we recommend our Low Loss material described on page 27.

MOULDINGS—(Continued)

Woodflour-filled materials are supplied mainly in the form of dry, granular powders. They readily soften and flux under suitable heat and pressure, which permits their being formed in hardened steel moulds, into a limitless variety of forms. The woodflour-filled materials are employed for such commonly known articles as radio tube bases, tube and bottle caps, switch plates, wall plugs, door knobs, telephone receiver sets, buttons, pencil barrels, and many others.

These powder materials compress in the moulding process to about 40 per cent. of their original volume. That is, the volume of the moulding powder is about 2½ times the volume of the moulded product. When pre-formed before moulding their volume is about 1½ times that of the moulded product.

Moulded woodflour-filled materials are used principally in applications requiring lightness, superior finish, and mechanical strength together with good electrical properties.

COLORED MATERIALS

These materials are produced in stock colors, black, brown and several attractive mottle combinations. A line of bright colors is available on a made-to-order basis. Upon demand, special colors to match samples are obtainable.

MOULDING SHEET

Bakelite moulding material in sheet form is made in one standard size approximately 18 inches long, 40 inches wide, and $\frac{7}{16}$ inches thick. Special sizes and thicknesses, within a narrow range, may be obtained at a slightly additional cost. Moulding sheet is hard and brittle when cold, but as a preliminary to moulding can be softened in a short time, preferably in an oven at 180° to 200° F., or, as a last resort, on a hot plate, placing an insulating material, such as cotton duck, between the sheet and the hot plate. In this softened condition the sheet may be cut, or in some instances, punched into suitable form for changing the mould.

This moulding sheet was developed for use in overflow or flash moulds, where there are no facilities for tableting; also for moulding complicated forms which require a material that is more plastic than the standard powder materials. It has, in general, the same physical characteristics as the woodflour moulding powder, and, in moulding, requires the same pressure, time of cure, etc. However, unless exceptional moulding plasticity is required, it is not recommended, since it is slightly inferior to the powder materials in mechanical strength.

An interesting application of moulding sheet is the production of matrices for rubber printing plates, as employed in the bag industry.

THE MINERAL-FILLED MATERIALS

The following table gives the range of properties characterising this group:

1. Specific Gravity: 1.8 to 2.0.
2. Weight per cubic inch: 1.1 to 1.2 oz. or 31.2 gms. to 34.5 gms.
3. Tensile Strength: 5,000 to 10,000 lbs./sq. in.
4. Compressive Strength: 18,000 to 36,000 lbs./sq. in.
5. Impact Strength $\frac{\text{(Energy to break test piece)}}{bd^2*}$
   1.5 to 4.5 ft. lbs. for an inch square.
6. Flexural Strength (transverse): 8,000 to 20,000 lbs./sq. in.
7. Modulus of Elasticity (by flexure): 1.0 to 4.5 x 10^5 lbs./sq. in.
8. Distortion under heat (2½ kgm. load): 120° to 135° C.
9. Specific Heat: .25 to .35 gm. calories per gm. per °C.
10. Thermal Conductivity: 0.0008 to 0.0020 calories/sq. cm. per second per °C. per cm.
11. Co-efficient of Heat Expansion: 0.00002—per degree C.
12. Dielectric Strength (Instantaneous 60 cycles): 200 to 400 volts per mil; (Step 60 cycles): 150 to 300 volts per mil.
13. Volume Resistivity (at °C.): 10^3 to 10^5 megohm-cms.
14. Power Factor (10^3 cycles): .10 up (10% up); (10^6 cycles): .05 to .10 (5% to 10%).
15. Dielectric Constant (10^3 cycles): 4.5 to 20; (10^6 cycles): 4.5 to 20.
16. Water Absorption (Disc 2" diameter x ⅛" thick—24 hrs.): .01 to .3%; Water Absorption (Disc 2" diameter x ⅛" thick—144 hrs.): .10 to 1.0%.
17. Standard Colors—Black and Brown.
18. Colors made to order—a limited variety.

Values 3 to 16 inclusive, represent A.S.T.M. Standard Tests. *b = width; d = thickness (measured in the direction of force application).

The mineral-filled materials are somewhat more difficult to process in the moulding and tableting operations than the woodflour materials and their moulded products are less easily machined. They are employed when higher heat-resistance and better water-resistance are desired than could be obtained with the standard woodflour-filled materials. Also they have a lower co-efficient of heat expansion and lower shrinkage in the moulding operation, which in some instances is an advantage.

A number of these materials have been developed, each especially suited to a particular type of service. Applications include moulded commutators, heater connectors, outdoor insulation, handles of cooking utensils, and the like.

THE IMPACT MATERIALS

The incorporation of primary resinoid with woodflour, as in the production of the standard woodflour filled materials, provides good moulding quality and improved impact resistance in the moulded product. Incorporation of the primary resinoid with paper or fabric, as in the production of the so-called Laminated materials, gives a product that may be hot pressed into plates or other very simple forms only, but which has greatly increased resistance to impact.

The impact moulding materials bridge the gap between these two extremes. There is a whole series of these materials, providing impact strengths of 5 to 6, 9 to 11, 11 to 13, 18 to 20, and 25 to 30 ft. lbs. for an inch square, respectively. The first in the series gives moulded products having impact strengths about three times that of standard woodflour-filled moulded products, and with but little sacrifice of moulding or pre-forming qualities. The last in the series gives moulded products having 10 or more times the impact strength of the standard woodflour filled materials, but must be moulded under a pressure of about 5,000 pounds per square inch and can be pre-formed in a hand press only, instead of an ordinary tableting machine.

Thus the purpose of these materials of intermediate impact strengths is that of providing moulded objects having impact strength adequate for a given use without unnecessary sacrifice of moulding and pre-forming qualities.

The properties of objects moulded from the material of the series having the highest impact strength are given in the following table. The moulded products of the other impact materials differ mainly in the possession of lower impact strengths and better pre-forming and moulding qualities.

MOULDED HIGH-IMPACT MATERIAL

1. Specific Gravity: 1.37—1.40.
2. Weight per cubic inch: .79 to .81 oz. (22.4 to 22.9 gms.)
3. Tensile Strength: 6,800—7,200.
4. Compressive Strength: 20,000—30,000.
5. Impact Strength $\frac{\text{(Energy to break test piece)}}{bd^2*}$
   25. to 30. ft. lbs. for an inch square.
6. Flexural Strength (transverse): 10,000 to 13,000.
7. Modulus of Elasticity (by flexure): .70—1.00 x 10^6.
8. Distortion under heat (2½ kgm. load): 130° C.
9. Specific Heat: .30 to .35.
10. Thermal Conductivity: 0.000003 to 0.000004 Cal./sq. cm. per sec. per °C. per cm.
11. Co-efficient of Heat Expansion: 0.000045.
12. Dielectric Strength (Instantaneous 60 cycles): 300 to 400; (Step 60 cycles): 200 to 300.
13. Volume Resistivity (at 30° C.): .5 to 1.0 x 10^5 megohms per cubic centimetre.
14. Power Factor (10^3 cycles): .08 to .20 (8% to 20%); (10^6 cycles): .05 to .10 (5% to 10%).
15. Dielectric Constant (10^3 cycles): 4.5 to 6.0; (10^6 cycles): 4.5 to 6.0.
16. Water Absorption (Disc 2" diameter x ⅛" thick—24 hrs.): about 1.0%; Water Absorption (Disc 2" diameter x ⅛" thick—144 hrs.): about 3.3%.

MOULDINGS—(Continued)

17. Standard Colors—Black, Brown and Tan.
18. Colors made to order—a limited range.

Values 3 to 16, inclusive, represent A.S.T.M. Standard Tests. *b = width; d = thickness (measured in the direction of force application).

SPECIAL MATERIALS

Uncommonly exacting service conditions have called forth special materials to meet them.

Thus there have been developed materials of exceptional water-resistance. Discs moulded from one of these materials, after immersion in water for a year, show a diameter increase of less than 0.001" per inch and no surface effect. In boiling water for a year the increase is only about 0.003" per inch, and the surface effect very slight.

Still another type of material shows only slight surface effect from immersion for twenty-four hours in boiling 5 per cent. caustic soda solution.

A special material of the mineral-filled type has been developed for use in moulded ash trays. Here there is exceptional heat resistance at the surface of the moulded tray. Such trays do not blister.

There is a "low loss" material especially useful in radio condenser forms and housings. It has a low power factor (audio 1.6 per cent., radio 0.75 per cent.) which suffers little change after a day's immersion in water. This material has a high volume resistivity (about 10^8 megohms per cubic centimeter) which drops off much less with rise in temperature than in the case of ordinary materials.

A special material developed for magneto insulation is finding use in aircraft ignition, where a material of high insulation resistance, high dielectric strength, and improved resistance to carbonization under a low amperage arc is necessary. When moulded this material is less rigid than the regular materials. It has been found of advantage for use when moulding a relatively thin wall of material around a large metal insert.

Of interest is a special material which has marked opacity to the X-ray, and which finds use in the manufacture of X-ray shields.

A UNIQUE COMBINATION OF SUPERIOR PROPERTIES

Not only are moulded products exceptional in their strength, hardness, and electrical properties, but they are also highly resistant to heat. The woodflour-filled products, for instance, withstand for hours, without distortion or charring, temperatures up to 150° C. (320° F.). The tensile and impact strengths of certain of the mineral-filled products are unaffected for short periods by temperatures up to 235° C. (455° F.). Again, not only are these products highly resistant to water, but also to oil, to the common solvents, to mild alkalies, and to organic and dilute mineral acids. They are disintegrated, on the other hand, by strong sulphuric or nitric acid, or strong alkalies.

The electrical industry early recognised the value of Bakelite products as the solution to numerous insulation problems.

The automotive industry selected the moulding material for ignition parts, not alone for its good electrical properties, but because of its high resistance to heat, water and oils, and the accuracy and economy with which it can be fabricated. These characteristics have long been sought in structural materials generally; thus it is that we find Bakelite moulded products widely employed for purely mechanical purposes, replacing metals, woods, and a number of other natural materials. The high impact materials are especially adapted for parts which must withstand rough handling, such as golf club heads, handles and ledger covers.

Because of their high corrosion resistance, these materials are also used for parts of apparatus in the chemical industry, such as moulded fittings for pipe lines conveying acids that would attack and destroy iron or brass.

It is this unique combination of superior properties that accounts for the many and varied ways in which Bakelite moulded products are rendering valuable service.

STANDARD TESTS FOR MOULDED PRODUCTS

Engineers have long recognised the need of standard methods for testing moulded products. Without agreement on methods, agreement in results is not to be expected.

It is well known, for instance, that, depending upon the method employed in making the test, a wide range of values may be obtained for the dielectric strength of any material. For one thing the voltage required to break down a given material is not proportional to the thickness. With Bakelite moulded products it varies approximately as the square root of the thickness. It would be entirely incorrect, therefore, to assume that by doubling the thickness of a piece of insulation, the breakdown voltage would also be doubled. Conversely, it would not be proportionately reduced if the thickness were cut to one-half. The thickness of the piece tested is therefore a highly important factor and should always be stated when giving figures for dielectric strength. Also, the shape of the electrodes used and the rate at which the applied voltage is increased materially affect the value obtained.

Similarly the values obtained for other electrical properties depend on the conditions of test.

So also with mechanical tests; such, for instance, as the impact or shock-resistance test. This may be defined as the energy in foot pounds required to break a specimen having a cross-section an inch square; that is a square that measures an inch on a side, not a square inch of any shape of section.

To meet the need for methods of testing that would be acceptable to engineers and manufacturers generally, the American Society for Testing Materials some years ago appointed a committee known as "Committee D-9" composed of engineers from some of the leading electrical companies and the manufacturers of insulating materials, for the purpose of working out standardised methods for such tests.*

As a result of the intelligent labors of this committee, "A.S.T.M." standards are to-day accepted generally in the electrical world.

THE MOULDING PROCESS

Moulding is performed in hardened steel moulds, which are subjected simultaneously to heat and pressure in suitable presses. As regularly carried out, a weighed quantity of moulding powder, or a preformed tablet of compressed powder of suitable weight, is put into the lower half of a heated mould. A powerful press compresses the material as it closes the mould. A short period later the pressure is released, the mould is opened, and there emerges a finished product, formed to the exact shape of the mould—complete and ready for use, except for the removal of the thin mould fin.

Under heat and pressure, a modern miracle has taken place. The fusible material has first fluxed, completely filling the mould; then has hardened, never to soften again. The material has been transformed into a homogeneous solid mass as the result of pressure and a chemical change induced by heat.

The moulds may be heated directly as by the circulation of steam through channels provided in them, or indirectly by heating the platens of the press. For the standard woodflour-filled materials moulding temperatures range from 140° C. (285° F.) to 165° C. (330° F.), depending upon the material used and the design of the object moulded. In practice these temperatures correspond to steam pressures of 100 to 150 lbs. depending on whether the moulds are directly channeled or get their heat indirectly from the platens of the press.

The moulding time varies with temperature and pressure, character and excess of material used, and thickness of the moulded object. The modern practice of discharging the mould hot has greatly speeded up the moulding process, so that to-day, employing a rapid-curing material, the complete moulding cycle for a thin-walled object (say $\frac{1}{16}$" thick) may be as low as a minute or less. Increase of thickness calls for more than proportionate increase in moulding time. Employing standard materials the moulding cycle for objects of average thickness (say $\frac{1}{8}$" to $\frac{1}{4}$") is from two to three minutes. Many small objects of such thickness are moulded in shorter time.

*For full description of these tests, see leaflet, "Standard Methods of Testing Moulded Insulating Materials," issued by the American Society of Testing Materials, 1315 Spruce Street, Philadelphia, Pennsylvania.

Fidelity of reproduction characterises all Bakelite moulding. Each piece leaves the mould accurate in all its dimensions and mirrors faithfully the lustre or special characteristics of the mould surface. Letters and graduations are produced in the moulding operation as sharply as though engraved.

The speed with which this accuracy of reproduction and this fine finish can be obtained, and the readiness with which inserts of all kinds can be securely embedded during the moulding process, make Bakelite moulding materials peculiarly suited to quantity-production. Expensive assembling and finishing operations are thus eliminated and manufacturing costs proportionately reduced.

The moulded articles can be drilled, tapped or otherwise machined when necessary, but as a general rule such requirements can be provided for in the mould. Even threads of great strength and accuracy can be moulded in the material. In all cases the moulded product retains its form permanently and does not deteriorate with age.

THE MOULDS

Hardened steel moulds are necessary to withstand the high moulding pressures employed. Such moulds are relatively expensive and ordinarily do not justify their cost unless the number of pieces to be moulded is large. Obviously sample pieces cannot be produced without first making a mould for the purpose.

Broadly speaking, there are two primary types of moulds used. They are known respectively as "overflow" (or "flash") and "positive" moulds.

The "overflow" mould is made so that the upper and lower portions rest one on the other as they are brought together under pressure. The mould charge may be either a suitable pre-formed tablet, a proper quantity of moulding sheet, or, if the mould is sufficiently deep compared to the size of the piece to be moulded, the proper weighed or measured quantity of moulding powder. It is not necessary that the weight of the charge be exact, but a slight excess must be assured, this excess material, sometimes called the "flash," being squeezed out as the edges of the mould come together.

In the "positive" mould the top force or plunger telescopes within the lower portion of the mould.

Powder material is generally used in moulds of this type. Careful weighing or measuring of the mould charge is required here, as there is no provision for excess "flash" or overflow. The moulds, therefore, must be made of sufficient depth to hold the charge. A powder charge of woodflour material compresses to about 40 per cent. of its initial volume.

Moulds are often of complicated design and comprise many separate parts. The more simple the design the less will be the mould cost and the larger the output per mould per day.

MACHINES

For machining Bakelite moulded products diamond cutters give the best results. "Stellite" and chrome-tungsten-steel alloy cutters also give good service.

Tools for machining should be similar to those used for working brass. These permit a scraping action rather than a cutting action and are better than tools used for machinery steel.

Several manufacturers are now making drills especially designed for drilling moulded parts. These drills are made with an extra clearance on the edge of the flutes, to reduce friction and prevent overheating. A drill speed of 3,000 r.p.m. should be used for small diameters.

It is well to determine the number of holes that can be drilled in pieces of a given type before the drill becomes dull. Instructions can then be given the operator to change drills at this point. Avoid excessive pressure when forcing the drill into the material as this tends to heat the drill and destroy the cutting edge.

Such approved machining practice prevents rejects and greatly increases the life of the tools.

THE PRESSES

Presses are of two general classes, hydraulic and mechanical. They are usually heated by steam. Of each class there are two types, the "Hot Plate" and the "Semi-Automatic."

Removable, or "hand," moulds are used in presses of this type. In regular practice the charged moulds are subjected to a "curing" period in the hot press. The moulded pieces are then ejected hot and left to cool. Occasionally, when an exceptionally fine surface finish or a "close tolerance" is desired, the moulds are removed directly from the hot press to a chilling press for rapid cooling. They are then taken to the work bench to be unloaded and recharged.

There are two different designs of semi-automatic presses, designated, respectively, as "Tilting Head," and "Retracting Ram" presses. While varying more or less in design they are alike in the respect that the moulds can be clamped rigidly in place and do not have to be handled by the operator. The moulds for presses of this type are made with channels through which steam or cold water may be circulated alternately. The moulded pieces are automatically ejected with the opening of the press.

The choice of press to be employed is determined largely by the size and shape of the pieces to be moulded, and the number of pieces required.

An "accumulator" and a high pressure pump are used for supplying hydraulic pressure. Special pressure regulators also are employed. Also presses heated electrically and closed mechanically are used.

PRE-FORMING

The practice of "pre-forming" or compressing the charge into a tablet is now recognised as an advantageous step in the moulding process and is very generally employed.

The operation consists of cold-pressing the moulding powder into a compact mass of proper form and weight. In form, the tablet should follow roughly the contour of the mould. For pre-forming woodflour materials a pressure of 4,000 to 8,000 lbs. is required; for impact materials, 6,000 to 10,000 lbs.

A heavy type of tableting machine especially designed for the purpose will pre-form several thousand tablets a day. While pre-forming involves an extra operation, it is a cleaner and more convenient method than weighing the charge and has the advantage of eliminating waste and of speeding up and simplifying the moulding operation, thus increasing the daily output per mould and insuring a more homogeneous moulded piece.

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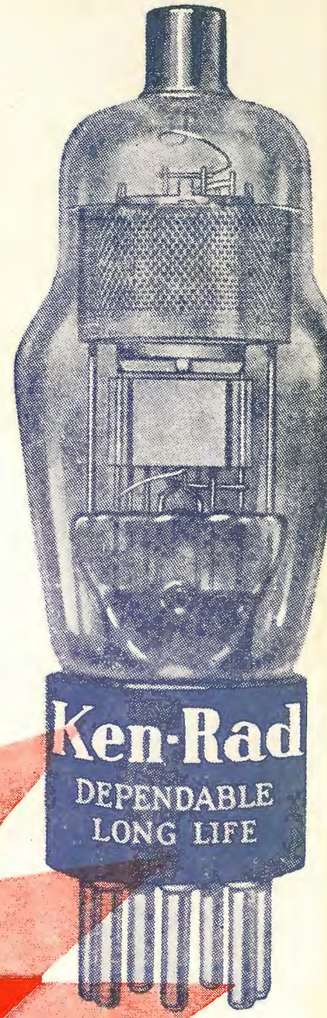

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