BAND-PASS SUPERHETERODYNE.

The Wireless World

AND RADIO REVIEW

The Paper for Every Wireless Amateur

4D

Wednesday, November 5th, 1930.

No. 584. Vol. XXVII. No. 19.

have you met the P.M.256A

It is intended primarily for use as a large power amplifying valve in cases where the signal available from the preceding stages of amplification is already so powerful that it would overload any ordinary power valve. It is capable of delivering sufficient power for operating all forms of loudspeakers, including the moving coil type. Its excellent performance is obtained at a very moderate anode voltage of 200, while the filament consumes only 0·25 amp. at 6 volts which may, if desired, be obtained by a step-down transformer from the A.C. electric light mains.

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Max. Filament Voltage	6.0 volts	*Anode Impedance	1,400 ohms
Filament Current	0.25 amp.	*Amplification Factor	3.6
Max. Anode Voltage	200 volts	*Mutual Conductance	2.6 mA/volt

*At Anode Volts 100; Grid Volts Zero.

PRICE 13/6.

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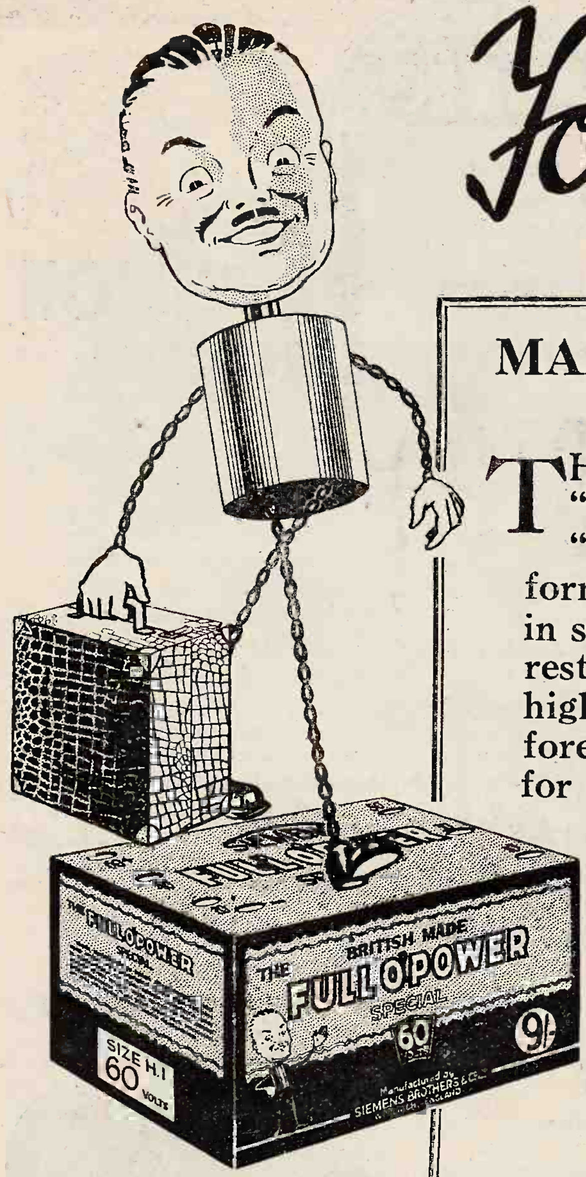

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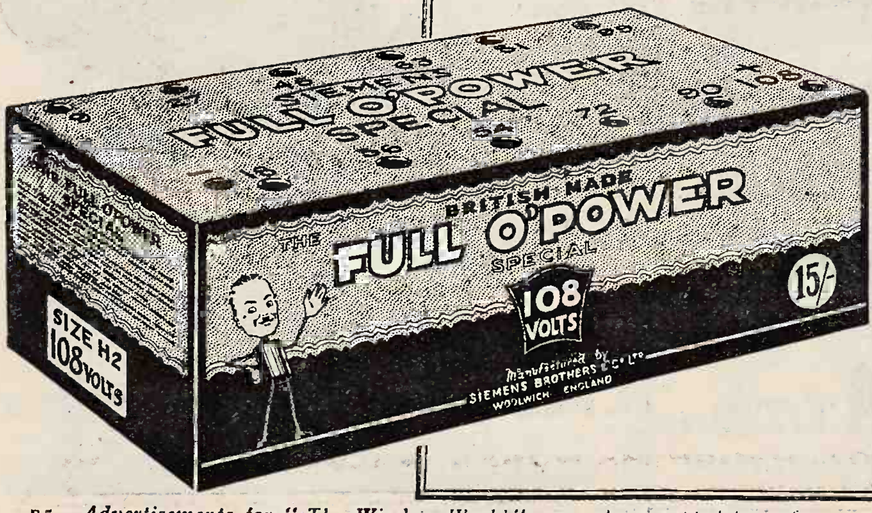
H.2	108	9 ,, ,,	$9\frac{7}{8} \times 5 \times 3\frac{1}{4}$	8	0	15	0
H.3	120	12 ,, ,,	$8\frac{1}{4} \times 6\frac{5}{8} \times 3\frac{1}{4}$	8	8	16	6
GRID BIAS BATTERIES							
G.2	9	$1\frac{1}{2}$-volt steps	$5 \times 1 \times 3\frac{1}{8}$	0	11	1	6
*G.4	18	18 ,, ,,	$5 \times 1\frac{7}{8} \times 3\frac{1}{8}$	1	5	3	0

**For National and Symphony Portable Sets.*



WRITE FOR THE
FULL O'POWER BOOKLET

which contains many useful notes for listeners, together with sizes and prices of the complete range of Full O'Power Batteries.

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HAS CHANGED THE FASHION IN SPEAKERS . . . *for good!*

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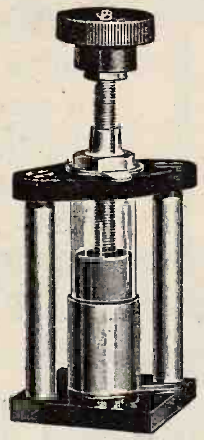

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J.B. have concentrated for years on the manufacture of their Precision Condensers and Dials. The excellence of these products to-day justifies this specialisation.

No one could glance at a J.B. Condenser without being struck by its beauty of finish and its workmanlike appearance. Closer inspection shows all the accuracy, careful thought and attention to detail that have gone to make it what it is.

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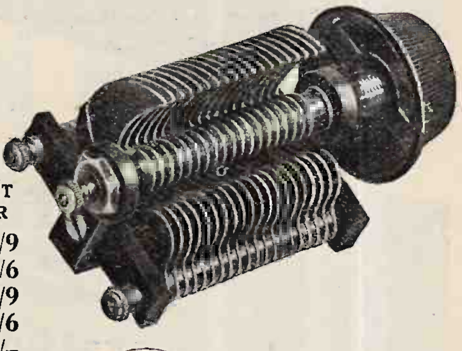

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·00025	5/9
·0002	5/6
·00015	4/9
·0001	4/6
·00004	4/–
·000025	3/9

PRECISION INSTRUMENTS

Advertisement of Jackson Bros., 72, St. Thomas' St., S.E.1. Telephone: Hop 1837.

How's this for Selectivity!

The "Wireless Trader" test report on the GAM-BRELL A.C. THREE, said:—

"TOULOUSE, clear of LONDON REGIONAL, LANGENBURGH clear of MIDLAND REGIONAL, KOENIGSWUSTERHAUSEN clear of 5XX and RADIO PARIS, a feat not generally performed by a set of this nature under these conditions of test."

"11 miles from Brookmans Park . . . it was possible to limit the spread of both the London Regional and National stations to 3 degrees on a 100 scale. This, of course, represents extremely good selectivity and sensitivity."

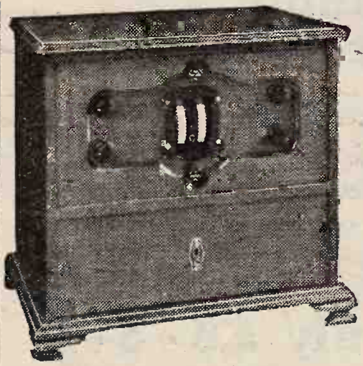
"The tone was found to be well balanced, with a good bass response and crisp high frequencies."

The "Music Seller" said:—

"With a little care and practice in tuning, some forty stations are to be received at good strength."

THE GAM-BRELL A.C. 3 and 4 v. RECEIVERS as tested by the above journals.

These sets incorporate every possible refinement. Modern circuit gives long range, good volume and perfect reproduction. Reception of programmes in any room without the use of an aerial. Many British and Continental programmes are available when an aerial is used. Special device gives hair-line to broad tuning at will. Calibrated wavelength chart makes tuning exceedingly simple. Terminals for pick-up. Volume control on radio and gramophone.



All-Electric Three:
For A.C. £26 15
For D.C. £24 0

All-Electric Four:
For A.C. £33 0
For D.C. £27 0

Both in Oak or Mahogany Cabinet.

Write for full descriptive leaflet of Gam-brell All-Electric Receivers.

There are now three types of the famous

GAM-BRELL NOVOTONE

The full beauty of the bass notes and the brilliance of reproduction when using electrically recorded records, can only be obtained by placing a Novotone in your amplifying circuit.

Even in present-day recording there are still serious losses which must be compensated for if realistic reproduction is desired.

Type S for Standard pick-ups - - **£5**
Type H for High resistance pick-ups - **£5**
Type J exactly as type S but having less amplification **£3 3s.**

The NOVOTONE imparts to your records:

Full-bodied and true reproduction of the bass notes.
Appreciable brilliance of the higher notes.
An increase in general amplification.

Full descriptive Novotone Folder on request.

GAMBRELL RADIO LTD.,
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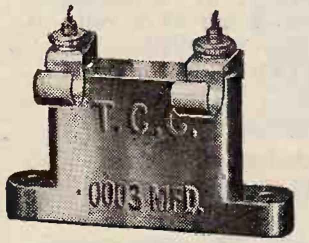
LITTLE STORIES OF GREAT MOMENTS

"Look! It's going-it's going!"

There was gladness in some hearts and consternation in many when Stephenson's Rocket started on its first perilous journey. Long embittered critics were confounded and the habits of a nation transformed. It was the complete triumph of a lifetime spent in doing one thing and doing it well.

It is this same spirit of "doing one thing and doing it well" which has, for years, been behind all T.C.C. endeavour. That is why T.C.C. have never made anything but Condensers, and that is why T.C.C. Condensers are unmatched —for accuracy and for dependability.



One of the many types is shown here. It is the T.C.C. .0003 mfd. Upright Mica Condenser. Price 1/6.

T.C.C. CONDENSERS

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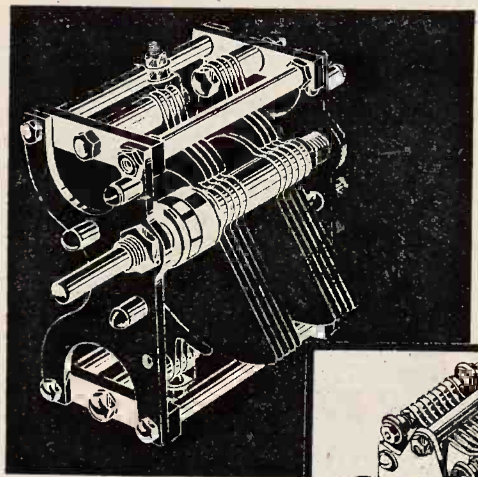
Creators of High Grade Precision Condensers



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REVOLUTIONISED BY SERIES GAP

ALWAYS first with essentially new developments since the infancy of Radio. CYLDON marked a milestone with Log Mid-Line. Now Series Gap, to revolutionise tuning on 'low down' waves, a double section CYLDON without pigtail or rubbing contact, with dead end plates and dead centre spindle. The new tuning principle introduced opens out the tuning scale at 5 to 10 metres to broadcast simplicity and entirely eliminates 'condenser noises.' Added to a mechanically correct design, superior materials, construction and workmanship, the choice of a condenser for short waves is decidedly limited to Series Gap. **Build with CYLDON.** It costs more, but many outstanding constructional features amply justify it.

List No.		Max. Capacity	Min.	
S.G. 1	-	.0001	.000005	15/-
S.G. 15	-	.00015	.000007	16/6
S.G. 2	-	.0002	.00009	18/-
S.G. 25	-	.00025	.000012	19/6
S.G. 02	-	.00002	.000004	14/-

Extension Handle outfit, 4/6 extra.

AIR-Spaced is best; you have proved that. The CYLDON Differential Condenser (illustrated in inset) is the only air dielectric differential. Well worth the extra cost, too.

List No.		Capacity each half.		
Dif. 1.	-	.0001	-	7/6
Dif. 2.	-	.00015	-	8/6
Dif. 3.	-	.0002	-	9/6

cyldon

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Chassis only, as shown, £9 : 10 : 0.

Also available in Table and Pedestal Cabinets in Oak, Mahogany and Walnut, and a Table Model in Rexine covered Metal Case. Ask your dealer or write for descriptive pamphlet.

FERRANTI

Moving Coil **MAGNO-DYNAMIC SPEAKERS**

FERRANTI Ltd., Head Office and Works, HOLLINWOOD, LANCS. LONDON: Bush House, Aldwych, W.C.2

VALVE EFFICIENCY

MARCONI ML-4

FOR THE FINAL STAGE OF THE A.C. ALL-ELECTRIC RECEIVER — **MARCONI ML-4,** an indirectly heated output valve of exceptional efficiency, combining an amplification factor of 9 with an impedance of only 3,000 ohms—mutual conductance 3.0 M.A/VOLT. ML-4 provides a stage magnification which hitherto has only been possible with valves of much higher impedance; at the same time its undistorted output is ample for most requirements. In construction it retains the essential features of all Marconi A.C. valves—lasting emission, permanency of characteristics, special mesh anode and exceptional vacuum. ML-4 is the ideal output valve for most A.C. Receivers. ITS DEPENDABLE EFFICIENCY HAS BEEN PROVED BEYOND DOUBT—MARCONI ML-4 IS ALL BRITISH—AND COSTS ONLY 17/6.

CHARACTERISTICS.

Amp. factor—9	Fil. volts.—4.0
Impedance—3,000 Ohms	Fil. amps.—1.0
Mut. Conductance—3.0 MA/V.	Anode Volts—200 max.

MARCONI ML-4—THE FOREMOST INDIRECTLY HEATED OUTPUT VALVE FOR A.C. RECEIVERS—PRICE 17/6

SCIENTIFIC FACT

EXPERT APPRECIATION

Marconi Valves are used by The B.B.C., Imperial Airways, Croydon Control Tower, Metropolitan Police, Trinity House Beacon Stations and Lightships, Empire Wireless Communications, Large Passenger Liners, &c., &c., because of their longer life—clearer tone—greater range and volume.

PUBLIC APPRECIATION

A letter typical of many received regarding the splendid service given by Marconi Valves:—

"On May 1st, 1924, I purchased two of your valves—2-volt General Purpose Type, costing at that time 21/- each.
These valves have been in daily use ever since, and to-day are giving me fine results. I have also another one bought three years ago, and these three are working on a P.W. Magic 3 set which I constructed a few weeks ago . . . . Your notice re long life attracted my attention, and I thought how true it was, as I have found it out myself. . . . The volume and selectivity are wonderful, considering I have no Power Valve in my set."

W. S. R., Swansea.

USE A MARCONI

THE VALVE THE EXPERT USES

G. Marconi

The Wireless World AND RADIO REVIEW

(18th Year of Publication)

No. 584. WEDNESDAY, NOVEMBER 5TH, 1930. VOL. XXVII. No. 19.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

Circuit Diagrams and Service

AT a time when so much interest centres around the problem of what is the best means of ensuring service in connection with the sale of wireless sets, we think it an opportune occasion for raising a matter which, in our opinion, has a most important bearing on this intricate subject.

There was a time, happily now past, when wireless was such a mystery that sales of a receiver could be enhanced by advertising that it incorporated a "special patented circuit." The more mysteriously new or unusual the circuit, the more likely the receiver was to attract public interest. But the secrets of circuits can no longer be used as a stimulus to sales, and this out-of-date policy has led to the practice of withholding from the purchaser of a receiver the circuit diagram. As a result the owner of a set is often unable to carry out simple tests for himself if anything goes wrong, and the local service agent—unless he is intimately acquainted with the particular receiver—may actually spend hours in tracing out the circuit of a modern complicated receiver before he is in a position to begin to tackle a correction or repair intelligently.

We see no reason why a set manufacturer should disclose to all and sundry in his leaflets and catalogues the circuit diagrams of his sets if he prefers to withhold this information, but surely the purchaser of a receiver has the right to expect that the manufacturer will communicate to him the nature of the circuit, seeing that, having once purchased a set, he could, with the expenditure of time and trouble, obtain the circuit eventually for himself, either by tracing it out or by getting an expert to do so for him.

We believe that an important step towards reducing service troubles would have been taken if manufacturers agreed to include a detailed circuit diagram with every receiver sold.

After all, what possible purpose can be served by withholding this information? If a manufacturer is afraid that a competitor may copy his design, he is certainly not safeguarding himself by declining to supply a circuit diagram, for any manufacturer who desires to copy the design of another will purchase a set for himself and an hour or two in his laboratory will serve to disclose everything connected with that receiver on which he desires to be informed.

This reticence in supplying circuit information is peculiar, we believe, to British manufacturers. In America circuit diagrams are supplied and are regularly published without the least reserve, and the position is the same with most of the established manufacturers on the Continent of Europe.

We would strongly urge that manufacturers should at once decide upon a policy of including the circuit diagram with every receiver sold, the circuit to be securely affixed to the receiver on the inside of the lid of the cabinet, or some other convenient permanent position.

In This Issue

"THE WIRELESS WORLD" BAND-PASS SUPERHETERODYNE.
PRE-SELECTION.
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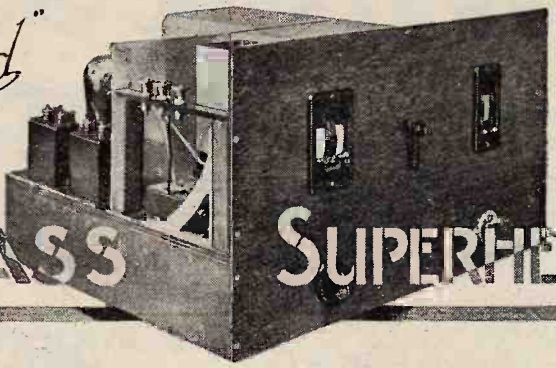
"VOUS VENEZ D'ENTENDRE."
BROADCAST BREVITIES.
UNBIASED OPINIONS.
PICTURE ANALYSIS AND TELEVISION.
LABORATORY TESTS.
CORRESPONDENCE.
READERS' PROBLEMS.

"The Wireless World" BAND-PASS SUPERHETERODYNE



A Long-Range Frame-Aerial Receiver.

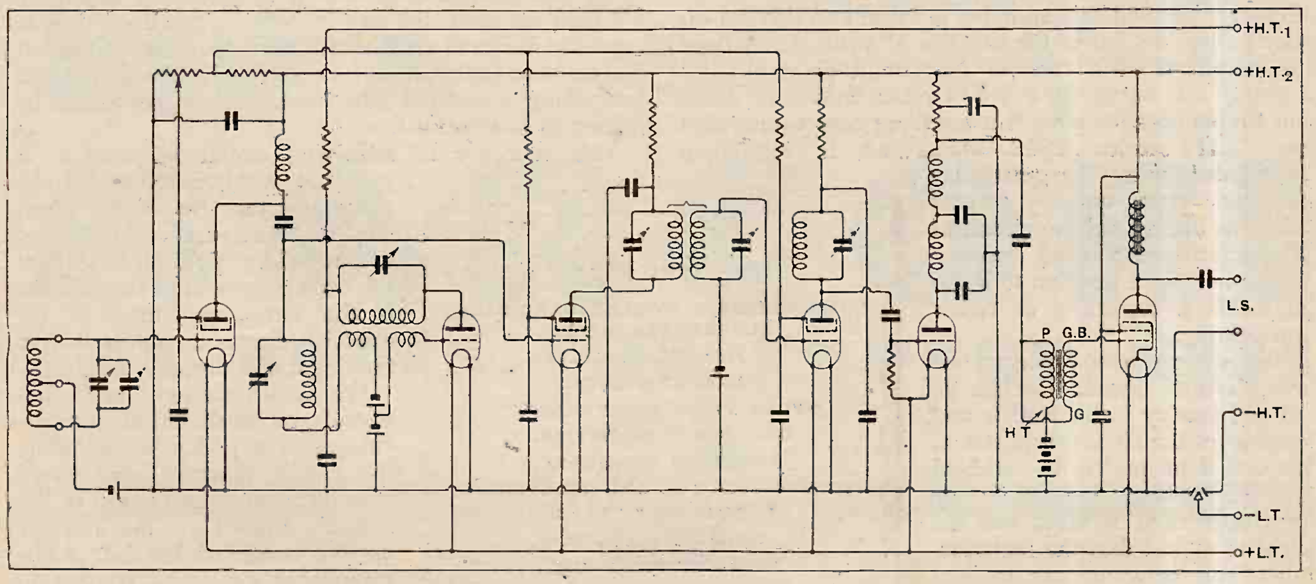
By A. L. M. SOWERBY, M.Sc., and H. B. DENT.

> **SPECIFICATION.**
>
> *A selective frame aerial receiver embodying the supersonic heterodyne principle.*
>
> *Battery-operated but an H.T. eliminator can be employed.*
>
> *Band-pass tuning for the I.F. amplifier.*
>
> *Provision made to receive the local programme on three valves using an H.F., detector and pentode circuit.*
>
> *Screen-grid valves employed in H.F. and I.F. amplifiers also for the first detector.*
>
> *Leaky grid second detector followed by 7 : 1 transformer to a pentode output valve.*
>
> *Waveband switching.*

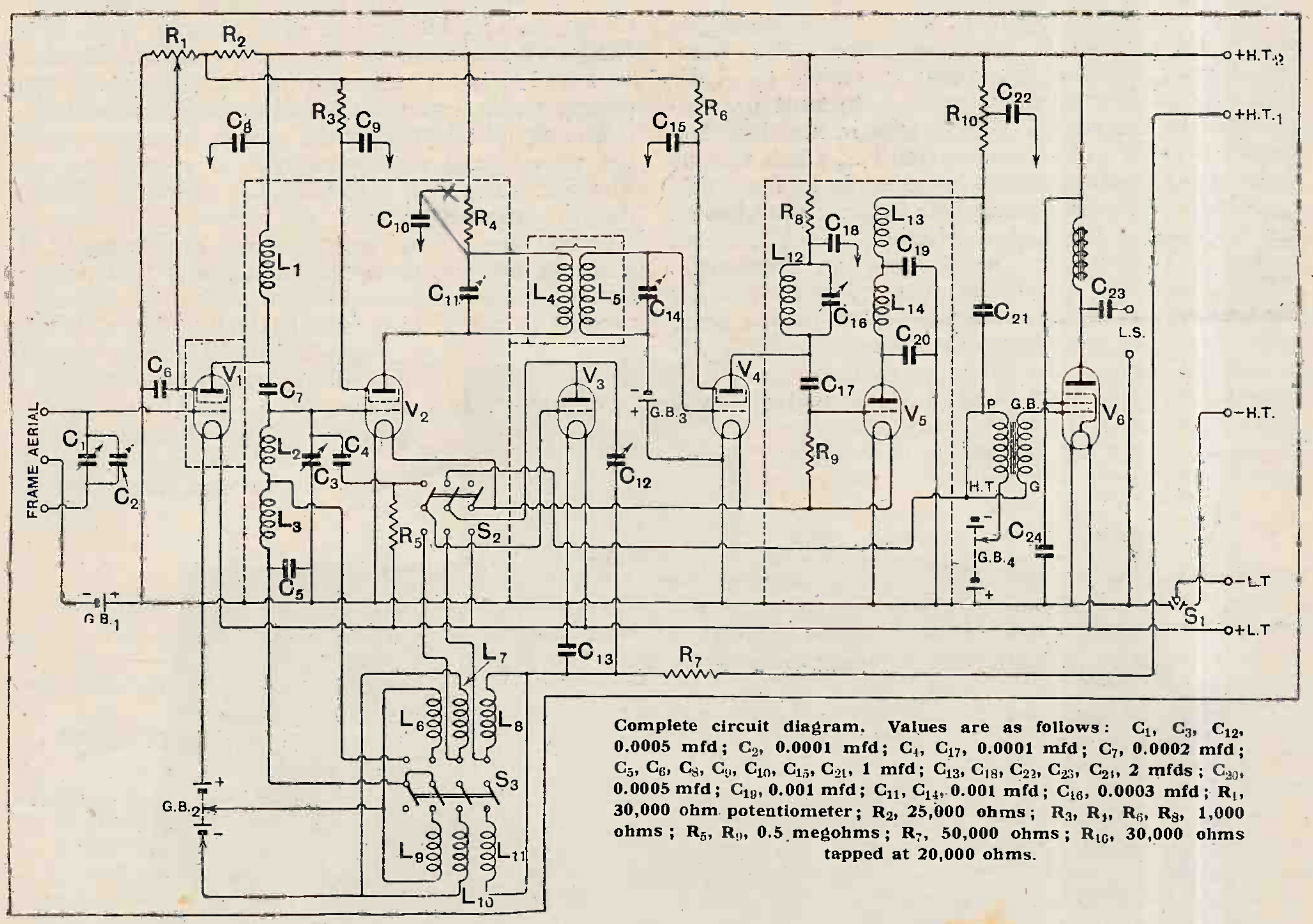
EVER since the opening of the twin transmitters at Brookmans Park it has become evident, at least to the Londoner, that the most difficult problem confronting the listener is that of attaining selectivity enough to enable stations other than the two "locals" to be heard without interference.

The problem of selectivity can be approached from several different angles. If a full-sized aerial is used in conjunction with a set employing three or four tuned circuits in cascade, loss of sidebands becomes excessive before even moderate selectivity is reached. If a band-pass filter is used to avoid this defect, the total number of tuned circuits becomes considerable.

If, as an aid to adequate selectivity, the full-size aerial is dropped, and a frame aerial substituted for it, most of the difficulties disappear, for we no longer have such overwhelming power delivered to the set from the local stations. It thus becomes reasonably easy to cut them out. To set against this, however, we now require very considerable high-frequency amplification to make the more distant stations audible. In practice, two or three stages will be found necessary, unless, of course, we are prepared to push reaction beyond the limits set by the requirements of good quality. Such high overall gain as is required when using a frame aerial makes it once more necessary to resort to the most meticulous care in



Simplified circuit diagram; details of the switching have been omitted.



Complete circuit diagram. Values are as follows: C_1, C_3, C_{12}, 0.0005 mfd; C_2, 0.0001 mfd; C_4, C_{17}, 0.0001 mfd; C_7, 0.0002 mfd; C_5, C_6, C_8, C_9, C_{10}, C_{15}, C_{21}, 1 mfd; C_{13}, C_{18}, C_{22}, C_{23}, C_{24}, 2 mfds; C_{20}, 0.0005 mfd; C_{19}, 0.001 mfd; C_{11}, C_{14}, 0.001 mfd; C_{16}, 0.0003 mfd; R_1, 30,000 ohm potentiometer; R_2, 25,000 ohms; R_3, R_4, R_6, R_8, 1,000 ohms; R_5, R_9, 0.5 megohms; R_7, 50,000 ohms; R_{10}, 30,000 ohms tapped at 20,000 ohms.

screening—no longer for the sake of selectivity, but in order to make the set stable.

By making use of the superheterodyne principle the extremely high standard of selectivity here suggested as desirable can be attained without the use of any out-of-the-way precautions. The receiver here illustrated reaches this standard—can, indeed, be made to exceed it—when the directional properties of the frame aerial are used to help it. Nevertheless, it makes use of quite sketchy screening, and has but three tuning controls.

LIST OF PARTS.

2 Variable condensers, 0.0005 mfd. (J.B. Double Thumb Gang).
1 Variable condenser, 0.0005 mfd. left hand with vernier thumb control drum dial (J.B., with No. 2 control).
6 Valve holders (Burton Midget).
1 H.F. choke (McMichael Binocular Junior).
1 H.F. choke (Burndept).
2 H.F chokes, iron-cored (Wearite H.F.O.).
1 L.F. transformer, 7 : 1 (Ferranti AF6).
1 L.F. choke, 30 henrys (R.I. Hypercore).
2 S.G. cells, 0.9 volt (Siemens).
7 Fixed condensers, 1 mfd. 400 volt D.C. test (T.C.C.).
5 Fixed condensers, 2 mfd. 400 volt D.C. test (T.C.C.).
4 Decoupling resistances, 1,000 ohms (Wearite).
1 Resistance, 30,000 ohms, tapped at 20,000 ohms (Colvern, Colverstat).
1 Resistance, 25,000 ohms (Colvern, Colverstat).
1 Resistance, 50,000 ohms (Colvern, Colverstat).
1 Wire potentiometer, 30,000 ohms (Claude Lyons, Clarostat).
1 Switch, 4-pole change-over, lever pattern (Utility W.147/4).
1 Switch, 3-pole change-over, lever pattern (Utility W.147/3).
1 Grid bias battery, 4½ volts (Siemens).
1 Grid bias battery, 16½ volts (Siemens).
1 Switch, 3-point direct indicating (Gripso).
2 Grid leaks, 0.5 megohm (Ediswan).
2 Porcelain grid leak holders (Bulgin).
1 Fixed condenser, mica, 0.0001 mfd. (T.C.C. upright type).
1 Fixed condenser, mica, 0.0002 mfd. (T.C.C. upright type).
1 Fixed condenser, mica, 0.0005 mfd. (T.C.C. upright type).
1 Fixed condenser, mica, 0.001 mfd. (T.C.C. upright type).
1 Fixed condenser, mica, 0.0001 mfd. (Graham Farish Parvor).
1 Ebonite 6-ribbed former, 2¼in. dia., 6in. long (Becol No. 2).
2 Semi-fixed condensers, 0.001 mfd. (R.I. Varicap No. 5).
1 Semi-fixed condenser, 0.0003 mfd. (R.I. Varicap No. 3).
1 Semi-fixed condenser, 0.0001 mfd. (R.I. Varicap No. 2).
1 Pair Brackets, 4in. (Magnum).
10 Terminals (Eelex).
1 Terminal strip, 18in. × 1½in.
1 Screening box, 6½in. × 6½in. × 6in. (Magnum).
1 Screening box, 4½in. × 6½in. × 6in. (Magnum).
2 oz. each Nos. 28, 34 and 38 D.S.C. wire.
2 oz. No. 28 D.C.C. wire.
2 oz. No. 30 enamelled wire.
Wood, screws, systoflex, wander plugs, etc.

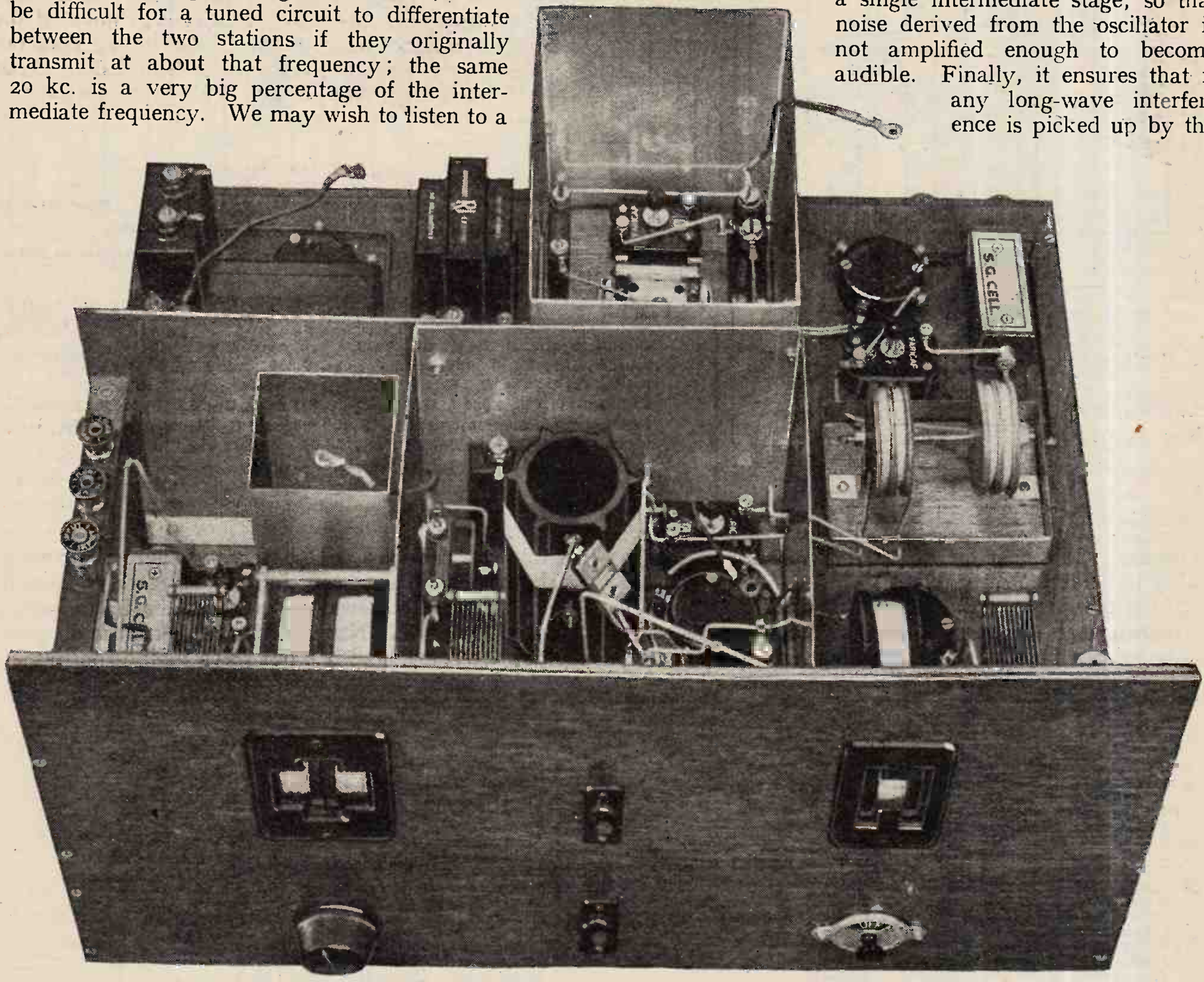
Approximate cost (excluding valves), £13.

In the "List of Parts" included in the descriptions of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

Band-Pass Superheterodyne.—

Those who have forgotten how a superheterodyne works are referred to a recent article (*The Wireless World*, October 1st, 1930) in which the basic principles of this much-maligned instrument are discussed. In the present receiver the intermediate frequency is about 30 kc., and not 100 kc., which was the figure assumed for purposes of example in the article mentioned. This low intermediate frequency was chosen for the sake of the higher selectivity which it makes possible. Two stations transmitting on frequencies differing by 20 kc. will still be separated by 20 kc. after the frequency-changing process has taken place. Since 20 kc. is a small percentage of 1,000 kc., it will be difficult for a tuned circuit to differentiate between the two stations if they originally transmit at about that frequency; the same 20 kc. is a very big percentage of the intermediate frequency. We may wish to listen to a station on 300 metres, but may suffer interference from a station on 306 metres. Separation will be a matter of difficulty. By using a frequency-changer, followed by a 30-kc. amplifier, the interfering station is given as big a proportional separation from that which we wish to hear as if we had banished it entirely from the broadcast waveband and compelled it to transmit on 900 metres. This comparison is not strictly fair, on account of the fact that we really need to listen to a whole band of frequencies, but it does give an idea, even if an exaggerated one, of the enormous gain in selectivity conferred by the adoption of the superheterodyne principle with a very long intermediate wavelength.

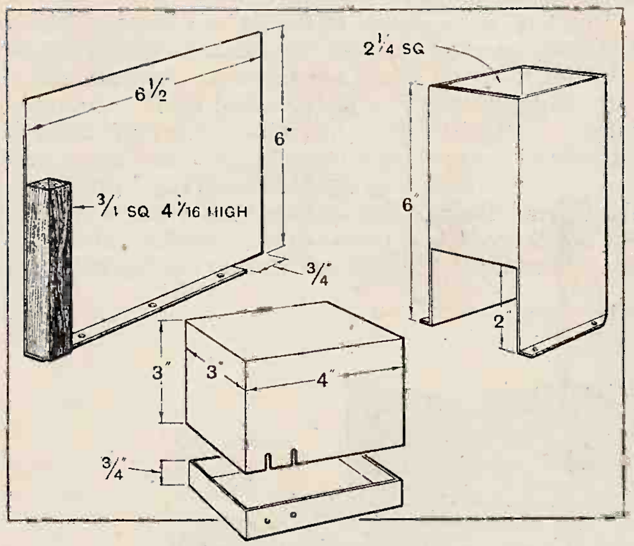
The circuit adopted for the present receiver is unlike the conventional superheterodyne in several respects. The first valve is a high-frequency amplifier of usual design, intended to give the signals a preliminary "boost" before they reach the frequency-changer. It also completely removes "second-channel" interference (except, of course, from the local station), and makes it possible to obtain high enough amplification with only a single intermediate stage, so that noise derived from the oscillator is not amplified enough to become audible. Finally, it ensures that if any long-wave interference is picked up by the frame from commercial telegraphy stations, this shall not be passed on to the intermediate amplifier, and, conversely, allows the set to be connected to a small aerial if desired without making oneself a nuisance to others by radiation from the oscillator. It is thought that this list of advantages is formidable enough to compensate for the extra tuning control involved by the fundamental H.F. stage.



Three-quarter plan view with covers of screening boxes removed. Note the method of mounting the I.F. band-pass transformer.

Band-Pass Superheterodyne.—

For first detector a screen-grid valve, adjusted to act as anode-bend rectifier, has been chosen. Justification for this departure from precedent is found in the fact that the frequency-changing stage as a whole amplifies some 30 to 50 times. Users of triodes have usually implied, if they have not stated, that a loss at this point is to be expected.



Details of the screening box for the I.F. transformer, the first S.G. valve cover and the vertical shield.

The L210 valve used as oscillator has an untuned grid coil, and a tuned plate coil, since it is found that harmonics are less prominent with this arrangement. The anode current of this valve, which, if uncontrolled, is liable to run up to fantastically high values, is limited by a series resistance between the valve and H.T.+ to about 2½ milliamps. Oscillations are fed into the grid circuit of the first detector by a pick-up coil in the usual way.

The coupling between the first detector and the single I.F. valve is made by a long-wave band pass filter of suitable design. The two parts of the filter are tuned by semi-fixed condensers to give the response curve required, and when once this has been done the filter need not be touched again.

The intermediate-frequency valve is a screen-grid valve, coupled to the second detector (a triode) by a McMichael Junior Binocular H.F. choke, which, with the addition of another semi-fixed condenser, forms a tuned-anode circuit.

The second detector is another L210 valve, working as grid-circuit rectifier, supplied, for the sake of good quality, with as great an anode voltage as is economically possible. It is followed by a two-stage low-pass filter to remove the long-wave component of the anode current, the audio-frequency component being passed on, through a Ferranti AF6 transformer, to the pentode which is used in the output stage. The combination of parallel-fed transformer and pentode gives an accentuation of high notes which approximately compensates for the suppression of sidebands by the frame aerial; and so renders the use of a band pass filter at this point unnecessary.

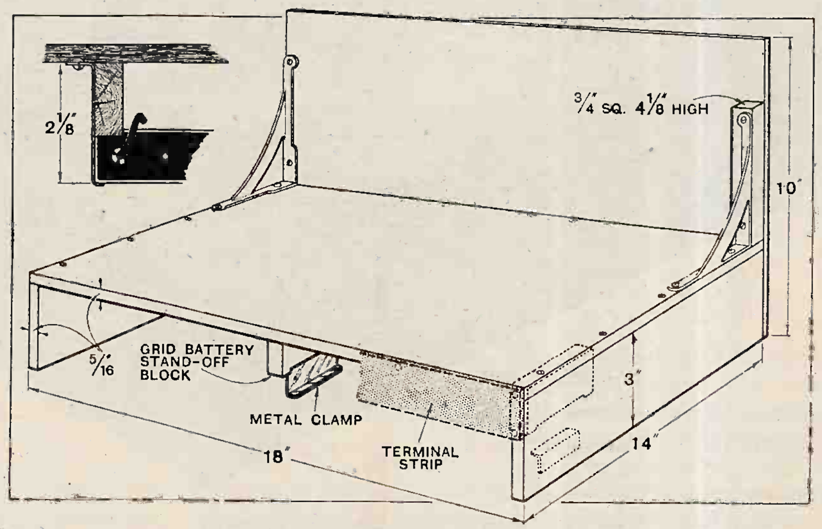
The receiver is primarily intended to be used with a centre-tapped frame, the whole of which is tuned, while half only is connected across grid and filament of the first valve. This has the dual advantage of making the frame very sharply directional, thus rendering the elimination of the local station much easier, and of cutting down to an absolute minimum any interference from electrical machinery in the neighbourhood of the set. Nevertheless, where electrical machinery does not interfere, there is no reason why a short indoor aerial and a tuning coil should not replace the frame if so desired.

Local Station Reception.

The circuit diagram of the set is very considerably complicated by the presence of two switches; with the aid of the foregoing analysis, however, the main outlines of the circuit should not be difficult to follow.

Of the two switches, one is the usual wave-change switch. In the grid circuit of the first detector a loading coil is used for long waves; the oscillator couplers for the two wavebands are completely independent.

The remaining switch converts the set into a perfectly ordinary three-valve receiver (H.F.-detector-pentode) with which to receive the local stations, the oscillator valve then acting as grid detector. The usual accusation of losses due to switching in high frequency circuits can quite justly be made against this arrangement; it is thought, however, that any inefficiency due to the switching is as nothing compared to the inefficiency of using six valves to receive the local station.



Details of the wooden frame giving the principal dimensions; note the supports on the underside for the large grid battery.

The receiver therefore combines two sets in one—there is a simple receiver for local-station work, while

Band-Pass Superheterodyne.—

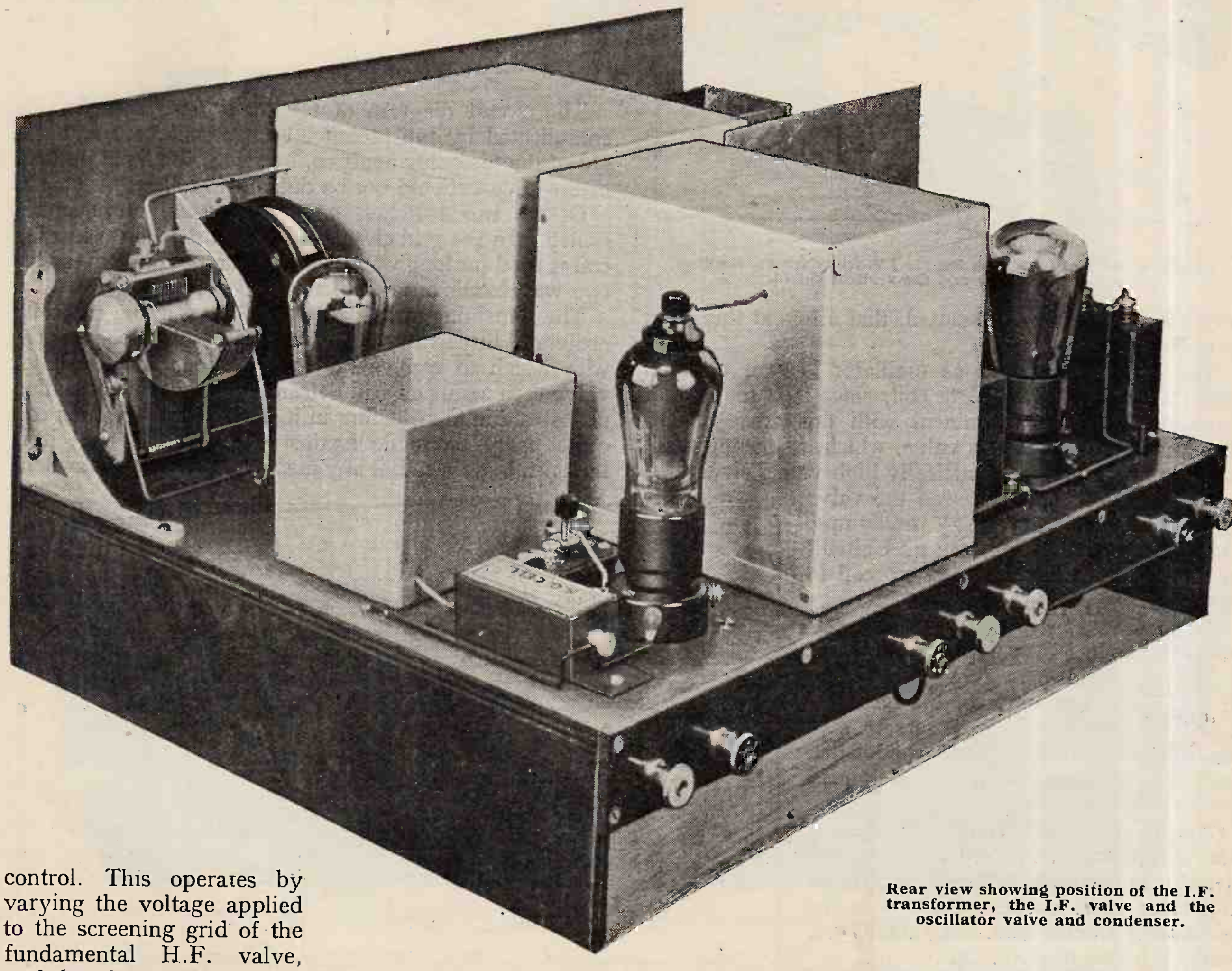
the flick of a switch converts it into a long-range receiver of exceptional selectivity for picking up more distant stations. In either form it covers both the usual wavebands.

The presence of the switch has raised the minimum capacity across the second tuning condenser to so high a value that a 0.0005 mfd. tuning condenser has to be used to cover the 200-600-metre band. Edgewise drums are provided for both frame and H.F. tuning, there being a trimmer across the frame condenser to permit of matching the two circuits. This done, the set, even when all six valves are in use, has virtually only two tuning controls. The third control, the oscillator tuning, has a slow-motion drive, as the tuning of this circuit is necessarily very sharp.

Of the remaining controls on the panel one is a volume control. This operates by varying the voltage applied to the screening grid of the fundamental H.F. valve, and therefore can be used as well with three valves only as with the full six. The superheterodyne part of the receiver works "all out" whenever it is in use. No post-detector volume control is fitted, for the second detector can only just supply the pentode with the signal voltage it requires before it is itself overloaded. For the same reason it is vital to use the high-ratio L.F. transformer specified and to have a pentode, and not a power valve, in the last holder.

The "On-off" switch, besides controlling the filaments, breaks the H.T. return lead in order to cut off the current drawn by the potentiometer supplying the various screening grids, which would otherwise inflict a continuous drain on the batteries.

The total consumption of the set was found to be 22 milliamps at 160 volts with the particular set of valves used for test; this is not too much for dry batteries of large capacity, and is easily provided by H.T. accumulators. It can be reduced, if necessary, by using a pentode of lower current consumption—and hence with less power output—than the Marconi PT240, which was the writers' choice. The set is run off a single voltage, the necessary voltage controls being provided within the set. In addition, there is sufficient decoupling to permit the use of any eliminator capable of delivering the necessary current; no decoupling or voltage dividing resistances need be incorporated in the eliminator. A separate H.T. terminal is provided for the oscillator in case extra smoothing may be needed for this valve, which is the most sensitive to hum. In normal use this terminal will be strapped to the main H.T. terminal.

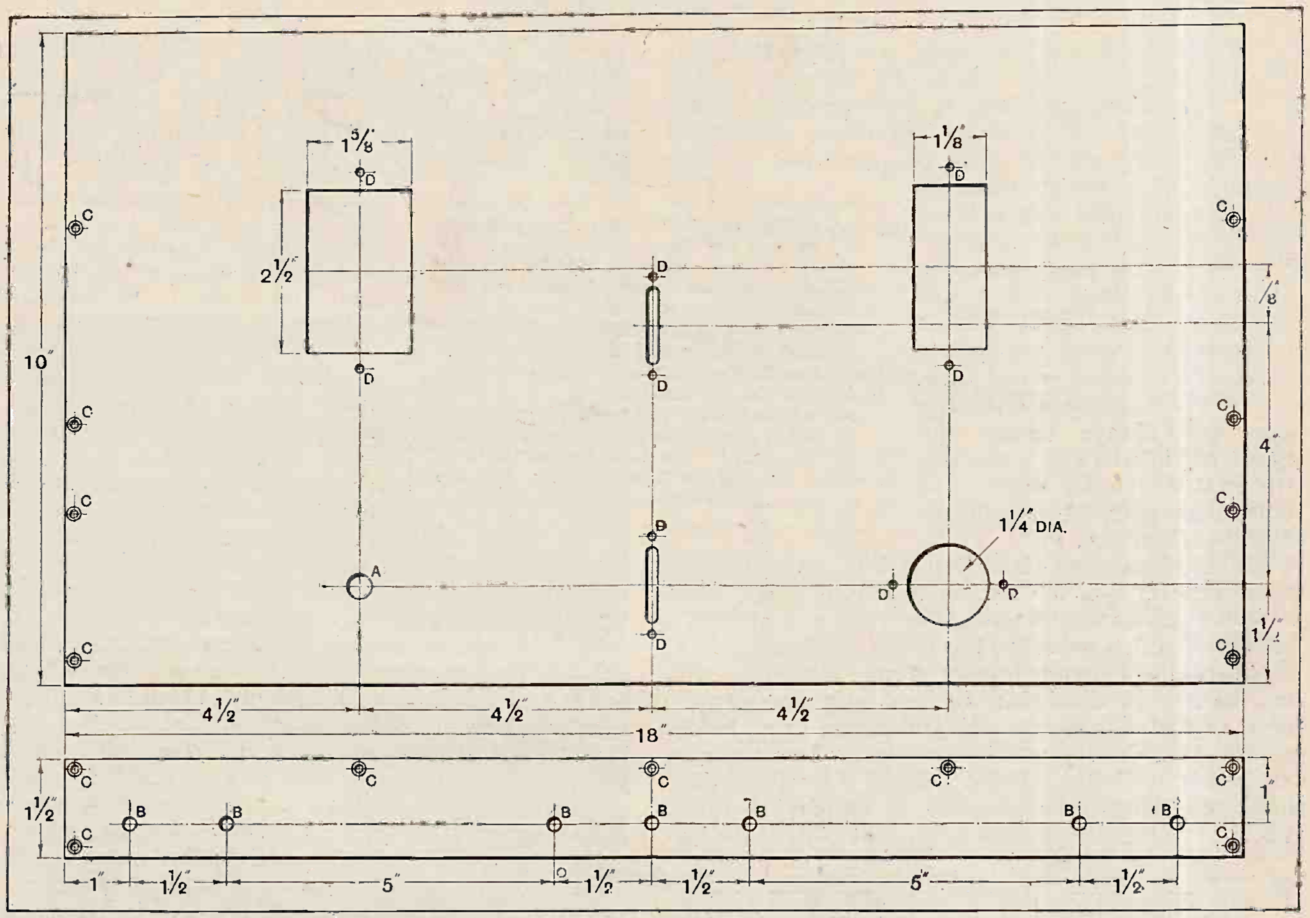


Rear view showing position of the I.F. transformer, the I.F. valve and the oscillator valve and condenser.

Band-Pass Superheterodyne.—

Two points, of interest to the prospective builder of the set, have been particularly kept in mind throughout the design. Perhaps the more important of these is that special care has been taken to eliminate stray reaction effects. As a result, the set is very easy to reproduce, for it does not depend for its efficiency upon small stray couplings or the characteristics of individual valves. Although, at a conservative estimate, the overall amplification between frame and loud speaker is in excess of a hundred million times, the receiver may be built with complete confidence by any constructor who has handled a set containing a high-frequency stage.

The second point is that the special coil-assemblies inseparable from a superheterodyne have been reduced in number as far as possible, and those which could not be eliminated have been made cheap and very easy to assemble. *(To be concluded.)*



Drilling details of the front panel and the terminal strip. Sizes of holes are as follows: A, ⅜in. dia.; B, 7/32in. dia.; C, ⅛in. dia.; countersunk for No. 4 wood screws; D, ⅛in. dia.

ADJUSTING SCREENING GRID POTENTIAL.

THE practice of using a *variable* instead of a fixed potentiometer for supplying the auxiliary grid of an S.G. valve is becoming increasingly common. A common practice is merely to connect a special power potentiometer having a value of about 50,000 ohms across the source of H.T., the auxiliary grid of the valve being connected to the slider. The danger of this, however, is that it is very easy to apply the full voltage of the eliminator to the screening grid. Not only is this detrimental to the valve, but it is totally unnecessary, since the requirements of the screening grid in the matter of voltage are rarely more than half, and sometimes less than one-third, the requirements of the plate. It is an excellent idea, therefore, always to connect in series with the positive side of the potentiometer a fixed resister which is equal in resistance value to that of the potentiometer. Apart from its function of preventing too high a voltage value being applied to the auxiliary grid of the valve, this arrangement enables the potential of the screening grid to be adjusted more easily, since the variation of voltage for a given movement of the slider of the potentiometer is obviously halved.

PRE-SELECTION

How to Prevent Cross-modulation with the Screen-grid Valve.

By W. I. G. PAGE, B.Sc.

A SHORTCOMING of the screen-grid valve which is not always appreciated is its inability with ordinary tuned circuits to accept signals larger than a small fraction of a volt without introducing a peculiar form of interference known as cross-modulation. While a pre-H.F. volume control does much to mitigate the trouble, of primary importance is the selectivity of the first tuned circuit. It is shown that a resonance curve of rectangular form such as that of a band-pass filter is highly desirable for this circuit. The more efficient the intervalve coupling the greater is the tendency towards cross-modulation.

MANY readers will probably have found that there exists with the screen-grid valve in certain circumstances a form of interference which was not experienced with the neutralised triode. A faint but irritating background of music or speech may mar the reception of a foreign transmission, the unwanted signals being traced probably to a high-powered station many kilocycles away—so far away, in fact, that the trouble can hardly be accounted for by ordinary lack of selectivity. Adding tuned H.F. stages which increase selectivity does not always reduce this type of interference, so that we must search for some cause other than damping due to low dynamic resistance.

As the phenomenon is only met with where the first valve in a set is of the screen-grid variety it will be as well to examine what happens when the grid and plate circuits of such a valve are tuned to a transmission. At resonance these circuits behave as pure resistances, and for the present discussion we need only consider the effect of the plate circuit—the grid circuit being looked upon as a necessary arrangement to produce volts for the grid of the valve. When a signal is received, three important things take place in an amplifying valve. The grid voltage swings equally on either side of the bias potential, the anode voltage swings well above and below the actual pressure applied, and the anode current changes in sympathy. The cycle of events can be critically examined by drawing a straight line across the anode volts/anode current curves of the valve. By Ohms Law $R = \frac{E}{C}$ where R can represent the dynamic resistance of the tuned plate circuit at resonance and E and C the necessary change of voltage and current. To represent, for instance, a tuned circuit of 90,000 ohms—rather better than a good plug-in coil, say a 1½in. solid wire coil—we must draw a line to embrace a change of 160 volts and 1.65 mA. for 160/0.00165 amp. = 90,000 ohms approximately. Such a line—known as a "load line"—is drawn in Fig. 1 and marked AOB. Similarly a load line of 200,000 ohms for a really efficient 3in. coil is plotted as COD.

To trace out the cycle in the case of the valve whose characteristics are given in Fig. 1—one of the latest A.C. screen-grid valves—we must make the load lines cut the operating point O, which is the normal point of bias (−1.5 volts) and the maximum H.T. (200 volts) under static conditions. Let us now assume that a signal of one volt is applied so that the grid swings to −2 volts on the right and −1 volt on the left—it must not trespass beyond the latter point because grid current begins to flow when the grid is nearly one volt negative in the valve under discussion. The working cycle is given either by AOB or COD, the first for the "poor" coil of 90,000 ohms and the second for the "good" coil of 200,000 ohms. Clearly, the poor anode coil gives *fairly linear* amplification, for AO is nearly equal to OB, so that the anode voltage change is nearly proportional to the grid voltage change. With the good coil OD is nearly twice as long as CO, and for a grid swing of ½ volt either side of the bias point the anode voltage change would be anything but proportional—one half-cycle would be amplified much more than the other, which would result, of course, in rectification. To find out the grid swing along COD giving nearly linear amplification, Eg−1.4, Eg−1.6 volts, etc., would have to be plotted, but an estimate shows the figure to be $\frac{1}{10}$ to $\frac{1}{5}$ volt. The deduction is that with an efficient

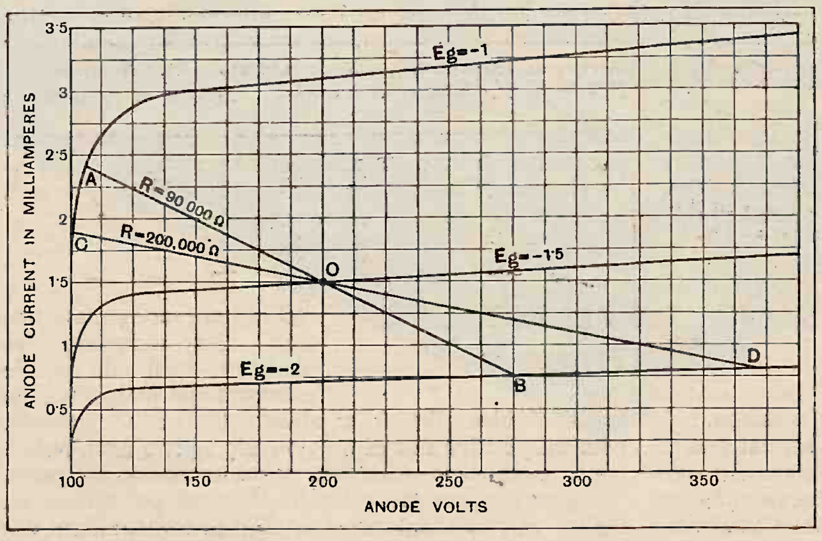
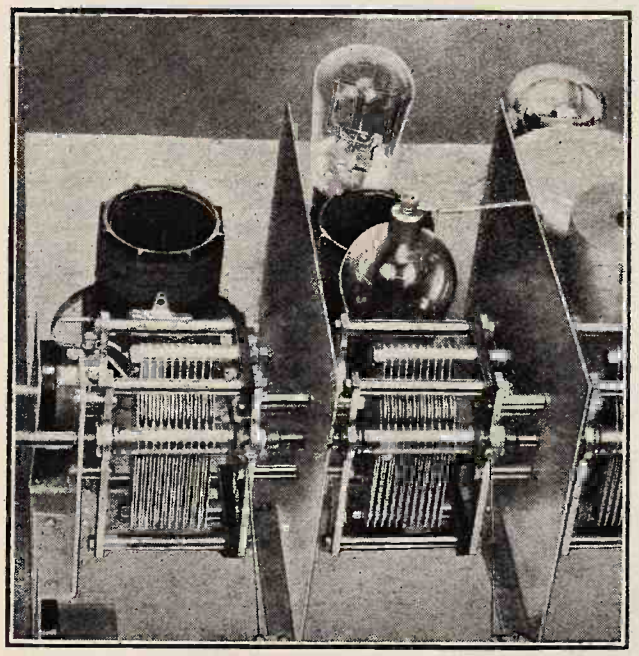


Fig. 1.—By drawing load lines across the anode volts/anode current curves of one of the latest screen grid valves it can be seen that for a given signal input, rectification and hence cross-modulation gets worse as the anode tuned circuit gets more efficient. The line AOB representing a tuned intervalve coupling of 90,000 ohms at resonance shows only slight rectification, while COD for a low-loss circuit of 200,000 ohms would give serious rectification.

Pre-Selection.—
intervalve coupling following a screen-grid valve the input may have to be reduced to a small fraction of a volt, otherwise rectification ensues. If a poor anode coil is used there is less chance of trouble from this cause, but a greater number of stages must be employed to make up for lost amplification.

Rectification *per se* is likely to cause distortion, but there is a more obscure effect due to the voltage developed in a moderately unselective aerial circuit by a powerful station differing in wavelength by many metres from the station it is desired to hear. Let us consider Fig. 2, where a typical resonance curve XYZ is given for the aerial circuit L. The skirts X and Z may extend to 60 or more kilocycles either side of the tune point, and it is possible that a powerful station Z, 50 kilocycles away, may develop a large enough fraction of a volt



The input coupled circuit of "The Wireless World Four" which functions as an efficient pre-selector. The valve and coil screens are not shown.

grid swing to cause rectification, the resulting low-frequency impulses will modulate the H.F. carrier of the station being received, and interference known as cross-modulation or secondary modulation will appear. This explains the form of apparent unselectivity referred to at the beginning of the article.

The curvature of the anode volts/anode current characteristics of a triode is in the opposite direction to that of a screen-grid valve, so that the load lines follow a path of more linear amplification the better the anode coil; furthermore, larger grid swings generally are possible without rectification. Before discussing methods of combating the evils of cross-modulation in the receiver the suggestion is put forward that valve manufacturers should try to prevent the flow of grid current on the negative side of zero grid with S.G. valves. This, together with a general reduction of A.C. resistance, would help to minimise unwanted rectification.

The first thing that would suggest itself to the designer of an S.G. set is a pre-H.F. volume control to cut down the response to the unwanted station to such small limits that rectification does not occur. It may often happen,

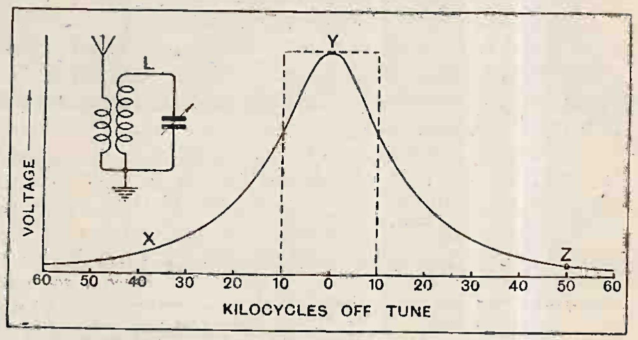


Fig. 2.—The voltage developed on the grid of the S.G. valve by Z, a station 50 kilocycles away from resonance may be sufficient to cause cross-modulation when the response curve of the input circuit is like XYZ. If the pre-H.F. volume control is adjusted until all traces of cross-modulation disappear it is possible that the voltage developed by the desired station will have become excessively small.

however, that to do this the wanted station, which, perhaps, is a distant one, may be reduced so much in signal strength as to require a wasteful extra number of amplifying stages, in which valve noise may become troublesome. When it is realised that the signal from a Regional station may develop up to 8 or 9 volts across the first tuned circuit of a receiver used with an outside aerial a few miles from the transmitter, it will be obvious that a pre-H.F. volume control is essential to prevent ordinary overloading, but alone it is not necessarily a sure cure for cross-modulation.

From the foregoing it is, therefore, of primary importance that in the selectivity scheme of a modern receiver special attention be given to the first tuned circuit. There must be no tailing off in the resonance curve as in Fig. 2, otherwise rectified voltages may appear from unwanted stations 30, 40, 50 or more kilocycles away. The response curve of this circuit must have the minimum of skirts and approximate to the dotted rectangle (see Fig. 2) embracing but 10 kilocycles. This is only possible

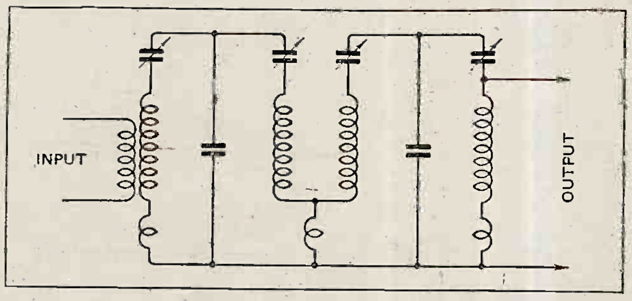


Fig. 3.—Will it come to this? A pre-selection band-pass filter with four ganged condensers. The mixed capacity and inductive coupling ensure a constant rectangular resonance curve over the waveband.

with a coupled circuit, the simplest form of which is the two-member band-pass filter. The overall selectivity of a screen-grid receiver is not determined entirely by the number of tuned circuits or by their efficiency, but to a great extent by the behaviour of the first circuit or pre-

Pre-Selection.—

selector. If cross-modulation occurs in the first circuit any number of highly selective high-frequency stages will not help. An efficient pre-selector is also necessary to combat the evils of beat interference.[1]

The writer does not wish it to be inferred that all screen-grid sets without input band-pass filters must suffer from cross modulation. There are localities where quite modest aerial circuits suffice, but with the increasing congestion of the ether the harmful effects of rectification are bound to be met sooner or later unless the response of the first tuned circuit is kept within certain defined limits. It is undoubtedly important to see that any adjustable voltage controls which may be included in the first screened valve circuit are only used to obtain optimum working conditions, and not to prevent instability by overbiasing or unduly reducing screen volts. Either of these causes greater curvature in the valve characteristic with consequent increased chance of rectification.

Pre-selection will become increasingly important as the Regional scheme develops, and it may be necessary to consider input filters with three or four members (see Fig. 3), for the greater the number of coupled circuits the more nearly is the ideal rectangle approached. The succeeding intervalve couplings would need to be of only small dynamic resistance, for the whole of the necessary selectivity would have been obtained in the aerial circuit.

[1] See note elsewhere in this issue entitled "Beat Interference."

Transmitters' Notes.

International Short-Wave Radio League.

In our issue of July 30th we drew attention to a society of short-wave listeners that had recently been formed in U.S.A. with its headquarters at Jamaica Plain, Boston, Mass, and we can now state that a European branch of this League has been established, with offices at 105, Lord Street, Southport, in charge of Mr. M. Barnett. The official bulletin will be published monthly, and a specimen copy will be sent free to those interested if they will send in their names to the European headquarters.

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28 Megacycle Transmissions.

Mr. D. W. Heightman (G6DH) is transmitting from Clacton-on-Sea on 10 metres every Saturday at 14.00 and on Sunday at 11.00, 14.30 and 16.00 G.M.T., using a DET1 S.W. valve with a self-excited circuit and coupled by a two-turn coil to the end of a horizontal aerial 20 metres long, i.e., the aerial is voltage fed and working on its fourth harmonic. Communication has been established with Finland, Northern Rhodesia, and Egypt, and reports received from the Azores, South Africa, Iraq and the 9th district of U.S.A.

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Short-Wave Experiments.

Mr. H. E. Whatley (G2BY), 37, Paddenswick Road, Hammersmith, W.6, who is one of the enthusiastic group of short-wave workers in the western district of London to which we drew attention in our issue of March 12th, asks us to state that he is transmitting regularly on the 5-metre waveband almost every Sunday between 14.00 and 15.00 G.M.T., and will welcome reports. He keeps up regular schedules with G2OL, G6XN, G6WN, G2OW, and G6CO on 5.26 metres.

He is also experimenting on the 20-metre band, and will be interested to learn up to what distance his ground-wave is audible. He will therefore be grateful for reports from listeners within 150 miles' radius of Hammersmith and outside the London area.

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Beam Tests by PCJ.

The new beam aerial at the Philips short-wave station in Eindhoven, Holland, mentioned in "Current Topics" on October 15th, is favourably reported on by listeners in the neighbourhood of Colombo. In the bulletin of the Radio Club of Ceylon for the week ending September 27th a listener stated that signals on September 24th, at about 10 p.m. (Ceylon time), when transmitted by the beam (B) aerial were very strong, and overloaded his loud speaker, but when PCJ switched over to their normal aerial (A) a decided decrease was noticed, and the signals gradually faded out. Another listener 70 miles east of Colombo found the strength of PCJ on aerial B greater than that of the local station. A little fading was noticed, but even with his aerial cut out the signals were still faintly audible.

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Another W.A.C. for Telephony.

Mr. F. R. Neill has been awarded the W.A.C. 'Phone Certificate of the I.A.R.U. for working all continents on telephony from his station GI5NJ at Belfast. This was the first amateur transmitting station licensed in Northern Ireland, and the first in Ireland to gain the W.A.C. certificate for telephony, though it has previously been gained in Great Britain by Mr. H. L. O'Heffernan (G5BY), whose station is in Croydon.

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G2DT, owned and operated by Mr. E. T. Somerset at Dorking, Surrey. In the centre is the 7, 14 and 28 MC receiver with Reinartz-Grebe circuit and a screen-grid detector. On the receiver stands the frequency-monitor supporting the Wortley-Talbot challenge cup awarded by the R.S.G.B. in 1929-30 for early work on 5 metres. The transmitters comprise one for 56 MC, one TP.TG for 14 MC, and on the right is seen the 7 MC Hartley transmitter and a 28 MC 1-V-1 receiver.

New Call-signs and Addresses.

G2US (ex 2AJT) C. C. Mortimer, The Grosvenor, Thornton Road, Thornton Heath, Surrey.
G5WY C. L. Wood, 95, Fore Street, Exeter.
2AJY H. C. Thornton, 181, Woodside, Todmorden Road, Burnley, Lancs.
2BYP F. M. Smith, 253, Westbourne Avenue, Hull.

CURRENT TOPICS

Events of the Week in Brief Review.

RADIO COMMEMORATION.

On November 2nd (All Souls' Day) all Italian wireless stations observed a profound silence for a brief period, writes our Turin correspondent.

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LISTENERS CHOOSE THEIR ANNOUNCER.

Out of 116 applicants for the post of announcer at Radio-Barcelona, six were chosen to undergo the acid test at the microphone. Each candidate was given an evening to himself, and listeners were asked to express their preference by vote.

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NO MORE RADIO EVENINGS.

Several towns are known to have instituted laws forbidding the use of loud speakers after about 10 p.m., but the town of Arles-en-Provence (France) has gone further. The police superintendent there has issued an edict that all loud speakers are to "shut up" at sunset!

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A RADIO DUEL.

Probably the first duel in radio history is that which has just been fought between M. Georges Delamare, director of the Tour Eiffel studio, and M. Georges-Armand Masson, an artist, whose caricature of the former in a French radio journal gave offence. Happily, no blood was shed, writes our Paris correspondent. Four bullets were exchanged without "reception" on either side.

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DRAMATIC BROADCASTING STATION.

The Berne broadcasting station, which will shortly resume transmissions, will specialise in radio drama. A school of radio elocution is to be formed for the training of the fifteen or twenty actors who will compose the station's dramatic company.

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MICROPHONE CONTROL AT R101 ENQUIRY.

Six microphones and four loud speakers are being used at the official enquiry into the R101 disaster, which is being held in the hall of the Institute of Civil Engineers, Great George Street, London, S.W.1. The installation, which was specially designed by the Marconiphone Company, includes an ingenious system of control whereby the various microphone circuits can be cross-connected so that, for example, questions and answers from different parts of the hall can be heard clearly by all concerned.

THE REASON.

Yet another excuse has been found by the wireless "pirate." A farm labourer at Market Bosworth, summoned for operating an unlicensed set, pleaded that he did not get a licence as he was expecting to leave the district soon.

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IRISH!

For the best criticisms of the Dublin and Cork programmes an Irish newspaper offers fifty free wireless licences. Problem: Does one criticise without a licence?

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RADIO ON ITALIAN TRAINS.

Successful tests are being conducted with radio receivers on trains running between Milan and Turin. Travellers can listen in on payment of three lires.

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RADIO AGEN REDIVIVUS.

We understand that Radio Agen, the station which was almost completely destroyed in the great French floods some months ago, will again make itself heard in the near future. A State subsidy of £2,400 has been allotted for its reconstruction.

FRENCH STATION RESUMES BROADCASTING.

Montpellier-Languedoc, which lapsed into silence a year ago, has suddenly resumed transmissions on its allotted wavelength of 286 metres.

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FINE VOLUME CONTROL.

A Bethnal Green wireless dealer has been fined 40s. with three guineas costs at the Old Street Police Court for operating a loud speaker outside his shop in such a manner as to cause annoyance and disturbance to the public.

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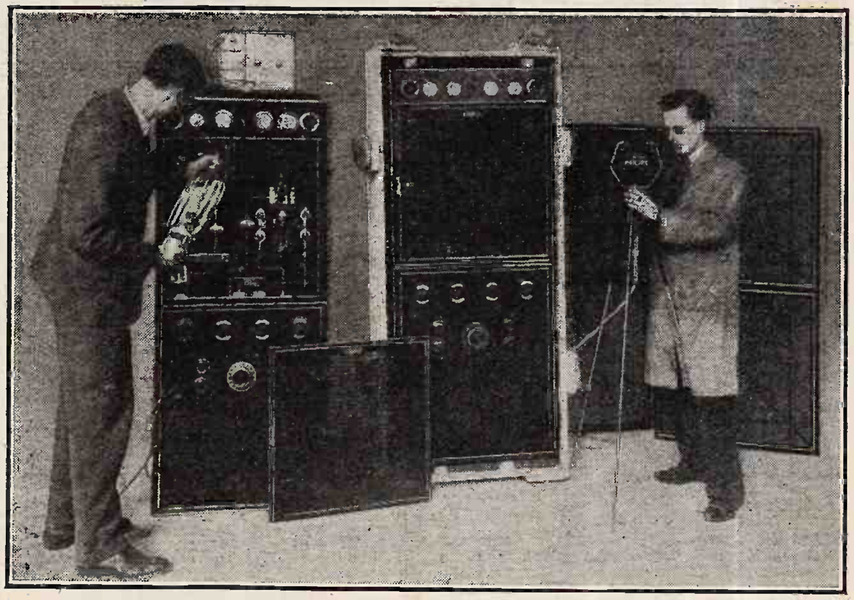
O.B.E. FOR R101 WIRELESS OPERATOR.

The traditional heroism of the wireless operator's profession was splendidly maintained by Mr. Arthur Disley, operator on the R101, whose gallantry has been recognised by the award of the Medal of the Civil Division of the Order of the British Empire for Meritorious Service.

Mr. Disley, after escaping from the airship wreck with serious burns, refused treatment before he had telephoned the first details of the disaster from Beauvais to the Air Ministry.



A COMPACT AMPLIFIER. Testing a Philips 500-watt amplifier which gives an output of 1½ kW. The engineer on the left is inserting a valve which takes a plate voltage of 4,000. The microphone on the right is similar to those in use at Hilversum and PCJ.

BROADCAST RECEIVER PATENTS.

We learn that the Gramophone Co., Ltd., Marconi's Wireless Telegraph Co., Ltd., and Standard Telephones and Cables, Ltd., have made arrangements whereby patents owned or controlled by any or all of the three companies, including those resulting from the research facilities at their disposal, will be available for use by licensees through a single organisation.

Applications for a joint licence by the three companies are invited from interested manufacturers of broadcast receiving apparatus. Such applications should be addressed to Marconi's Wireless Telegraph Co., Ltd., Marconi House, Strand, London, W.C.2. In approved cases a licence will be granted which will be generally similar as regards conditions and field of use to the licence hitherto issued by the Gramophone and Marconi companies jointly and known as Type "A3," or the Marconi general licence.

All present holders of the usual "A3" licence will be able to obtain the benefit of patents owned or controlled by Standard Telephones and Cables, Ltd., without any increase in the rates of royalty.

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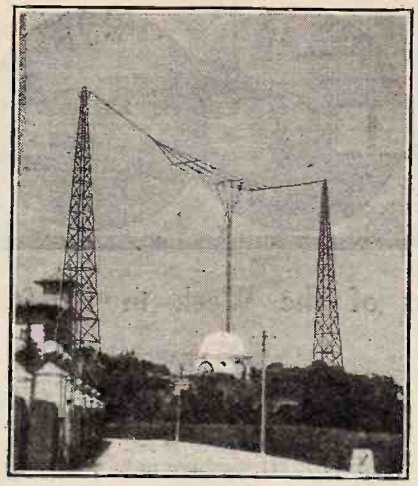
1,200 kW. FROM KDKA ?

Broadcasting power in excess of 1,000 kilowatts is the ultimate goal of station KDKA, whose engineers are now conducting experiments with the new 200 kW. Westinghouse valves in the expectation of going on the air shortly in a series of after-midnight tests with super-power, writes our Washington correspondent.



IN SUNNY SPAIN. Radio Barcelona, which operates on 268 metres with a power of 10 kW.

KDKA's experimental licence from the Federal Radio Commission authorises the use of up to 400 kW. in the series of experiments. This will require the use of two of the giant 200 kW. valves, each of which stands 6ft. in height and requires the passage of five tons of cool water through its water jacket every hour.

It is learned on reliable authority, however, that the Westinghouse engineers are arranging the plant of KDKA so that six of the valves may ultimately be used, which would give the station an output of 1,200 kW.—the highest power ever attempted on either the broadcasting or communications wavelengths.

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RADIO RESEARCH CENTRE FOR ITALY.

Italy will soon possess a new radio experimental station, controlled by the Central Council of Research, of which Marquese Marconi is president. At the last meeting of the Council, writes our Turin correspondent, it was decided that experiments should be made in television, a subject which has been neglected in Italy. The director of the new research centre will be Prof. Dr. Vallauri.

NEWS FROM THE CLUBS.

A Proud Record.

Forty-four lectures and demonstrations in one year, besides visits to Brookmans Park and Savoy Hill, was the proud record of the Woodford and District Radio Society as disclosed at the annual meeting held on October 20th.

In view of the growth in membership it has been decided to move the Society's headquarters to The Men's Institute, High Street, Wanstead, E.11, where the first meeting will be held on November 6th at 8 p.m.

Hon. Secretary, Mr. H. Crisp, 7, Ramsay Road, Forest Gate, E.7.

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Short-Wave "Superhet" Adaptors.

The design of peak amplifiers to cope with the narrow frequency band available to amateurs gave material for a profitable discussion among members of the Kentish Town and District Radio Society at a recent meeting.

Another topic which is to be discussed at an early date is that of short-wave "superhet." adaptors on the lines recently suggested by *The Wireless World*.

Full details concerning the Society can be obtained from the Hon. Secretary (temporary), Mr. C. J. Townsend, 14, Hamilton Street, N.W.1.

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A Radio Film.

Two interesting films were shown at a recent meeting of Slade Radio (Birmingham).

The two came under the title of "Radio Record," and the first, entitled "Pertrix," showed many of the operations in the making of these well-known batteries.

The second, the "Mazda Valve" film, displayed various processes in valve manufacture. The films were supplied by Messrs. Ensign, Ltd., and shown by Mr. Martin, of the Midland Radio.

The month of November sees the Society entering on its third year with expectations of still greater prosperity in the future.

Wireless enthusiasts interested in the Society are invited to write to the Hon. Secretary, 110, Hillaries Road, Gravelly Hill, Birmingham, who will be very pleased to forward details of membership.

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Behind the Screen.

Remarkable evidence of the advances made in loud speaker design was forthcoming at the last meeting of the North Middlesex Radio Society, when a comparative test of speakers was carried out. A number of instruments owned by various members was tested, switching arrangements enabling a rapid change-over to be made from one speaker to another. The test was made on broadcast speech and music, and all the loud speakers were concealed by a curtain to aid unbiased judgment. On counting the votes, it was found that the first three instruments were identical for both tests.

A noteworthy feature of the test was the great strides made in the reed-driven type, particularly in the response to the lower notes.

The Society is open to receive new members at any time, and any who are interested in wireless in the district are invited to apply for particulars to the Hon. Secretary, Mr. E. H. Laister, "Windflowers," Church Hill, N.21, or to attend any meeting. These are held in the lower clubroom, St. Paul's Institute, Winchmore Hill, on alternate Wednesdays at 8 p.m., and an attractive syllabus of lectures, demonstrations, etc., has been drawn up for the session.

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New Headquarters in Golders Green.

New headquarters have been found for the Golders Green and Hendon Radio and Scientific Society, which has moved to Woodstock School, Golders Green Road, near Golders Green Tube Station. Meetings are held on the second and fourth Thursday of each month at 8.15 p.m. The interesting winter programme will include visits to the National Physical Laboratories at Teddington, the Air Port at Croydon, and the Gramophone Company's factory at Hayes.

Recently Mr. Maurice Child gave a helpful lecture on "Difficulties and Troubles in Wireless Reception." The lecturer supplied valuable hints on remedying faults.

A few vacancies exist for new members, and full particulars will be sent on application to the Hon. Secretary, Lt.-Col. H. A. Scarlett, D.S.O., 60, Pattison Road, N.W.2.

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A High-frequency Dispute.

A storm of protest arose at the last meeting of the South Croydon and District Radio Society, when, in a discussion on the redesigning of one of the chief demonstration sets, it was suggested that H.F. amplification would be unnecessary. Calm reasoning gradually invaded the meeting. After all, did the Society really need a receiver capable of doing what the vociferous pro-H.F. members demanded? What it most needed was a fairly simple set which would give perfect reproduction of the local station's programmes.

It was eventually agreed that this particular demonstration set need have no H.F. amplification, and, following this vital decision, the set was gradually built up diagrammatically on the blackboard. It was decided that all current should be taken from the A.C. mains. The valves' filaments would be indirectly heated by A.C. current, except the last, which would have the alternating current applied "raw" to its filament. The Society's famous mains unit would be incorporated to supply H.T. and a dry metal rectifier would be used to provide the moving-coil loud speaker with field current.

It was decided to use anode-bend detection.

Hon. Secretary, Mr. E. L. Cumbers, 14, Capden Road, South Croydon.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 5th.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. At the Institution, Savoy Place, W.C.2. Inaugural Address by the Chairman, Mr. C. E. Rickard, O.B.E.

North Middlesex Radio Society.—At 8 p.m. At St. Paul's Institute, Winchmore Hill, N.21. Lecture: "The Theory, Design and Operation of Pick-ups," by Mr. W. D. Oliphant, B.Sc. (Burndept Wireless).

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture by Mr. H. E. Penrose (H.M.V.), who will demonstrate the Epidioscope and new H.M.V. Radio-Gramophone.

THURSDAY, NOVEMBER 6th.

Ilford and District Radio Society.—At the Wesleyan Institute, High Road. Lantern Lecture: "A.C. Operation," by Mr. F. Youle, of the Marconiphone Co., Ltd.

Slade Radio (Birmingham).—At 8 p.m. At the Parochial Hall, Broomfield Road, Erdington. A novel microphone test.

FRIDAY, NOVEMBER 7th.

Radio Society of Great Britain (in conjunction with Lensbury Radio Society). At 6.15 p.m. At 16, Finsbury Circus, E.C.2. Discussion of Radio Rectifiers. Lecturer: Mr. A. Gay (G6NF).

TUESDAY, NOVEMBER 11th.

Bec Radio Society.—At 7.30 p.m. At Bec School, Beechcroft Road, S.W.17. Lecture: "A.C. Valves," by Mr. G. Parr (Ediswan).

Highest actual amplification!

— due to its abnormally low inter-electrode capacity

The effective H.F. amplification per stage that can be obtained in any Screened Grid Set is largely controlled by the inter-electrode capacity of the S.G. Valve. It is well known that the lower the self capacity of the valve the greater its effective stage amplification. Important features in its design and construction permit the inter-electrode capacity of the new Cossor 215 S.G. to be reduced to the order of .001 micro microfarads. This is substantially lower than the self capacity of any other Screened Grid Valve on the market. It follows, therefore, that this new valve permits a big increase in effective amplification. In fact, results are obtained which, a year ago, would have been considered quite impracticable.

Cossor 215 S.G. 2 volts, ·15 amp. Impedance 300,000. Amplification Factor 330. Mutual Conductance 1·1 m.a/v. Normal working Anode Volts 120. Positive Voltage on Screen approx.) 60. Price **20/-**

THE NEW
COSSOR
215 S.G.

GREATEST *EFFECTIVE* STAGE GAIN

A. C. Cossor Ltd., Highbury Grove, London, N.5.

6515

Radio is becoming ALL-ELECTRIC

You can make your battery set All-Mains quite simply. No need even to alter it. Think of the added power—constant, unlimited, unfailing; the added range, selectivity. Think of being able to use the Six-Sixty Mains Valves.

Convert your set with the Six-Sixty A.C. All-Mains Conversion Equipment—the great success this season! Price, Complete from £8 : 5 : 0 Mains Unit only (H.T., L.T., & G.B.) £6 : 6 : 0.

Dimensions do not exceed those of the batteries it replaces. No internal wiring alterations. Made to suit any A.C. supply. Specially selected Six-Sixty A.C. valves and Six-Sixty 5/4 pin valve holder adaptors.

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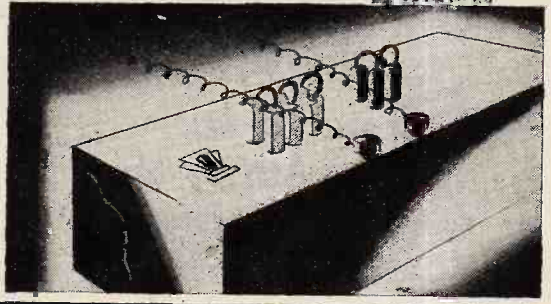
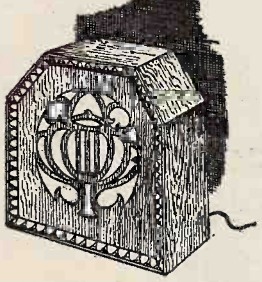
(B.V.A. RADIO VALVES AND EQUIPMENT.)



FREE! *Write for FREE Booklet giving full and interesting information on how to make your set up to date.*

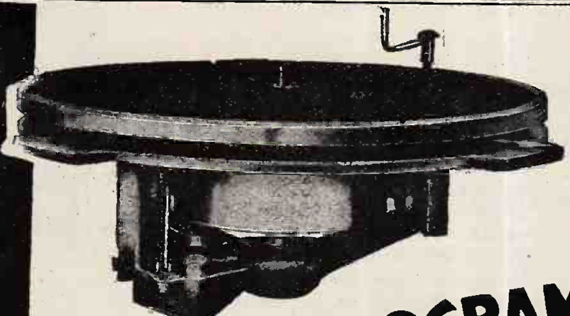
Six-Sixty Radio Co., Ltd., Six-Sixty House, 17/18 Rathbone Place, Oxford St., London, W.1.
Telephone: Museum 6116-7.



Everybody's calling for

Player's Please

PLAYER'S NAVY CUT.



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No brushes or commutator to cause interference. No belt. The motor runs smoothly and silently, without variation in the revolution speed even with largely fluctuating mains current. 12" velvet-covered turntable, automatic brake and cut-out. For 100-130 and 200-250 v. A.C. 7¾" × 5½" × 5⅞".

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Portable Gramophone Cabinet fitted with Paillard Motor, Super Pickup and volume control, £8/15/0 complete.

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"Vous Venez D'Entendre"

An Englishman Broadcasts in Paris

By A SPECIAL CORRESPONDENT.

BROADCASTING in France is much more casual than at Savoy Hill. I had some experience of this recently, when asked to give two talks to the French wireless public.

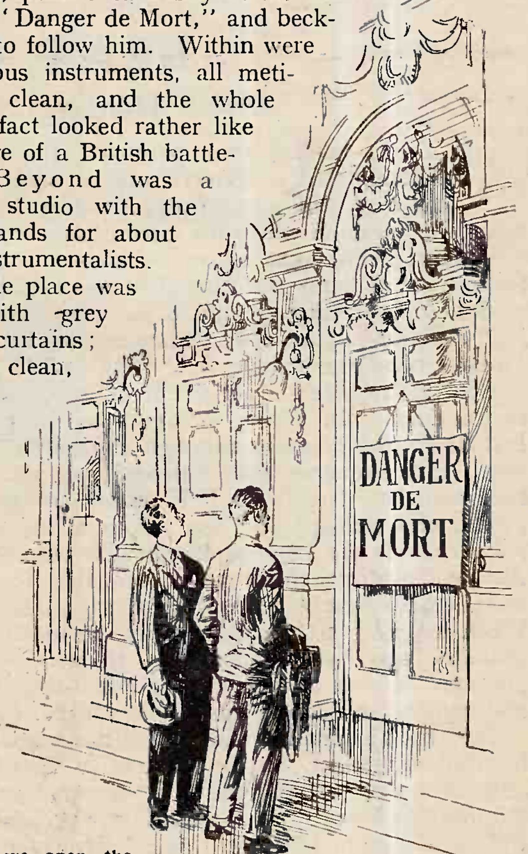
A friend and I arrived at the offices of the broadcasting station of "Radio Paris" about 7 o'clock so as not to be late for the appointment. Our punctiliousness was quite unnecessary. The large house in which are situated the studios is not far away from the Eiffel Tower. We walked in at the door marked "Artistes," expecting to be challenged by a doorkeeper, b·t as there was no one there, we walked timidly upstairs, anticipating that every moment some fierce guardian of the sacred spot would demand to know our business. But apparently the whole house was deserted. If it had not been for loud speakers situated at the corners of several rooms, from which issued the sounds of some gentleman giving what appeared to be an interminable lecture on some intensely dull and technical subject, we should have imagined that we had come to some French gentleman's house that was shut up for the summer.

A Mysterious Door.

At last we came to a door that was closed, rather like the pass door that leads behind the stage of a theatre. On this was written "Danger de Mort." We hesitated. Should we open the door and risk instant electrocution, or should we continue to wander along deserted corridors, possibly missing our appointment? Discretion prevailed, and we turned our backs on the mysterious door and walked up yet another flight of stairs. Here on a landing there were as many closed doors as in a French farce. We opened three nervously, only to find that the rooms were empty. The fourth suddenly opened and two gentlemen in straw "boaters," both smoking cigarettes and talking at once, hurried out, passed us as if we were non-existent, and ran down the stairs. Again there was complete silence, except for the invisible lecturer.

We then turned the handle very gently of the fifth door, and peeped in. There, sitting alone at a table, was the lecturer talking into the microphone. We closed the door again very softly and experimented with the last and sixth door. A courteous official rose and shook hands. He said that he was "enchanted" to meet us, and invited us to wait downstairs.

Then, realising that I was English, he asked: "Would you care to see some of the works behind the scenes?" I replied that nothing would give me greater pleasure than to have the privilege of visiting their engineering staff. He bowed, led us once more down the stairs, pushed carelessly at the door marked "Danger de Mort," and beckoned us to follow him. Within were the various instruments, all meticulously clean, and the whole room in fact looked rather like the bridge of a British battleship. Beyond was a spacious studio with the music stands for about sixty instrumentalists. The whole place was hung with grey velvet curtains; was very clean,



"Should we open the door and risk instant electrocution?"

"Vous Venez D'Entendre."—

and gave the impression of smoothness and efficiency.

We were then taken upstairs again to a similar studio, and I was asked to sit down at a table, where, at a given signal, I began to talk. As soon as I had started our guide left us alone in the studio, and I wondered exactly what would happen should I venture to make some reckless or indiscreet statement. Was somebody listening in the lonely building who would have cut me off at any offence? There had only been one mechanic in the instrument room, and except for our guide, no other official had been seen. However, nothing untoward occurred, and our duty over, we walked out while the official had taken our place and was giving announcements.

On another occasion I spoke from "P.T.T.," which is a Government wireless station and is situated in the Government offices of the Post and Telegraphs. It was a little after 8 p.m. as I walked into the courtyard and hundreds of officials were just leaving work. There was the same rush, the same harassed appearance, the same impression of born bureaucrats as may be witnessed every day by the Londoner who stands at the corner of Whitehall at 5 p.m. The French civil servant apparently leaves off work three hours later, having had, of course, two hours for lunch.

We were shown into a studio where a gentleman at the microphone was dilating on the virtues of certain photographic apparatus. The studio here was very different from that of Radio Paris, for everything was shabby, and there was an atmosphere of improvisation. It was part of one large room, possibly at one time the *salon* of the old house, which was divided into two by curtains.

The director then invited us to venture behind the curtains. Walking along creaking boards, we followed him and found the instrument room on the other side. One mechanic was doing all the work, and the floor was littered with wires, almost as if the instruments had only been put together half an hour before.

The photographic lecture was rather dull, and the director courteously offered to stop it so as to allow me to speak before my time. But remembering what a heineous crime it is at Savoy Hill to depart even for half a minute from the authorised programme, I said that I would wait a little longer for my dinner and come on at the advertised time.

At last the discussion of plates and developers and printing frames ceased. An electric sign close to the microphone announced that the next talk would be broadcast, not only in the Paris region, but around Limoges and Toulouse.

I gave my talk, and was replaced by a weary looking teacher who was to give a lesson in English. As we left the building we heard him monotonously repeating, "La parapluie—the Um-brel-lah," and I rejoiced to think that before long I should be able to tune in once more for Jack Payne!

BEAT INTERFERENCE.

The Dangers of Rectification in H.F. Valves.

AN article in this issue entitled "Pre-Selection" explains that a receiver with a selective aerial coupling will give greater freedom from interference than one in which the same degree of selectivity is obtained chiefly by means of the inter-valve couplings. Some form of band-pass filter is almost essential under modern broadcasting conditions in order to avoid not only cross-modulation or secondary modulation, but also "beat" note interference.

With an unselective aerial circuit the local stations may impress quite a large voltage upon the grid of the first H.F. valve, even although the aerial circuit is tuned to a frequency very different from either of the local stations. Nearly all H.F. valves rectify to some extent, and consequently, the output of the first H.F. valve consists of a large number of different frequencies. Among these frequencies are two equal to the sum of, and the difference between, the two original frequencies. When the intervalve tuned circuits are tuned to either of these "sum" and "difference" frequencies, the programmes of both stations can be heard simultaneously and without an audible heterodyne whistle.

The action is identical with that of the ordinary superheterodyne receiver, for the H.F. valve takes the place of the first detector, and one of the transmitters replaces the local oscillator. On the medium waveband trouble will usually occur from the "sum" frequency, and the interference will be greatest on the shortest wavelengths. "Difference" frequency jamming may be found, however, but this will usually be evident on the higher wavelengths.

On the long waveband the trouble usually arises from the "difference" frequency. The beat note of any two stations, on any wavelength, whose frequency difference falls between about 150 kc. and 330 kc. may cause trouble. The writer recently experienced jamming of this kind from the two Brookmans Park stations; both stations were audible and sharply tunable on a wavelength a little lower than 1,000 metres.

Band-pass Filter Provides a Cure.

Now the National and London Regional stations transmit with frequencies of 1,148 kc. and 842 kc. respectively; the frequency difference, therefore, is 306 kc., which is equivalent to a wavelength of 980 metres. The trouble was easily cured by substituting a band-pass filter for the single-tuned aerial circuit. The extra selectivity afforded by the filter reduced the undesired input voltages sufficiently to prevent the H.F. valve from rectifying appreciably, thus preventing the formation of a beat note.

It is thought that this form of interference may be widely experienced and unrecognised. It is often impossible to detect it, unless the two stations heard can both be definitely identified. It is easy to mistake it for two transmitters working on the same wavelength, and to blame the crowded conditions of the ether, whereas the fault really lies in the receiver. W. T. C.

BROADCAST BREVITIES

By Our Special Correspondent.

Trouble in the Midlands.

Many receivers in the Midland region probably underwent a healthy overhaul between October 7th and 16th. During this period signals were noticeably weaker, and, in the absence of a statement by the B.B.C., many listeners quite naturally attributed the fault to their sets. Actually the trouble was due to a damaged aerial, which was temporarily replaced by a stand-by antenna 370 feet high.

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A Word to the Engineers.

The time seems opportune to repeat a plea made in these columns on August 27th. When a B.B.C. station reduces its radiation, even for a short period, the public should be informed. The humility of the average listener is such that he will always suspect his receiver before considering the possible vagaries of the transmitter.

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Perish the Thought!

Can it be that the B.B.C. engineers suddenly reduce transmission power in order to promote the general overhaul of receivers?

oooo

More About Empire Broadcasting.

As I hinted at recently, the discussion on Empire Broadcasting at the Imperial Conference has turned in the direction of a *quid pro quo* arrangement, the Dominions being desirous of exchanging programmes with this country.

In addition to the sentimental value of such a plan, the delegates see its uses in the stimulation of Imperial trade and commerce.

oooo

Four Programmes from Britain.

The latest proposals are for four separate Empire programmes daily from Great Britain: a Colonial programme in the afternoon, a programme for Africa coinciding with the ordinary evening programmes of the B.B.C., an Australasian programme in the morning outside the existing B.B.C. transmission hours, and a Canadian programme in the "small hours," which would require a special staff.

oooo

Staff Attitude at Savoy Hill.

There is some eagerness at Savoy Hill over the new jobs that are likely to arise when Empire Broadcasting is adopted, and it would not surprise me if some of the lost sheep who recently strayed into the talkie and gramophone wilderness were to return to Savoy Hill in the interests of the Empire.

oooo

A Dismantled Aerial.

A friend who motors daily past the Brookmans Park station was mildly startled the other day on seeing that the "National" masts were bereft of their aerial wires. The explanation is simply that the aerial was being thoroughly cleaned. Now that the Regional transmitter handles the bulk of the daylight transmissions, the National can enjoy a wash and brush up almost any day. Not so the Regional, which has to confine its ablutions to queer, unheard-of hours, such as 6 a.m. on Sunday.

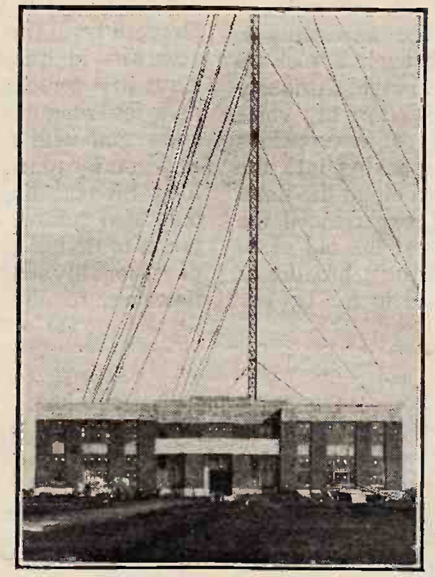
A Forgotten Birthday.

There comes a time when a man wishes to forget his birthday. The same sentiment seems to be swaying the B.B.C., for I find that, for the first time since 1923, there are to be no staff birthday celebrations on November 14th.

oooo

The Impersonal B.B.C.

A man may have personal reasons for keeping his birthday dark, but the reasons of the B.B.C. are literally impersonal, there being so few left of those original persons who set the ball rolling in November, 1922. Again, the B.B.C. itself, now a vast Corporation, has lost



MOORSIDE EDGE. A photograph taken last week showing the newly completed station building for the Northern Regional transmitter. The design is identical with that of Brookmans Park. The masts are 500 feet high.

the intimate touch with its listeners, and we are no longer kept agog over the doings and sayings of a dazzling family of microphonic uncles and aunts.

oooo

Those Pioneers.

Of the very first pioneers I can think of only three who are still to be found at Savoy Hill. They are Sir John Reith, Mr. Stanton Jefferies, and Miss Cecil Dixon.

But I must not forget that frequent visitor, Lord Gainford, now Vice-Chairman of the Governing Board, who accepted the chairmanship of the British Broadcasting Company in December, 1922.

For India *via* 5SW.

For the benefit of Indian listeners His Majesty the King Emperor has approved the broadcasting through the short-wave station 5SW of his speech at the opening of the Indian Round Table Conference at 12 noon on Wednesday, November 12th. The speech will go out from all the B.B.C. stations, and will be followed by that of the Prime Minister.

oooo

The National Orchestra at Close Quarters.

The new series of Sunday evening orchestral concerts from Big Tree Wharf studio opened in promising style on October 26th. As a member of the studio audience I felt that the listener by wireless was probably receiving a more proportionate impression of the abilities of the new orchestra than was possible to persons seated within a few feet of the 'cellos and the brass.

Even at close quarters, however, there was no mistaking the richness and balance of the orchestra on which Mr. Adrian Boult has bestowed so much care to bring to perfection. Only 78 of the 114 players were engaged, but they gave all the volume that the microphone could have required.

oooo

"Joe" Lewis in London.

Mr. Joseph Lewis, who had a large "following" in the Midlands by reason of his success as musical director at the Birmingham station for seven years, has now been transferred to the headquarters staff at Savoy Hill. He will act as a conductor of the B.B.C. Orchestra, and will be actively concerned in programme-building on the musical side.

At one time Mr. Lewis was assistant conductor of the City of Birmingham Orchestra under Mr. Adrian Boult.

oooo

Ceolraidh Ghaidhlig Inbhirnis.

This is the real title—I always suspected it—of the Inverness Gaelic Musical Association, which is to broadcast a concert from 5XX on November 20th. The long-wave national transmitter will be used to ensure that the choral selections can be heard in the far north of Scotland, an area outside the range of the Scottish stations.

oooo

Is the World Out of Joint?

One of the most important series of talks that the B.B.C. has yet undertaken will be opened on November 10th by Professor Arnold Toynbee, his title being "World Order or Downfall?"

I am told that the talks will be a warning to our civilisation against the danger of disintegration which threatens it unless immediate steps are taken to save it.

oooo

Story of the Week.

During an orchestral rehearsal in the studio last week Mr. Adrian Boult's lady secretary was sitting near the conductor, notebook on knee, ready to record any points which might arise, when Mr. Rubinstein, the pianist, walked in. Directly he saw the young lady he imagined her to be an autograph hunter. With an impatient little bow and "But permit me, Madam," he signed his name in her book.

Unbiased.

By *FREE GRID.*

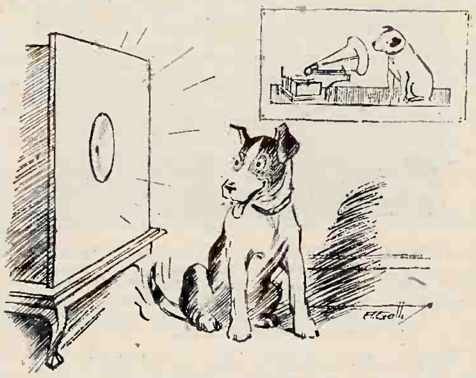
I HAVE been amusing myself recently with a home recording outfit, borrowed from an obliging friend who was persuaded into buying it against his will by a clever salesman at Olympia, who emphasised the necessity of his perpetuating his voice for the benefit of posterity, although he omitted to explain precisely why posterity should be thus inflicted. I must confess that I did not expect anything much in the way of results owing to the extremely low price of the outfit, and was all the more surprised, therefore, at the remarkable clarity with which my voice was reproduced. I am not going to pretend, of course, that the results were in the same street as those obtainable from a recording by one of the big gramophone companies, but my voice was clearly recognisable, and indeed I tested this by literally trying it on the dog, a procedure which was suggested to me by the well-known symbol of our old friends the Gramophone Company. My only complaint was that the volume obtained was extremely poor on an ordinary non-electric gramophone, but since the apparatus is actually intended to be reproduced through a pick-up and amplifier this is not really a disadvantage. Curiously enough, I noticed that in my very first effort my voice was very tremulous, betraying a state of nervousness which, indeed, I felt whilst actually speaking into the instrument, although I was alone in the room at the time. The feeling was akin to that which I experienced the first time I ever faced the microphone at the old 2LO, and which was only overcome in subsequent broadcasts by following certain sage advice offered to me by my old friend and monitor Captain Eckersley. Even to this day, however, I must confess to a certain feeling of trepidation each time I "go on the air," as the Americans put it, and I am always glad when my "turn" is over.

Tell-tale Screeches.

I got most amusement out of the apparatus, however, by "canning" certain portions of the broadcasting programme, parts of which came out extremely well. Now it so happens that I possess a neighbour who, figuratively speaking, still dwells in the dark ages of radio, and possesses a fearsome engine of reception in the shape of a brute-force stabilised 3-v-3 receiver of 1922 vintage, which in spite of its three H.F. stages also has a huge swinging reaction coil to overcome, when needed, the aforementioned brute-force stabilisation, which consists of aerial damping and grid current. This reaction coil is used freely, far too freely for the comfort of myself and my neighbours, and its effects show themselves clearly in my record of the news bulletin, which is punctuated by horrible screeches and whistles, as to the origin of which I am not in the slightest doubt. I am left wondering if this clearly recorded proof of legal and moral turpitude would be admissible as evidence in a court of law. If so, I can foresee that the vendors of the recording apparatus are likely to reap a rich harvest on the sale of their instruments to fellow sufferers who, like myself, know full well who is the offender, but have no really substantial testimony to offer to the Postmaster-General. Evidence against pirate transmitters could be similarly recorded.

Capturing Croydon.

There is one source of entertainment which I always find interesting, although perhaps strictly speaking not amusing, and that is the continuous variety turn provided by Croydon and his ethereal satellites. Most sets are capable of tuning to these transmissions, but in the case of more than one of the sets I have tested recently I have found it impossible to tune in Croydon at full strength owing to the fact that the long wave side of the receivers in question did not quite tune down to the necessary wavelength. This need not be so, of course, as a few moments' reference to the necessary abac will show that with a tuning condenser of the conventional maximum capacity it is possible to cover both short and long broadcasting wavebands without a break, using only two tuning coils, provided that moderate care is taken to design the coils correctly and to use condensers of reasonably low minimum capacities. To do this does, however, require extreme L.C. ratios at certain points of the scale, and consequently either sensitivity or selectivity suffers at these points, and it would be better to cover it by three coils with proper low-loss switching arrangements, a procedure which is actually adopted in one particular commercial receiver I have used.



Trying it on the dog.

Comparisons are Melodious.

Now that the moving-coil type of loud speaker has become almost ubiquitous it seems hard to realise that it is only four years since it first made its appearance in this country. I well remember my first constructional effort in this direction, which might aptly be described as being all bass and battery, since its over-emphasis of the former and heavy demands on the latter were its principal features; but still, its quality of reproduction was a marked advance on anything that had been heard up till then. Judged by modern standards, of course, its efforts were atrocious, and I sometimes drag it out of my radio museum and compare it with my latest instrument to my infinite satisfaction.

Picture Analysis and Television

Reducing the Width of Sidebands by Graded Definition.

By J. H. OWEN HARRIES.

IN television there are two mutually opposing factors, namely, the size of the picture and its clearness; and the limitations of technique as regards the total amount of detail, or "clearness," it is possible to transmit. For example, if either picture size or clearness is doubled, the transmission band-width will be doubled also.

For producing televised pictures of commercially useful size and proper uniform clearness over the whole surface, both the scanning speed and transmission band-width must be very great indeed. For instance, a picture the same optical size as that of the screen in a cinema theatre, viewed from the best seats, and having a "clearness" the same as that of pictures sent by the well-known newspaper systems of photo-telegraphy, may be rigidly proved to need about 300 strips per picture, and a transmission band width of 1,500,000 cycles odd—a totally impractical figure. This admits of no argument. The question, then, is, in what way can these facts be utilised—they cannot be ignored—and a commercial system produced?

ONE of the limitations in television is the high frequency that results when an attempt is made to sub-divide the picture into a sufficient number of points of light to give sharp definition. A considerable saving results by grading the analysis of the picture so that nothing is lost at the centre of interest while the background is effective but less well defined.

The "tolerance" of the brain to moving images is far too slight an aid out of this difficulty. Hitherto, television using radio transmission has been limited to very small "head and shoulder" pictures for this reason. Even in laboratory working, where wider transmission bands may be used, it has been far from possible to obtain the amount of detail really needed. The author has, therefore, devised and worked out a method of overcoming these rigid requirements of the usual television transmitted picture. He has found that the solution lies in the interpretation of the word "whole" in the second paragraph above, and in the exploitation of a not very well-known physiological property of human vision.

Briefly, the method consists of only reproducing the portion of interest in a picture in full detail. The rest of the picture is "blurred." Thus only part of the surface of the picture requires a wide transmission band width per unit area. The portion of interest of the scene will be small, and, therefore, though of high definition, will be practicable to transmit. The rest of the picture will also be easy to transmit because, though large, it is of low definition and will not require a wide transmission band width. It will be shown that the result is a very substantial economy of transmission bands.

How an Observer "Sees" a Scene.

The image of an object on the retina of the eye is extraordinarily imperfect. If the arm is held out at full length, only the area of the thumbnail is seen clearly at a time. The rest of the image on the retina of the surroundings is very blurred indeed. Most people have considerable difficulty in believing this fact, for they feel that they can see much better than this. Why?

The answer is that a purely mental action of the brain enters into the question. Quite unconsciously the very small "point of distinct vision" is moved over part of the field of view. It is guided to objects of interest in the field of view by the blurred image on the rest of the retina ("out of the corner of one's eye," colloquially) and by previously remembered details of the scene. The brain and mind then build up a more or less complete mental image of the whole scene, from the blurred image and from the tiny, clear "bits" the moving eyes supply it with—a kind of rapid and endless jigsaw puzzle.

A trained observer will get a much more complete idea of his surroundings than an untrained one, but even the most stupid person will build up a marvellously good mental picture, especially when aided by the sense of hearing as well. Yet the actual optical image is a very crude one. Further, observation shows that the point of distinct vision is moved over astonishingly little of the field of view. It is extraordinarily tiring to try to examine more than a very small part of the field of view all over by the point of distinct vision. Watching a game of tennis from a position too close to the net will show this. For similar reasons the page of a newspaper is divided into narrow columns. Proof-readers know the tiring effect of reading a MS. with long lines travelling right across wide pages.

The Movements of the Point of Distinct Vision.

Fig. 1 shows the relative sizes of the tiny point (*a*) of distinct vision and that of a cinema screen seen from the best seats in the theatre. The point does not move all over the screen at each change of scene shown, and the screen is not therefore examined in detail. Most

Picture Analysis and Television.

people imagine that it *is* examined in detail, for they judge from the adequateness of the mental image they remember of the scene. They imagine, as a rule, that their point of distinct vision travels completely over the

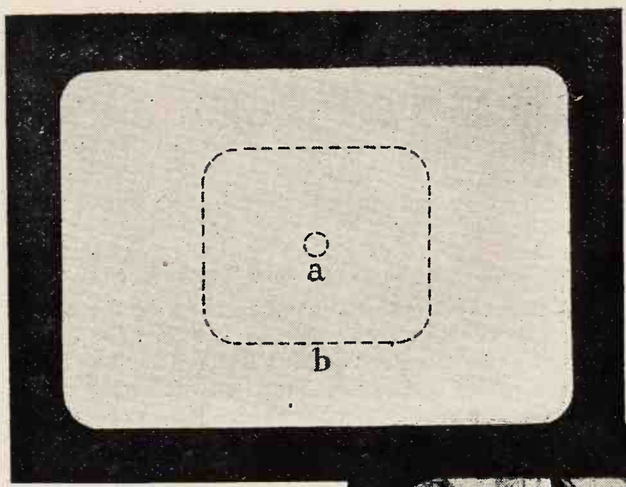


Fig. 1.—The circle (a) represents the average area of distinct vision when viewing a cinema screen, while (b) is the approximate area actually explored in detail.

screen, but they will be partly undeceived if asked to describe the scene in detail. It will be found that the remembrance is of the "centre of interest" of the scene only (*e.g.*, the hero's and heroine's faces), and the rest is casually dismissed as being "a dining-room" or "a forest"—but whether the room is well furnished, or how it is furnished, or whether the forest is of oak or beech trees, is quite forgotten—or, rather, has never been known.

Fig. 2.—The large clear-all-over picture which is the unobtainable ideal.

Experiment shows that a characteristic path of the point of distinct vision is about as in (*b*) Fig. 1. Inside the dotted line the screen is continually re-examined in detail. Outside this area, unless the producer especially intends otherwise (which is only very occasionally the case), the blurred area of the image on the retina and the sounds (if the film is a talkie) are relied upon by the audience to keep them *au fait* with the play. One cannot obtain exact figures for the relative times the eyes rest on the dotted, enclosed area (*b*) and on the rest of the screen in Fig. 1, because of the obvious dependence of these times on the exact nature and artistic treatment of the subject filmed. But a guide is as follows:—It has been stated, on good authority,[1] that the majority of dramatically interesting situations in a play on the screen reduce to two, or, at the most, three, persons. These would be shown in "three-quarter close-ups" on the film (showing only a half to three-quarters of the figure). Also, it is stated that in ordinary motion picture practice, it is usual to have 80 to 90 per cent. of the film in the form of such "three-quarter close-ups."

"Vignetting" in Films.

The observer's seemingly paradoxically adequate notion of the story or event about which the film producer is trying to tell him exists because of the before-mentioned building-up action of the brain, and because the producer, like all artists who create for the eye, deliberately keeps his "centre of interest" in or about a small part of the picture. All artists do this. The spot light in the theatre is an adaption of the principle. A painter is not photographically accurate. He accentuates his "centre of interest," and glosses over the rest. A cartoonist carries this to its extreme. "Vignetting," or deliberate blurring of the edge of the picture, is an artifice frequently resorted to by many film producers.

The results of experiments on these lines may be summed up by stating that, in order to "see" a scene clearly, an observer has only to actually see a small part clearly at a time. If the observer also has the use of his sense of hearing, the portion of the scene actually examined in detail by his point of distinct vision will be still more restricted, and will represent quite a small area.

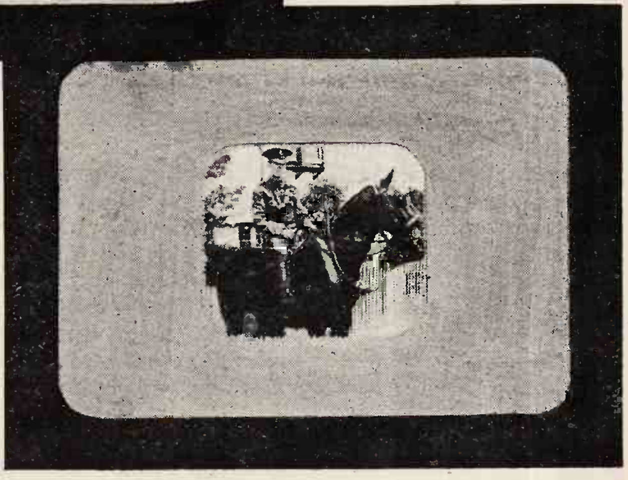


Fig. 3.—A picture of considerably reduced area which principally attracts the observer's attention, and which can be much more readily analysed without the production of excessively high frequencies.

Thus it may be shown that there is no need whatever for a picture to be uniformly clear all over. On the contrary, an actual artistic advantage may be, and often

[2] *Proc. Inst. Radio Engineers*, Sept. 1929, Vol. 17, No. 9, p. 1585.

in film work is, gained by blurring the background. As a rule, the blur is positioned best at the edges of the picture.

Adaptation to Television.

A method[1] of adapting the principle to television consists in transmitting two images of the same scene. One large, and therefore blurred, and one small and clear. They are combined at the receiver to make a composite unevenly defined image. The result may be compared with the use of a spot light in a theatre.

Since the arrangement is purely dependent for success on physiological reasons, it is, unfortunately, very hard to convey the idea on paper. But the illustration (Fig. 2) represents a large, clear-all-over picture, such as is unobtainable in television transmission. In Figs. 3 and 4 are shown the nearest practical approach to this ideal possible hitherto, i.e., Fig. 3 shows the small part of the ideal (Fig. 2), which can be transmitted so as to be clear all over; and Fig. 4 shows a picture the same size as the ideal (Fig. 2) but blurred all over due to the limitations of analysis.

Finally, Fig. 5 shows the combination of Figs. 3 and 4 in accordance with the proposed method. The much closer approximation to the ideal, compared with either Figs. 3 or 4 alone, found in this case needs no comment.

The amount of transmission economy effected by the new method depends on the *area* of the blurred border of the picture. Hence the economy is proportional, roughly, to the *square* of the width of the border. Thus a small increase in width means a large increase in economy. But the eye is only concerned with the width of the border in judging how much economy is allowable.

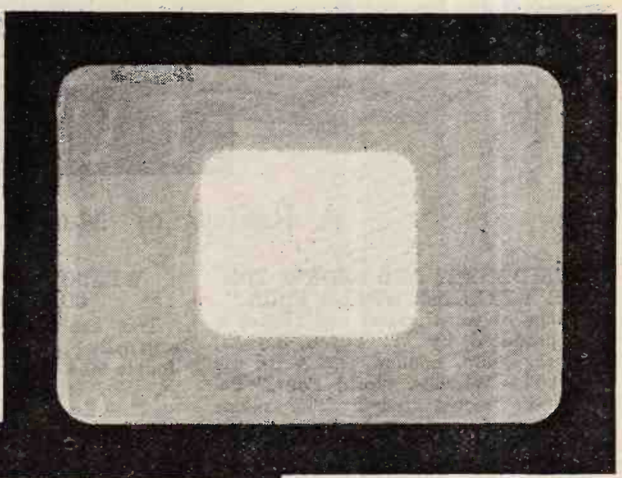


Fig. 6.—Relative sizes of the clear and blurred portions.

Fig. 5.—By grading the definition so as to obtain a sharp image at the centre of interest little is lost.

Fig. 4.—The blurred-all-over picture which results owing to the limitations in analysis.

As an example of the economy possible with a narrow border, consider the transmitting of a picture 4×5 inches square or 20 square inches with ten pictures sent a second, or 20×10—that is, 200 square inches of picture will be sent a second. A moderate degree of clearness would be obtained with a transmission band width of 500 cycles per square inch sent per second. Hence, the total band width required is 100,000 cycles wide, which is impractical.

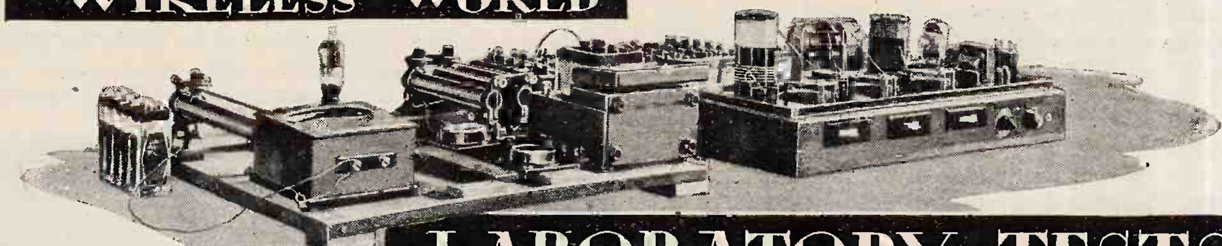
By making use of the modification here described, the small clear-all-over centre may be 6 square inches in area. With the above values of band width per square inch per sec. and picture rate, the transmission band will be 30,000 cycles. The large blurred picture will need 200 square inches per second. The band width might be reduced to 100 cycles per square inch per second, and the band width will be 20,000 cycles.

The total band width needed, therefore, is 30,000 + 20,000, or 50,000 cycles, giving an economy of about a half. The relative sizes of the clear and blurred parts are shown in Fig. 6.

For purposes of explanation in this brief article, transmission band-width economies only have been mentioned. Actually, important savings also occur in light sources, scanning speeds, and in synchronism, etc. The result is that even a seemingly small economy in the total detail it is necessary to transmit each second is of great practical importance.

[1] Brit. Pat. No. 326,603.

WIRELESS WORLD



LABORATORY TESTS

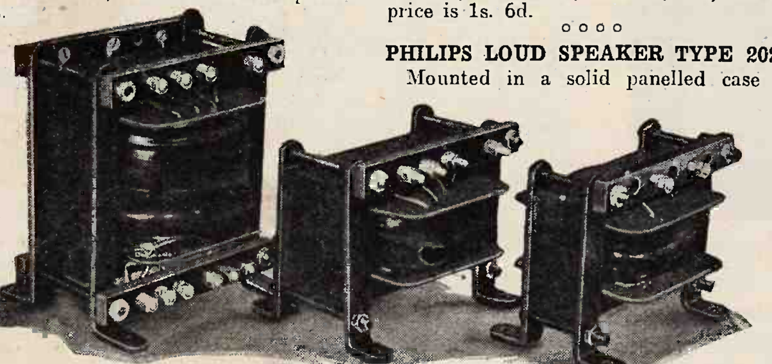
A Review of Manufacturers' Recent Products.

TRANSFORMERS AND CHOKES FOR "THE WIRELESS WORLD FOUR."

A range of transformers and chokes is being produced by W. Bryan Savage, 292, Bishopsgate, London, E.C.2, for use with "The Wireless World Four," described in recent issues. The mains transformer gives the following outputs: 300-0-300 volts 50 mA., 5 volts 1.6 amps., 4 volts 3 amps., and 4 volts 0.275 amp. This transformer has been tested by giving inclusion to it in "The Wireless World Four" receiver, and measurement of the various anode voltages showed that under conditions of load all potentials were correctly maintained. The type number of this transformer is W.W.4 and the price is 34s.

The output choke has a core of generous cross section, and its inclusion in the receiver gave entirely satisfactory results. In addition to being centre tapped, another tapping is included stepping off a quarter of the total winding. It bears the type number L.C.36 PG and the price is 19s. 6d.

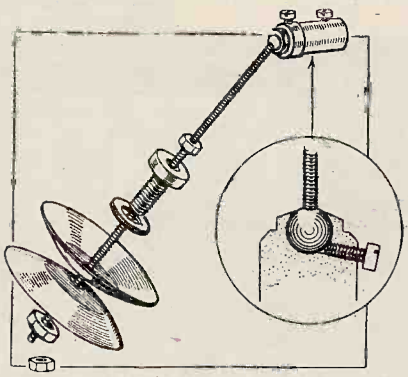
Smoothing chokes were similarly tested and were found to be entirely satisfactory, while their resistance was such that the various voltages were correctly maintained. It will be remembered that the bias of the output valve is obtained by a voltage dropped across one of the smoothing chokes. Its resistance value is therefore important, and it was noted that it had been adjusted to 440 ohms, which is, of course, the correct value. Styled W.W.4C, this choke is priced at 15s.



Savage mains transformer, tapped output choke and smoothing choke produced for "The Wireless World Four."

WEEDON'S SELF-CENTRE FOR CONE DIAPHRAGMS.

This centre-fixing device, which was originally produced for use with the double-cone type linen diaphragm, has been redesigned, and in its new form is suitable for attachment to any type of cone diaphragm. It consists of two large diameter aluminium washers clamped on a hollow boss through the centre of which passes a spindle. The spindle is adjustable for length, and on one end is mounted a collar to take the driving spindle on the unit.



Weedon's "Self-centre," fitted with adjustable spindle for use on linen diaphragms.

This centre-fixing device is made by J. H. Weedon and Co., 80, Lonsdale Avenue, East Ham, London, E.6, and the price is 1s. 6d.

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PHILIPS LOUD SPEAKER TYPE 2024.

Mounted in a solid panelled case of weathered oak with a fret cut to resemble a set of organ pipes, this loud speaker is notable for its simple and dignified design.

The useful frequency response lies between 150 and 3,500 cycles, and over this range the output is remarkably uniform. There is a minor resonance at 2,200 cycles and another between 250 and 350, but the latter is not sufficient to marr the reproduction of speech. From 3.500 up to 6,000 cycles there is still a definite response, but at a low level compared with the output in the 150-3,500 cycle band. Similarly, although the output falls below 150 cycles, there is still something at 50 cycles, and there is no trace of frequency doubling at the latter frequency.

Philips type 2024 loud speaker in weathered oak cabinet.

The variation of impedance with frequency is shown in the following table:—

Frequency.	Impedance.
50	2,150 cycles
100	2.890 ,,
200	2,880 ,,
400	5.440 ,,
800	10,400 ,,
1,600	18,900 ,,
3,200	38,600 ,,
6,400	—

The sensitivity, although satisfactory, is slightly below the average, but the power handling capacity is more than sufficient for all ordinary domestic receivers.

Made by Philips Lamps, Ltd., 145, Charing Cross Road, London, W.C.2, the price is £4 10s.

STIKTAPE AERIAL.

This aerial consists of a narrow strip of material, closely resembling adhesive insulating tape, ¼in. wide, on one side of which is stuck a strip of stout tinfoil. The foil terminates in a spade terminal for connecting to the set.

The adhesive side will stick to any clean, dry surface, such as glass, cloth, wallpaper, wood, or any painted surface free from dust particles, so that its installation is a very simple matter. A further use would be as an indoor earth lead, when the strip may be laid below linoleum or other floor covering, thus being concealed and protected from damage.

It is essential to see that the foil does not become broken, a circumstance that might readily occur and not be observed, particularly when using the "Stiktape" as an earth lead.

This is of American origin, and marketed in this country by the Rothermel Corporation, Ltd., 24, Maddox Street, London, W.1.

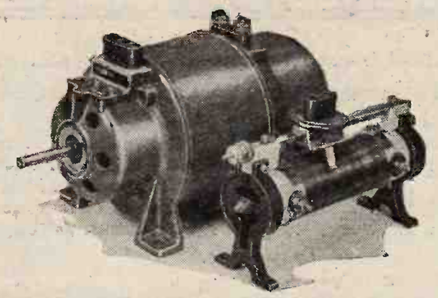
It is sold in tins containing 50 feet approximately, and the price is 5s.

"Stiktape" aerial is an adhesive strip coated on one side with tin foil.

M-L ROTARY TRANSFORMER.

The machines dealt with in this review are the types H.E.A. and H.F.A., designed to deliver an A.C. output at 110 volts, or 230 volts, 50 cycles when connected to a D.C. supply main. The machines are available for high-voltage input of the order of that supplied to private houses or wound to operate from a low-voltage source, such as a 6-volt or a 12-volt accumulator. Machines can be obtained wound especially to suit the voltage of country-house installations or the D.C. plants on private yachts, thus enabling "All-A.C." sets to be operated when only a D.C. supply is available.

The H.E.A. machine is capable of delivering a 40-V.A. output, while the H.F.A. type gives 85 V.A. The corresponding machines for low-voltage input



M-L rotary transformer, Type H.F.A., rated at 85 V.A. output and regulating resistance.

circuits are designated types L.E.A. and L.F.A. respectively.

The first measurements made were the A.C. voltage output at various current loads; the input current was measured also. The machines tested were wound for 200 volts D.C. input and rated to give 230 volts A.C. output. The results obtained are given below in tabulated form, the last column giving the output as a percentage of the input.

A similar set of measurements were made with the 85-V.A. machine—type H.F.A.—and these are given also in tabulated form.

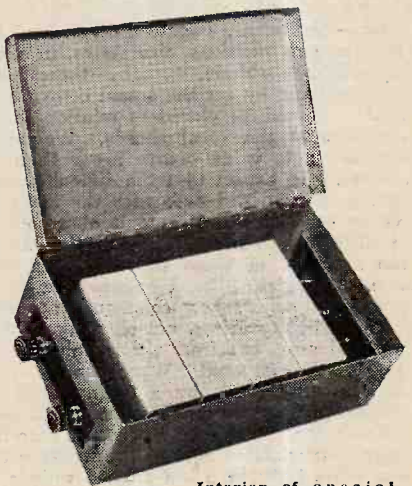
In both cases the rated output voltage is obtained only when the machines are fully loaded. When the output load is comparatively light an input-regulating resistance must be used. A suitable resistance is supplied by the makers, the price being £2.

The machines were tested for interference by using a fairly sensitive A.C. receiver embodying a screen-grid valve as H.F. amplifier, a regenerative detector, and a super-power amplifier. There was considerable interference, which drowned all but the strongest broadcast matter. The special Anti-Interference Unit designed for use with these machines was then connected up, and this entirely eliminated every trace of electrical interference, although no special precautions were taken to screen the D.C. supply leads or the A.C. output leads. The machine was located about three feet from the receiver.

The machine is not excessively noisy mechanically, but for full enjoyment of the broadcast matter it should be mounted in a soundproof cabinet or housed in a separate room and mounted on rubber blocks to deaden the noise. The Anti-Interference Unit for these two machines costs £4 10s. These units will not be required when the rotary transformers are used to operate amplifiers only.

The price of the Type H.E.A. (and L.E.A.) rotary transformer is £13: the 85-V.A. model, Type H.F.A. (and L.F.A.) costs £17.

All M-L machines of less than 100 V.A. output have permanent magnet fields and a double-wound armature is standardised throughout. The commutator and slip-rings are mounted on one end of the armature spindle, and on the other end is a small fan for cooling purposes. The makers are the M-L Magneto Syndicate, Ltd., Coventry.



Interior of special anti-interference unit designed for use with M-L. machines Types H.E.A., L.E.A., H.F.A. and L.F.A.

Type H.E.A. Rotary Converter—40 V.A. Rating.

D.C. Input.			A.C. Output (R.M.S. Values).			Efficiency.
Volts.	Current mA.	Watts.	Volts.	Current mA.	Volt/Amps.	
200	200	40.0	290	20	5.8	14.5%
200	232	46.5	283	40	11.3	24.3%
200	265	53.0	277	60	16.6	31.4%
200	295	59.0	270	80	21.6	36.6%
200	325	65.0	264	100	26.4	40.6%
200	350	70.0	257	120	30.8	44.0%
200	380	76.0	250	140	35.0	45.7%
200	412	82.5	243	160	38.0	47.0%
200	450	90.0	236	180	42.5	47.2%
200	490	98.0	230	200	46.0	47.0%

Type H.F.A. Rotary Converter—85 V.A. Rating.

D.C. Input.			A.C. Output (R.M.S. Values).			Efficiency.
Volts.	Current mA.	Watts.	Volts.	Current mA.	Volt/Amps.	
200	295	59.0	310	40	12.4	21.0%
200	355	71.0	302	80	24.2	34.0%
200	417	83.5	292	120	35.0	42.0%
200	485	97.0	283	160	45.3	46.7%
200	555	111.0	274	200	54.8	49.4%
200	625	125.0	266	240	63.8	51.0%
200	690	138.0	257	280	72.0	52.2%
200	750	150.0	248	320	79.4	53.0%
200	810	162.0	239	360	86.0	53.0%
200	870	174.0	230	400	92.0	52.8%

CORRESPONDENCE

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

BROADCASTING GRAMOPHONE RECORDS.

Sir,—I was considerably alarmed to read your suggestion in *The Wireless World* of October 15th that the B.B.C. should introduce gramophone records in their programmes "without necessarily making any announcement to that effect."

Gramophone records can usually be distinguished by what might be termed "pitch-wobble"—a wavering in pitch, particularly noticeable in sustained notes. This is a form of distortion peculiar to the gramophone, and can be rather distressing to a musically sensitive ear. Being a mechanical defect, however, it may be overcome in the near future. Herein, in fact, lies the danger of your suggestion.

To a person of imagination a great part of the pleasure of listening to a wireless transmission lies in the knowledge that one is listening to a performance that is actually taking place at the same time. One visualises, for example, the great concert hall with its audience and orchestra; sees the conductor as his entrance is greeted with applause; and experiences the thrill of the sudden stillness as he raises his baton. There is that feeling of being "en rapport" with the artist, and not merely listening, but "listening-in." It is this that makes wireless reception worth while, despite such drawbacks as heterodyne, atmospherics, and Morse interference. Once, however, let there be a doubt as to whether one may be listening to a live performance or a record, and the peculiar fascination of wireless reception is gone, never to be recaptured.

By all means let us have occasional broadcasts of records, but let them be announced as such.

For my own part, though, if I had wanted to listen to records I should have bought a gramophone instead of a wireless set. Even a gramophone record sounds better first hand.

Grimsby. ERNEST W. DUNN.

PITCH OF THE HUMAN WHISTLE.

Sir,—Sir Richard Paget, in his book, "Human Speech," which Mr. Harmon mentions, also states, in connection with the pitch of the human whistle, ". . . there is an unexpected difficulty in identifying by ear the actual octave in which a whistled note . . . should be placed in relation to notes produced by the vibration of the vocal chords. We normally imagine that a whistled note is an octave lower than it really is."

One might expect that the difficulty would be less when comparing the whistled note with the notes of a piano. Yet some 85 per cent. of Mr. Harmon's observers placed the lower limit of the human whistle at middle C. Mr. Harmon asks, "Were the majority of these people making what Mr. Pile calls a common mistake?" I believe that they were, and that the experiment shows how common the mistake may be.

The difficulty arises, not on account of the complexity of the whistled note, but from the complexity of the piano note with which it is compared. When a purer comparison note is used, such as that given by a tuning fork, a tin whistle, a loud speaker driven by pure audio frequency current, or a good gramophone running on a constant note record, the tendency to assign the whistled note to the wrong octave is greatly reduced. The beats between a low-pitched whistle and a 512-cycle tuning fork can readily be heard, but no such beats are obtainable with a fork of 256 cycles (middle C).

If Mr. Harmon will try this I think he will be convinced that the pitch can be definitely ascertained without the need for any oscillograph analysis N. FLEMING.

Teddington.

Sir,—Mr. Fleming's experiments give valuable information on the question as to the lower limit of the pitch of the human whistle, and they serve to illustrate the remarkable nature of this sound. In repeating Mr. Fleming's results I have found that some observers identify a whistled note with middle C on the piano, and immediately afterwards identify the same whistle with upper C on a tuning-fork! This is a somewhat embarrassing experiment, as the subjects of it feel that they have been caught out in an unfair manner.

Will someone who possesses the necessary apparatus produce an oscillogram of a low whistled note? Perhaps the research department of the B.B.C., or of one of the gramophone companies, might be induced to settle the question.

JOHN HARMON.

Sir,—With reference to the correspondence on the above subject, I think that the reason why Mr. Harmon's test was so inconclusive was owing to the difficulty of comparing the pitch of two such entirely different tones as those of the piano and the human whistle. The piccolo stop of the organ provides a satisfactory means of comparison owing to the similarity of its tone to that of the human whistle, and on experiment showed, beyond any manner of doubt, that upper C and not middle C is the lower limit of the latter.

It would be interesting to hear Mr. Harmon's explanation of the alleged lack of fundamental power in deep organ tones. While not professing any special knowledge of acoustics, I am firmly of Mr. Seymour Pile's opinion that the notes produced by large wood organ pipes are almost devoid of harmonics, and very much doubt whether bottom C on a 32-foot length pipe (one octave below lowest C on the piano) would produce any sound whatever in a moving-coil speaker.

Bromley, Kent. VERNON C. COOMBS.

SHIELDING AND H.F. RESISTANCE OF COILS.

Sir,—I have read with great interest Mr. Horle's letter in your issue of October 29th with reference to the change in resistance of a radio-frequency inductance coil when placed inside a metal screen. In stating that a coil may show a lower resistance when screened than when unscreened, I assume that Mr. Horle is confining his attention to the properties of the coil itself, and that the decrease in resistance is not due to the fact that some component, whether a conductor or insulating material, is screened from the field of the coil when the screening conductor is placed over the coil. It can easily be understood that where the resistance of a coil includes the losses in some neighbouring component or material, the reduction of the field common to the coil and this material by the interposition of the screen will cause a decrease in the resistance of the coil. I gather that Mr. Horle's remarks refer to the actual wire resistance of the coil quite apart from the effect of any external objects. In this respect I regret to state that I have no knowledge of any results showing that the resistance of a screened coil is lower than that of such a coil unscreened. So far as I am aware, no results of this nature have been published, and I think it would be very useful to all who are interested in this matter if Mr. Horle could be induced to publish some of the results of the measurements on coils to which he refers. At the same time it would be useful if Mr. Horle could describe briefly the method employed for the measurement of these resistances at radio-frequencies. While it is not inconceivable that for a coil carrying current at radio-frequencies, the secondary field due to the presence of a screening container might so alter the distribution of current in the conductor of the coil, it is not easy to visualise how such a result may be brought about.

Any further explanation which Mr. Horle could offer on this point in reference to his own measurements would be very useful and of great interest. R. L. SMITH ROSE.

Teddington, Middlesex.

READERS' PROBLEMS

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below.

What Is a Filter?

A number of band-pass circuits have recently been described in your journal, but I am still uncertain as to what is the essential difference between a filter and a two-circuit aerial tuner. Will you please examine the enclosed diagrams of various aerial input tuners, and tell me how each of them should be classified? R. DE L. J.

Each one of your sketches (not reproduced) shows an arrangement that may, by proper adjustment of coupling between individual circuits, be made to operate as a band-pass filter. Broadly speaking, two circuits suitably linked together capacitatively or inductively, or by a combination of the two methods, are always capable of providing a "double-humped" resonance curve. The real difference between the filter and the two-circuit tuner is that the former is deliberately designed with the object of getting a resonance curve of this kind, and not merely from the point of view of attaining maximum signal strength and selectivity.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(3.) *Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(4.) *Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(5.) *Practical wiring planscannot be supplied or considered.*

(6.) *Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.*

(7.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.*

For Long-range Work.

Will you please give me a word of advice regarding the simplest and least expensive circuit arrangement likely to be suitable for consistent long-distance reception of British and foreign stations? The set is to be used in the West of England, and, as it must be battery-operated, I naturally do not wish to use more valves than are necessary. A. E. B.

Although the modern three-valve H.F.-det.-L.F. set can be highly sensitive, and often affords satisfactory reception of foreign stations, particularly after dark, we always consider that two H.F. stages are almost essential for consistent long-range work. If this attitude is tenable —and there can be little doubt that it is, especially when the set is to be used in a remote locality—the simplest arrangement likely to meet your needs is a 2-v-1 circuit, probably with grid detection and reaction

Although interference is unlikely to be particularly troublesome, it is strongly recommended that either a two-circuit aerial tuner or an input filter should be used; it is now generally admitted that the screened valve can hardly give of its best unless the principles of "pre-selection" explained in this issue are used.

o o o o

"The Wireless World Four" Output Stage.

As my requirements in the matter of volume are comparatively modest, I propose, in building "The Wireless World Four," to substitute a P.625 output valve for the super-power pentode as specified. If this alteration is permissible, will you please let me know what circuit modifications will be necessary? H. C.

By substituting a triode, a certain reduction in overall magnification will be brought about; there will also be a loss of power output, as you yourself suggest, but otherwise there is no objection to making this change.

It so happens that the P.M.24A. and P.625 valves consume almost exactly the same anode current, and also require similar values of negative grid voltage. In consequence, the values of resistances, etc., as already specified, may stand unaltered, but a voltage-absorbing resistance should be inserted in series with the anode, as shown in Fig. 1. This diagram indicates all necessary modifications; from it you will see that the tone-regulating resistance and condenser are omitted, and that a plain output choke is used in place of one with a centre tap.

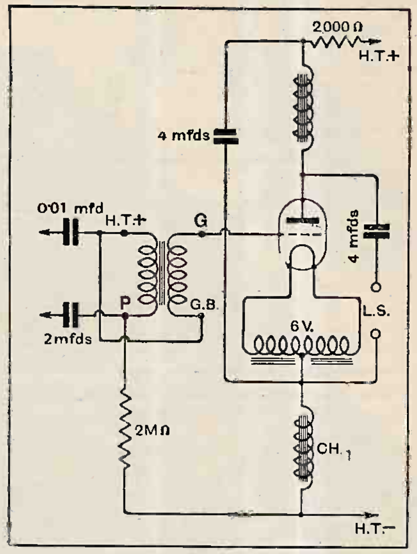


Fig. 1.—"The Wireless World Four" output stage with a triode in place of the original pentode.

o o o o

Bias Resistance Calculations.

I understand that output valves used in a push-pull arrangement are normally supplied with a negative bias of the same value as if they were used singly. If this is correct, I suppose that one can safely assume, when changing over to the push-pull system, that no change would be necessary in the value of an automatic bias resistance? R. D. M.

No, this is wrong, as the current passing through the bias resistance will be approximately doubled when an extra valve is added; in consequence, its ohmic value should be halved to produce the original bias voltage.

Automatic Bias for Anode Bend Detection.

I have successfully converted my 1-v.-1 receiver for A.C. mains operation as far as its H.T. and L.T. circuits are concerned, and should now like to make provision for automatic bias both for the anode bend detector and for the output valve. With regard to the last-mentioned, I do not anticipate any trouble, as it is intended merely to insert a resistance in the negative feed lead—there is ample H.T. voltage to spare. My real difficulty is to arrange for detector bias; as I use different types of valves in this position, some provision for continuous adjustment must be made.

Any suggestions as to how this problem may be solved in a simple and inexpensive manner would be appreciated. It should be added that indirectly heated valves are now used.

B. C. A.

You do not tell us the total anode current taken by the set, or the maximum

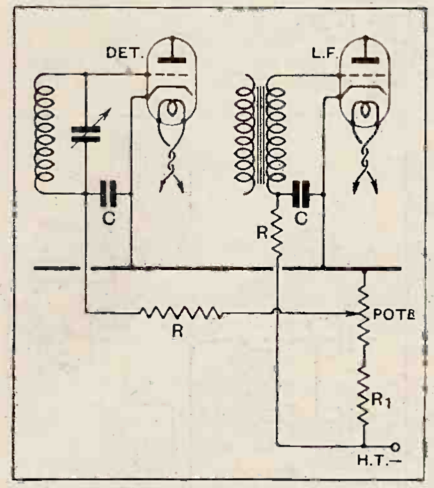


Fig. 1.—Variable "automatic" bias for an anode bend detector.

value of negative bias needed for the detector; without this information it is not possible to give full information regarding this alteration, but we think that the arrangement suggested in Fig. 1 will be found satisfactory.

As you will see from this diagram, the normal grid bias resistance R_1 is connected in series with a potentiometer; the sum of these two resistances should be equal to that required to produce the proper voltage drop for application to the output valve grid.

The detector grid return lead is taken to the potentiometer slider, and so any voltage from zero up to the maximum developed across the resistance may be applied. This brings us to the crux of the matter—the resistance of the potentiometer. Allowing a total anode current of 30 milliamps—a reasonable enough figure for a set deriving its H.T. from the mains—a potential drop of 12 volts will be produced across 400 ohms, which is the value of the usual commercial component. This voltage is likely to be sufficient for any valve ordinarily used as an anode bend detector, but if more is required, or if total plate current amounts to less than that assumed, it will be necessary to use a potentiometer of higher resistance.

Grid decoupling resistances and condensers, which may be of 100,000 ohms and 2 mfds., are indicated by R. and C.

oooo

Economies in Anode Current.

I am about to construct a self-contained 4-valve battery set, but am uncertain whether to adopt an H.F.-det.2-L.F. circuit or to use two H.F. stages followed by a detector and one L.F. stage. It is specially desired to reduce anode current consumption to the lowest possible figure. Bearing this point in mind, will you please advise me as to which arrangement is likely to be the most satisfactory?

W. B.

The difference in anode current consumption between an S.G. valve and a triode of the type likely to be used in a high-magnification L.F. stage is almost negligible, and would hardly amount to more than a milliampere or so. By using resistance coupling, possibly as much as 3 milliamperes might be saved by adopting the "2-L.F." circuit, but amplification would possibly be insufficient for a frame aerial set with a single H.F. stage. The "2-H.F." circuit is undoubtedly the best for your purpose, but is, of course, more difficult to design and to construct.

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Better Coils: Larger Coupling Condensers

I am thinking of making up a capacity-coupled input filter with two 3in. Litz-wound coils ("Wireless World" specification) which are already in my possession. A single-knob tuning of low-resistance circuits of this kind is unlikely to remain "in step" over the whole tuning range, it is proposed to fit a trimming condenser in an accessible position on the front panel. The filter is to be followed by a two-stage H.F. amplifier.

Do you consider this to be a practical scheme? Of course, I intend to use a smaller coupling condenser than usual, as the coils are of higher efficiency than those generally used in filter circuits.

J. R. S.

It is always rather dangerous to use coils of exceptionally low resistance in a filter, although in your case the resulting sharply defined tuning peaks are not likely to be altogether a disadvantage, as there is to be a succeeding H.F. amplifier, presumably with intervalve couplings consisting of single-tuned circuits.

Your proposed external-trimming condenser will be of some value, but its inclusion will not completely overcome the inherent difficulties in the way of "ganging" tuned circuits of high efficiency.

Finally, we would point out that it is wrong to assume that the coupling condenser should be smaller than usual. Actually, the contrary is the case, and we suggest that you should use a mutual capacity of at least 0.015 mfd.

Capacity-coupled Two-circuit Tuners.

I have just made a two-circuit tuner unit with a tapped aerial connection to the first coil and capacity coupling (by means of a small variable condenser of 0.00015 mfd.) between the two circuits.

Selectivity is disappointing, although it is better than that of the single-circuit "aperiodic" tuner previously used. Coils are of 3in. diameter, wound with No. 22 gauge wire in accordance with the instructions given in your issue of September 3rd, and I am sure that there are no high-resistance joints or serious leakages. Can you suggest why tuning should be less sharp than one would expect?

H. M. C.

A capacity-coupled tuner of this type should be highly satisfactory, and, with a sufficiently loose coupling between its circuits, should provide high selectivity. We think that your failure to obtain these results must be due to the use of an excessively large coupling condenser; the capacity of the component that you are using may be too great, even when it is set at minimum.

It is therefore suggested that you should either obtain another condenser with a maximum capacity of certainly not more than 0.0001 mfd., or even considerably less, and with a low minimum value, or that you should remove about half the vanes from your present condenser.

FOREIGN BROADCAST GUIDE.

FRANKFURT-AM-MAIN

(Germany).

Geographical Position: 50° 6′ N. 8° 40′ E.

Approximate air line from London: 397 miles.

Wavelength: 390 m. Frequency: 770 kc. Power: 1.5 kW.

Time: *Central European Time.
** Coincides with B.S.T.*

Standard Daily Transmissions.

05.55 B.S.T. weather forecast from Stuttgart; 06.00 physical exercises; 07.00 (Sun.) relay of concert from Hamburg; 08.15 relay of concert from some Rhineland Spa, *e.g.*, Kreuznach, Wiesbaden, etc.); 12.15 gramophone records or orchestral concert; 16.00 (Sun.) relay from Wiesbaden Kurhaus; 19.30 or 20.00 main evening programme; 23.00 dance music; occasionally night concert from 00.30 to 01.30.

Man and woman announcers. Opening Call: *Hier Suedwestdeutsche Rundfunk Frankfurt-am-Main und Cassel.*

Interval Signal: Metronome, followed by abbreviated call: *Frankfurt-am-Main und Cassel.*

Regularly exchanges programmes with Stuttgart.

Closes down with usual German formula and the playing of *Deutschland ueber Alles* (German National Anthem).

Relay: Cassel. 246 m. (1,220 kc.)

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66R
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Blue Spot

66R
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Here for you to choose from are the two units acclaimed the best in Europe by the trade, the press and the public. Which is your choice? Visit your dealer and make the test for yourself. Choose between the two most famous units of a very famous range—whichever you choose you'll have chosen well.

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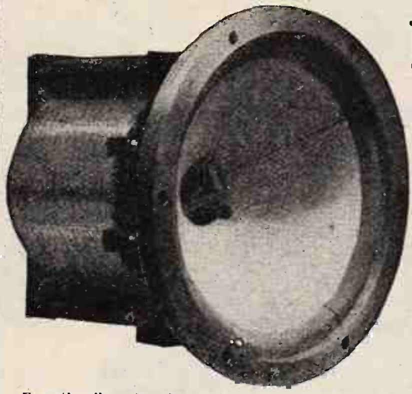
'Phone: CLERKENWELL 3570. *'Grams:* "BLUOSPOT, SMITH, LONDON."

Distributors for Northern England, Scotland and North Wales; H. C. RAWSON (Sheffield and London), LTD., 100 London Road, Sheffield; 22 St. Mary's Parsonage, Manchester; 183 George Street, Glasgow.




The Wireless World DIARY

MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is:

12 words or less, 2/- and 2d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue: 13 consecutive insertions 5%; 26 consecutive, 10%; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to **FIRST POST** on **THURSDAY MORNING** (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on **WEDNESDAY MORNING** at the Branch Offices, 19, Hertford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham; 260, Deansgate, Manchester; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. 000, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

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RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain; Radio Doctors.—Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

G.E.C. World Wide Screen Grid Four, milliampmeter, 160v. Exide double capacity H.T. accumulators, L.T. 6v. Marconiphone moving coil speaker, latest, in mahogany cabinet, set and batteries in 4ft. high mahogany cabinet, double doors, all new 1930; heard any time; cost £48, accept £22.—Hopkins, 126, Long St., Birmingham. [1948

Receivers for Sale.—Contd.

PHILIPS 2511 Electric Receiver, 4-valve, 240 volts, £21; Philips 2013 moving coil L.S., £7; set and speaker complete, £26; H.M.V. No. 163 gramophone, mahogany, £18.—Saul, 8, Ansdell Rd., S. Ansdell, Blackpool. [1944

FOREIGN Listeners Four, perfect, £10; Loftin White gramophone amplifier, magnificent reproduction, £10; both complete with valves, 100-110-volt A.C.—Chamier, Vickers House, Westminster. [1950

6-VALVE McMichael Superhet., also speaker, frame aerial, H.T. and L.T. accumulators, never used; £12, offer.—124, Hazelhurst Rd., King's Heath, Birmingham. [1973

NEW Kilomag Four, in special cabinet, complete with valves, scarcely used; sacrifice, £10.—Darnton, Sissinghurst Court, Cranbrook. [1972

OSRAM Music Magnet Four, in perfect order, with grid battery, no valves; £6/15.—C. M. King, Walldown, Whitehill, Hants. [1963

NEW 1930 Osram Music Magnet Three, with valves, £7; 7-valve superhet., £5.—41, Woodside View, Leeds. [1958

HIGH Quality Console 2-valve Receivers, with incorporated speaker and all accessories, £8; selective aerial tuners, from 5/-; 2-valve sets, in Camco cabinets, 54/-; retail; lists free.—Chalgrove Radio, 6, Grove St., Wellingborough. [1954

YOUR Old Receiver or Component Taken in Part Exchange for New; write to us before purchasing elsewhere and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226

AMPLION 4-valve 2S.G. Portable, in use 3 weeks, perfect condition; £17/10.—Box 7898, c/o *The Wireless World.* [1936

ELECTRIC Gramophone and 5-valve Wireless Receiver, in handsome oak cabinet, mains driven moving coil speaker, last stage 1 L.S.6A, 240v. A.C., superlative reproduction of radio and records, infinitely better reproduction than any commercially produced article; cost over £100, accept £45.—Mann, 41, Montagu Rd. Tel.: Hendon 2737. [1980

£25 or Nearest.—Marconiphone 3S.G., D., P receiver, Marconi L.S., 2 accumulators, D.C. 220 Marconi eliminator; cost £35 last April; sale by executors.—Houghton, Broughton, Preston. [1986

PHILIPS Receiver, A.C. 240, with Marconi moving coil speaker, perfect; £19.—Ellis, 28, Redhill Drive, Edgware, Middlesex. [1989

McMICHAEL Super Range Portable Four, 1930, perfect condition, with Ekco H.T. unit; £17, or nearest offer.—Cooper, 33, Pullan Av., Eccleshill, Bradford. [1990

MEGAVOX, to "W.W." specification, complete with incorporated Regentone H.T. eliminator or standard No. 3 H.T. battery, unused, gramophone pick-up and control, Baker Perm-electro M.C. speaker chassis; cost £46, accept £23, or will separate.—5, Lychett Rd., Bromley, Kent. [1993

McMICHAEL'S Screen Grid Dermic-Three, complete with A.C. 200-250 eliminator, accumulator, trickle charger attached; £10/10; equals all electric, perfect.—Nelson, 9, Brewster Gardens, North Kensington, W.10. After 8 p.m., or 'phone: Temple Bar 3681. [1995

5-VALVE Hide Case Portable, fitted Regentone combined H.T. and L.T. mains unit, A.C. 200-220; £12/10; demonstration after 7.30 p.m.—28, St. Andrew's Av., Sudbury, Wembley. [1996

P.P.V.2 Set, H.T. 120v. and L.T. accumulator, complete in mahogany cabinet, easily convertible to radiogram, Ormond speaker; £5/5; with B.T.H. H.T. and L.T. charger, 200-250 A.C., 2 amp., £8/5.—E.W., 94, Fernside Rd., Balham. (After 7.30 p.m.) [2002

MARCONI Superhet Model 82, complete, good condition, numerous accessories, including mains unit, accumulators, 2 speakers; sacrifice, what offers?—Full particulars from Captain X., c/o F. T. Harris and Co., Bude. [2008

"WIRELESS World" Record III, including new A.C. valves and complete eliminator, cost over £30 6 months ago; best offer accepted; week's trial gladly.—Hear it at 7, Whitchurch Gardens, Edgware. 'Phone: 0493. [2010

CONVERT Your Set to All Electric.—Complete kits for eliminators and all electric conversions, any A.C. voltage; transformers for A.C. valves, 4v. 3 amp., 9/6; A.C. valves from 9/6; all components tested and guaranteed; write for lists, stating requirements.—Hill's, 25, Byron Gardens, Sutton, Surrey. [2022

NATIONAL 5-valve Portable, only needs new batteries; £4.—Box 7970, c/o *The Wireless World.* [2024

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Realism in Reproduction. Mains receivers made by specialists of Mains equipment high stage gain Screen Grid H.F. valve, detector and power pentode, illuminated dial. Walnut or Mahogany Cabinet.

3v. RECEIVER

2v. - 12 Gns.
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H.T. 120 V. at 15 m/a **£2 17 6**

H.T. and L.T. (with Westinghouse Rectifier) combined **£5 10 0**

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Volume Controls; Potentiometers; Rheostats; Wave Traps; Dual-range and Screen-grid Coils; H.F. Chokes; Compression-type Condensers, etc.

ohms.	each.
1,000/3,000	5/-
4,000/40,000	4/-
50,000	5/-
60,000	6/-
75,000	7/-
100,000	8/-

SOVEREIGN (OF BRITISH MANUFACTURE)

SOVEREIGN PRODUCTS, LIMITED,
52/54, Rosebery Avenue, London, E.C.1

Receivers for Sale.—Contd.

R.I. Madrigal A.C. Three, new; cost £30, accept nearest offer, £20.—6, Mayville St., Leeds. [2027a

THOUSANDS of "Wireless World" Readers are Building the Band-pass Three. See advert. under Coils.—Groves Brothers. [2003

ACCUMULATORS—BATTERIES.

WET Battery Replacements, new process sacs, approximately 30,000 m.a.; 2/6 per dozen; particulars free.—Scottish Batteries, Braeside, Uphall Station. [1728

120V. Exide Battery and Trickle Charger (220v.); 30/-.—Bryant, 2, South Ridgway Place, Wimbledon. [2012

CHARGERS AND ELIMINATORS.

PHILIPSON'S Safety H.T. Supply Units are Famous for Reliability and Silent Working.

OUR New Prices Again Make Them Famous for Value; for D.C. mains model D.C.4 gives 120v. at 15 m.a., 27/6; D.C.5. 150v. at 25 m.a., 1 fixed, 2 var. tappings, 35/-; for A.C. mains model A.C.7, 120v. at 20 m.a., £3; A.C.5. 150v. at 30 m.a., 1 fixed, 2 var. tappings, £3/17/6; A.C.6, for 25 cycle mains, £5.

PHILIPSON'S Safety H.T. Supply Units are Guaranteed for 12 months; write for our booklet, "Radio Power."

PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. 'Phone: 2038. 'Grams: Safety, Bolton. Est. over 50 years. [0318

TANTALUM and Lionium for A.C. Rectifiers, blue prints for inexpensive H.T. and L.T. chargers.—Blackwells Metallurgical Works, Ltd., Garston, Liverpool. [1209

CHESTER BROS.—All types of mains transformers and chokes to any specification.—Chester Bros., 495, Cambridge Rd., London, E.2.

CHESTER BROS.—Type V3 220+220v., 35 m.a., 5v. 1.6a., C.T., 4v. 4a. C.T., 27/6.

CHESTER BROS.—Type W.10, for H.T., 3 or 4, output 135v. 50 m.a., and 4v. 4a., C.T.; 23/6.

CHESTER BROS.—Smoothing chokes, constant inductance, type C.B.2, 45 henrys, 25 m.a.; 15/-.

CHESTER BROS.—Write for lists of standard models. Please note change of address. [1477

RADIELLE D.C.100 (200-250 D.C.), output 200 volts, 100 m.a., and 2 variable tappings; cost £9/10, sell £3; brand new; sent c.o.d.—Priestley, 8, Grosvenor Gardens, Muswell Hill, London, N.10. [1969

ELIMINATOR, 300v., 60 m.a., tappings, 4v. 4a., for A.C. valves; £4.—Ascombe, "Craigmore," Totley Rise, Sheffield. [1964

SAVAGE'S Specialise in Wireless Power from the Mains; reliable apparatus at reasonable prices.

SAVAGE'S Transformer Laminations and Bakelite Bobbins; intending home constructors should write for list.

SAVAGE'S Reliable Smoothing Condensers, 1,500 volts D.C. test, 1 mfd. 2/-, 2 mfd. 3/-, 4 mfd. 5/3; 500 volts D.C. test, 1 mfd. 1/6, 2 mfd. 2/3; 4 mfd. 3/9.

SAVAGE'S Power Chokes for the Power Pentode Two, smoothing L.C.36G, 18/-; output L.C.36P.G., 19/6; many other types available, write for list.

SAVAGE'S Mains Transformers for the New Westinghouse Units; please write for list.

SAVAGE'S New Foreign Listeners' Four Equipment. —Transformer, N.F.L.4, 33/-; smoothing choke, C32G, 20/-; output choke C32/0, 20/-.

SAVAGE'S "Wireless World" Four Equipment, mains teransformer, W.W.4, 34/-; smoothing and bias chokes, type W.W.4C, 16/- each; centre tapped output choke, L.C.36P.G., 19/6.

SAVAGE'S Mains Transformer, B.T.4, 500-0-500 volts 120 m.amps., 7½ volts 3 amps., 6 volts 3 amps., 4 volts 2 amps., 4 volts 1 amp., 4 volts 1 amp., all centre tapped, specially developed to facilitate automatic bias in all stages; 57/6.

SAVAGE'S Mains Transformer, V.T.37, 250-0-250 volts 60 m.amps., 4 volts 1 amp., 4 volts 1 amp., 4 volts 1 amp., 4 volts 2 amps., all centre tapped, a useful instrument for modern receivers with automatic bias in every stage; 35/-.

SAVAGE'S Mains Transformers and Power Chokes are carefully constructed from first class materials with an exceptionally generous margin of safety; they are fully guaranteed and may be purchased with confidence.

SAVAGE'S Have Moved to Larger Premises; please note new address: 292, Bishopsgate, London, E.C.2. Telephone; Bishopsgate 4297. [1784

AMPLIFIER, A.C. main, 200-250v., complete with moving coil, Rolo speaker, electric gramophone motor, pick-up, eliminator and amplifier, spare valves, enough volume for a very large hall; bargain, £15.—J. R. Jeffery, 25a, Strathville Rd., Southfields, S.W.18. Phone: Putney 6128. [2019

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Your voltmeter converted into a COMPLETE TESTING SET FOR 2/6

By plugging a Sifam Circuit Testing Adapter on to the spike of your voltmeter you can use it for detecting Short Circuits, Open Circuits, Condenser Trouble, Bad Connections, and testing Valve Filaments. The adapter costs only 2/6, but functions as efficiently as an expensive instrument.

PRICE 2/6 FROM *Including Battery* **ALL RADIO DEALERS**

SIFAM POCKET VOLTMETER FRIE 7/6

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Circuit Testing ADAPTER

If any difficulty write to:
SIFAM ELECTRICAL INSTRUMENT Co., Ltd., BUSH HOUSE, ALDWYCH, LONDON, W.C.2.

"RED DIAMOND" SWITCHES

TRADE MARK RED DIAMOND REGD

Robust Construction. Definite 'on' and 'off' positions. No shaking. Perfect contacts. Large terminals for easy fitting.

			By post
RD39	2 point	1/3	1/6
RD49	„ dead spindle	1/3	1/6
RD37	3 point	1/6	1/9
RD47	„ dead spindle	1/6	1/9
RD44	Radio-gram 3 point	2/-	2/3

"RED DIAMOND"

As used for the "Wireless for the Blind" Crystal Sets.

RD40
2/-
By Insured Post 2/3 or 2/9 with shield.

Can be mounted on brackets or through panel. Once set always ready. Not affected by vibration. Each one is tested on broadcast before despatch.

Of all high-class Radio Dealers or Sole Makers:
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EPOCH

MOVING COIL SPEAKERS

The greatest range of Permanent and energiser Speakers in the World.

(See page 24)).

Chargers and Eliminators.—Contd.

M-L Generator, type E, 12-volt input, 400-volt output at 150 m.a., complete with smoothing apparatus, as brand new; £10.—J. R. Jeffery, 25a, Strathville Rd., Southfields, S.W.18. 'Phone: Putney 6128. [2020

B.T.H. Tungar Rectifier for Sale, A.C., volts 115, cycles 60; D.C., volts 75, D.C. amps. 6; excellent condition; accept £8 for quick sale.—Pearce, 36, Cranborne Gardens, Welwyn Garden City, Herts. [2014

BRYCE'S Constant Inductance Smoothing or Output chokes, 220 ohms resistance, 22 henrys at 50 m.a.; price 15/-, post 1/-; also write for transformer lists.—Bryce's, 54, Dawson St., Bury, Lancs. [2001

MAINS Transformers for Westinghouse Metal Rectifiers, from 16/6; mains transformers and smoothing chokes made to specification in 24 hours.—Challis, 22, Park Rd., Rugby. [1999

DAVENSET Battery Charger, A.C. 200-220 volts, output 40-2-volt, 20 act. amp.-hr. cells; list price £14, accept £6/15, complete; little used.—Clifford Radio Co., Clifford Av., S.W.14. Richmond 2439. [1994

EDISWAN 12-volt 2-amp. Trickle Charger, brand new; 37/6, or offer.—Grenfell, 8, Beacontree Rd., E.11. [2027

CABINETS.

DIGBY'S Cabinets.—Table models in solid oak and mahogany; from 11/6 to 71/-.

DIGBY'S Cabinets, fitted with Radion or Resiston ebonite if required.

DIGBY'S Cabinets.—Pedestal model, with separate battery components; from 56/- to £12.

DIGBY'S Cabinets Made to Customer's Own Designs.

DIGBY'S Cabinets.—Write for new 16-page art catalogue.—F. Digby, 9, The Oval, Hackney Rd., E.2. 'Phone: Bishopsgate 6458. [0128

CABINETS for All Requirements.—F. W. Ramsey, 63, Shaftesbury St., London, N.1. Clerkenwell 7139. [1479

KAY'S Cabinets.—Exclusive practical models in radio and radiogram cabinets, 50% cheaper than elsewhere, used and recommended by the most distinguished and discriminating radio experts; a range of 60 designs to select from; illustrated price lists free.—H. Kay, Wireless Cabinet Manufacturer, Mount Pleasant Rd., London, N.17. 'Phone: Walthamstow 1626. [1789

ARTCRAFT Cabinets, illustrated list free; radiograms, from 79/6; unbeatable value.—Artcraft Works, Grant Rd., Croydon. Established 1925. 'Phone: 1981. [1814

COILS, TRANSFORMERS, ETC.

TRANSFORMERS and Chokes for Battery Eliminators.—Chester Bros., 495, Cambridge Rd., London, E.2. [9706

600 and 1,000 ohms Decoupling Resistances, specified for the largest and most important "Wireless World" receivers; 1/6 each, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1732

BAND-PASS Three Coils, 30/- set; slotted formers for winding, 8/6 set; grooved primary supports, 2/- set, all post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1904

MULLARD 240 volts Filament Transformer; 20/-.—S. M., 213, Willesden Lane, N.W.6. [1957

COILS.—"Wireless World" Four, complete, screens, switches, 52/-; Band Pass Four, 25/-; Band Pass Three, 37/6 per set, c.o.d.—Smith, 3, Park Parade, Harlesden, N.W.10. [1977

BAND-PASS Three Coils, 47/-; Band-Pass Four, 70/-; Regional One and Band-Pass unit, coils, 17/6 pair; All D.C. Three, coils, 32/6; D.C. Foreign Listeners' Four, ganged coils with links and condensers, 52/6; coils for all "Wireless World" and other receivers; complete lists post free; trade supplied.—Simmonds Bros., The Original and Best Coil Manufacturers, now at 33, Rabone Lane, Smethwick. [1627a

DYNAMOS, ETC.

M-L Converter, 12v. input, 300v. 50 m.a. output, new; £6.—"Oakdene," Upper Bell, Rochester. [1953

GRAMOPHONES, PICK-UPS, ETC.

B.T.H. Pick-ups and Tone Arms, cranked, 22/6 each; send for list.—G2VM, 27a, Bridget St., Rugby. [1834

BURNDEPT Electric Soundbox, fitted to Raytrak radial tracking carrier, with adjustable counter-balance; total cost £3, will accept 30/-, bargain.—Farr, 30, Cleaveland Rd., Surbiton. [1965

BLUE Spot Pick-up, played less than 50 records, perfect; cost 63/-, accept 47/6.—R. C. Edwards, South View," Barcombe, Sussex. [1947

Gramophones, Pick-ups, etc.—Contd.

GAMBRELL Novotone, £3; Lissen needle armature pick-up, 15/-; both unused.—Pickthorn, 30, Grapes Hill, Norwich. [1945

BANKRUPT Stock, 3 9-valve gramophone amplifiers, suitable for cinema and demonstration work, containing the following: Three-stage, push-pull, using Ferranti transformers, pye chokes, B.T.H. pick-up arms, 2 Kolster Brandes electric turn-tables, universal voltage, Weston meters, M.L., H.T. and L.T. smoothing equipment, in metal cases, size, 33in. high, 19in. wide, 36in. long, as new and in working order, suitable for A.C. or D.C. when worked by motor generator; price £17/10 each.—Below.

3 DITTO 7-valve Resistance and Choke Coupled, in similar cases; £17/10 each.—Below.

ONE Samson 12-valve, 3-stage push-pull amplifier, type Pam 16, in oak case, £18; valves to suit same, 7/6 each.—Franks, 42, St. George's St., Cannon St. Rd., Commercial Rd., London, E.1. [2009

VALVES.

AMPLIFIER Valve.—If you require power you cannot do better than one of these (or matched in pairs if required).

FILAMENT Volts 6, plate volts 400 (maximum), grid bias 84 volts (approx.), impedance 800 ohms, amplification factor 3.8, mutual conductance 4.35 m.a./volts; price now reduced to £5; see article "The Wireless World," 24th July, 1929, then send to North London Valve Co., Ltd., 22½, Cazenove Rd., Stoke Newington, London, N.16. [0341

SEND for Quotation for American Tubes; Diatron brand.—Agents, Perry Co., 32, Dawes Rd., Fulham. [1966

LOUD-SPEAKERS.

BAKER'S SELHURST RADIO 36-page Booklet, "Sound Advice is Yours for the Asking"; write now for new edition; see displayed advertisement on page 23. [0231

REALISTIC Speakers, true to name, the greatest advance to perfection, not a cone or horn type; write to-day for particulars; Realistic chassis and speakers demonstrated daily.—Realistic Speakers, 72, Penton St., N.1; also 52, Broadwater Rd., Worthing. [1296

LAMPLUGH Inductor Speaker Chassis, as new; 55/-.—Chalkley, Grove St., Wellingborough. [1955

LONDONA Moving Coil Speaker, permanent magnet; £3; after 7 p.m.—C. H. Brundle, Ely Lodge, St. Faith's Rd., Dulwich. [1956

AMPLION Lion Power Chassis, had very little use; £3.—Younie, 51, High St., Forres. [1952

SOUND SALES.

MAGNAVOX.—Still time to secure a bargain.

SOUND SALES Super Speakers.

SOUND SALES Speaker Service.

SOUND SALES.—Special offer, a limited number left of recent models, one of the finest in the Magnavox line, 200-240 A.C. type, complete with mains transformer, dry rectifier and input transformer; £4/15 nett.

WE Cannot Repeat After Present Stock is Exhausted; nearly 50% off list prices.

SOUND SALES Offer Their Sincere Apologies for Any Delay in the Past, and have now increased their staff to meet the demand.

SOUND SALES Supply Special Magnavox Speakers for 100-volt and 25-cycle Mains.

SOUND SALES Will Give You the Highest Possible Allowance on Your Old Speaker in Part Exchange for New 1931 Model Magnavox Speakers; this offer is restricted to new speakers and not bargain lines.—Sound Sales, Tremlett Grove, Highgate. [2015

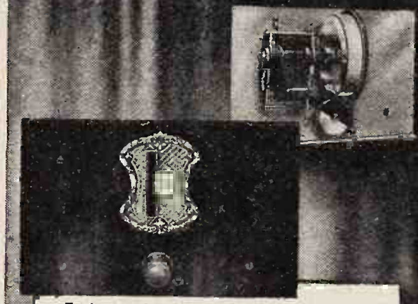
FERRANTI A.C. Speaker Chassis, cost £11/15, 4 months old, perfect condition; accept £7/15.—Gill Commercial Hotel, Plasmarl, Swansea. [1988

BAKER'S Super Power Moving Coil Speaker, pentode coil; bargain, £3/5.—G. Peppiatt, "The Limes," Highgate Rd., London, N.W.5. [1987

RICE KELLOG M.C. 100-250 D.C., with input transformer, 45/-; or for 200-250 A.C., 70/-; Western Electric Kone, 55/-.—55, Teddington Park Rd., Teddington. [1984

IRISH Linen for Loud Speakers, 20×20, 1/6; 22×22, 1/9; 24×24, 2/-; post free, or any size.—Irish Line Warehouse, Hotel St., Bolton. (*The Wireless World* regrets that owing to a printer's error the word "for" was omitted from the first line of this advertisement inserted in October 22nd issue.) [1831

LOTUS ASSEMBLED PANELS



Lotus Assembled Panels are supplied mounted with one ·0005 Condenser, Vernier Dial and Reaction Condenser.
The metal escutcheon plate is in Florentine bronze or heavy oxydised silver, and the drilling is already done.
Price fitted complete with components **£1 1s.**
From all Radio Dealers.

Write for illustrated Catalogue to
GARNETT, WHITELEY & CO., LTD., LIVERPOOL.

FIVE YEARS GUARANTEED

W B

There is a five years' guarantee behind the new W.B. Permanent Magnet Moving Coil Speaker. The massive Sheffield-made Magnet of Cobalt steel, weighing 10½ lbs., needs no energising from the mains. Its powerful field ensures sensitivity and adequate volume. Hear the new W.B. Permanent Magnet Moving Coil Speaker yourself.

Assembled in handsome finished Cabinet. Prices: Oak **£8 8 0** Mahogany **£8 18 6** Also available in chassis form with 14 in. baffle **£6 6 0**

Made by the makers of the famous W.B. Valveholders.
Whiteley Boneham & Co., Ltd., Nottingham Road, Mansfield, Notts.

Loud-Speakers.—Contd.

EPOCH Moving Coil Speakers.

EPOCH.—Everybody who heard the Model 99 agreed with the "Sunday Observer" that it was the finest Speaker in Olympia.

EPOCH.

EPOCH.—Everybody who heard—who didn't?—agreed with the London "Evening News" that the Super Cinema Model was truly named.

EPOCH.

EPOCH.—But those who managed to hear the new Model 101 (Domino) under fair working conditions will never forget it.

EPOCH.

EPOCH.—They will never rest until one of these Speakers is on their sets.

EPOCH.

EPOCH.—The new 101 (Domino).

EPOCH.—The new 101 (Domino).

EPOCH.—The new 101 (Domino).

EPOCH.—The new 101 (Domino).

EPOCH.—The greatest advance in the history of energised Moving Coil Speakers.

EPOCH.

EPOCH.—The new 101 cannot be adequately described.

EPOCH.

EPOCH.—All standards of quality reproduction must be revised.

EPOCH.

EPOCH.—Never before has such clarity been achieved.

EPOCH.

EPOCH.—Never before has such sensitivity and power been obtained in a Home model.

EPOCH Model 101.—The speaker of no comparison.

EPOCH.—Epoch Permanent Magnet Moving Coil Speakers; all models greatly improved.

EPOCH.

EPOCH.—First and foremost the Cabinet Models C12, C13, and C14, prices complete from £5/19/6.

EPOCH.—These contain very powerful permanent magnet Moving Coil Speakers.

EPOCH.—They are not just units fitted into cabinets, but are specially balanced as Cabinet Speakers.

EPOCH.

EPOCH.—No drumminess; no box resonance, but clear, sharp, marvellous reproduction.

EPOCH.

EPOCH.—Magnificent woodwork, very compact.

EPOCH.—They cost less than some makes of inferior units without Cabinets.

EPOCH.—Permanent Magnet Moving Coil Speaker Units for portables; £3/15; ready for use.

EPOCH.

EPOCH.—Standard Cross Magnet Permanent Magnet Speaker; price £4/4; the finest of its kind.

EPOCH.

EPOCH.—Permanent Magnet Super Speakers; they are £6/12/6.

EPOCH.—Remember, the famous 66 and 99 Speakers are heavily reduced in prices.

EPOCH.—The 99 is also further improved in sensitivity.

EPOCH Range of Moving Coil Speakers is the largest in the world; a Speaker for every requirement.

EPOCH.

EPOCH.—Send for booklet S4, the most interesting and useful publication on the subject.

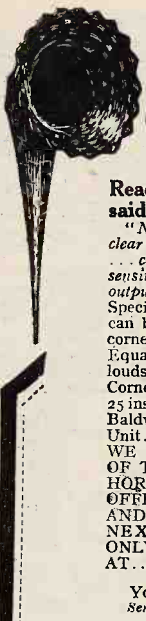
EPOCH.

EPOCH.—Send for the 7 days' approval arrangements.

EPOCH.—Send for the H.P. terms.

EPOCH.—Call for a demonstration.

EPOCH RADIO MANUFACTURING Co., Ltd., Farringdon Av., E.C.4 (between Holborn and Ludgate Circus). 'Phone: Central 1971 (3 lines). [1628



Scientific Sound Amplifiers

Read what "Wireless World" said in May 28th issue:—
"No noticeable horn resonances . . . clear and crisp . . . bass well brought out . . . combination of horn and unit very sensitive . . . good volume with small output valve."
Specially designed for home use and can be suspended in any convenient corner.
Equalled only by a good moving-coil loudspeaker.
Corner model horn, length 5 ft. Mouth 25 ins. **19/6**
Baldwin type Balanced Armature Unit **19/6**
WE WANT TO CONVINCE YOU OF THE SUPERIORITY OF THE HORN LOUDSPEAKER, AND ARE OFFERING THE ABOVE HORN AND UNIT, FOR THE NEXT TEN DAYS ONLY, COMPLETE AT **29/6**
Packed free, carr. fwd.
Your satisfaction is guaranteed.
Send for list of complete range of horns and other components.

SCIENTIFIC SUPPLY STORES,
126, Newington Causeway, London, S.E.1

IN YOUR SPARE TIME!

Demonstrate and sell "ELECTROCETS."

ALL Electric 2 and 3 valve receivers, Radio Gramophones, Eliminators.
(For A.C. Mains.)
Also 2 valve battery or mains operated receivers.

Demonstration receivers may be purchased on Deferred Payment terms, and are sent on 7 days' trial. Excellent commission.
Send to-day a 1½d. stamp for our brochure W.R. 4. which includes our illustrated catalogue and details of how you may obtain the sole agency for your district.

THE ELECTROCET RADIO CO.,
SOLIHULL, BIRMINGHAM.

SAXON 20-STRAND **AERIAL WIRE** EVERY STRAND INSULATED Improves Reception 100 FEET COILS **5/6** THE QUALITY AERIAL!
Obtain Particulars of Aerial Equipment Post Free from: SAXON RADIO CO., BLACKPOOL, LANCS.

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MOVING COIL
SPEAKERS
(Manufacturers Model)
£2 15 0
WILBURN & CO.
23 BRIDE LANE, E.C.4.
Central 6994

COMPONENTS, ETC., FOR SALE.

BELLING-LEE Panel Fittings are designed to give an expert finish to any home-constructed set; catalogue post free.—Belling and Lee, Ltd., Queensway Works, Ponders End, Middlesex. [0018

COMPONENTS Lent on Hire.—Details from Alexander Black, Wireless Doctor, 55, Ebury St., S.W.1. Sloane 1655. [0329

AMMETERS.—Hot wire, 0-1, 4/-; new moving coil milliammeters, 0-5 upwards, 15/-; portable micro ammeters, 5in. scale, 0-200 upwards, 105/-; double range voltmeters, 3/6; instrument repairs and alterations of every description; send for list.—The Victa Electrical Co., 47, High St., Battersea, S.W.11. [1552

VALVE Screen, 3/-; coil screens, 2/9; choke screens, 2/6; as specified in "Wireless World" Radio Gramophone and other circuits.—The Loud Speaker Co., Ltd., 2, Palmer St., Westminster, S.W.1. [1801

M.C. Speakers, pick-ups, cone speakers, microphones, transformers, etc.; send for list.—G2VM, 27a, Bridget St., Rugby. [1833

ELECTONE Times Your Wireless Programme in Advance; price, complete, 21/-.—Sole Patentees and Manufacturers. Fredk. J. Gordon and Co., Ltd., 92, Charlotte St., W.1. [1884

WESTON Ammeters, pattern 301, practically new, 0-5 m.a., 0-10 m.a., 1 amp., 10 amps.; half list price.—Write Franks, 78, Brook Green, London, W.6. [1975

FERRANTI Valve Tester, as brand new, type V.T.1, £3/17/6; Ferranti trickle charger, perfect, 27/6.—73, Crown St., Rochdale. [1974

HALF Price, 50/- Philips Pick-up for 25/-; also Raytrak Carrier and weight counterpoise, 15/-; condition as new.—A. H. M., 38, High St., Sydenham, S.E.26. [1970

SECOND-HAND Goods, all guaranteed selected from stock for sale as new, any sent c.o.d. or "Wireless World" deposit system.

COLVERN Dual Range Coil, 8/6; Telsen radio-grand transformer, 7/-; Ormond drum dial with 0.005 condenser, 6/-; Lotus double D.D. with two 0.0005 Lotus condensers, 19/6; Brown Vee unit, 12/6; R.I. G.P. transformer, 7/6; Varley R.C.C. unit, 7/-; P.M. R.C.C. unit, 4/-; Wearite Titian coil, 8/-; Lissen pick-up with arm, needle armature, 27/6, perfect; Varley pick-up with universal arm, 37/6; Watmel pick-up arm, 6/-; Edison Bell, 3/6; P.M. 1L.F., 3/6; Cossor 1L.F., 3/6; P.M.1A., 3/6; Dario H.F.210, 2/6; emission and condition perfect; T.C.C. electrolitic 2,000 mfd., 9/-; Junit multi switch, 4/6; Cossor transformers, 8/8.

RETAILERS' Bankrupt Stock, final clearance prices.—Polar Ideal 0.0005 slow motion condensers, 7/- each, or 13/- pair; Garrard D/S gramophone motors No. 10a, list price 53/6. my price 33/6; Mullard Permacore transformers, 10/6; Ferranti A.F.3c, can be used as ordinary, 16/6; Ferranti 25-1 transformers, 12/6; Osram L.S.5 valves, 16/-; Mullard D.F.A.7, 16/-; D.O.20., 16/-.

PHILIPS 506 Rectifier Valves, 12/6; Hydra condensers 2 mfd. 650v. test, 2/2; Hydra 4 mfd. 500v. test, 3/3; Hydra 4 mfd. 350v. working, 4/6; Hydra 1 mfd. 700v. working, 3/6; T.C.C. 4 mfd. 800v. working, 10/-; Hunt's Polymet 0.0003, 6d.; ditto 0.01, 1/-; ditto 0.001 7d.; mica, Graham Farish 5,000 ohm. resistances, 1/6.—G. A. Ryall, 182, Kennington Rd., London, S.E.11. Bus stop outside door, alight Fitzalon St. [1968

5-VALVE Set Mahogany Cabinet, L.T. accumulator. spare valves; £5.—32, Sefton Rd., Addiscombe. [1967

AMATEUR'S Surplus.—D.E.P.410, 3/6; S.P.55R., 3/-; standard power, 7/6; 2 volts, 2/-; Sifam 0-30 milliammeter, 12/6; Litz Everyman coils, 12/6 pair; Marconi Ideal 4:1, 10/-; Lissen, 2/6; 3 superhet intermediates, 2 oscillators, 12/6; T.C.C. 4 M.F.D. 800v. working, 7/6; Dynamo 6v. 8 amp., 12/6; new Marconiphone pick-up, 50/-.—Taylor, 18, Wentworth Park, Harborne. [1959

"WIRELESS World" Four, complete, as specified, with valves and coils, £24; Garrard motor, Blue Spot 66R., chassis, pick-up, cabinet, £15 extra; any part sold separate; send particulars.—Smith, 3, Park Parade, Harlesden, N.W.10. [1976

A.C. R.K. Speaker, with amplifier, complete, new, also Ferranti H.T. unit A.C. 200v. 100 m.a., new; offers wanted.—141, Market St., Chorley, Lancs. [1951

FERRANTI A.F.5, 18/-; Cyldon short wave condenser and extension, 7/-; 2 Jackson drum dials, 7/-; set of Colvern short wave coils and base, 10/-; Burndept short wave condenser, 5/-; Met-Vick D.C. eliminator, 27/-; Burndept and Igranic H.F. chokes, 2/6; Burndept dial, 3/-.—Easte, 18, Wellholme Rd., Grimsby. [1946

PART Exchange.—See our advertisement under Receivers for Sale.—Scientific Development Co., 57, Guildhall St., Preston. [0228

BAND-PASS Three (September 17th), the most popular set of the season. See advert. under Coils.—Groves Brothers. [2004

CELESTION C.12, oak, 50/-; Ferranti 230v. trickle charger, as new, 35/-; Varley R.C. coupler A, 7/6.—Kirkpatrick, 56, Gratwicke Rd., Worthing. [2018

"WIRELESS World" Kit Set Coils; 28/-; perfect. —Rendall, 38, Caroline Place, Chelsea, S.W.3. [1981

Components, Etc., for Sale.—Contd.

ELIMINATOR, 150-400 volts, and two variable tappings, £7, cost double; R.I. adjustable choke, 30/-; Squier double cone, 10/-; new Foreign Listeners' Four, boxes, coils, switches, mounted on baseboard, 35/-; Ferranti A.F.6, A.F.7, 20/- each; 12 non-inductive 1 mfd. condensers, 1/3 each; 2 M.S.4, 1 A.C/S., 10/- each; R.I. auto tone arm, 20/-.—Rogers, 21, New Rd., Brentwood. [2017

RETAILER'S Bankrupt Stock, all new and genuine, any c.o.d. or "Wireless World" deposit system.

EDISWAN Valves, 2-volt, H.F. 210, 5/6; L.F. 210, 5/6; R.C.C. 210, 4/6; P.V. 215, 7/-.

TELSEN Ace Transformers 3-1, 5/6; Pye 20H. chokes, 9/-; Hegra B.A. speaker cone units, semi adjustable, 7/6.

LOTUS Differential Reaction Condensers, 0.00034, 3/8; Wearite 4-pole rotary switches, 2/9; Precision antiphonic large valve holders, 7d.

EBONITE Leak Holders, 3d.; Watmel H.F. chokes, 1/-; Loewe 2 meg. leaks, 9d.; Ediswan ½ meg. leaks, 7d.; ditto ¼ meg., 7d.; Mullard 2 meg. and ¼ meg. leaks, 8d.; Graham Farish 100,000 ohm. resistances, 1/6; 150,000 ohm., 1/-; 250,000 and 500,000 ohm., 8d. each; satisfaction or cash refunded, my guarantee.—G. A. Ryall, 182, Kennington Rd., London, S.E.11. [2016

COPPER Earth Plates, area, over 500 square inches, 12ft. lead, genuine sound investment; 5/3, post paid.—Trueman, 141, Ince Av., Liverpool. [2013

EXPERIMENTER'S Extensive Surplus for Disposal; write for list.—7, Moorland Rd., Didsbury. [1998

WEBSON Moving Coil Speaker, 50/-; J.B. dual drum 0.0005, 10/-; Ormond 0.0005 slow dial, 10/-; Amplion L.S. unit, 12/6; Marconiphone V.2 valves, 60/-; Lotus relay, 5/-; Amplion R.O.1 Radiolux, 45/-; Lewcos binocular coils, aerial and transformer, 250-550. also 1,000-2,000, 5/- each.—BM/BNP3, London. W.C.1. [1983

THE Following Slight Used Material is offered subject to sale; every article will be severely tested before despatch, and guaranteed in workable condition; items are nett cash and carriage paid in Great Britain.

RESIDUE of Transformers.—Ferranti A.F.5, 19/6 each; Ferranti A.F.3, Marconi Ideal, R.I. Straight Line, Hypernu, Ferranti O.P.1 and 2, all one price, 14/- each; Ferranti A.F.4, 10/- each; B.T.-H., G.E.C., small Marconi Ideal, R.I. General Purpose, all one price, 8/6 each; Formo, Lissen, Eureka, Brandes, Igranic Shrouded, all one price, 5/6 each.

RESIDUE of Pick-ups.—Woodroffe, 35/- each; R.I. Varley, 25/- each; Brown, best model, 30/- each; Igranic Phonovox, G.E.C., Burndept, all one price 14/- each.

APPLEBY, Chapel St., St. Marylebone, London. [0340

MISCELLANEOUS.

SCOTT SESSIONS and Co., Great Britain's Radio doctors, officially approved as wireless repairers by Radio Society of Great Britain and Wireless League; old sets of every type repaired, rebuilt, modernised; send set for immediate quotation.

SCOTT SESSIONS and Co.—New sets constructed with your or our components, guaranteed finest workmanship; we specialise in "The Wireless World" circuits; remember, we have satisfied customers throughout the British Isles and in three Continents; if you so desire, we will design and construct high grade apparatus to suit your especial circumstances for quality, range and selectivity.—Tel.: Tudor 5326. Muswell Hill, London, N.10. [0262

ALEXANDER BLACK,

THE Original Wireless Doctor, will call (London and Home Counties) and cure your set.

CONSULTATIONS by Appointment without Obligation; sets installed, maintained and brought up to date; components and McMichael portable sets on hire; purity reproduction specialists.

55, Ebury St., Victoria, S.W.1. Sloane 1655. [0277

EASY Payments.—We supply, by easy payments, components, accessories, and sets, any make; 10% down, balance spread over 11 months.—Send list of requirements to London Radio Supply Co., 11, Oat Lane, London, E.C.2. [0337

RECORDING Stylus Cutters, special sapphire point to fit any pick-up or sound box; 2/2, post free. —Cairns and Morrison, Ltd., 33, Percy St., London, W.1. [1885

RYALL'S Part Exchange Service; your unwanted radio parts taken in part payment for new.

ONLY Brand New Goods Supplied, any make; please state condition and lowest price acceptable for your goods and, as far as possible, mention list price of new goods required, to save reference work.

NO Restrictions Made, goods bought for cash, if lowest reasonable price stated.

LENGTHY Quotations Cannot be Given.—Ryalls Radio, 182, Kennington Rd., London, S.E.11. [1710

LUMINOUS Paint Shows a Light in the Dark for Clocks; discs indicators, bell pushes, numbers; in boxes with brush, 2/6 and 4/6, post paid.—L. Sutton, 15, Elgin Av., London, W.9. [2011

E.C. WIRELESS.—"W.W." Four, chassis, valve screens, etc., with or without mounted components.—Premier Place, High St., Putney, S.W.15. [2005

 Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.

Miscellaneous.—Contd.

WIRELESS Notes.—A monthly service of information for all those who want the very best in wireless or gramophone reproduction; frank criticism of receivers and components; immediate postal help and advice in all difficulties; something new and unique; you must have it if you want to know the truth.—Full particulars free from Ernest H. Robinson, Langmead, Pirbright, Woking, Surrey. [1979

PATENT AGENTS.

PATENTS and Trade Marks, British and foreign.—Gee and Co. (H. T. P. Gee, Member R.S.G.B. and A.M.I.R.E.), 51-52, Chancery Lane, London, W.C.2. 'Phone: Holborn 1525. [0001

CHAS. J. R. BULLOUGH, Chartered Patent Agents.—Patents, designs and trade marks.—27, Chancery Lane, W.C.2. Holborn 8105. [1883

REPAIRS.

SCOTT SESSIONS and Co., Great Britain's radio doctors; read advertisement under Miscellaneous column. [0263

GUARANTEED Repairs by Experts.—Loud-speakers, headphones, cone units, pick-ups, any type, rewound, remagnetised, and adjusted post free 4/-; transformers from 4/-.—Howell, 91, Morley Hill, Enfield, Middlesex. [9555

LOUD-SPEAKERS, headphones, cone units, any type, rewound, remagnetised and overhauled; 3/6 post free; repairs guaranteed; 24 hours' service; terms to trade.—Walters, 1 Durns Terrace, Lower Compton, Plymouth. [1912

YOUR Transformer Repaired or Rewound and Returned Promptly; 3/6, post free.—James, 190, Bitterne Rd., Southampton. [2006

WANTED.

WANTED, all mains receiver, 220 A.C.—Barnes, Lismore, Fernleigh Rd., Plymouth. [2028

IGRANIC 0.0005 Three Gang Condenser.—Price and condition to Box 7972, c/o *The Wireless World.* [2026

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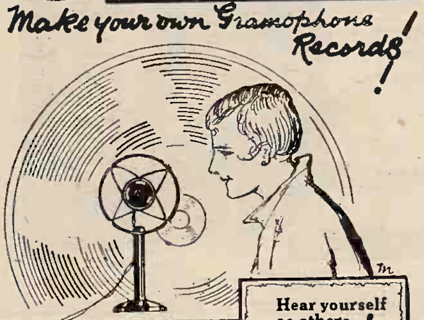

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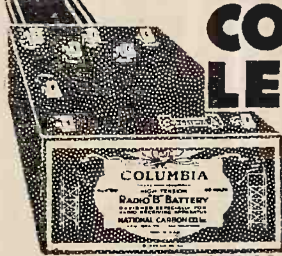

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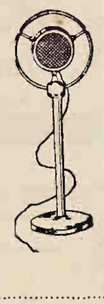

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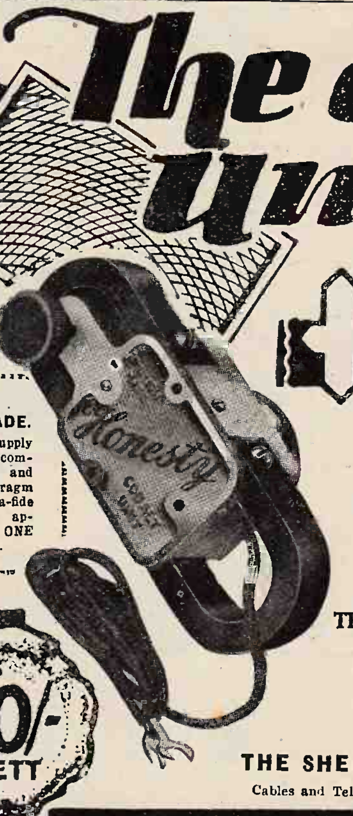

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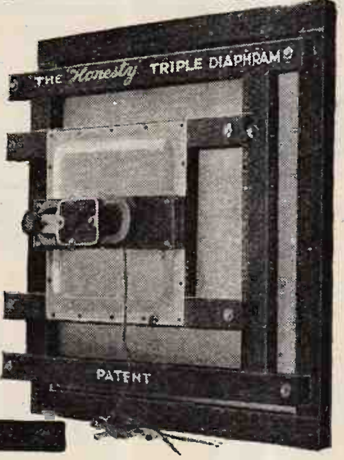

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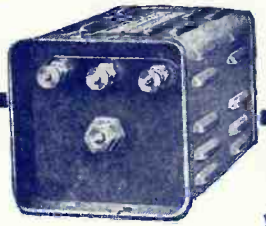

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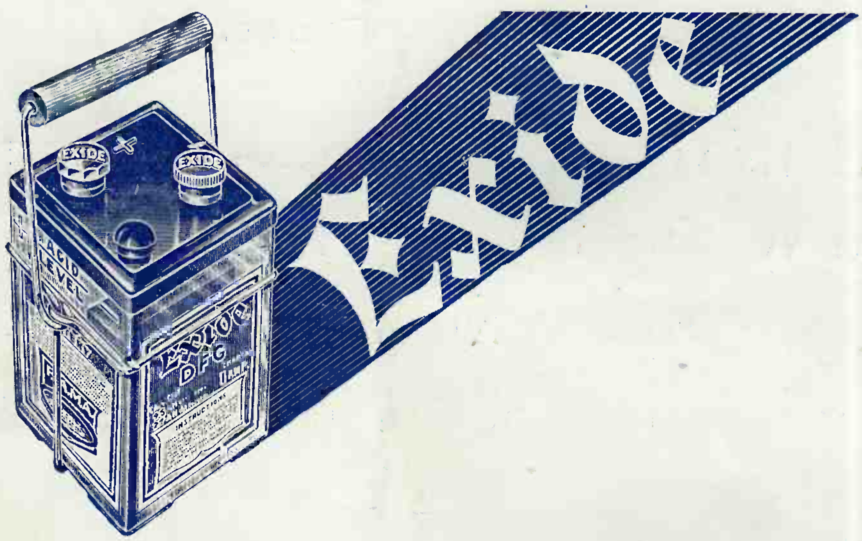

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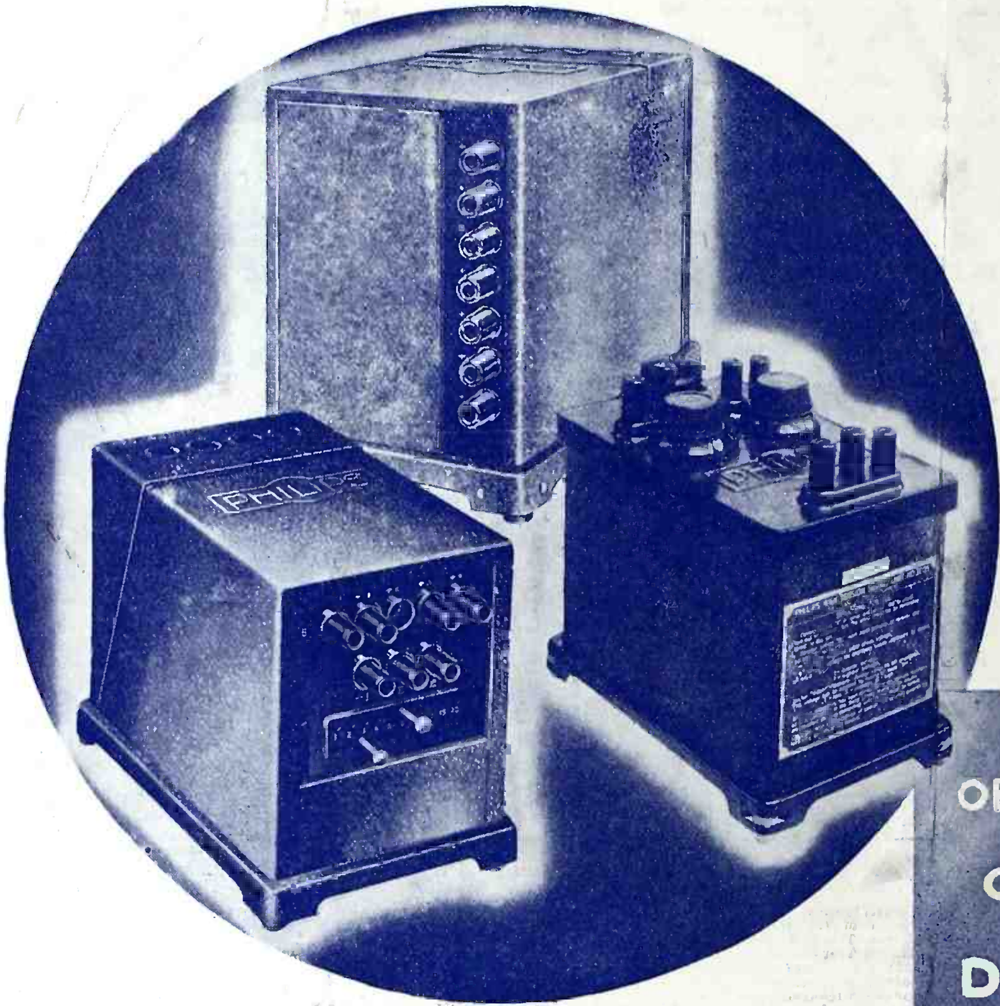

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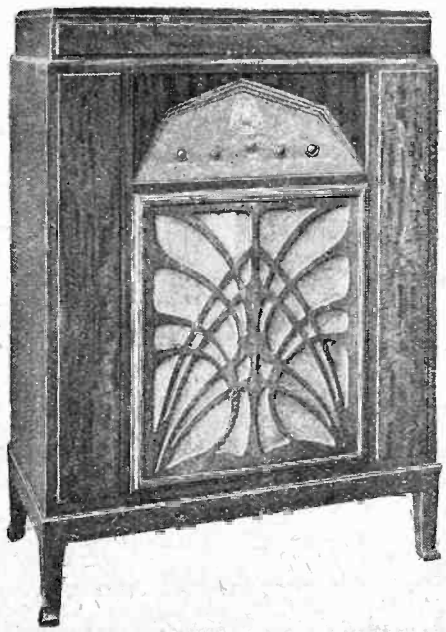

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Junior Model, pedestal type, **£2 15s.,** including volume control. **Senior Model,** pedestal type, **£3,** with no volume control. **Second-hand Table Model,** cabinet, **25/-** each, including volume control. **Second-hand Junior,** pedestal cabinet, **35/-,** including volume control. **Second-hand Senior,** pedestal cabinet, **40/-,** no volume control.

A.C. MAINS TRANSFORMER, as used in above, No. 3 Eliminator, **27/6** each.

D.C. SMOOTHING CHOKES, as used in No. 2 Eliminator, above, **15/-** each.

MOVING COIL SPEAKER, as used in No. 1 and No. 4 chassis, above, **55/-.**

Any price for other components, as used in the above ensembles, on application.

30-HENRY SMOOTHING CHOKES, 10/6 each, as used in Senior Panatrope.

A.C. TRANSFORMERS for 110 volts, 25 or 50 cycles, Mains **30/-** each. Weight, 21 lbs., as used in Senior Panatrope.

D.C. GENERATORS, 200/250 volts input, output 475 volts, at 200 milliamps., with adjustable resistance, in asbestos-lined box, made for Domestic Panatrope, **£6.**

As above, but 750 volts output, made for Brunswick Cinema Panatrope, **£7.**

A.C. input and D.C. output, prices on application.

ALL THE ABOVE GOODS ARE OF B.T.H. MANUFACTURE.

No valves are included in the prices quoted. These equipments are very suitable for restaurants, small halls, gramophone shops, etc.

Terms: Cash with Order.

Special Prices for Quantities.

All Goods can be inspected at our Showroom!

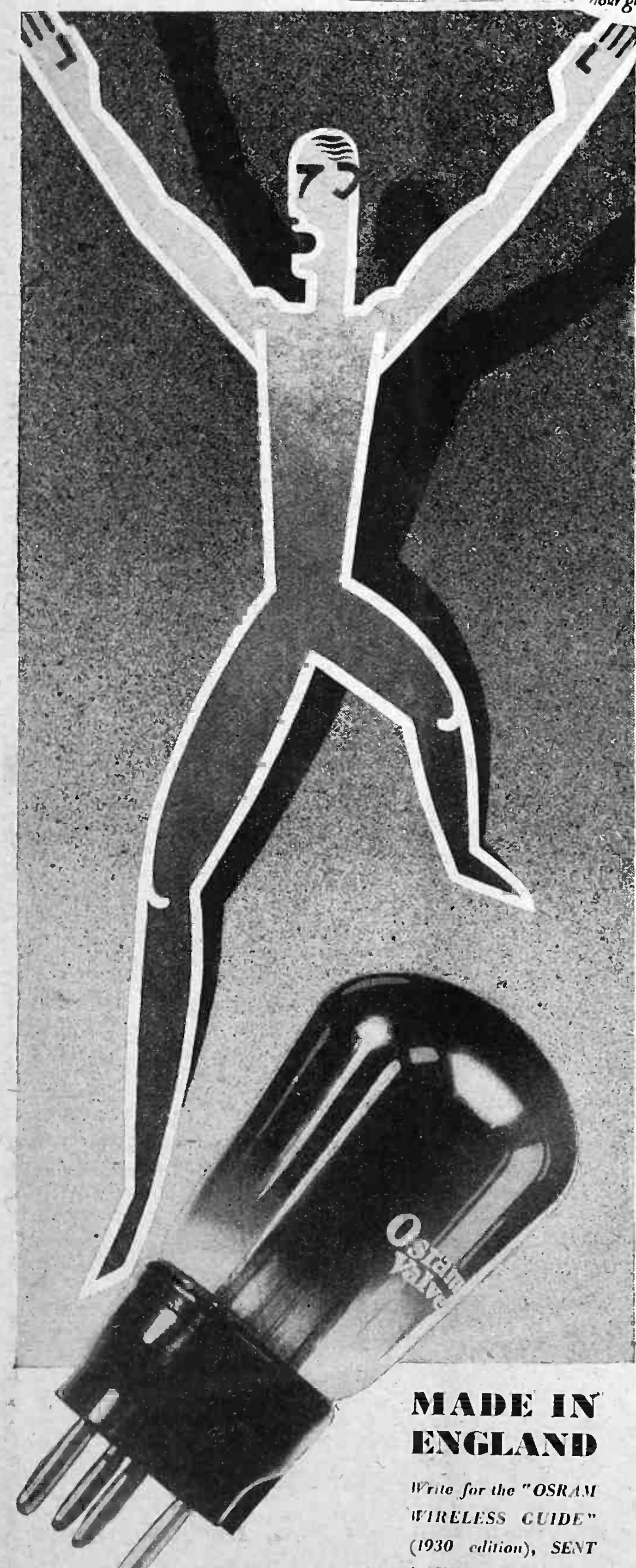
JOLLY'S

410-416, Aston Lane, Witton, Birmingham.

Also Aston Road, Birmingham.

'Phone: East 687.

EVERYTHING The G.E.C. your guarantee ELECTRICAL



MAKE YOUR SET YOUNG AGAIN!

OSRAM 2-volt valves specially designed for Portable Sets

Now is the time to look to your set in preparation for the winter and long nights.

Valves do not live for ever — a sign of honourable old age is a weakening in emission. You cannot get the best performance from your set unless the filaments of your valves are actively emitting electrons.

A fresh set of OSRAM 2-volt valves will put new life into your Portable Receiver. Every individual OSRAM 2-volt valve is tested for electron emission.

The OSRAM VALVES for Portable Sets

S 215 for Screen Grid Portable Sets

H 2	**Detector, H.F. & L.F. Amplifiers**
HL 210	
L 210	
P 215	**Power Valve**
P 240	**Super-Power Valve**

MADE IN ENGLAND

Write for the "OSRAM WIRELESS GUIDE" (1930 edition), SENT POST FREE on request.

Sold by all Wireless Dealers

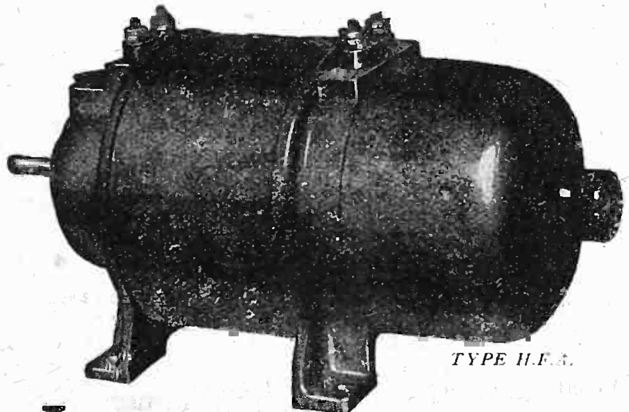
Osram Valves

Make your set young again

Advt. of The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2.

RELIABILITY in D·C to A·C MACHINES

YOUR power supply problems can be simply and efficiently solved by one or other of the M–L Machines. Write for your free copy of "The Book of the M–L Rotary Transformer," which deals with all machines of our manufacture.



TYPE H.F.A.

M-L ROTARY TRANSFORMERS

Types H.E.A and H.F.A. deliver an A.C. output at 110v. or 230v., 50 cycles when connected to D.C. supply mains. Machines supplied to run from any voltage; country house lighting plant or D.C. plants on private yachts. H.E.A. type, 40 watt, £13. H.F.A. type, 85 watt, £17. Recommended and used by Philips Radio, Marconiphone, Burndept, Kolster-Brandes, M.P.A., etc., etc.

M-L ANTI-INTERFERENCE UNIT

For use with M–L Rotary Transformers. Price £2.

THE M-L MAGNETO SYND. LTD., Radio Department, COVENTRY.
Telephone: 5001.

Contractors to the Air Ministry, the B.B.C., the G.P.O., Marconiphone, The Gramophone Co., Ltd., etc., etc.

ROTARY TRANSFORMER SPECIALISTS

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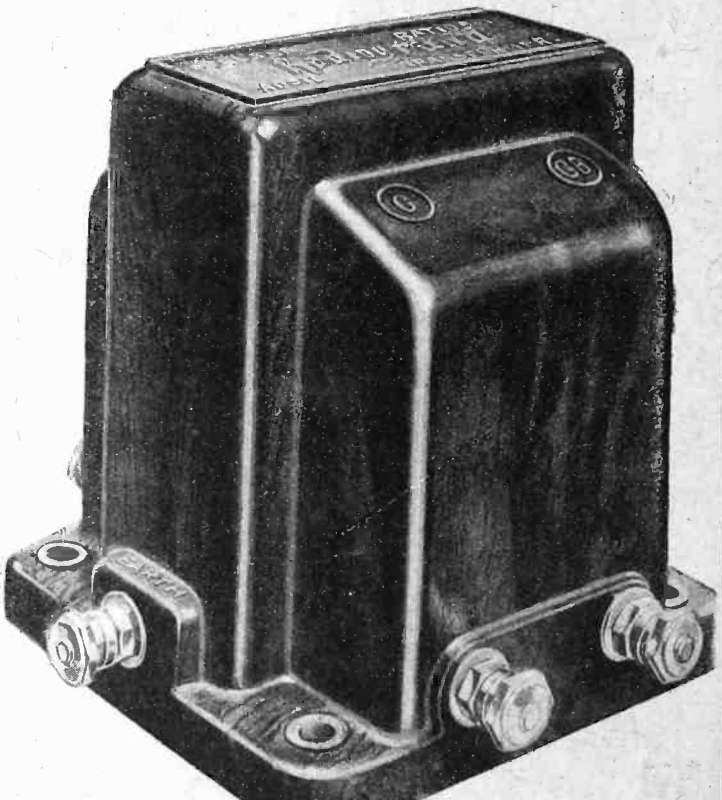
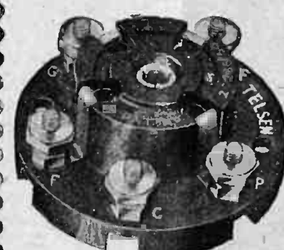
100% EFFICIENCY & RELIABILITY IN TELSEN COMPONENTS

Performance is built into them . . . The design is right . . . The workmanship . . . Superb! The materials . . . the best. They are constructed for the enthusiast who is appreciative of and determined to get the finest radio reproduction. Every component is made to function perfectly . . . individually and collectively. Try them . . . Modernise your old set . . . or insist on Telsen Components for your 1931 Receiver, and get 100% efficiency.



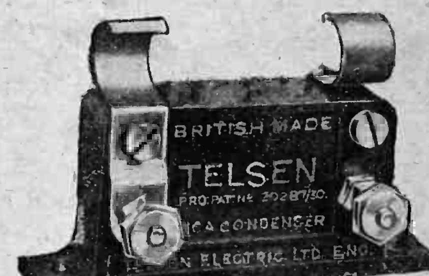


TELSEN VALVE HOLDERS. Low capacity, self-locating, supplied with patent soldering tags and hexagon terminal nuts. Price 1/-

5-pin Valve Holder
PRICE 1/3

TELSEN FIVE-PIN VALVE HOLDER. Pro. Pat. No. 20286/30. Genuine Bakelite Mouldings fitted with Nickel Silver shock-absorbing spring contacts. Price 1/3 each.

4-pin Valve Holder
PRICE 1/-



TELSEN FIXED (MICA) CONDENSERS. Shrouded in Genuine Bakelite, made in capacities up to ·002 mfd. Pro. Pat. No. 20287/30. ·0003 supplied complete with Patent Grid Leak Clips to facilitate series or parallel connection. Can be mounted upright or flat. Tested on 500 volts. Price 1/- each.

Telsen "Radiogrand" Transformer, new model, shrouded in Genuine Bakelite, with new windings and core, fitted with earth terminal. Made in ratios 3—1 and 5—1. Price **12/6** each.
Telsen "Ace" Transformer, the ideal model for all Portable Sets, and where space is limited. Made in ratios 3—1 and 5—1. Price **8/6** each.
Telsen 7—1 Super Ratio "Radiogrand" Transformer, giving enormous amplification with perfect reproduction, shrouded in Genuine Bakelite, with new windings and core, fitted with earth terminal. Price **17/6** each.

TELSEN H.F. CHOKES. Designed to cover the whole wave-band range from 18 to 4,000 metres, extremely low self-capacity, shrouded in Genuine Bakelite. Inductance 150,000 henries. Resistance 400 ohms. Price **2/6** each.

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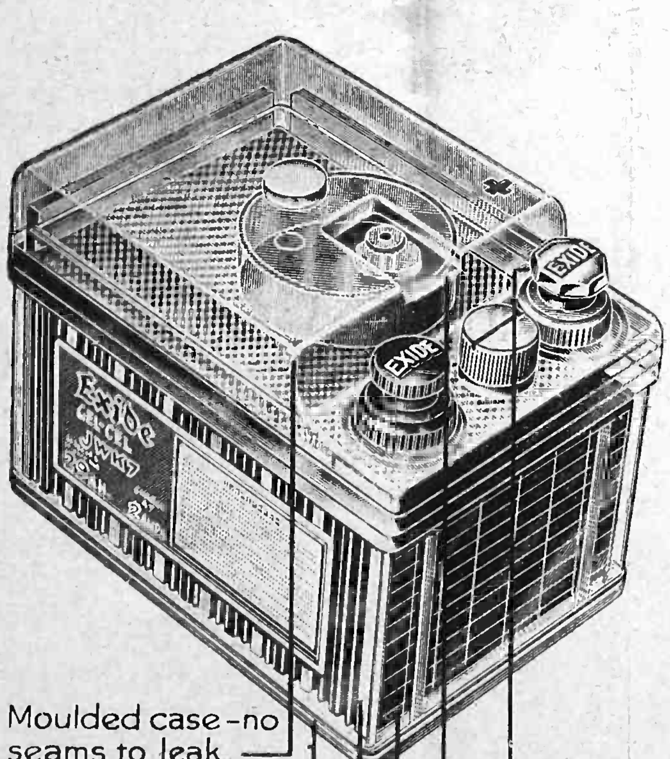
Advt. of Telsen Electric Co. Ltd., Birmingham

Voted—
the best battery
in Wireless World public Ballot

AGAIN an Exide Battery has won first place in the "Wireless World" Olympia Ballot. Every year an Exide Battery wins this distinction. This now-famous Ballot is voted in by the more advanced wireless experimenters—men who know what to look for in a battery. In the Exide Gel-cel—the new jelly acid battery—they have seen advantages never before available in a low tension battery for portables. Examine them yourself and when next you need a battery for a portable set you will insist on an Exide Gel-cel.

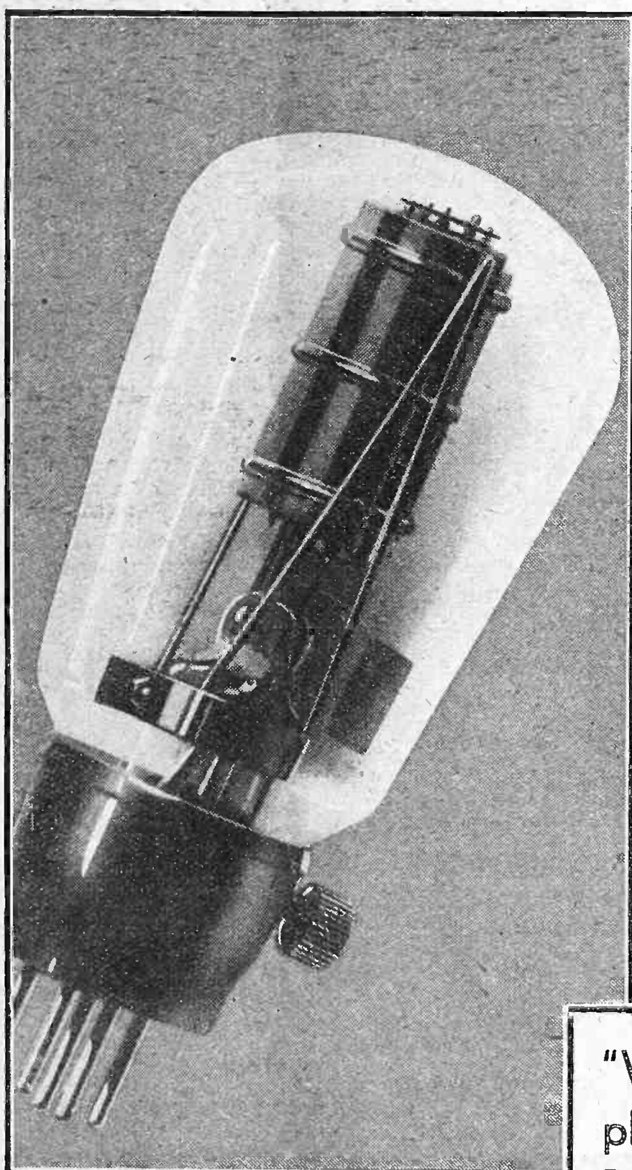


Exide
GEL-CEL

There is a size to suit every set. Prices range from 13/-

From Exide Service Stations or any reputable dealer. Exide Service Stations give service on *every* make of battery

Exide Batteries, Clifton Junction, near Manchester. Branches at London, Manchester, Birmingham, Bristol and Glasgow



"The best valve at the Show"

"Wireless World" readers place the Mazda A.C. Pen **FIRST** in the class for Valves in the Olympia Show Competition !

THE AMAZING

MAZDA

A.C.PEN

PRICE 27/6

Here is striking evidence of the excellence of the Mazda A.C.Pen—and to the value it offers! "Wireless World" readers—the most critical public—placed this Valve FIRST in the class for valves (section 6) in the Olympia Show Competition. There could be no better testimony than this to our slogan "The finest range of valves the world has ever known."

ASSOCIATED ELECTRICAL INDUSTRIES, LTD.

THE EDISON SWAN ELECTRIC CO., LTD.
Incorporating the Wiring Supplies Lighting Engineering, Refrigeration and Radio Business of the British Thomson-Houston Co. Ltd.
Radio Division
1a Newman Street, Oxford Street, W.1
Showrooms in all the Principal Towns

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V.91

THINK OF THE SAFETY FACTOR

1. FERRANTI Condensers are of the Rolled Foil paper insulated type, and are not of the Mansbridge pattern.
2. Their guaranteed insulation resistances are not less than 200 megohms for 2 mfd. This figure is twice the value usually provided in condensers of corresponding types.
3. They are hermetically sealed in their cases in addition to the usual wax sealing thus preventing deterioration in service as commonly occurs where this provision is not made.
4. Their test voltages are three times their A.C. working voltages, and twice their D.C. working voltages.
5. They comply with the British Standard Specification for Condensers and with the latest recommendations of the Institution of Electrical Engineers.
6. They are built by Engineers with unrivalled experience in the Electrical industry in the manufacture of High Tension apparatus, including condensers for pressures up to 1,000,000 volts!

PRICES:

2 mfd.
C1. 1050 v. D.C. test .. 5/6
C2. 600 v. D.C. test .. 3/9
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C5. 1500 v. D.C. test .. 7/-

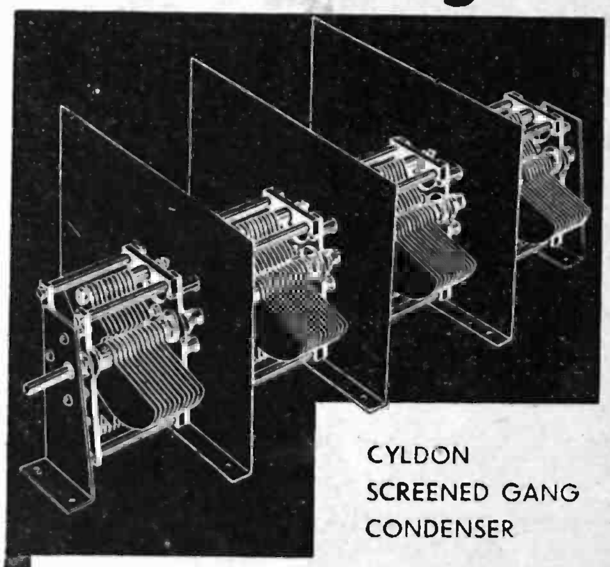
4 mfd.
C6. 1050 v. D.C. test .. 7/6

NO BETTER CONDENSERS ARE AVAILABLE AT ANY PRICE.

FERRANTI
FIXED CONDENSERS

FERRANTI LTD., Head Office and Works: HOLLINWOOD, LANCS. LONDON: Bush House, Aldwych, W.C.2

Creators of High Grade Precision Condensers



CYLDON
SCREENED GANG
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CYLDON ALONE GIVES ACCURATE MATCHING

Gang control, adopted for the Wireless World Four, depends entirely for its efficiency upon accurate sectional matching such as CYLDON construction alone can give. Superior raw material skilfully fashioned, many outstanding mechanical features, gauge tested machined parts, precision built, and capacity bridge tested after complete assembly, recommends you to **build with CYLDON** . . . it costs more but its construction amply justifies it. Send for details of full range.

STG 25 Twin .0005 30/-
STG 35 Triple .0005 46/6
★STG 45 Four .0005 65/-

★ Specified for the WIRELESS WORLD FOUR. Supplied complete, assembled with special screens.

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FIVE YEARS GUARANTEE

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TRIUMPHANT AT OLYMPIA

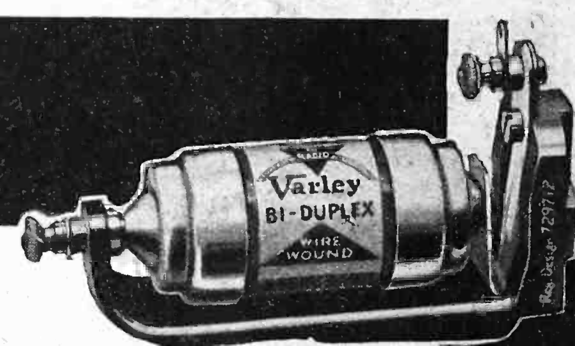
IRRESISTIBLE PREDOMINANT

First in the Wireless World Ballot . . . First in public estimation! . . . There has never been anything in Radio to compare with the Pye TWINTRIPLE Portables. New in technique, new in presentation, new in performance. Completely portable and completely self-contained (Battery model or All-Electric models) . . . altering and widening the whole outlook of radio reception, the Pye TWINTRIPLE Portables have created the greatest public demand in the history of radio.

PYE TWINTRIPLE PORTABLES

Pye Radio Ltd., Sales Organisation, Paris House, Oxford Circus, W.1.

ADAPTABLE FOR ANY SET



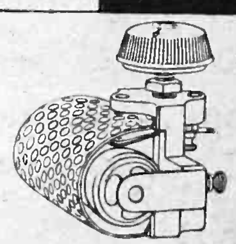
Accurate, constant in value, silent in use and free from breakdown—use Varley Bi-duplex Wire-wound Anode Resistances wherever you need a fixed resistance for radio purposes.

Their special "Universal Holder" allows them to be fixed either vertically or horizontally, making them adaptable for *any* set. And they are guaranteed accurate to within 5%.

Varley Components are the outcome of more than 30 years' experience. The famous Varley Bi-duplex Winding is giving to tens of thousands of listeners a quality of radio that would otherwise be unobtainable.

Complete range from 5,000 ohms to 500,000 ohms. Prices 4/6 to 17/6 (including Universal Holder).

Write for Section B & C of the Varley Catalogue.



VARLEY POWER POTENTIOMETER.

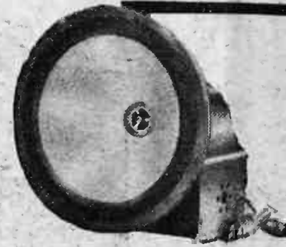
Ideal for use as voltage regulator in H.T. eliminators. Wire-wound. Spring loaded contact arm. Carries up to 20 watts.

Complete range, 9/6 to 11/6.

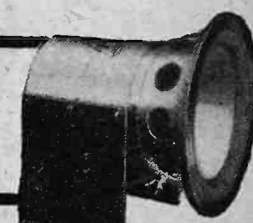
For RADIO
OLIVER PELL MANUFACTURE
Varley

Advertisement of Oliver Pell Control Ltd., Kingsway House, 103, Kingsway, London, W.C.2. Telephone: Holborn 5303.

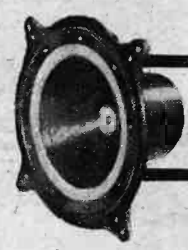
Perfect reproduction now costs less



SENIOR R.K. (For A.C. Mains Field Excitation). Fitted with 10" corrugated cone, with moving coil having an impedance of 10-15 ohms at 50/4000 cycles. Price £10 10s. Also supplied complete with Oak cabinet £20. Mahogany cabinet £24 10s. Walnut cabinet £25 10s. Also supplied without rectifier.



JUNIOR R.K. Fitted with 6" corrugated Cone, with moving coil having an impedance of 10-15 ohms at 50/4000 cycles. Price £4 15s. This model is not supplied complete with cabinet.



PERMANENT MAGNET R.K. Fitted with 8" Corrugated Cone. Price £6 15s. Also supplied complete with Oak cabinet £16 16s. Mahogany cabinet £21. Walnut cabinet £22.

The wonderful R.K. reproducers have stood the test of four years and still remain in unchallenged supremacy. They are without doubt the finest reproducers ever built. We agree that R.K.'s cost a little more than some other loud speakers, but the results are so far superior as to make the additional cost seem absurdly inadequate. Our unique hire purchase facilities are at your disposal, so that you can possess and use one of these remarkably fine speakers on payment of only a small deposit.

RK

REPRODUCERS

ASSOCIATED ELECTRICAL INDUSTRIES LTD. AEI

THE EDISON SWAN ELECTRIC CO. LTD.,
Incorporating the Wiring Supplies, Lighting Engineering, Refrigeration and Radio Business of the British Thomson-Houston Co., Ltd.
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1a, Newman Street, Oxford Street, W.1
Showrooms in all the Principal Towns

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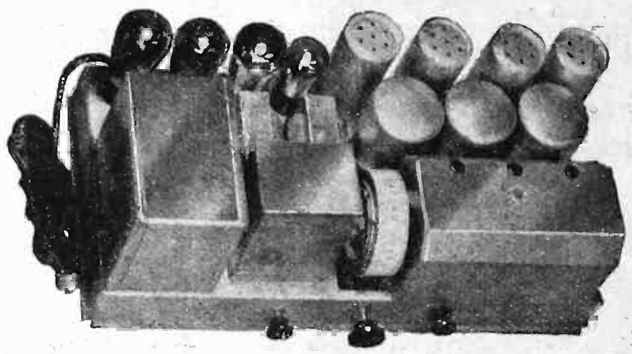
 Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.

The Radio of To-morrow is here to-day



Peerless A.C. Screen Grid 8

THE Peerless 8 is stocked by all up-to-date high class dealers throughout the country. Write to-day for full details.

The Rothermel Corporation Ltd.
24, Maddox Street, London, W.1.
'Phone: MAYFAIR 0578/9.
Continental Sales Office: 27, Quai du Commerce, Brussels, Belgium.

The new Peerless Screen Grid Eight is undoubtedly the finest value in A.C. operated radio sets. The design and performance of the Peerless is unchallenged and embodies improvements which are years in advance of all other types of radio receivers. Consider the following outstanding units of the Peerless Eight and consider the marvellous value which you receive.

3 Screen Grid Radio Frequency. Power Detector. Power Output. Oversized Power Pack. Dynamic Speaker Reproduction. Complete Wave Length Range 200-2,000 metres. Marvellous selectivity, Sensitivity and Tone. Completely shielded and A.C. operated. Illuminated Drum Dial Tuning. Noiseless Volume Control.

£36

COMPLETE WITH DYNAMIC SPEAKER AND VALVES ROYALTY £2 net. 110 volt or 230-240 volt, 50 cy. A.C.

"VIBRANTI"

LOUDSPEAKER CABINETS AND BAFFLE BOARDS.
BUILT FOR THE LATEST CONE UNITS
TO IMPROVE REPRODUCTION.

BAFFLE CABINET (as illustrated). Height 24 in., width 24 in., depth 9½ in., Centre Opening 9½ in. or 12 in. diameter. Price **22/6**, Oak or Mahogany finish.

BAFFLE BOARD. 24 in. x 24 in. x ⅜ in. Price, Oak finish, **9/6** ea. Copper or Silver Stucco, **11/6** ea.

Screen Fittings. Oxidised Copper, **5/3** set. Oxidised Silver, **6/6** set.

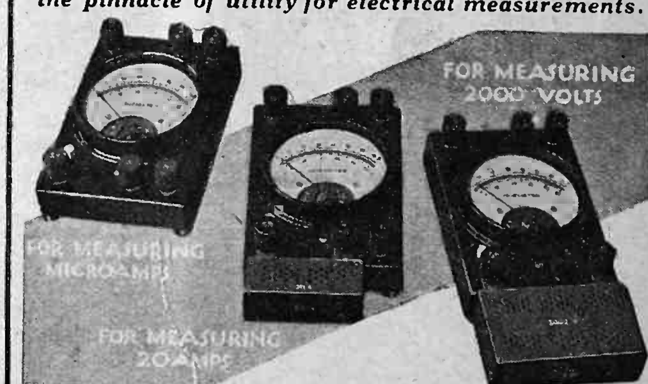
From Radio Dealers, or

CHAS. BORST & SONS, 306-308, Euston Rd., London, N.W.1.

You want an "ELECTRADIX" Radio Tester to get exact results.

The Dix-onemeter,

the pinnacle of utility for electrical measurements.



50 ranges on one meter.
The Rolls-Royce of Radio Testers. Highest Grade at a low price.
50 Electrical Instruments in 1
AMPS VOLTS OHMS
Only Six Terminals, but what Ranges!

The DIX-ONEMETER is portable size to go in the pocket, but big enough to cover the whole range of D.C. electrical measurements. You can have multipliers to work from 50 micro-amps to 150 amps and 20 milli-volts to 2,000 volts. What other instrument to Brit. Elec. Standard Assocn. Standard of Accuracy for First Grade meters is available at the price? None! A novice can use it as accurately as an expert. No switch to be accidentally turned with disastrous results, as each range has its independent multiplier and a safety button controls the moving coil.

METER ONLY, 50/- **RADIO SET, £4 10s.**

Half the price of old-fashioned designs. Order one for 1930.

SAVES RADIO USERS POUNDS.

ELECTRADIX RADIOS,
218, Upper Thames Street, London, E.C.4.
Blackfriars Station, Underground Railway. 'Phone: City 0191.

How to bring in Foreign Stations

READ WHAT " THE WIRELESS TRADER " AND " THE MUSIC SELLER " SAY ABOUT

THE GAM-BRELL A.C. ALL-ELECTRIC THREE

" The Wireless Trader " says :—

" . . . . . 11 miles from Brookman's Park, using an inside roof aerial . . . it was possible to limit the spread of both the London Regional and National stations to 3 degrees on a 100 scale and still obtain them at good volume. This, of course, represents extremely good selectivity and sensitivity."

London National	261	Metres
Toulouse (France)	255	,,
Midland Regional	479	,,
Langenberg (Germany)	473	,,

Königs Wusterhausen, Radio-Paris, Daventry National

ALL CLEAR OF EACH OTHER

This is the Receiver tested and reported upon by " The Wireless Trader " and " The Music Seller."

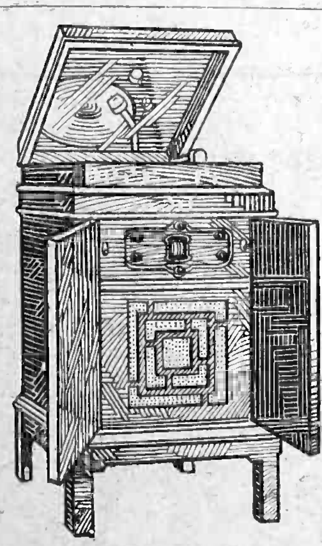
" The Music Seller " says :—

"Gambrell Radio Ltd. have fitted every refinement to this Receiver and the results have repaid the trouble taken in this respect."

"Hair-line selectivity is arrived at by an additional tuning device . . . This greatly assists in reducing interference."

'With a little care and practice in tuning, some forty stations are to be received at good strength."

RECEIVED AT GOOD STRENGTH



THE GAM-BRELL RADIO NOVOGRAM

In addition to having most modern type of valves and circuit, giving long range, volume and maximum output, this instrument is fitted with Garrard electric gramophone motor with automatic stop. B.T.H. pick-up. One-at-a-time needle cup. Highest class electro dynamic loudspeaker. Volume control on both radio and gramophone. The famous Novotone is, of course, incorporated, and the result when reproducing records is "amazing realism."

Nothing has been spared in order to make Gam-brell All-electric Receivers the most perfect and ideal musical instruments obtainable.

Every possible refinement is incorporated, with the result that each model is "outstanding" of its type.

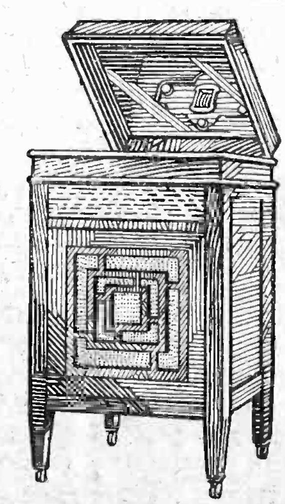
THE GAM-BRELL ALL-ELECTRIC THREE
D.C. £24 - 0 - 0 A.C. £26 - 15 - 0

THE GAM-BRELL BUCKINGHAM MODEL
D.C. £37 - 0 - 0 A.C. £45 - 0 - 0

THE GAM-BRELL RADIO NOVOGRAM
D.C. 62 Guineas. A.C. 70 Guineas.

Send for Descriptive Folder, "R.W."

Demonstrations Arranged without any obligation



THE GAM-BRELL BUCKINGHAM MODEL

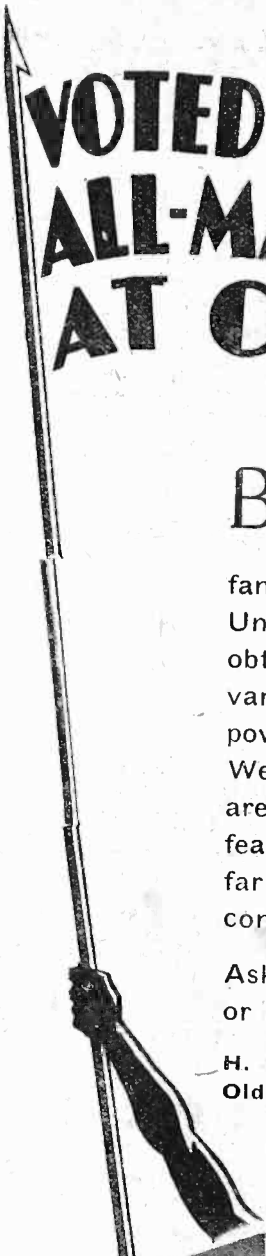
The new Gam-brell receiver was designed to meet the need for an All-electric receiving set incorporating its own highest class moving coil loudspeaker, yet occupying but little floor space.

Selectivity is of the highest order, tuning is simple as a calibrated card is supplied giving wavelengths. Changes of programmes are assured without using an aerial, but with one, numerous Continental and British stations are perfectly received. Can be moved from room to room, as cabinet is fitted with easy running castors.

GAMBRELL is the name to know—for All-electric RADIO

GAMBRELL RADIO LTD., 6, Buckingham Street, Strand, London, W.C.2.

VOTED THE FINEST ALL-MAINS UNITS AT OLYMPIA



BY winning the first place in the "Wireless World" Competition, the already famous "ATLAS" ALL-MAINS Units are voted the finest value obtainable at any price. Two variable Tappings, unrivalled power, small size, and the Westinghouse Metal Rectifier, are among the outstanding features that lift Model A.C.188 far above the level of all competitors.

Ask your dealer for Folder 55, or write direct to the makers.

H. CLARKE & CO. (M/CR) LTD.,
Old Trafford, Manchester.

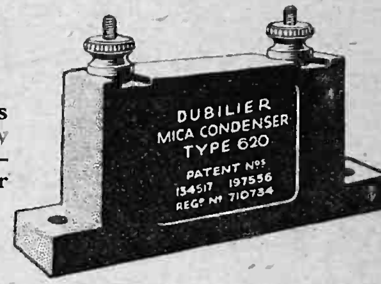
MODERNISE YOUR SET WITH

"CLARKE'S ATLAS"

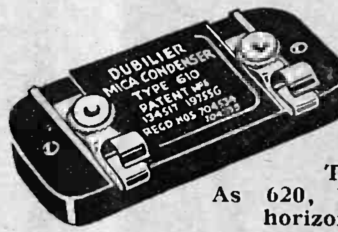
MODEL A.C.188

CASH PRICE
£6
OR 10/- DEPOSIT & BALANCE IN EASY MONTHLY PAYMENTS

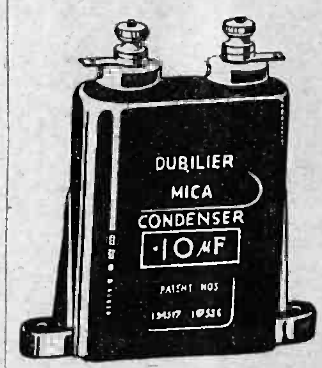
Dubiliers make a mica condenser for every job!



TYPE 620
For use in radio circuits where comparatively small capacity is required. Arranged for vertical mounting.
PRICES 1/8 to 3/-



TYPE 610
As 620, but arranged for horizontal mounting.
PRICES 1/8 to 3/-



TYPE B775
Primarily designed for resistance coupling, but suitable for use in other circuits where comparatively large capacity, capable of withstanding several hundreds of volts, is required.
PRICES 3/- to 18/-

Use Dubilier Condensers and be certain of satisfaction.

DUBILIER CONDENSERS

DUBILIER CONDENSER CO. (1925) Ltd.,
DUCON WORKS, VICTORIA ROAD, N. ACTON, W.3.

EVERYTHING *The* G.E.C. *your guarantee* ELECTRICAL

THIS MOVING COIL SPEAKER HAS SURPRISED THE MOST EXPERT CRITICS

NO MORE "BOOM"
NO MORE LOST NOTES
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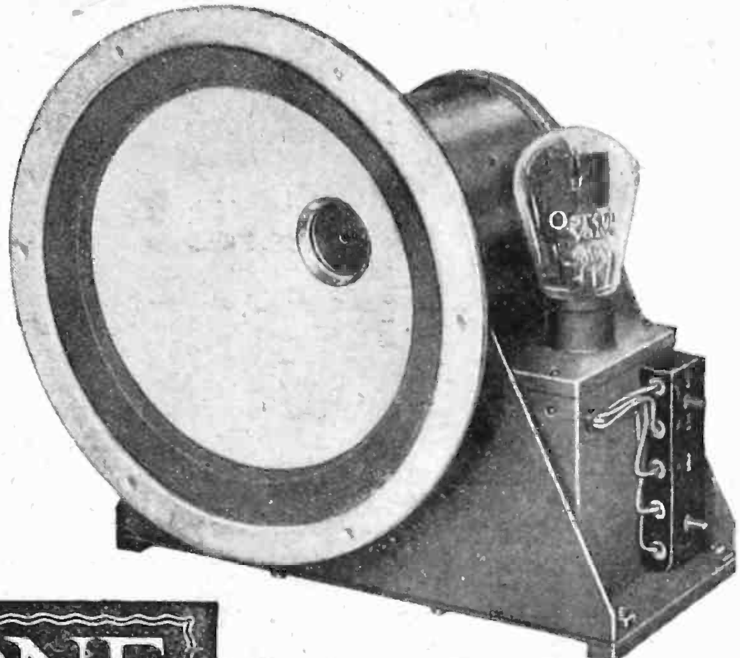

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The Wireless World

AND RADIO REVIEW
(18th Year of Publication)

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Editorial Comment

A Maximum Royalty.

WE have on several occasions remarked that the old royalty of 12s. 6d. a valve stage, which British manufacturers have paid on their receivers until the comparatively recent reduction, had the effect of influencing receiver design in the direction of limiting the number of valves. Manufacturers strained to get the utmost out of the minimum number of valves, and this very often resulted in seriously handicapping the designer of a set who, if he had had a free hand, would have produced a better set if an extra valve or so had been permissible.

American sets have not paid royalties in proportion to the number of valves, and this is probably one of the reasons why nearly all the better class American sets employ many more valves than our own and are credited with being on the whole more selective than any but the most modern of British sets.

Now that agreement has been reached on the subject of licensing under the patents owned by Marconi's, the Gramophone Company, and Standard Telephones, as announced in our issue last week, and the royalty is to be substantially less than formerly, the question arises as to whether it would not be to the benefit of all concerned if a maximum royalty were fixed so that any receiver employing valves in excess of, say, four stages, would not be called upon to pay a proportionately increasing royalty. Such an arrangement would, in our opinion, stimulate the production of sets of more valve stages, and the designer would have a free hand in the choice of circuit, irrespective of the number of valve stages.

It seems fairly certain that better sets would result from such a policy, whilst the cost of sets employing more valves might not be seriously enhanced, because, to some extent, elaborate screening and other points which are a costly item in manufacture would be minimised where the aim was no longer to get the last ounce out of every valve stage.

Gramophone Broadcasts.

WE believe that the recent experiment of the B.B.C. in transmitting an all-gramophone record concert met with wide approval. One is prompted to enquire why these transmissions, which must obviously be somewhat inferior to direct broadcasts, should be so well received. First, we think that the gramophone record concert had the advantage that every item was short—limited to the length of a record—so that listeners had plenty of variety, and, secondly, the items were by first-class performers representing a fund of talent which could not possibly have been gathered together in the flesh for one evening's performance. If there is any lesson to be learned from the experiment it would seem to be that the public appreciates brevity as a change in broadcast subject matter.

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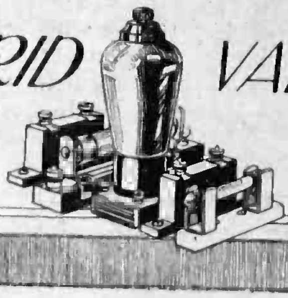


Obtaining Stage Gains of 200 and Over.

By D. McDONALD, B.Sc.,

Of the Engineering Laboratory, B.T.H. Co., Rugby.

THIS article describes what the author believes is a new method of connecting a screen-grid valve for audio-frequency amplification, enabling a stage gain of over 200 to be obtained. Before describing the method, it will be well to run over the elementary principles of resistance-capacity amplification.

The maximum amplification that can be realised with a triode is, for the case of resistance-capacity coupling, considerably less than the amplification factor of the valve, and for transformer coupling may actually reach the full magnification factor, and even pass it at the secondary resonance. If R_1 is the effective anode load resistance, R_a the A.C. resistance of the valve, μ the magnification factor, and m the effective stage amplification, then for resistance-capacity coupling we have $m = \mu \frac{R_1}{R_1 + R_a}$.

The term R_1 is called the effective anode resistance because it is composed of the actual anode resistance and the grid resistance of the following valve in parallel. Fig. 1(a) shows the valve V_1 resistance-coupled to V_2; R is the anode resistance, and R_G the grid resistance. The equivalent circuit for alternating signals is shown in Fig. 1(b). The resistances R and R_G are in parallel, since the H.T. positive and H.T. negative should be at the same A.C. potential, the battery providing no effective resistance.

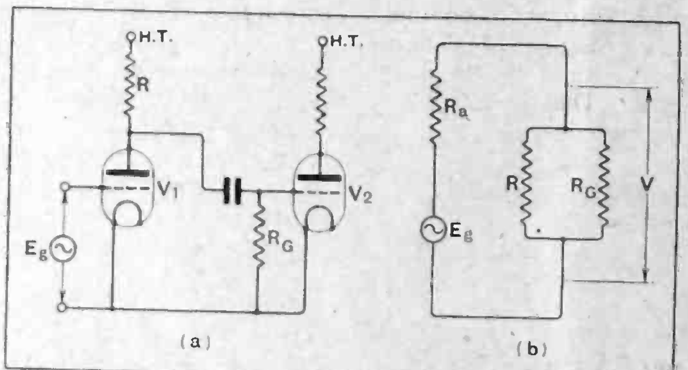


Fig. 1.—Circuit of a conventional resistance-capacity coupled L.F. stage (a). The equivalent circuit with the valve as a fictitious alternator is shown in (b).

The stage gain is: $m = \frac{V}{E_g} = \mu \frac{R_1}{R_1 + R_a}$, where $R_1 = \frac{R R_G}{R + R_G}$. This formula does not take into account the effect of the succeeding valve in shunting the resistance R_G with its own input impedance, which is never infinite. It always consists of a resistance term and a capacity term. The resistance may be positive or negative, depending on whether the valve anode load is capacitative or inductive. The chief trouble, however, arises with the capacity term. Obviously, if this capacity is large enough, it will effectively shunt R_G, at the higher frequencies, and hence lower the magnification. Roughly, this capacity is equal to the anode-grid capacity of the valve multiplied by the effective amplification of that valve. Even for small valves this capacity may be several hundred micro-microfarads, and this, in some cases, definitely limits the value of R_G to a rather low value.

For screen-grid valves, if we assume perfect screening of the anode in the valve, it can be considered as a constant current generator. That is, for a given signal on the control grid a definite fixed alternating current flows in the anode circuit. This is true only if the anode voltage is above the screen-grid voltage; this latter point is important. It can readily be seen that if the above conditions are fulfilled, any value of resistance can be placed in the anode circuit, and there will be developed across this resistance a voltage equal to the product of that resistance and the alternating current.

This can be represented by Fig. 2, if g is the mutual conductance of the screen-grid valve in milliamps per volt on the grid, and R R_G are as before; then a current of gE_g milliamps flows through the circuit and develops across R R_G a voltage V.

And $V = \frac{gE_g}{1,000} \times \frac{R R_G}{R + R_G}$ volts $= \frac{gE_g R_1}{1,000}$. Hence $m = \frac{V}{E_g} = \frac{g R_1}{1,000}$

Thus, we reach the conclusion that the magnification for resistance-capacity-coupled screen-grid valves is dependent only on the mutual conductance and the anode-load resistance, so long as we have perfect screening of the anode and so long as the anode voltage is greater than that of the screen grid. No screen-grid valve has a perfectly screened anode, and it will be shown later that the loss of magnification due to imperfect screening may be considerable.

IT is well known that there is a serious limitation in the stage gain possible with L.F. resistance coupling using three-electrode valves. This is due to the input impedance which results from an appreciable internal anode-grid capacity. In this article a method of detection and low-frequency amplification is given, using the screen-grid valve which has negligible input impedance. Stage gains of over 200 are shown to be possible, and an ingenious automatic compensating device to keep the screen voltage below that of the anode is described.

Screen-Grid Valve as Low-frequency Amplifier.—Now, if the anode voltage can be kept above that of the screen grid, very large magnifications can be obtained. For instance, if we have $R_1 = 500{,}000$ ohms, $g = 0.5$ mA./volt, $m = \frac{R_1 g}{1{,}000} = 250$. It can readily be seen that the slope is a maximum for high anode current, and diminishes as this is reduced. In other words, the curve of anode current against control grid voltage—keeping the screen-grid voltage constant—curves round at the foot, and tends to a straight line farther up. Of course, the valve for this purpose should be worked on the straight portion.

This will be made clear by referring to the curves for an A.C./S.G. valve shown in Fig. 5. These show the variation in anode current when the control grid volts are varied, keeping the anode voltage constant. The slope of these curves at any point gives the value of g, which is seen to decrease very much for very low values of anode current, no matter what may be the anode voltage or grid voltage.

Here we have a limitation, because to pass a reasonably high anode current through, say, 500,000 ohms would require an enormous anode voltage. The figure of merit for a valve for this work would be the value of g for a very low anode current. The chief difficulty encountered when running screen-grid valves resistance-capacity-coupled with high anode resistances is as follows:—If the valve bias is adjusted to give the correct anode current, which gives a suitable anode voltage, any other adjustment may easily throw the anode volts up or down to the screen-grid volts. Changing the valve would probably do this also. An example will make this point clear. If $R = 300{,}000$ ohms, and anode current $= 1$ mA., with H.T. volts $= 450$ and screen-grid volts $= 60$, then anode volts $= 450 - 300 = 150$. This would operate satisfactorily. Suppose now a new valve is substituted which with the same grid voltages gives 1.4 mA., then anode volts $= 450 - 420 = 30$. This valve would distort hopelessly under these conditions.

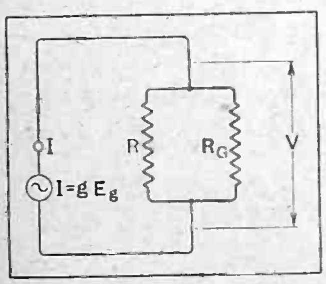


Fig. 2.—The screen-grid valve may be considered a constant current generator if the anode voltage is maintained above that on the screening grid. The amplification of a screen-grid resistance-coupled L.F. stage depends almost entirely upon mutual conductance and anode load resistance.

A Compensating Device.

Obviously, some kind of compensating device must be used to keep the anode voltage considerably higher than the screen-grid voltage. One method of doing this is shown in Fig. 3. This employs a large trailing resistance R_T, through which the anode current passes and creates a negative bias voltage several times too great for the valve. This voltage is reduced with respect to the grid by a battery as shown, which is of such a value that the grid voltage becomes normal. The condenser merely by-passes the alternating currents. It can be seen that, if the valve is changed, any change in anode current, however small, causes a relatively large change in bias voltage, which, to some extent, tends to bring the anode current to the normal value.

This method operates satisfactorily, and is used at present in one commercial, direct-coupled amplifier, with this difference, that the battery is replaced by a positive voltage obtained from a potentiometer. The objection to this method is that it is clumsy and rather expensive.

Automatic Screen-grid Compensation.

The author has devised a method of compensation which is cheap and simple and practically fool-proof.[1] This consists in deriving the screen-grid voltage direct through a high resistance from the anode, as shown in Fig. 4, fixing the voltage of the screen to earth by a condenser as shown. As this screen-grid resistance effectively shunts the anode resistance, it should be made at least twice as large. This connection, in effect, makes the screen-grid valve as simple to use as a triode, as we need now only supply one H.T. voltage, while amplifications of the order of 200 can be obtained.

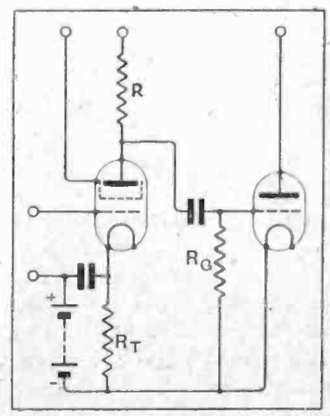


Fig. 3.—A trailing resistance R_T in association with a grid battery tends to keep the anode current constant, which in turn prevents the anode voltage from decreasing to a figure below that of the screening grid.

The action of the valve with this connection may seem rather complex at first. In fact, it would be rather difficult to calculate the running conditions, as even when the complete performance curves of the valve are known, including the screen-grid current values, it necessitates a trial and error method of arriving at the screen-grid voltage. However, the working is easy to visualise. First, we have the screen-grid and anode current passing through the anode resistance and causing a certain voltage drop therein. Then from the anode the screen-grid current causes a further drop in R_g. The latter drop constitutes the working voltage difference between the anode and the screen grid. When the signal comes on, the screen-grid voltage does not fluctuate, being practically at earth

[1] Pat. application No. 15334/30.

Screen-Grid Valve as Low-frequency Amplifier.—

potential for alternating currents, due to C offering little impedance compared with R_S. However, the anode voltage does fluctuate, and the voltage difference mentioned above should be greater than the peak value of the voltage swing.

It will be found that for large voltage outputs, say, of the order of 100 volts, R_S should be of the order of 0.5 to 1 megohm; indeed, it is inadvisable to go below these values, as this resistance effectively shunts the anode resistance for alternating signals. In any case, the value of R_S does not seem at all critical. This method also provides a convenient and cheap method of supplying screen-grid voltage, and if a value of R_S is chosen sufficiently high, say, 0.5 megohm, it seems that the connection would also hold for high-frequency amplification, although this has not been tried out.

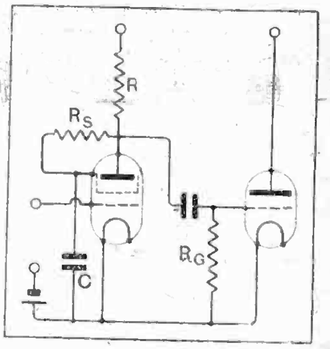


Fig. 4.—Automatic screening-grid compensation can be arranged by feeding the screen and anode through R_S and R respectively.

The value of the condenser C should bear the same relation to R_S as the coupling condenser to the value of R_G. That is, its impedance at, say, 50 cycles per second, should be reasonably small compared with R_S.

It may be thought at first that, in the case of a valve taking negative screen-grid current, the screen volts would rise above the anode volts. This, however, will not occur, as negative screen-grid current arises from secondary emission from the screen grid, and no emission will occur unless the anode voltage is above that of the screen grid. In connection with this it might be advantageous to shunt the condenser C with a resistance. This would ensure a greater voltage difference between the screen grid and the anode.

The amplification which could be obtained from screen-grid valves by the above method was measured at various anode voltages, and with various values of R, R_S, and R_G, the frequency being 500 cycles per second. These are shown in Tables I and II. Table I is for a Mazda A.C./S.G. valve. It will be noticed that, by changing the anode voltage from 450 to 570, the value of the stage gain is nearly doubled. This is probably due to the value of *g* increasing. The value of *g* at the low anode currents used is very much smaller than the rated *g*.

TABLE I. E_B = Battery volts.

E_B.	E_G.	R.	R_S.	R_G.	*m*.
450	−1.5	0.5×10^6	3×10^6	3×10^6	127
570	−1.5	0.5×10^6	3×10^6	3×10^6	210
570	−1.5	0.5×10^6	1×10^6	1×10^6	187
570	−1.5	1×10^6	1×10^6	1×10^6	156
570	−1.5	0.25×10^6	1×10^6	1×10^6	163
500	−1.5	0.2×10^6	0.5×10^6	0.5×10^6	84
450	−1.5	0.2×10^6	0.5×10^6	0.5×10^6	77
400	−1.5	0.2×10^6	0.5×10^6	0.5×10^6	70
350	−1.5	0.2×10^6	0.5×10^6	0.5×10^6	64
300	−1.5	0.2×10^6	0.5×10^6	0.5×10^6	57

Table II shows the results for a Mazda 215 S.G. valve, and Table III the effect of frequency on the amplification, the slight fall off at the higher frequencies being due to the input capacity of the thermionic meter used to measure the volts across R_G. This latter effect, and the grid current, and leakage current in certain valves, limit the value of R_G to less than 1 megohm for power valves. Also, 0.5 megohm should be considered the maximum for R. Even with these limitations, this method can be put to good use, and if the anode voltage is kept sufficiently above the screen grid, by suitable values of R and R_S, a voltage swing of 100 can be obtained across R_G.

The value of the magnification obtained for the 215 S.G. valve was calculated from the measured slope at the operating conditions. This was about 20 per cent. higher than the actual value. The reason for this was put down to the assumption that the valve anode current was unaffected by anode voltage, when the latter was above the screen-grid voltage, i.e., that the valve was perfectly screened. Actually, in every screen-grid valve the curves show a slight variation in anode current with anode volts. Of course, the effect of this would be to decrease the amplification.

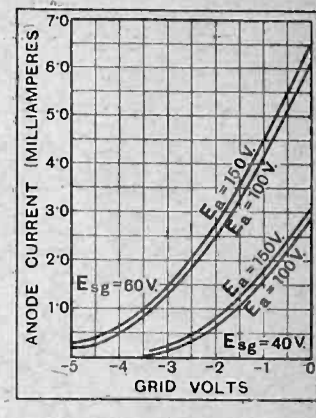


Fig. 5.—Grid volts/anode current curves of an AC/SG valve.

TABLE II.

E_B.	E_G.	R.	R_S.	R_G.	*m*.
450	−1.5	0.5×10^6	1×10^6	1×10^6	93
360	−1.5	0.5×10^6	1×10^6	1×10^6	78
270	−1.5	0.5×10^6	1×10^6	1×10^6	63
180	−1.5	0.5×10^6	1×10^6	1×10^6	45

TABLE III.

Cycles.	E_B.	R.	R_S.	R_G.	*m*.
50	450	0.5×10^6	1×10^6	1×10^6	90
250	450	0.5×10^6	1×10^6	1×10^6	93
500	450	0.5×10^6	1×10^6	1×10^6	93
1,000	450	0.5×10^6	1×10^6	1×10^6	93
3,000	450	0.5×10^6	1×10^6	1×10^6	92
6,000	450	0.5×10^6	1×10^6	1×10^6	84
8,000	450	0.5×10^6	1×10^6	1×10^6	77

The screen-grid valve used in this manner makes an excellent detector, and no trouble was experienced in loading up a Mazda P.P.3/425 power valve with a grid swing of approximately 100 volts straight from the detector, resistance-capacity-coupled. No reaction was used, as the station was local. Another advantage of using the screen-grid valve in this position is that it imposes very little load on the tuned grid current when used as an anode bend detector, hence tuning can be made much more efficient and sharper.

THE 1931 "SUPER" CELL

A Photo-Electric Model de Luxe.

By D'ORSAY BELL, M.A.

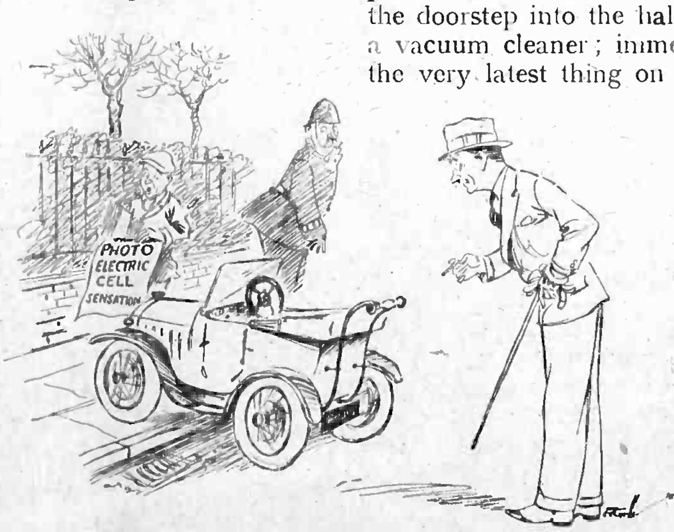
Note.—When this article was submitted to us, we wrote to our contributor to enquire whether it was intended as a serious scientific contribution or as an elaborate jest. The reply is given below.—Ed.

To the Editor of "The Wireless World."

Dear Sir.—I was glad to receive your enquiry, as it gives me an opportunity to state definitely the lines on which this article—like all my numerous other articles—was written. So far as statements as to Wireless and allied subjects are concerned, these are all based on serious scientific announcements. In suggesting future developments I may allow myself to give rein to my imagination—as I may do also in incidental remarks which are in no way connected with Wireless; but apart from these easily identified points I am always ready to give chapter and verse for anything I say in my articles. I hope you will publish this letter, because 99 per cent. of the value of these articles would disappear if their readers imagined they were mere fiction.

Yours faithfully, D'ORSAY BELL.

IN a previous article[1] I said that the photoelectric cell was beginning to be used for about as many purposes as the Austin Seven. Since writing those words I have been more and more impressed with the excellence of this comparison. The very next day, a few hours after meeting a Baby Austin tootling along with two large milk churns sitting pompously side by side, I was told that a new use had been found for the photoelectric cell—it is being carried round from house to house by officials of electricity companies to test the accuracy of their meters by an ingenious stroboscopic method. A few days later, after dodging, on my way, two Austin Sevens masquerading as (a) a motor fire-escape (or perhaps it was only a window-cleaner's gadget) and (b) as a chimney-sweep, complete with paraphernalia, I saw a journal which described how photoelectric cells are now being used to weigh paper in the process of manufacture (the weight is proportional to the opaqueness, and to measure this is, of course, child's play to the photoelectric cell), and how they are also being used to watch over the level of liquids, especially in high-pressure plants.



"—I noticed a Baby Austin with a perambulator handle at the back for lifting it up over the doorstep—"

During the next week I noticed a Baby Austin with a perambulator handle at the back for lifting it up over the doorstep into the hall—where, I imagine, it acts as a vacuum cleaner; immediately after that, I read that the very latest thing on the German State Railways is an automatic train control system in which a pulsating beam of light is sent out vertically from the cab of the engine and reflected back on to a photo-sensitive cell in the cab by mirrors erected overhead at suitable points on the track; these mirrors may be manipulated like ordinary signals, and in addition the cab installation may have a speedometer device incorporated so that the train is automatically pulled up if it passes a mirror at an excessive speed.

The New Model.

These are just a few examples, chosen at random, of the multifarious new uses for photoelectric cells. Many other uses were mentioned in my previous article—and of course the best known use of all is in connection with commercial facsimile telegraphy, television, and above

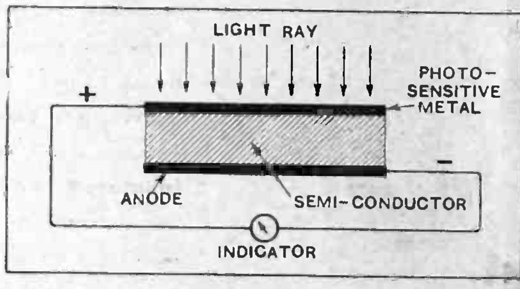
[1] *The Wireless World*, 29th January, 1930.

The 1931 "Super" Cell.—

all, the talkies. And now comes quite a sensational announcement—the discovery of an entirely new design of photoelectric cell, claiming enormous advantages over the usual kind.

In terms of the Austin Seven, it is as though the 1931 model had the following specification features: Speed on top gear, 1 to 300 m.p.h.; petrol consumption, 250 m.p.g.; can be folded up and packed behind the umbrella stand. That this is hardly at all an exaggerated way of regarding the claims of the new cell is indicated by the following fact—the inventor (a serious scientific worker writing in a highbrow scientific journal[2]) distinctly implies his belief that with a little improvement his invention will be useful for the direct conversion of the sun's energy into electrical energy. In fact, the baby car specification suggested above—which you thought rather far-fetched—may very shortly be regarded as old-fashioned; the modern specification may contain such phrases as "daylight performance 100 m.p.h., moonlight performance 70 m.p.h., emergency (glow-worm) performance 25 m.p.h."

The idea at the bottom of this new invention is quite a simple one. In all photoelectric cells the action depends on the fact that a ray of light, falling on a metallic surface (usually potassium), supplies certain electrons inside the metal with enough additional energy to enable them to emerge from the surface and buzz off to the anode across the intervening space—generally a vacuum or a rarefied gas. Now these electrons, when they emerge, are not so full of energy as they might be, because they have had a struggle to get past the surface of the metal; and the severity of the struggle depends on what is called the "contact potential" between the surface and what is touching it (the vacuum or the rarefied gas, in the ordinary cell). It has been realised for some time that the contact potential between a metal and a semi-conductor, such as copper oxide, silver iodide, etc., is far less than the contact potential between a metal and a gas or a vacuum; but hitherto no practical use has been made of this fact. Now Herr B. Lange has made very practical use of it.



Diagrammatic representation of Herr B. Lange's photo-electric cell, for which enormous advantages are claimed.

Shorter Journeys for Electrons.

Full details have not yet been published, but the general idea is as follows. Instead of having his photo-sensitive surface exposed to a vacuum or to a rarefied gas, Lange squeezes up against it a layer of semi-conductor; on the other side of this layer he presses his anode—as shown in the diagrammatic representation on this page.

The first result of this arrangement is that, instead of having a metal-to-vacuum or metal-to-gas surface for the electron to penetrate, he has a metal-to-semi-conductor surface with its low contact potential; the second result is that, instead of leaving quite a large distance for the electrons to traverse before reaching the anode, he can reduce the distance to microscopic dimensions by making his semi-conductor layer very thin indeed—in fact, he makes it so thin that it is only a molecule or two thick.

Efficiency Already Increased Ten Times.

The first fact ensures that for a given amount of light energy the photoelectrons emerge with far greater energy than in the older type of cell; or, alternatively, that they emerge with the same energy as in the older type, in response to an amount of light energy far too small to have any effect on the older type. Incidentally, this means that the new cell is sensitive to rays in the infra-red part of the spectrum; it will respond to waves ten times longer than the ordinary average cell will respond to.

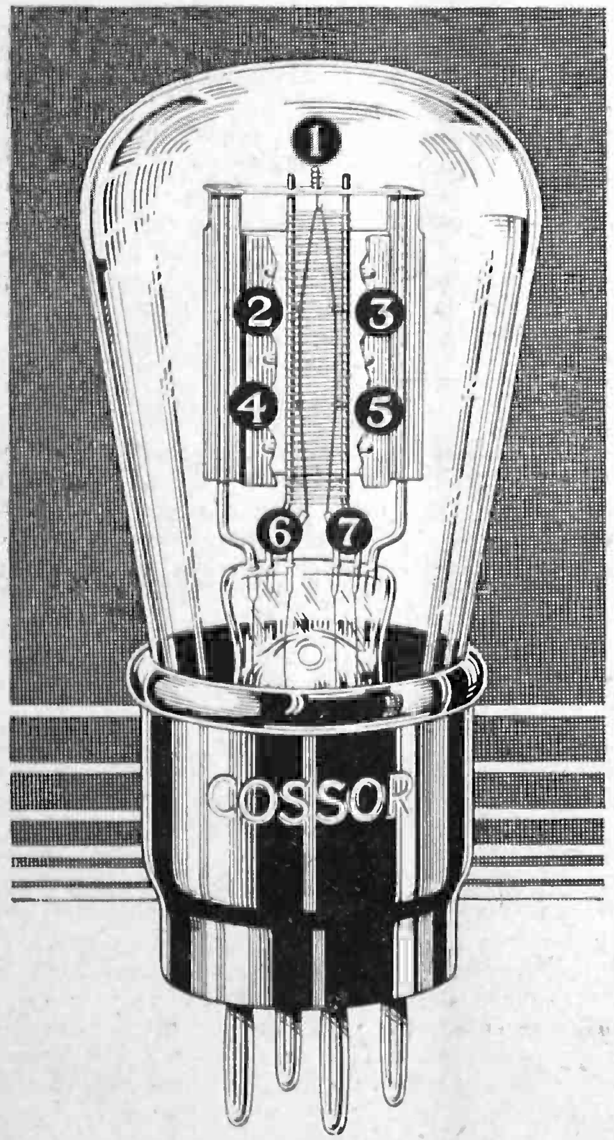
The second fact ensures that the cell has practically no inertia or "lag," and will therefore reproduce very high frequencies perfectly—an important point for sound-films. Also, that its internal resistance is very small; a consequence of this is that no permanent "polarising" voltage is needed with this cell as it is with the ordinary type—the electrons have such a short distance to travel to reach the anode that they need no guiding voltage to steer them.

A point of importance is that whereas, in the ordinary photo-electric cell with vacuum or rarefied gas, the ray of light passes through the vacuum or gas, falls on the sensitive surface, and ejects the electrons from that same surface, in the new cell the light has to fall on the *outside* of the sensitive metal plate, and yet the electrons have to emerge from the *inside* surface next to the semi-conductor and the anode plate. This seems to imply that the photo-sensitive metal plate must be very thin. Nothing, however, is said about this, but the inventor states definitely that he has already obtained efficiencies ten times greater than those given by the older type of cell, so that this point does not seem to present any difficulty. By suitable choice of the semi-conductor, it is apparently possible to produce a kind of resonance effect between the atoms of the latter and the electrons, with the result that sensitivity can be very greatly increased for a particular part of the spectrum. No doubt this property of the new cell would be made use of in any attempt to convert the energy in sunlight into electrical energy. Herr Lange's paper is stated to be only a "preliminary communication"; further news from him will be awaited with considerable interest.

[2] The *Physikalische Zeitschrift* of 1st February, 1930.

"THE WIRELESS WORLD" BUYERS' GUIDE TO SETS. Next week's issue will contain this popular annual feature. Readers desiring to select or make reference to specifications of any commercial set will find the Guide invaluable.

Seven point suspension *definitely prevents* microphonic noises



Cossor 210 DET., 2 volts, .1 amp. Impedance 13,000. Amplification Factor 15. Mutual Conductance 1.15 m.a./v. Normal working Anode Voltage 90-150. *Price* **8/6**

—by eliminating filament vibration

Microphonic noises in a Receiving Set are usually traceable to the Detector Valve. Nine times out of ten the cause is filament vibration. Look at the illustration alongside. This shows the internal construction of the new Cossor Detector Valve. See how the filament is held—not only top and bottom—but also by four insulated hooks spaced at intervals throughout its length. The purpose of these hooks is to damp out any tendency for filament vibration. Therefore by using this "steep slope" Cossor Detector Valve in your Receiver the possibility of microphonic noises is definitely eliminated and you are assured of greater volume with absolute tonal purity.

We have just issued a novel, circular Station Chart which gives identification details of nearly 50 stations and space is provided for entering your own dial readings. Price 2d. each they are obtainable from any Wireless Shop. In case of difficulty write us, enclose 2d. stamp and head your letter "Station Chart W.W."

THE NEW COSSOR DETECTOR VALVE

DEFINITELY FREE FROM MICROPHONIC NOISES

6567

"FOR BETTER VALVES"

"... improvements to existing sets by the listener has wisely got down or been forced back to essentials—better valves."

"*The Music Seller*," *October*, 1930.

That is true, and it applies to every set, battery-operated or all-electric. As there are no better valves than Six-Sixty write NOW for our new FREE booklet. It gives the whole Six-Sixty range, is interesting, informative and tells you also how you may make your battery-operated set All-Mains *without internal wiring alterations.*

SAY SIX-SIXTY

(B.V.A. RADIO VALVES AND EQUIPMENT).

Six-Sixty Radio Co., Ltd., Six-Sixty House,
17-18, Rathbone Place, Oxford Street, W.1. *Tel.: Museum* 6116-7

Quality Radio Components

IGRANIC CHOKE

Designed for those who truly appreciate fine quality in radio reception.

IGRANIC L.F. CHOKES.

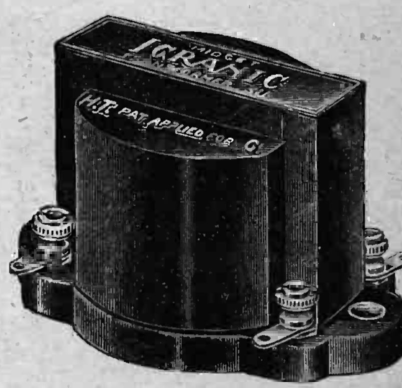
Type C15.	20 Henries 15 milliamps.	PRICE **10/6**
Type C30.	20 Henries 20 milliamps.	PRICE **15/6**
Type C60.	20 Henries 60 milliamps.	PRICE **21/-**
Type C150.	20 Henries 150 milliamps.	PRICE **45/-**

IGRANIC FIXED CONDENSERS.

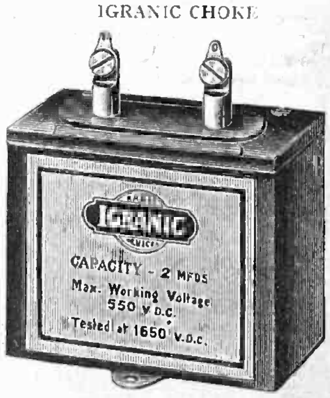
2 Mfd. 250 volts	PRICE **3/-**
2 Mfd. 550 volts	PRICE **4/2**

IGRANIC MIDGET TRANSFORMER.
PRICE **10/6**

IGRANIC DIFFERENTIAL CONDENSER.
·00015 Mfd. each side .. .. .. PRICE **3/9**



IGRANIC MIDGET TRANSFORMER



IGRANIC FIXED CONDENSER

147, Queen Victoria Street, LONDON.

IGRANIC ELECTRIC COMPANY LIMITED

Write for copy of our new catalogue to Dept. U.318.

IGRANIC DIFFERENTIAL CONDENSER

CURRENT TOPICS

Events of the Week in Brief Review.

DID YOU HEAR THE BUZZ ?

Radio-Strasbourg P.T.T., which gave its inaugural transmission yesterday (November 11th), sends out an identification signal consisting of a deep buzz sounded for five seconds with five-second intervals. The power is 12 kilowatts, and the wavelength 345.2 metres.

oooo

BRITISH RAILWAYS, PLEASE NOTE.

The legend, "Radio," now appears on certain of the coaches on the Warsaw-Lodz railway, indicating that travellers should choose these if they wish to enjoy broadcast reception. The charge is ninepence per pair of headphones.

The man who saw "Radio" on a British railway coach is receiving optical treatment.

oooo

WAVE-SHARING IN AMERICA.

Mexico's highest powered broadcasting station has begun operations on a wavelength of 385 metres. The station is situated in Mexico City, writes our Washington correspondent, and employs the call-sign XEW. Actually the wavelength is shared by CKY, Winnipeg, and by a number of low-power American stations, but no interference has been reported.

oooo

WHERE TO FIND THE "RADIOS."

New York leads other American States in the number of wireless sets within its borders, the estimated total being 1,752,000. Next comes California with approximately 1,470,000. These figures have been evolved by the Department of Commerce after a rough survey of the 1930 Census forms, in which, for the first time in U.S. history, citizens were required to answer the question: Have you a radio?

The grand total of receivers in the United States is estimated at 13,478,600.

oooo

RECORDS, OLD AND NEW.

Pre-war gramophone records in which all frequencies under about 400 cycles, and all above 1,200, were lacking, provided a striking contrast when compared with modern electrically recorded specimens during the lecture-demonstration given by Mr. J. H. A. Whitehouse (of the Gramophone Co., Ltd.) at Portland Hall, Regent Street Polytechnic, on Wednesday last, November 5th. Mr. Whitehouse's lecture, which dealt entertainingly with the progress of sound reproduction, was one of a series on "Science in Everyday Life" which are being delivered in the coming weeks on behalf of King Edward's Hospital Fund for London. The complete programme can be obtained at the Polytechnic or on application to the Secretary, at 7, Walbrook, E.C.4.

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GERMAN LICENCE FIGURES

On October 1st German licensed listeners numbered 3,241,725, as compared with 2,843,569 at the corresponding period last year.

oooo

A RADIO BANQUET.

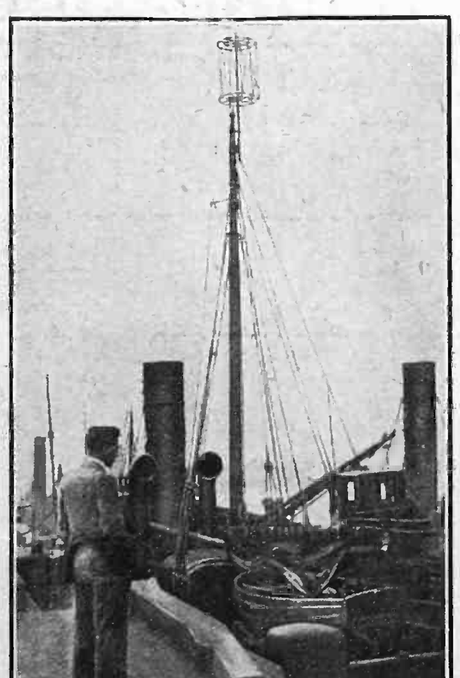
One of the strangest banquets ever held took place on Saturday, November 8th, when 11,000 employees of the H. J. Heinz Company, distributed all over the world, sat down at exactly the same moment to exactly the same menu to listen to exactly the same speeches.

President Hoover was one of the speakers, and others included Mr. Howard Heinz, president of the company, and Sir Henry Worth Thornton, head of Canadian National Railways.

In America the main banquet was held at Pittsburgh, while other banquets were held in London, Manchester, Liverpool, Bristol, Leeds, Hull, Birmingham, Edinburgh, and Glasgow, the London banquet being held at the Heinz headquarters at Harlesden. Other feasts took place simultaneously in cities in Canada, Australia, France, Germany, Spain, and Belgium.

All the gatherings were linked up by wireless, the speeches being broadcast from the Pittsburgh short-wave station, on 48 and 25.4 metres.

In London and the other European centres the land lines were connected to a Marconiphone installation. In London alone some six or seven hundred people were present.



CAGE AERIALS AT SEA. Owners of small single-masted ships are showing a preference for aerials occupying a minimum amount of space. This recent photograph of the trawler "Ardrossan" shows the Ashton cage aerial in use.

oooo

THE POWERS THAT BE.

According to a German statistician, the total energy radiated by the broadcasting stations of the Fatherland amounts to 535 kilowatts. Other countries listed are: Britain, 470 kW.; Russia, 222 kW.; Sweden, 120 kW.; Czecho-Slovakia, 107 kW.; and France, 64 kW.

oooo

OPTIMIST.

Having advocated stringent regulations for the suppression of all electrical apparatus causing interference with radio reception, a Paris wireless journal has received a letter from a reader which runs as follows :—

"Should your campaign prove successful, we shall no doubt soon read in the Press that M. ——, possessor of a crystal set, has obtained a legal injunction shutting down a 30,000-kilowatt generating station!"

oooo

ANOTHER 50 KW. STATION FOR U.S.

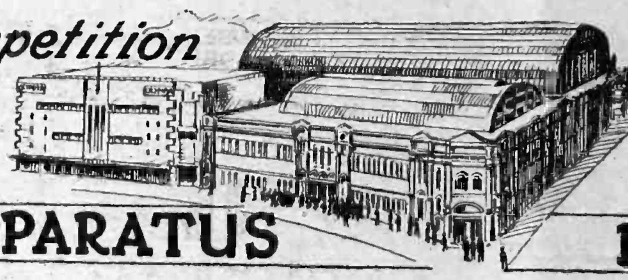
The Columbia Broadcasting System will shortly rebuild station WABC, Wayne Township, Passaic County, N.J., installing a 50 kw. transmitter. Authority for the power increase has been granted by the Board of Public Utility Commissioners of New Jersey, which has assumed jurisdiction over inter-State radio.

oooo

CATHOLIC RADIO CONGRESS.

Despite the presence of two cardinals and several bishops, the "Wireless Catholic Congress" which was held in Paris on November 4th, 5th, and 6th was not purely religious in scope, writes our Paris correspondent. Radio apparatus and gramophones were on view, and the discussions dealt with the programme side of the organisation of listeners. Members of the Congress visited "Radio Paris" and other stations.

Our Show Competition



WINNING APPARATUS DESCRIBED

IN the following pages we illustrate and describe the apparatus which, in the voting competition arranged by "The Wireless World" in connection with the Olympia Radio Show, gained first place in the total of votes cast by our readers in each of the various classes into which we divided the Olympia Show exhibits as a whole. It will be recollected that readers were asked to vote, first for what they considered to be the outstanding single exhibit at the Show, and, in addition, to make their choice of apparatus in each of seven classes into which the exhibits at Olympia as a whole were divided. The classes were:—(1) Receivers of all types, either mains or battery operated. (2) Radio Gramophones. (3) Batteries of all kinds, including accumulators for both high tension and low tension. (4) Mains supply units, both D.C. and A.C. (5) Loud speakers of all types. (6) Valves. (7) Other apparatus not classified above, also amplifiers, component parts such as transformers, condensers, tuning coils, resistances, etc., etc.

As already announced, the Pye "Twintriple" A.C. receiver was voted the outstanding single exhibit, and the following apparatus gained first positions in the various classes:—(1) Pye "Twintriple" A.C. receiver. (2) R.G.D. Radio Gramophone de Luxe. (3) Exide "Gel-Cel." (4) Clarke's "Atlas" combined eliminator and trickle charger, model A.C.188. (5) Ferranti Magno-Dynamic Speaker. (6) Mazda A/C Pen. (7) Jackson Bros. "Chassimount" condenser. An announcement has already been made of the names of the readers of "The Wireless World" who have won the prizes in the ballot for their forecasts of the popular vote.

Pye Twintriple A.C. Receiver

AS so much attention has been devoted to the self-contained or portable type of receiver in this country, it is surprising that the average set of this class should embody so few features of real technical interest. Most of the designs are empirical, and although results are generally good enough, it is hardly an exaggeration to say that such sensitivity as they possess is largely due to incidental or intentional reaction effects. Those responsible for these sets seem to have been satisfied to copy an arrangement known to work tolerably well, and then to assert their individuality by devising fancy fretwork to cover the loud speaker diaphragm.

This state of affairs was bound to change, and for some time there have been indications that manufacturers are taking the "portable" more seriously. At any rate, the new Pye sets are illustrative of an important technical advance, and the self-contained A.C. "transportable," which forms the subject of this descriptive article, is interesting in every way—with regard to its circuit arrangement, its constructional details and its performance.

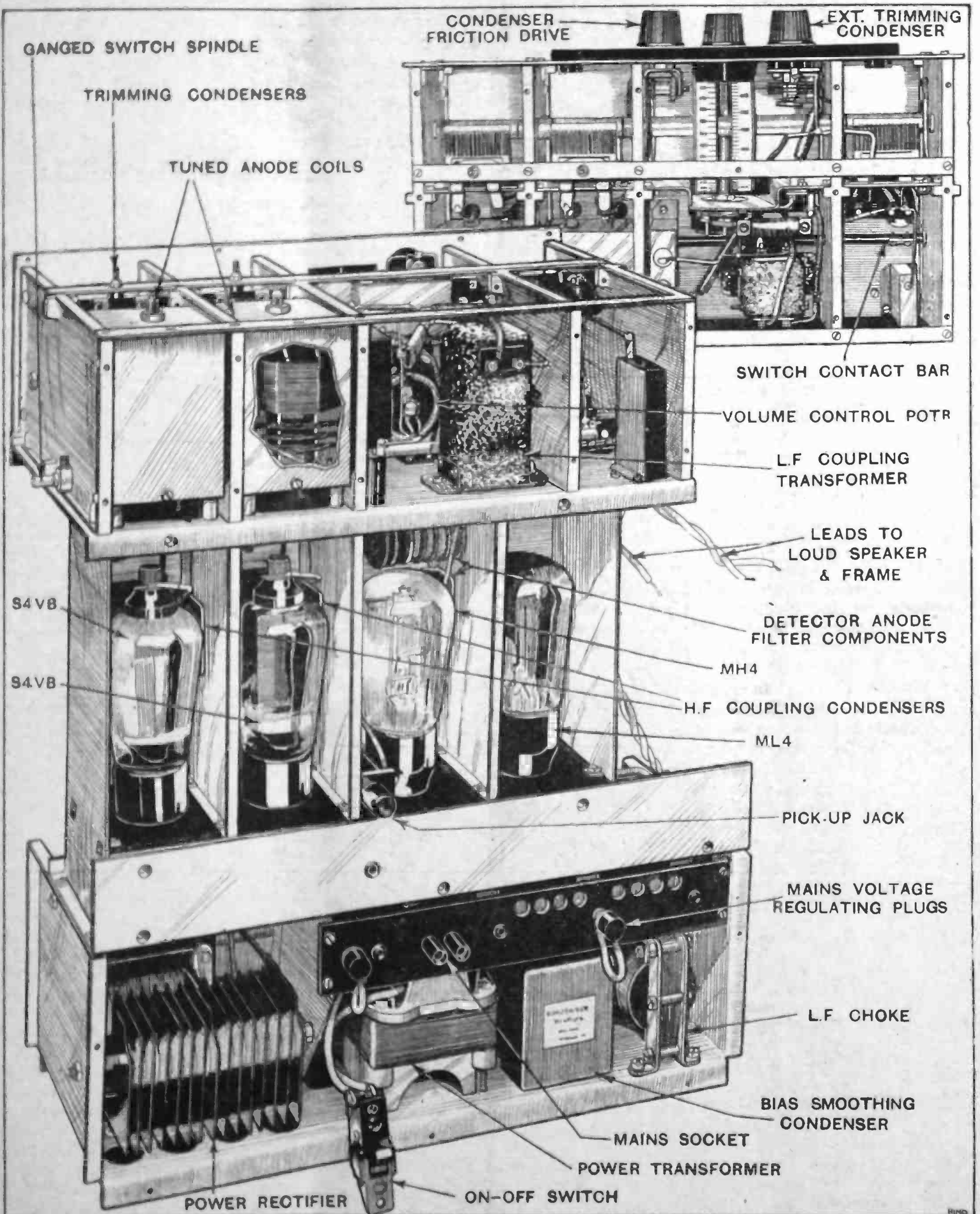
As shown in the accompanying circuit diagram, four indirectly heated A.C. valves are used. The H.F. amplifiers are linked by simple tuned-anode couplings and are followed by a power grid detector, with a filter to separate H.F. and L.F. components in its anode circuit. This valve is coupled to the L.F. stage through a directly connected transformer having a high permeability core. A choke filter output for the loud speaker is included.

The Pye receiver.

All three tuning condensers are controlled by a single knob, and are fitted with trimmers; that for the frame aerial circuit is operated by an external knob, but the remaining two are fixed at the works and do not need any subsequent adjustment.

Volume regulation is effected by variation of the grid bias voltage applied to the first H.F. valve, and the operation of this control may also be regarded as a form of reaction adjustment.

Power supply is through a Westinghouse metal rectifier connected in a voltage-doubling circuit, the smoothed output being applied across a potentiometer, from which suitable operating voltages for both grid and plate circuits are taken. Decoupling resistances and by-pass condensers are connected at every point where harmful interaction is likely to arise. A special tapped choke is used for smoothing, and is so arranged that A.C. potentials developed across it are balanced out.



The receiver chassis, with top and back cover plates removed. Above: plan view of the tuner unit.

Pye "Twintriple" A.C. Receiver.—In order not to distract attention from essentials, a few details have been omitted from the circuit diagram. Wave-range switching is effected by joining each set of long- and short-wave inductances (including those of the frame) in series, and connecting short-circuiting switches —which are, of course, linked mechanically—across each of the long-wave sections. To prevent disturbances of the ganged tuning system when changing over, special balancing condensers are connected between the tuned-anode coil junctions and earth. Other features not shown include a gramophone pick-up jack in the detector grid circuit and a combined plug socket and switch to allow of the use of an external loud speaker, either in conjunction with, or instead of, that already included in the set.

The aluminium chassis is built up as three units: receiver proper, shielded valve compartments, and power supply unit. This metal chassis, of which the general construction is shown in the accompanying illustration, is beautifully made; die-cast metal plates are used to divide up each of the "H.F." compartments and, in addition, there are sealed rectangular metal boxes for each of the tuned-anode coil assemblies.

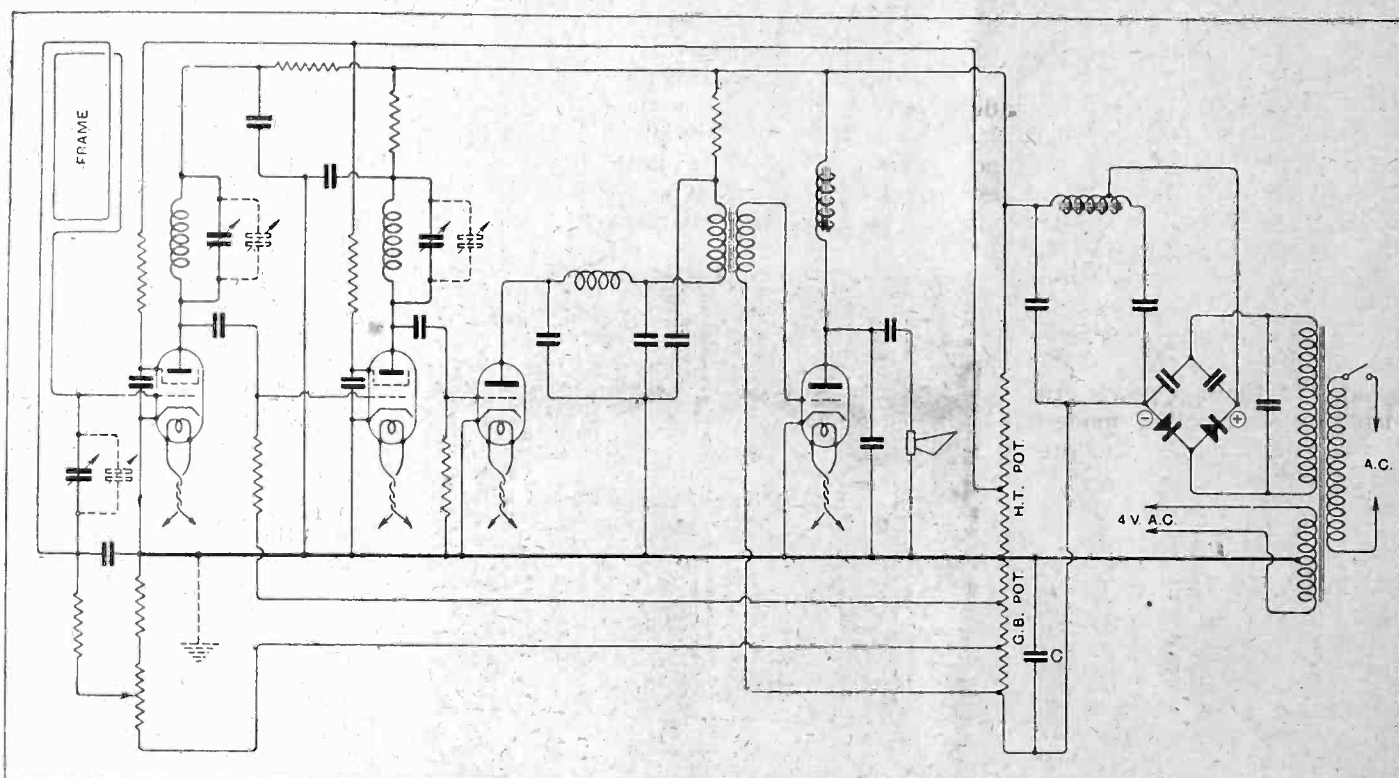
The sensitivity of the receiver is altogether exceptional, and, in spite of the fact that the pick-up of comparatively small frames is relied upon (there is no external aerial connection), real long-range reception is definitely assured even under comparatively poor conditions. Continental stations can not only be heard, but their programmes can be appreciated. Background noise is well below the average level for such a sensitive set, and there is a complete absence of A.C. hum, due probably to the special smoothing circuit.

Quality of reproduction must not be judged by the usual "portable" standard, as, in an A.C. receiver, ample power is available. In this respect, the set makes an extremely good showing, and the special "Celestion" loud speaker seems to suit its characteristics admirably. There is a slight resonance round about 400 cycles, but uniformity of response over the upper middle register is particularly well maintained.

Selectivity is considerably above the average standard, even for a "2-H.F." set, and, at seven miles distance from the twin London stations the two transmissions may not only be separated easily, but other stations on intermediate wavelengths may be received without interference.

The complete set weighs about 35 lb., and is compact enough to be moved from room to room; it is fitted with convenient hand grips for this purpose. Operation could hardly be simpler, as the trimming condenser does not need continuous adjustment, and the main tuning dial is directly calibrated in wavelengths.

Internal construction is unexceptionable, and there is no evidence whatsoever of skimped work; the set seems to have been built without regard to cost, and could not be considered dear if it were priced at considerably more than 28 guineas. The makers are Pye Radio, Ltd., Radio Works, Cambridge.



Circuit diagram, simplified by omission of certain features discussed in the text. An electrolytic condenser (C) is used for smoothing the bias voltage supply.

R.G.D. Radiogramophone De Luxe

THE popularity of the radio gramophone is due primarily to the wide range and variety of entertainment provided by a single compact unit of furniture. Nearly all designers have taken advantage of the facilities offered by the self-contained cabinet form of construction to fit moving-coil loud speakers and suitably matched power amplifiers. In most cases, therefore, quality and volume of reproduction leave little to be desired. Generally speaking, however, the radio side has been allowed to take a position of subsidiary importance to the gramophone side, and in most cases only local station radio reception is catered for.

In the R.G.D. Type S6 radio gramophone the entertainment value of foreign-station reception has not been overlooked, and in this respect the radio section is not inferior to the best receivers designed exclusively for long-range reception. Further, range has not been achieved by sacrificing quality, for the circuit includes band-pass tuning, power-grid detection, and other modern developments designed to preserve quality in the H.F. stages.

The Circuit.

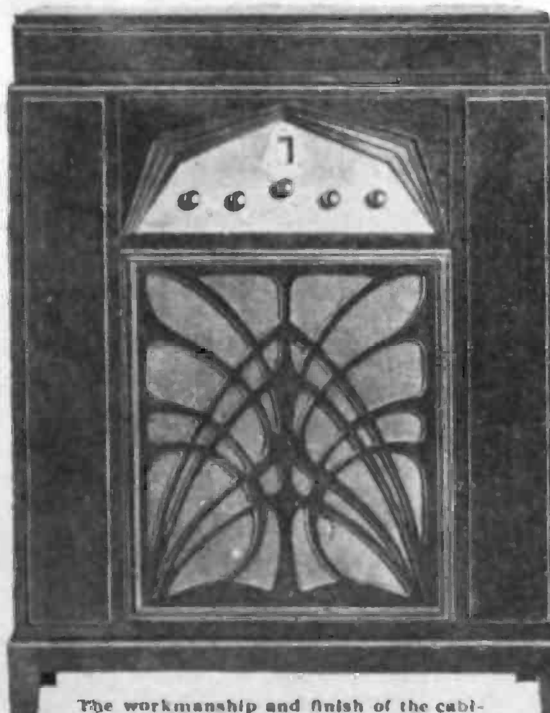
Briefly, the circuit is constituted as follows:—Two H.F. stages employing AC/SG valves, and coupled by parallel-fed tuned grid circuits, are preceded by a capacity-coupled band-pass filter which may be excited either by an external aerial or by the energy picked up on the perforated metal screen forming part of the ventilated back panel of the cabinet.

The screen-grid potential for both H.F. valves is supplied from a common variable potentiometer, both grids being provided with decoupling resistances and by-pass condensers. The potential variation available not only serves as a pre-detector volume control, but is also sufficient to permit oscillation in the H.F. stages, and the control is therefore marked "Reaction" on the front panel.

The detector is resistance-coupled to the first L.F. stage, and the anode voltage and circuit constants are so adjusted that the AC/HL valve functions as a "power-grid" rectifier with zero grid bias.

Volume Control.

Following the detector is a simple but effective volume control which controls both radio and gramophone. This takes the form of a centre-tapped potentiometer, with the centre point earthed. Volume increases as the slider is moved outwards in either direction from the zero position, and a quiet fade-out from radio to gramophone, or *vice versa*, is, therefore, possible. The pick-up is a new type R.G.D. with a good overall characteristic and low damping and record wear.



The workmanship and finish of the cabinet work in the R.G.D. radio gramophone de luxe are of a high standard and every precaution has been taken to avoid box resonances.

An AC/HL is used in the first L.F. stage, and is coupled to the output stage through a Ferranti AF5 transformer.

Two AC/P, valves in parallel supply the "Rola" moving-coil loud speaker through a 12:1 ratio transformer. Series resistances are included in the grid circuit of each valve.

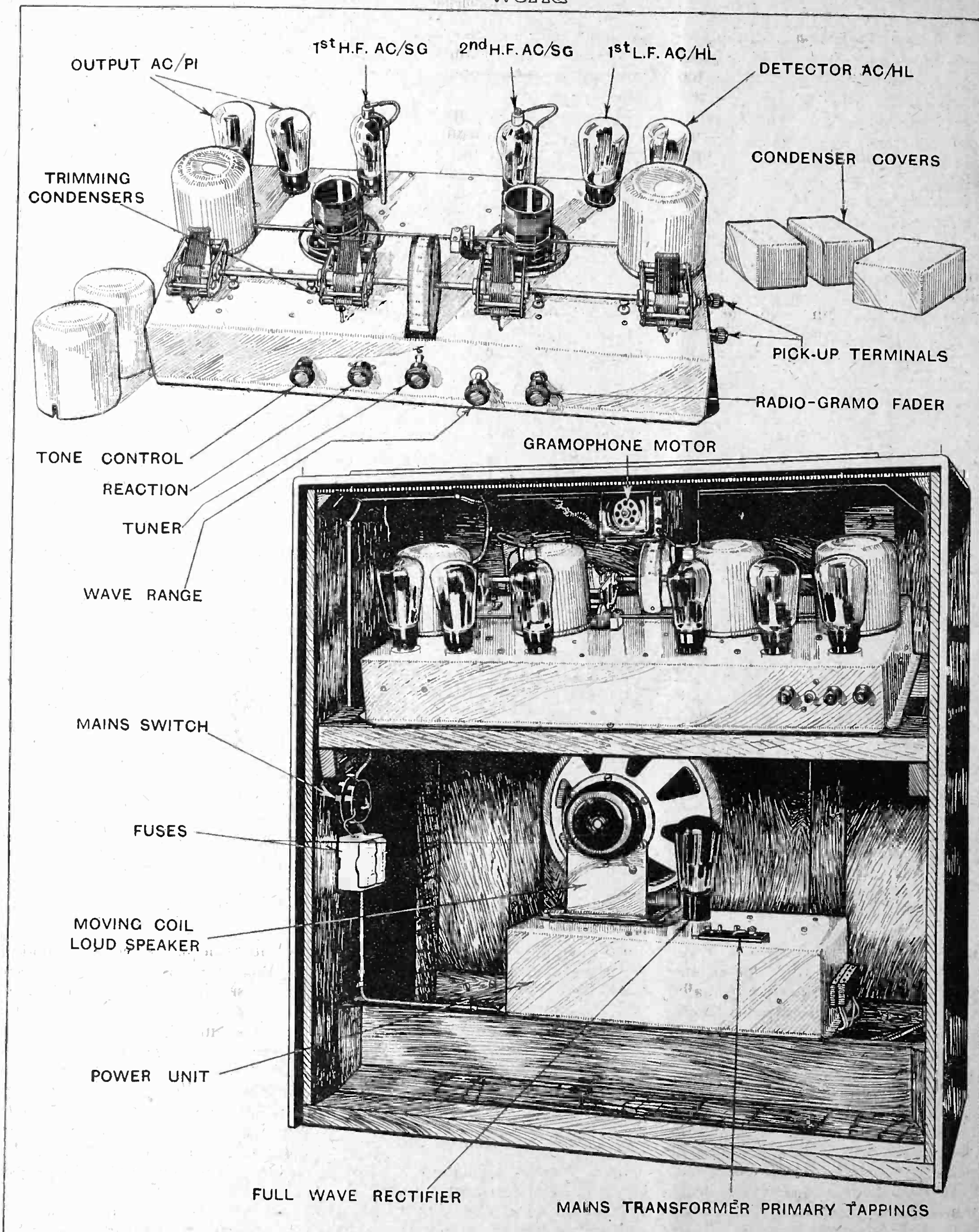
A Bayliss mains transformer of massive construction is the nucleus of the power supply unit. There are three separate filament heater windings, one for the first four stages of the receiver, another for the two power valves, and a third for the rectifier. The latter is a type D.W. 30 full-wave valve, the output from which is smoothed by a double filter. The choke in the second stage of the smoothing circuit is provided by the field winding of the loud speaker, which is energised by the total anode current of the set. Grid bias is provided by separate resistances in series with the cathodes of the valves in each stage.

The circuit is divided structurally into two units—the receiver-amplifier, which occupies the top half of the cabinet immediately behind the control panel, and the loud speaker and power unit, which is mounted behind the ornamental grille at the bottom of the cabinet. Connections between the two units are neatly executed in lead-covered wire in conjunction with shrouded power-type terminal blocks. The porcelain fuse-holders are also of the power type, and are placed in an accessible position on the inside of the cabinet.

Screening.

The layout of the receiver-amplifier unit gives a clean external appearance. The only components which appear on the outside of the heavy leaded iron chassis are the condensers, coil units, and valves. The coils and condensers are provided with individual screening boxes, but the valves, which are placed in an accessible position along the back of the chassis, have only their anode leads screened in small-diameter vertical tubes. The condensers and coil switches are linked by rods running parallel with the front panel, and the single tuning dial is illuminated.

The power chassis is also constructed of heavy gauge leaded iron, and contains the mains transformer and smoothing circuits and the out-



Layout of components in the receiver unit of the R.G.D. Type S.6 A.C. radio gramophone and inside view of cabinet with rear panel removed.

R.G.D. Radio Gramophone De Luxe.— put transformer to the loud speaker. The loud speaker is mounted on top of the case, together with the rectifying valve and the terminal panel for adjusting the primary of the mains transformer to the supply voltage.

Cabinet Design.

The cabinet is of exceptionally massive construction, and is entirely free from resonances. Actually, the thickness of wood is nowhere less than ¾in., and the sides are as much as 1⅛in. The loud speaker fret is also made unusually thick to prevent vibration. A recessed joint round the edge of the lid is a refinement which effectually keeps in all mechanical noise emanating from surface scratch.

The receiver unit is tilted, and the control spindles pass at right angles through the sloping control panel. The latter is of solid bronze, so that its rich colour is not likely to deteriorate with time. From left to right the controls are as follows:—"Tone" (high and low), "Reaction" (s.g., potential variation on both H.F. valves), "Tuner" (friction drum drive to the four gang condensers), "Wave Range" (short and long), and, on the extreme right, "Volume," for changing silently from radio to gramophone reproduction.

We have had an opportunity of handling the instrument under working conditions, and the performance is fully in keeping with the circuit specification. The radio side is extraordinarily lively, and after dark no difficulty should be experienced in tuning in at least thirty stations with an outside aerial, or twelve stations when using the metal grille at the back of the cabinet. The band-pass filter functions admirably, and there is a precipitous cut-off at each side of the useful frequency band. It was specially noted also that no change in quality takes place as the condenser is moved into or out of tune with a station, even when making full use of reaction with the small internal aerial. This is convincing proof that there is no cutting of side bands.

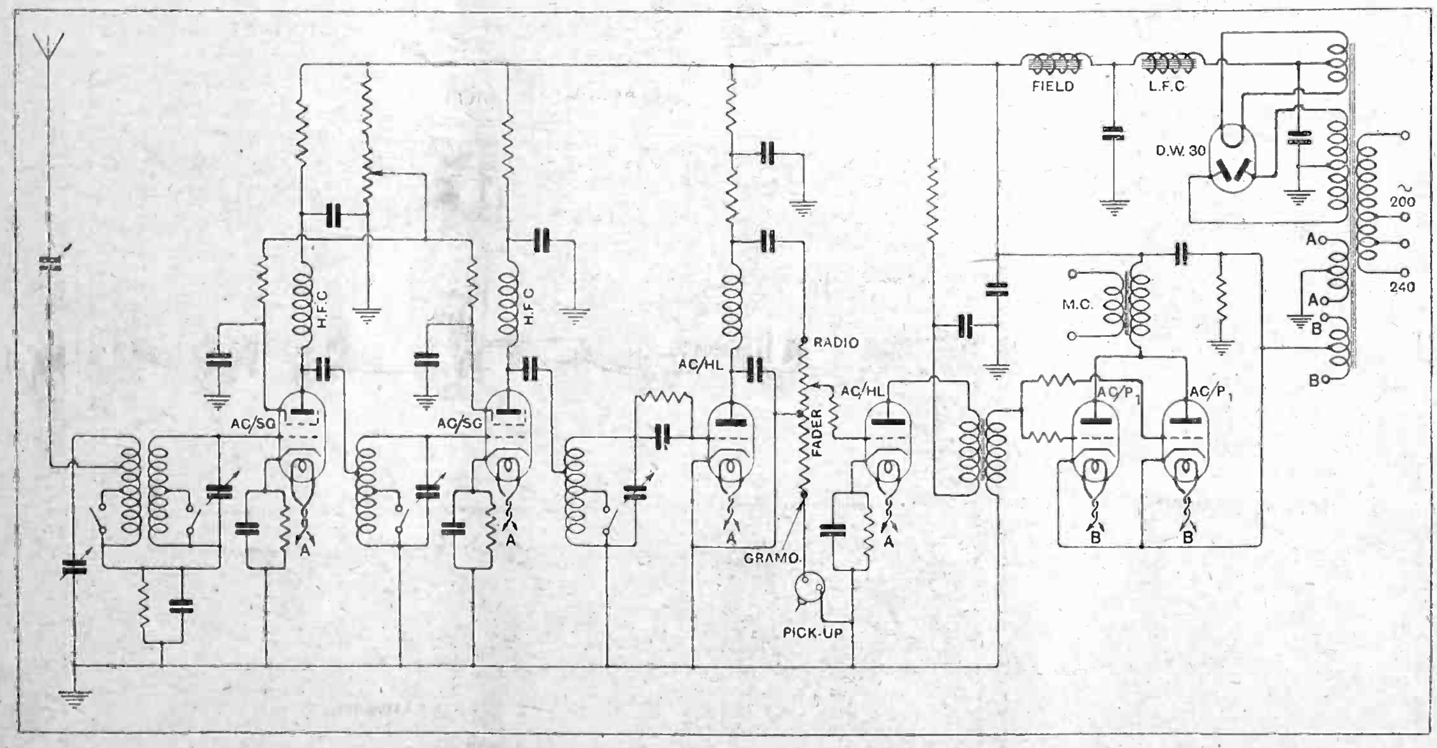
Volume and Tone Control.

The volume available is more than sufficient for most domestic requirements, and the instrument is easily capable of supplying dance music, etc., for hotels and restaurants. The quality of reproduction also gives no opportunity for criticism. There is no evidence of booming in the lower register, and the high-note reproduction is excellent. Both speech and music come through in a natural and effortless manner. For those who prefer the "mellow 'cello" type of quality a tone control has been fitted to suppress the upper register, but most discerning people will appreciate the excellent high-note response provided.

D.C. and A.C. Models.

A model designed for D.C. mains is also available. The valves used are the same as in the A.C. model, and the series resistance is provided with a special heat deflector which prevents an uncomfortable temperature rise in the interior of the cabinet. Since the H.T. voltage is limited with D.C. mains, provision is made for the introduction, if desired, of a bias battery for the output stage in order that the anode voltage may not be reduced by the volt drop in the usual cathode resistance.

There is also a special 50-watt super power model with two DO25 valves in push-pull in the output stage.

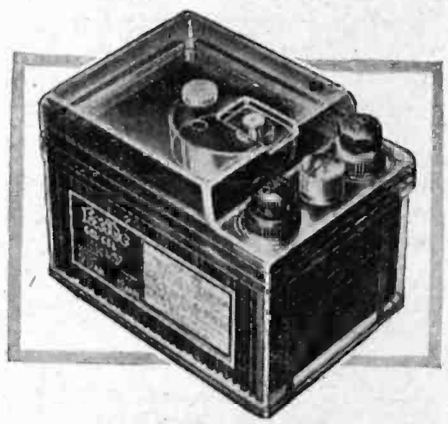


Circuit diagram of the R.G.D. radio gramophone Type S.6. A.C.

Exide Gel-Cel

USERS of portable sets realise that rarely is the accumulator entirely unspillable. The principal difficulty arises from acid spray finding its way through the vent hole and producing serious corrosion not only on the accumulator terminals and leads themselves but on metal parts in the receiver. The vital need of rendering the accumulator unspillable and spray-proof has been tackled by the Chloride Electrical Storage Co., Ltd., whose London address is 215-229, Shaftesbury Avenue, W.C.2.

This season a new battery has been introduced in which a jelly electrolyte is used which prevents spraying and avoids the free flow of the acid within the case. The use of jelly electrolyte in accumulators is not a new principle, and it will be remembered that Exide H.T. batteries were available at the start of broadcasting, optionally rendered unspillable by this method. The particular merit of the use of jelly electrolyte in a portable battery is that the acid is kept in contact with the entire surface of the plates irrespective of the position in which the battery is standing.



Exide Gel-Cel accumulator.

This form of electrolyte does not enter into the chemical reaction which takes place inside the battery, but merely serves as a means to hold the acid in the neighbourhood of the plates and thus prevent it flowing. Generous precautions are, however, taken to provide an acid lock in the top of the cell, so that gases may escape without carrying acid spray.

A special feature of the battery is its robust construction, brought about by the use of shaped celluloid pressings for top and bottom. By this means sharp corners are avoided and enormous strength with stiffness obtained. The Gel-Cel Type JWE7 measures 4¾in. × 4in. × 3¼in. and has the high ampere-hour capacity of 24, and allows a charging rate of 2 amperes. Seven positive and eight negative plates are fitted, measuring about 4in. × 1½in., thus giving a plate area greater than that customarily met with in portable-set accumulators. By the use of different screw threads on the positive and negative terminals, these cannot be interchanged, whilst one is octagonal and the other round.

Clarke's Atlas Combined Eliminator

ONE never quite knows what to do when the question arises of converting an existing battery-fed set for A.C. mains operation. If it is decided to make a clean sweep and to fit indirectly heated valves, with appropriate arrangements for supplying

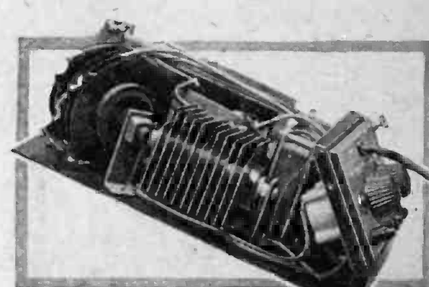
Compactness is a feature of the Atlas combined eliminator and trickle charger.

their anode, grid, and heater circuits with suitable voltages, there is an unpleasant possibility that, due to the improved "figure of merit" of the new valves, uncontrollable instability may result unless extra screening and, perhaps, more than usually extensive "decoupling" is provided. Further, the cost of a complete conversion is considerable, and there is often a natural reluctance to replace a set of valves that may still be capable of working satisfactorily for many months.

In such circumstances, the easiest, simplest, and certainly the cheapest solution of the problem lies in the fitting of an H.T. battery eliminator for anode current supply, coupled with the use of an L.T. trickle charger, which admittedly will not "eliminate" the filament accumulator but does largely eliminate all trouble in connection with it.

There remains the grid bias battery. Opinions are divided as to the desirability of eliminating this component; if the set is to be operated by someone without technical knowledge it is certainly as well that grid potentials should be provided automatically, but, when dealing with a converted battery set, it is not often worth while to introduce this extra complication, at any rate if the user realises that the battery should be tested occasionally.

The Atlas combined eliminator is intended for meeting anode current demands of the typical domestic receiver, and also includes the necessary equipment for recharging L.T. accumulators of 2, 4, or 6 volts at about 0.5 amp.—a rate that is more than adequate, in ordinary circumstances. The apparatus is mounted in a neat

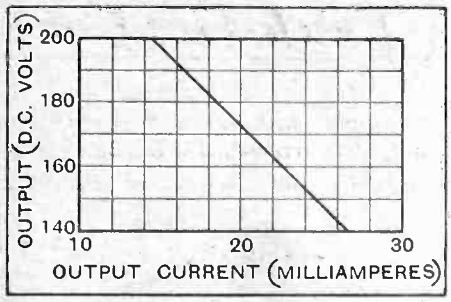


Internal arrangement of the eliminator components.

and compact ventilated metal case measuring about 3½in. high, 5¼in. wide, and 10in. deep. It is designed for operation on A.C. supplies of 200-250 volts, 40-120 cycles. A Westinghouse rectifier, with a rated output (after smoothing, and allowing a reasonable figure for choke resistance) of 25 milliamps. at 150 volts is connected in the conventional

Clarke's Atlas Combined Eliminator.—"voltage doubler" circuit. Its output will change with load, and the accompanying graph shows the voltage actually existing between the "negative" and "+150" sockets for different current demands.

There are two other output sockets, through which the earlier valves are fed: the first, marked "0-100 volts," is connected to an internal potentiometer with a variable resistance element, and is intended for supplying a low output current, as, for example, that passed by an H.F. valve screening grid or a detector. The remaining output is through a series variable resistance, which, like the potentiometer element, is of the compression type. It must be remembered that, in estimating the current and voltage obtainable from the power socket, it is necessary to subtract the current drawn through the variable outputs.



Regulation curve, showing how voltage rises as the output load is reduced.

Another Westinghouse rectifier of the low-voltage type is fitted for charging the L.T. battery, which is permanently connected to both unit and receiver, and automatically goes "on charge" when the H.T. circuits are switched off.

A test of the eliminator shows that it operates quite satisfactorily in conjunction with a typical H.F.-det.-L.F. three-valve set, and that there is hardly any trace of hum. When it is connected to a receiver with two L.F. stages, care should be taken to see that the manufacturers' instructions regarding separate feeds to each valve are observed.

The unit is made by H. Clarke and Company, Ltd., Atlas Works, Old Trafford, Manchester, and costs £6 complete.

Ferranti Magno-Dynamic Loud Speaker

FOR the second year in succession a Ferranti loud speaker has recorded the greatest number of votes in the loud speaker section. This year it is the "Magno Dynamic" moving-coil unit which has so favourably impressed visitors to Olympia. This is hardly surprising, for now that the flux densities provided by permanent magnets have been brought up to the standard set by mains-energised field magnets, we are at last relieved of the complication, expense and maintenance of A.C. rectifiers and the anxieties associated with back E.M.F.s when switching off D.C. mains fields.

In designing the permanent magnet, special attention has been directed to the question of permanence, and in this connection the designers are able to draw on 40 years' experience in the manufacture of permanent magnets for electric supply meters and measuring instruments, in which permanence of calibration is of prime importance. It is, therefore, interesting to find that the steel alloy in the field magnet contains as much as 35 per cent. of cobalt, and is by no means cheap to produce. The design of the magnet has been patented, and it is magnetised in a special machine so that it is not necessary to leave a magnetising coil inside the core. The pole pieces are electro-plated to prevent the formation of rust in the air gap, which is only 0.075in. wide. With this magnet a total flux density of 13,000 lines per square centimetre is obtained, and the useful flux density in the vicinity of the moving coil is 8,000 lines per sq. in. This figure is obtained by making use of a specially designed instrument in which the movement of the search coil is limited to $\frac{3}{16}$in.


Prize-winning model permanent magnet loud speaker.

The design of the diaphragm and moving coil is similar to that of the other moving-coil loud speakers in the Ferranti range. The 90-degree diaphragm is of comparatively small diameter, and is fitted with a centring device at the apex to prevent lateral movement of the speech coil. The latter has an average impedance of 20 ohms, and for the purpose of our own tests a Ferranti type OPM3 output transformer was used. Where push-pull amplification is employed a type OPM3L transformer will provide suitable matching.

Comparison with the records of previous tests on the mains-energised "Electro-Dynamic" Ferranti loud speakers showed that the sensitivity of the permanent magnet model is only very slightly less; indeed, a direct comparison would be necessary in order to appreciate the difference. Frequency tests over a range from 50 to 6,000 cycles revealed that the response in the middle register is sensitively uniform from 200 up to 3,000 cycles. Above and below these limits the characteristic rises. The increased output down to 50 cycles is sufficient to give body to the general result without introducing objectionable "boom." It is from 4,000 cycles upwards that the response is so unusually good, and the resulting brilliance imparted to the quality is probably unequalled

Ferranti Magno-Dynamic Loud Speaker.—by any other loud speaker. With a well-designed amplifier a certain amount of hiss may be experienced, but this is easily overcome with a simple form of tone control. In fact, it is quite a new experience to have a reserve of high-frequency output with which to experiment.

The choice of a permanent magnet moving-coil loud speaker is significant, for we believe that this type is destined ultimately to displace the older type of mains-energised field magnet.

Mazda A.C./Pen Valve

THIS valve, the sole representative of the pentode class with an indirectly heated cathode, affords striking evidence of the extraordinary advance which has been made in valve design and manufacture, and well deserves the high praise bestowed upon it by readers of *The Wireless World*. When one reflects on the difficulties encountered in supporting rigidly three grids, a large anode, a hairpin heater, a

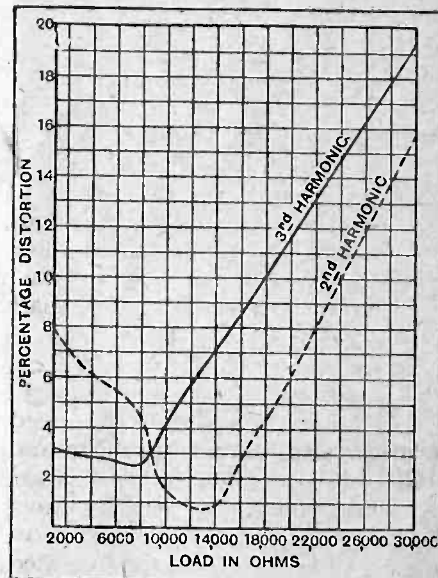
The Mazda indirectly heated pentode — the A.C./PEN.

cathode, two getter plates and a number of mica supports in such a restricted space, one realises that the factory production of such a valve is no mean achievement, and must be attributed to research over a long period. Mazda valves are made by the Associated Electrical Industries—a concern in which the research and manufacturing resources of the Metropolitan-Vickers, B.T.-H., and Edison Swan companies have been combined. It will be remembered that the Cosmos AC/G and AC/R valves made by the Metro-Vick Company in 1927 were the forerunners of a highly successful series of indirectly heated valves which are now available.

The intricate construction of the A.C./PEN can be seen from the illustration. The hairpin heater, which consumes 1 amp. at 4 volts, consists of a tungsten filament which has been dipped into a porcelain "slip." This is inserted into a nickel tube or cathode which is coated with the necessary emitter, and the whole assembly is held in position by mica locking bars. Surrounding the cathode is a control grid around which, in turn, are the screen grid and the earthed grid, all rigidly held not only by mica cross members but also by vertical supports which are embedded in the glass pinch. It is of fundamental importance in a pentode that there should be no negative resistance kink in the working characteristic due to secondary emission; this is effectively avoided by the presence of the outer grid, which is internally connected to the cathode.

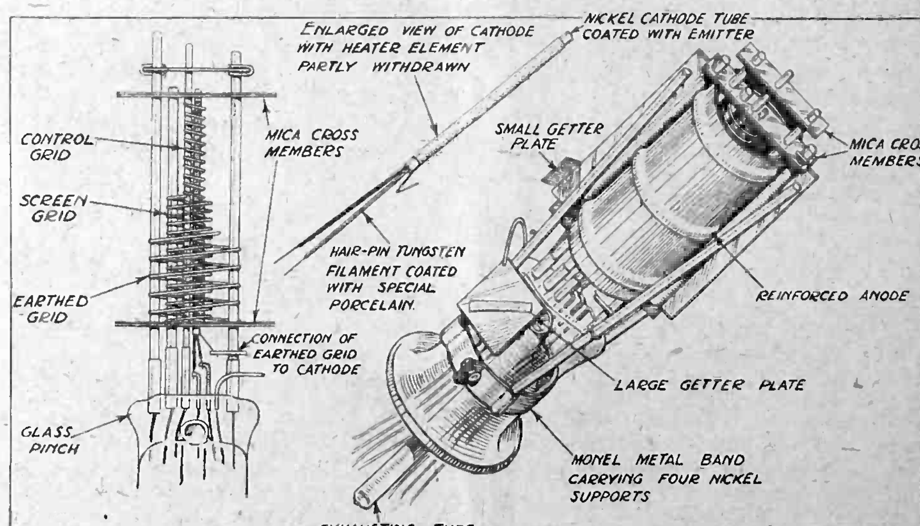
The multiple-electrode structure, including a reinforced anode, is stiffened by four nickel uprights attached to a monel-metal band clamped by a bolt and nut to a waist in the lower part of the glass pinch. As the valve normally dissipates about 8 watts, longitudinal expansion of every electrode is arranged.

Under amplifying conditions, with 10 volts negative bias and maximum anode and screen voltages of 250 and 200 respectively, the A.C./PEN will deliver about $1\frac{1}{2}$ watts of undistorted A.C. energy, assuming that it is worked into a load of correct value. Whilst a triode will not give



Curves showing the percentage distortion with different speaker impedances. The optimum load is 8,000 ohms.

audible distortion when a small deviation is made from the optimum load, a pentode will give a poor



Showing the disposition of the three grids (left). On the right is seen the multiple-electrode structure firmly bolted to the glass pinch. Two getter plates ensure a perfect vacuum.

Mazda A.C./Pen Valve.—account of itself unless the speaker impedance is chosen with accuracy. The accompanying curves show the percentage harmonic distortion given by the A.C./PEN when the load in the anode circuit is varied from 2,000 to 30,000 ohms.

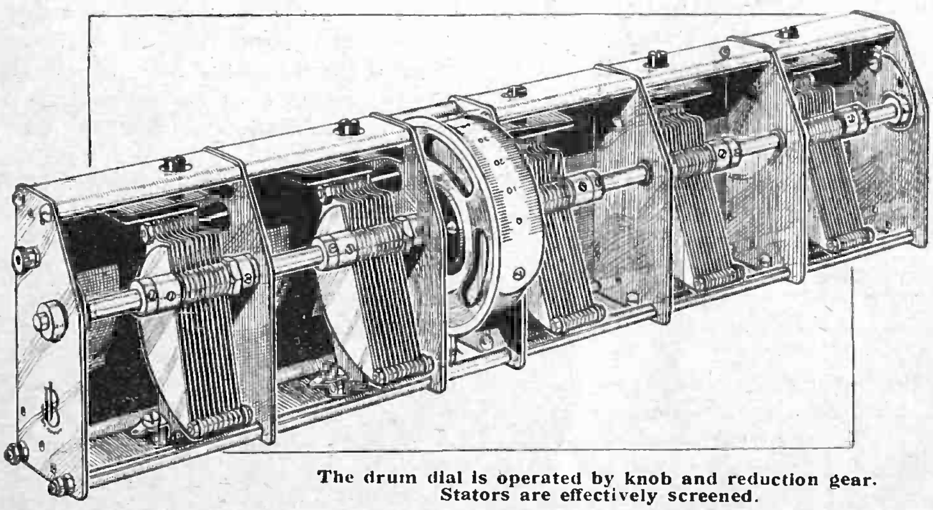
It will be seen, for instance, that a moving-iron speaker having an impedance rising to 20,000 ohms at the higher frequencies will cause a third harmonic component of nearly twelve per cent., which is very distressing to the ear, whilst with an 8,000-ohm load the distortion of both second and third harmonics is below five per cent. and is unobjectionable. With a moving-coil speaker having a special pentode speech coil the impedance of which does not vary substantially over the musical range, the A.C./PEN can be used with an ordinary one-to-one choke filter output, but with a moving-iron speaker an impedance-limiting arrangement, consisting of a condenser and resistance in series, should be used across the output device, and a tapped output choke should be employed to raise artificially the impedance of the speaker, which has probably been designed to give of its best at about 256 cycles when coupled to a 2,000-ohm triode. Not only will the A.C. pentode give a greater output per given volt grid swing than any three-electrode valve, but it will also deliver sufficient energy as a power grid detector to work a loud speaker direct without an intermediate low-frequency amplifier.

J.B. Chassimount Condenser

AT the time that the single-dial control of a multi-stage screen-grid amplifier was first introduced, difficulty was experienced in finding a condenser that could be readily gang operated. It was necessary to adopt the hollow spindle J.B. model as the most satisfactory, and to provide a steel shaft to link up the four sections.

Jackson Brothers, of 72, St. Thomas's Street, London Bridge, London, S.E.1, have quickly applied themselves to this new problem and produced a popular type of gang-operated condenser assembly incorporating two, three, four or five sections. This new gang-operated assembly made its appearance on the market shortly before the Radio Show, and is known as the "Chassimount." To conform to the popular requirement, a drum indicating dial is incorporated, though knob operation through a reduction gear is fitted in preference to thumb dial control. Passing through the centre of the drum is a ¼in. steel shaft which engages in bearings set up in the screening barriers between each section. The fixed plates take their support from the substantial aluminium barriers between the sections, and these in turn are held rigidly in position by means of four spacing bars running the entire length of the assembly. Easily removable shields clip over the individual sections and provide complete screening between successive sets of fixed plates.

When balancing between the individual tuned stages is necessary it is readily obtained by the use of the simple trimming condensers associated with each condenser section. The plates are of brass and are shaped to follow a logarithmic tuning scale. Pigtail earthing is fitted to the centre shaft.



The drum dial is operated by knob and reduction gear. Stators are effectively screened.

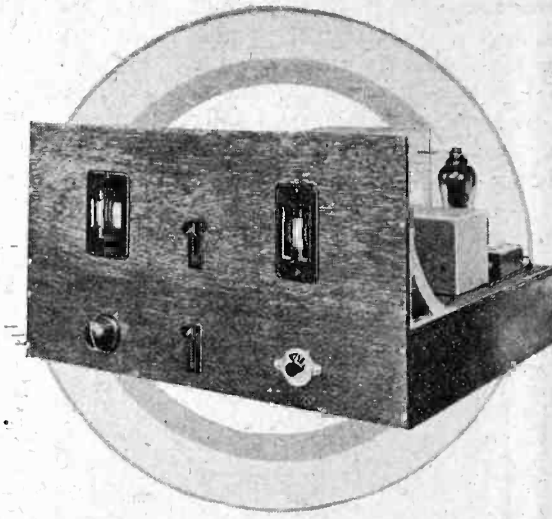
BOOKS RECEIVED.

Photocells and their Application, by V. K. Zworykin, E.E., Ph.D., and E. D. Wilson, Ph.D., of the Westinghouse Research Laboratories, comprising the History, General Theory and Mechanical features; the Methods of Preparing Photocells, Vacuum and Gas-filled Cells; the General Uses in Sound-films, Facsimile transmission, Television, etc., and predictions as to future developments. Pp. 209, with 98 illustrations and diagrams. Published by John Wiley and Sons, Inc., New York, and Chapman and Hall, Ltd., London, price 12s. 6d. net.

The Chronicle Wireless Annual (Eighth Edition), containing constructional articles on Various Types of Mains and Battery-operated Receivers, with useful information concerning Wave Traps, Volume Control, Operating the Televisor, Gramophone Amplifiers, Radio Societies, and many other wireless subjects of interest alike to the home constructor and the ordinary listener. Prepared by the *Manchester Evening Chronicle*. Pp. 191, with numerous illustrations and diagrams. Published by Allied Newspapers, Ltd., Manchester, price 1s.

Easy Lessons in Television, by R. W. Hutchinson, M.Sc. A book for non-technical readers, explaining the elementary principles of Electricity and Light and describing the Apparatus used in Television with the purpose and use of each component, and practical points to be observed in working the Televisor, synchronising the Motor and other adjustments, with a chapter on Tele-Cinematography, Tele-Talkies, Tele-Photography, etc. P. 175+vi, with 129 illustrations and diagrams. Published by the University Tutorial Press, Ltd., London, price 1s. 9d.

"The Wireless World" Band-Pass Superheterodyne



Details of Construction.

(Concluded from page 517 of previous issue.)

By A. L. M. SOWERBY, M.Sc., and H. B. DENT.

THE general layout of the receiver can be seen at once from any of the photographs. The baseboard is raised considerably, so that the decoupling components and grid-bias batteries, together with all the battery supply leads, can be run below it out of the way. This style of construction is particularly convenient when dealing with a receiver in which there is a certain amount of screening, as leads can be brought up through the bottom of the screening boxes.

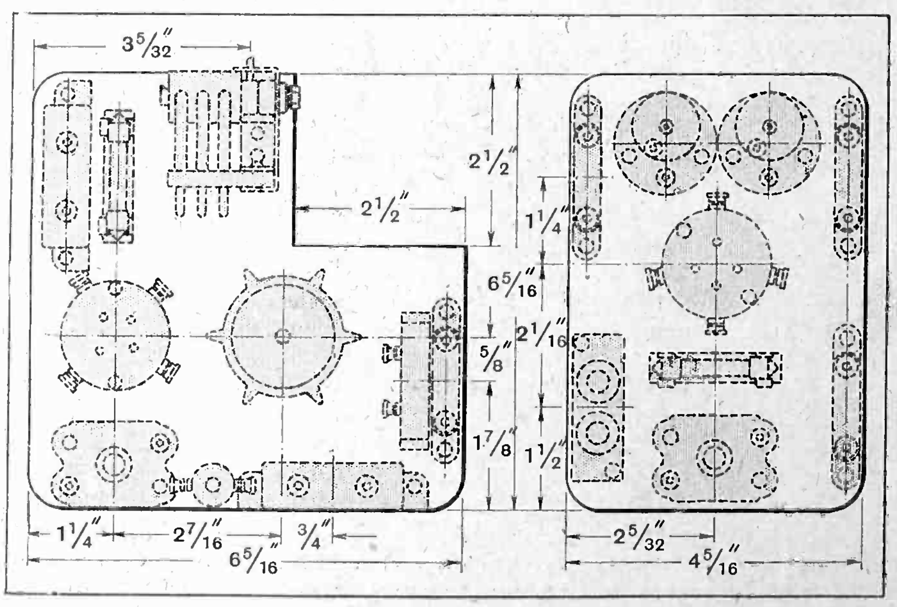
The panel has been kept short, and the components upon it symmetrically arranged, by putting the high frequency stage and the frequency-changer immediately behind the panel, with the rest of the set running back from right to left behind them. This brings input and output of the set into close juxtaposition, but thanks to a capacity screen between them and an efficient low-pass filter in the anode circuit of the second detector, no ill-effects result.

Wood has been used in place of the conventional ebonite as the material for the panel; its main advantage is cheapness. To the writer's eye it is as sightly as ebonite, but those who prefer to use the latter will find that the set works neither more nor less well as a result of substituting one for the other. For the two terminal strips, paxolin sheet has been preferred to ebonite on account of its greater mechanical strength.

Coil Details.

The first stage in the building of the receiver is the construction of the "chassis," which will naturally be done while the local dealer is getting in those components which he does not normally stock. The construction of the special coils employed in the receiver is also a task that can be embarked upon at an early stage. The two oscillator-couplers and the intermediate-frequency filter are wound on slotted formers built up from discs of $\frac{1}{8}$in. plywood, strung together on short lengths of 4 BA rod. Sixteen discs, 2in. in diameter, and ten discs $1\frac{1}{4}$in. in diameter, are needed for the whole set of coils. In winding them the ends of the wire are secured by bringing them out through holes in the larger discs, and the wire is run into each slot in turn by fixing the former in the chuck of a hand-drill and turning the handle just as fast as one dares, guiding the wire with one hand.

There are two large discs separating pick-up and reaction coils in the oscillator-couplers so that the ends of the reaction coils may be brought out between the discs without difficulty. Plate and reaction coils should be wound in the same direction, when the inside end of the plate coil goes to plate, and the outside end of the reaction coil to grid. (Actually, in the set, both go to switch.) Reversal of either of these two windings will prevent the oscillator from oscillating. The direction of winding and connecting the pick-up coil is a matter of complete indifference.



Disposition of the components in the screened units. (Left) The signal frequency H.F. stage; (right) the I.F. amplifier and second detector.

"The Wireless World" Band-Pass Superheterodyne.—

Some care must be taken in winding the I.F. filter coils, each of which has two slots with the windings connected in series. In each coil the wire is wound clockwise in one of the slots and counter-clockwise in the other; the two outer ends are then connected together, leaving the inner ends only as connections to the semi-fixed tuning condensers. A set containing wrongly-wound coils would show no visible fault, but would give no signals whatever. Coupling between the two parts of the filter is magnetic, fixed by the difference between them. Anything from 1⅛in. to 1½in. between inner faces of the two assemblies will be found perfectly satisfactory. The filter, like the oscillator-couplers, is mounted between a pair of small brackets, to which it is clamped by nuts on the 4 BA rod that holds the whole together.

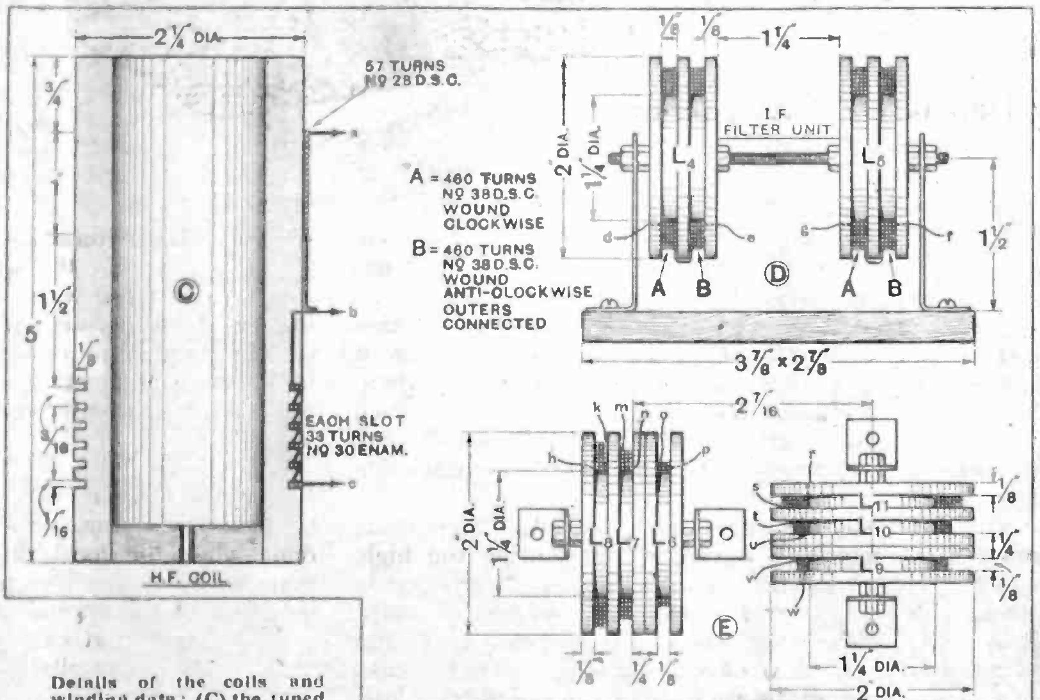
The coils wound and the various other components collected, the assembly of the set can begin in earnest. It will be well to start by mounting on the baseboard and panel all the components that are external to the two main screening boxes, with the exception of the pair of H.F. tuning condensers and the upper one of the two switches. The small box for the long-wave filter, which has been used as a precaution against direct pick-up of long-wave interference, can also be mounted in position at this stage.

As soon as this is done, it will be apparent that a good deal of the wiring can be carried out at once; it is a good plan to do it before the main screening boxes are put into position.

In going over the sub-baseboard connections, it will be noticed that there is a tapped 30,000 ohms resistance; the smaller section of this does duty as decoupling resistance, the rest acting as anode resistance for the second detector. A fixed resistance and a variable potentiometer are used in series to feed the screening grid of the first valve, and criticism may be levelled at taking the supply for the other two screening grids from the junction of fixed resistance and potentiometer. Admittedly, the voltage at this point depends to a slight extent on the current drawn by the first valve, and so on the setting of the volume control; the range of variation, however, is small, and lies between 55 and 65 volts, over which range the I.F. stage-gain and detector efficiency are not audibly, though they are measurably, altered.

As is usual where switches are used, there is a certain congestion of wires round the lower switch. The fact that the switch makes a convenient anchorage for six out of the twelve wires which form the ends of the oscillator-coupler windings is, perhaps, some compensation.

The fact that a frame aerial is to be used makes it necessary to screen all circuits carrying amplified high-frequency currents with some care. This accounts for the fact that the contents of



Details of the coils and winding data: (C) the tuned H.F. coil; (D) the I.F. filter unit, and (E) the oscillator coils.

OSCILLATOR COILS			
MEDIUM WAVE		LONG WAVE	
ANODE COIL	58 TURNS Nº 28 D.C.C.	ANODE COIL	230 TURNS Nº 34 D.S.C.
GRID COIL	35 TURNS Nº 28 D.C.C.	GRID COIL	50 TURNS Nº 34 D.S.C.
PICK-UP COIL	15 TURNS Nº 28 D.C.C.	PICK-UP COIL	28 TURNS Nº 34 D.S.C.

the main screening box are many and crowded. The components in this box are mounted on a small wooden baseboard, part of which is cut away to clear the tuning condenser. It is particularly to be noticed that the switch, which appears to be solely dependent on the panel for its support, is in reality mounted on a small bracket on this little base. The first stage in assembling the contents of the box is to mount and wire up as far as possible all the components, not forgetting the Graham-Farish condenser, which is the grid condenser of the detector in the three-valve arrangement. This has been slung on the wiring through sheer lack of space, but being small and light it is quite adequately supported.

When these jobs have been attended to, the screening-box can be mounted in position, with the tuning condenser through one side and with the slot for the switch registering with the slot on the panel. The baseboard with all its components is then dropped in the box, and the wires connecting it with the rest of the set soldered into position. A small iron is recommended here, as some of the joints are a little difficult of access.

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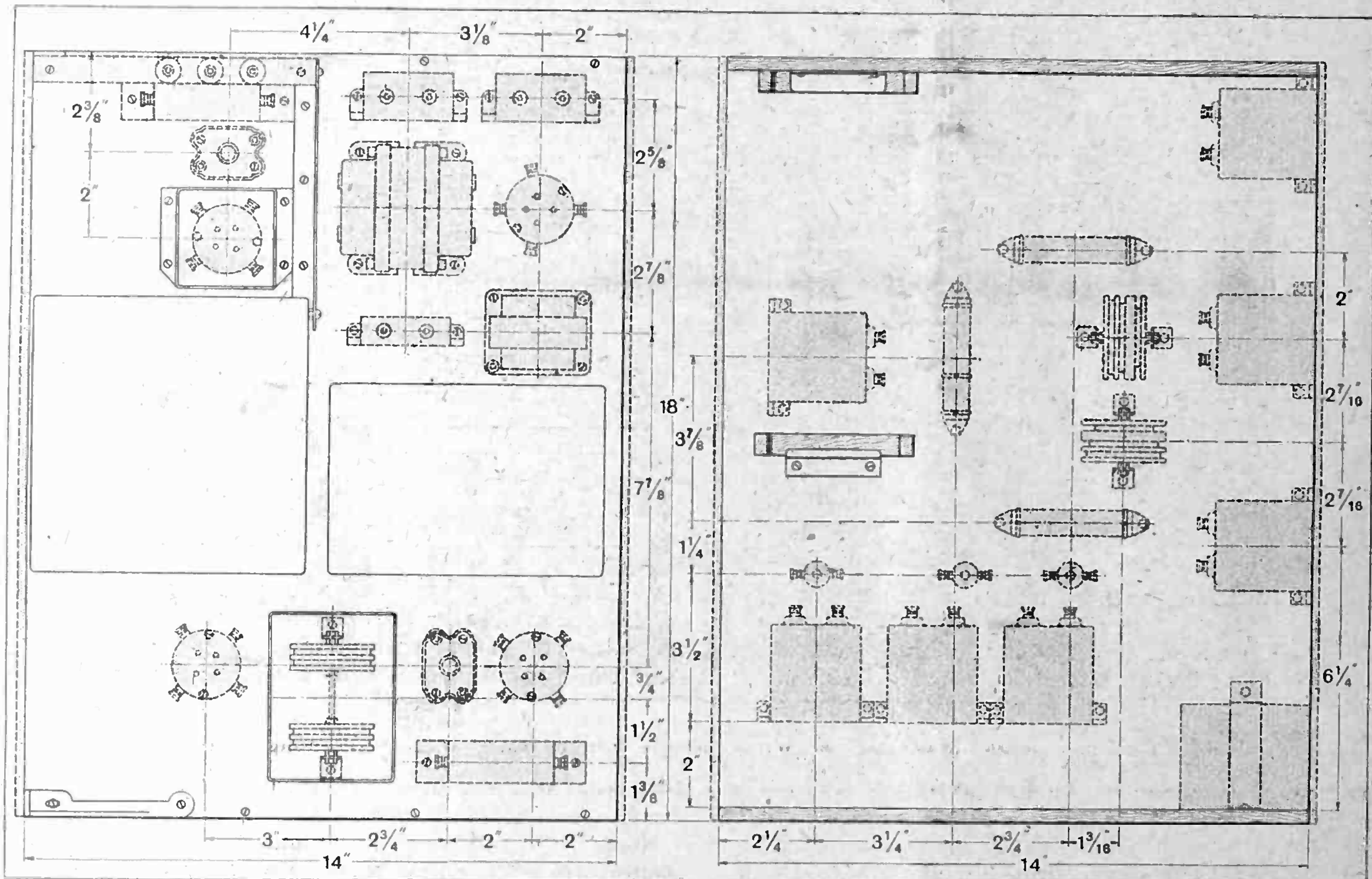
The contents of the smaller box can next be mounted on their base. As the H.F. choke used as an I.F. tuning coil is binocular, its close proximity to the screen is not harmful. The two Wearite chokes, with their associated condensers, and the condenser incorporated in the primary of the AF6 transformer, form a low-pass filter which should, theoretically, stop all but a fraction of 1 per cent. of the intermediate frequency, while passing about 75 per cent. of high audio-frequency notes of frequency 5,000 cycles per second. Whether its practical performance is as good as this is not known; at all events no signs of any I.F. currents could be detected in the loud speaker leads, while high audio notes are satisfactorily present. When the components in this compartment have been wired up as far as possible, they can be dropped into their box, and the remaining connections made. There are no special constructional difficulties here.

The last component to be fitted will probably be the screening box surrounding the H.F. valve; this was found necessary, because there was sufficient capacity coupling between the plate of the valve and the fixed plates of the frame condenser to cause instability on both wavebands.

Before putting valves into the sockets for the set's first trial it is as well to check over the wiring to make sure no mistakes have been made. As switching always makes a circuit much more difficult to follow, special attention should be paid to the wiring in this neighbourhood, where mistakes are most likely. Another possible fault is omission of the earthing connections to the various screens; without them the receiver will not be stable.

The receiver should now be ready for its first adventure in reception. The valves used for trial purposes, and selected as most suitable, were Mazda SG 215 screen-grid valves, Mazda L210 valves as oscillator and second detector, and an Osram PT240 as output valve. As has already been pointed out, the use of a pentode here is quite essential. The two triodes should be identical, or nearly so, because both have to act as grid detector preceding the transformer, one for local reception and one when all six valves are alight. The two H.T.+ terminals should be joined together, and a 160-volt battery connected. Grid bias for the oscillator should be set at $1\frac{1}{2}$ or 3 volts, and for the first detector at 3 volts; variations may be needed when the set has been got going. A centre-tapped frame aerial, if one is available, should be connected to the "Input" terminals, but if no frame is to hand a centre-tapped tuning coil may be used in place of it, a few yards of wire to act as aerial being connected to the "Input" terminal farthest from the panel. If an aerial is used it will be necessary to connect an earth-lead to the set (or to the L.T. accumulator); when using a frame, it



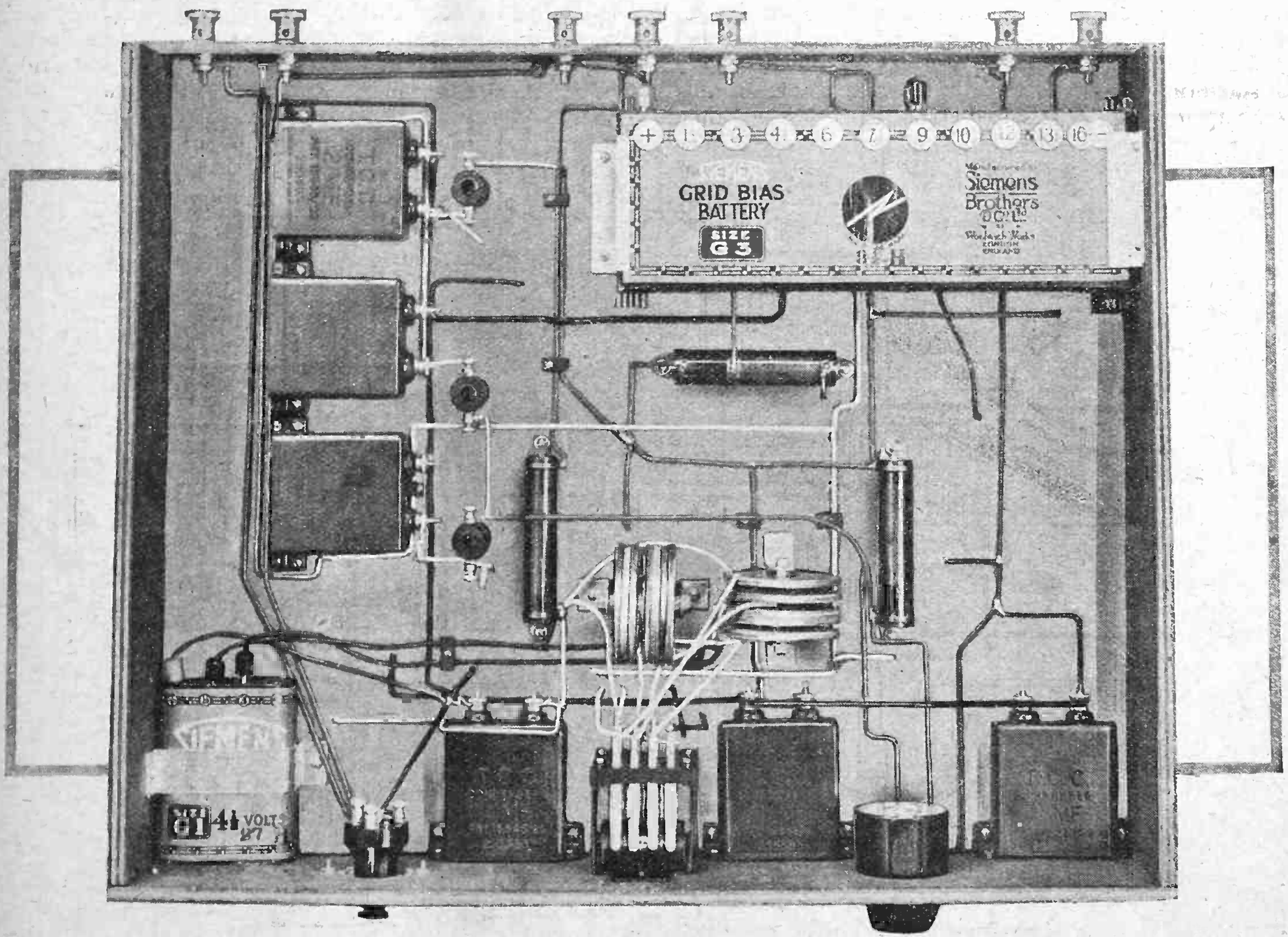
Layout of the components on the top and the underside of the baseboard.

"The Wireless World" Band-Pass Superheterodyne.—
makes no difference whatever whether the set is earthed or not.

With the lower switch up (medium waves) and the upper switch down (three valves) and the volume control set at maximum, the local station should be heard on rotating the twin tuning dials on the left of the panel. With the small energy collected by a frame or tiny aerial, tuning will be found to be very much sharper than the habitual user of a full-size aerial would expect.

It may be helpful to state that in the original set the condenser across the filter primary was screwed right home, that on the secondary nearly down, and the one across the tuned anode circuit was practically not screwed down at all.

When the I.F. tuning has been set roughly with the aid of signals from the local station, something a little more distant may be tried for—Midland Regional, for example. With this station tuned in, and the volume control turned well down to keep the signal strength



Plan view of the underside of the base, showing the position of the oscillator coils and wavechange switch.

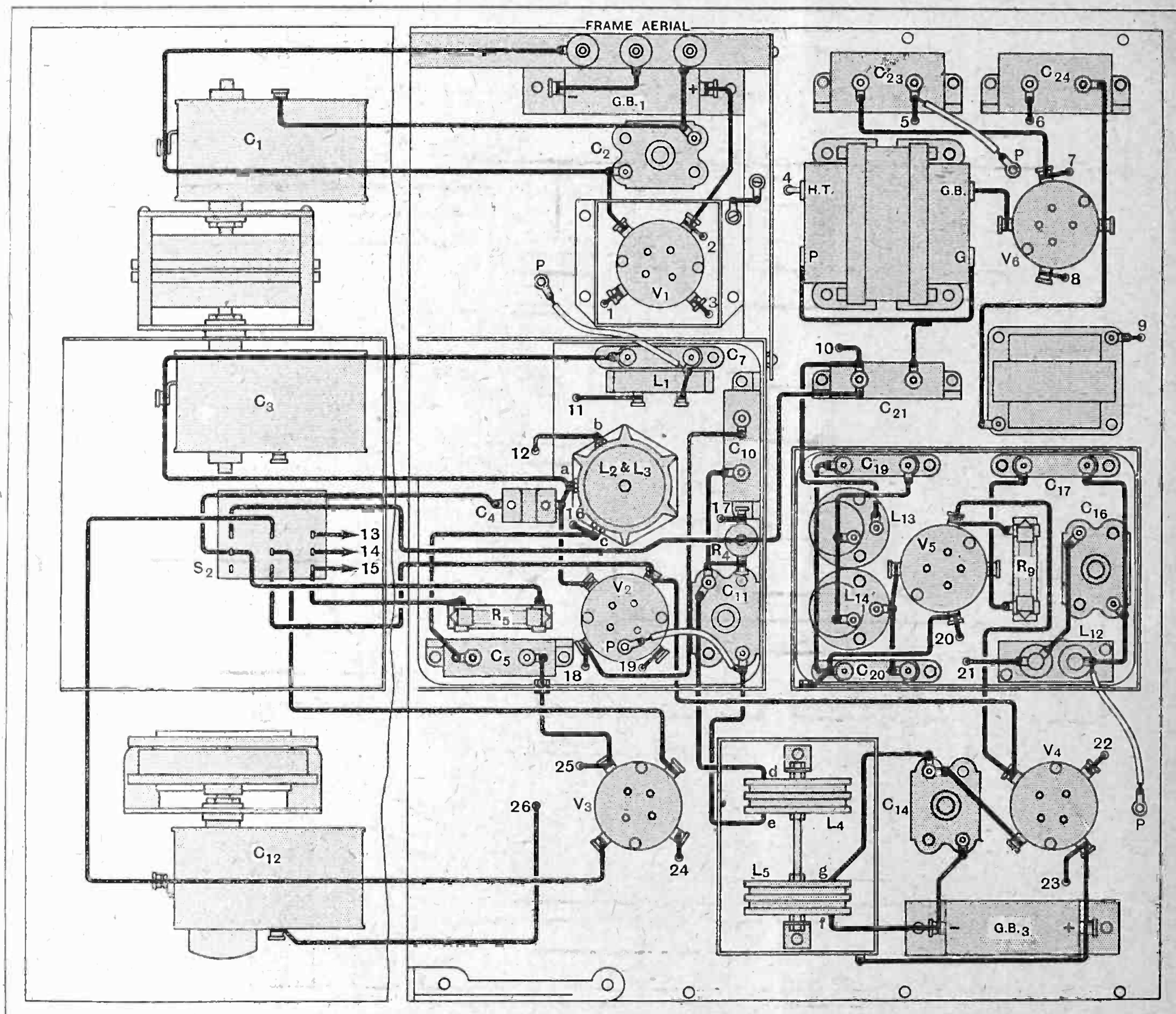
The local station is next tuned in accurately on the two dials, and the volume control slowly turned down till the signals are reduced to a faint whisper. Next, the upper switch is turned to bring in all six valves, and the oscillator dial is swung until signals are heard once more. The semi-fixed condensers controlling the intermediate-frequency tuning can now be set for maximum signals. In doing this, it is absolutely necessary that signals be kept very low by manipulation of the volume control, and, if necessary, of the frame tuning condenser, for the second detector chokes up and gives almost no output of signals if it is heavily overloaded, so that on an overwhelming signal louder music may be heard with the I.F. tuning set well away from its real best adjustment.

low, some more or less final touches may be given to the I.F. tuning condensers.

Next, the frame is turned to find the exact minimum position for 5GB, and is then set about twenty degrees from this position. By turning all the tuning condensers back by one degree, and then exploring a little with the slow-motion drive on the oscillator condenser, Langenberg should be heard. With its aid a really perfect and final setting of the three semi-fixed condensers can be achieved, for the presence of 5GB at a distance of 9 kc. away enables the width of the band passed by the I.F. filter to be correctly adjusted. If the settings are correct, it should not be possible to hear Langenberg without slight interference from 5GB, the latter station making itself heard by a kind of intermittent quacking

"The Wireless World" Band-Pass Superheterodyne.—

noise. This is the high-note modulation of 5GB, overlapping into the frequency band which we need to receive from Langenberg if we are to reproduce the higher notes that the German station transmits. When a setting of the I.F. condensers has been found, such six valves alight a station is tuned in at the bottom of the wavelength scale; the frame condenser will read higher than the H.F. condenser. The frame condenser is set to the same reading as its neighbour, and the station tuned in again by using the trimmer. Next, a station of wavelength well over 500 metres is found, and



Practical wiring plan of the components above the baseboard.

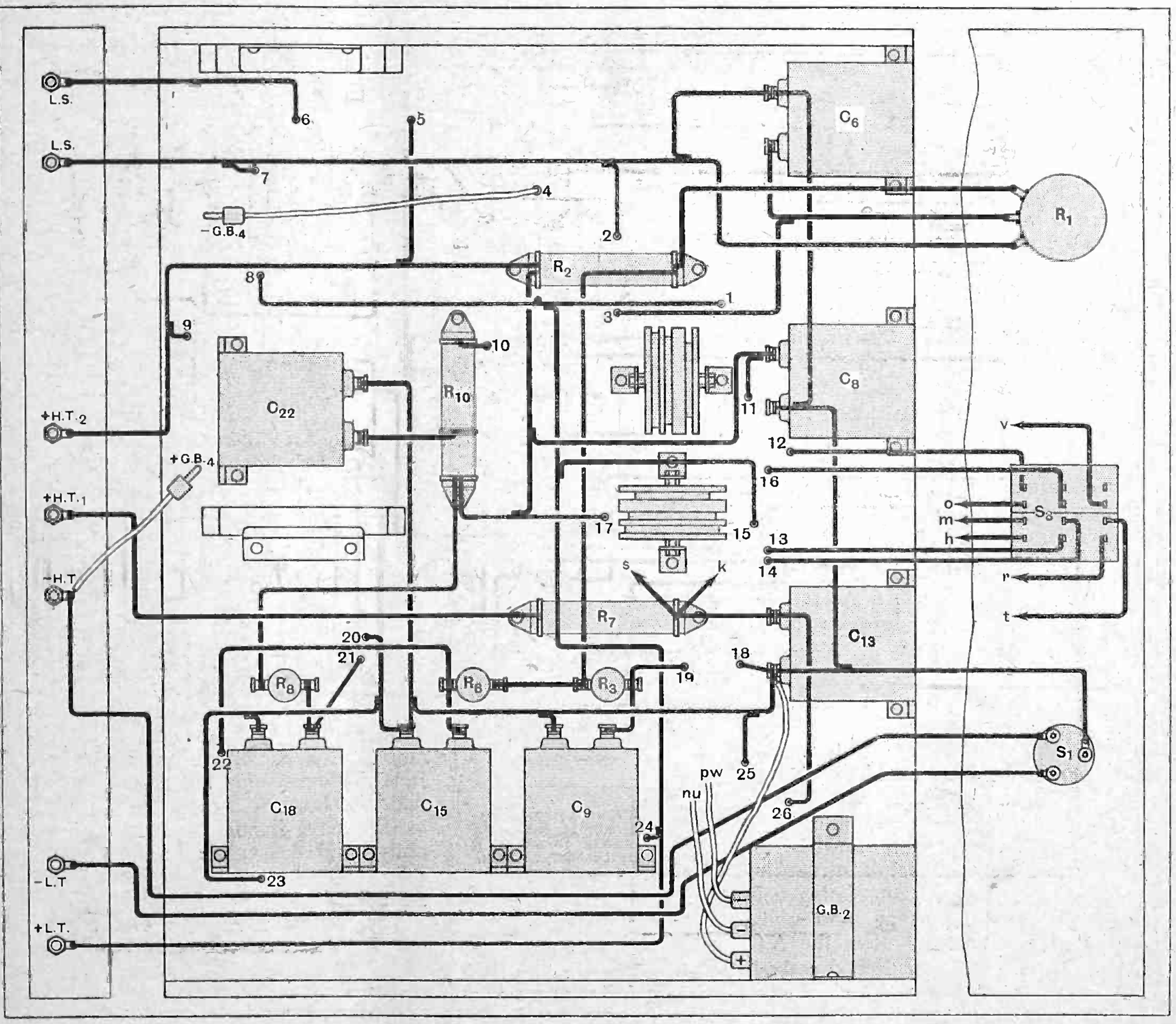
that the highest notes of music, or the consonants in speech, just break through intermittently when the set is tuned to Langenberg, their adjustment may be reckoned exactly right.

To listen to Langenberg in earnest the frame is set to the exact minimum position for 5GB, when the interference naturally stops.

The adjustment of the intermediate-frequency part of the receiver completed, nothing remains but to log stations. This attractive process will be considerably facilitated if the trimmer connected across the frame-aerial tuning condenser is brought into use. With all any difference between the readings of the two condensers is noted. Reverting to the original low-wavelength station, the H.F. condenser is set as before, but the frame condenser is set as many degrees behind or in advance of it as was required for the other station, and the trimmer is readjusted. Proceeding in this way, tuning in the two stations alternately, a setting of the trimmer is eventually found which allows one dial to be in advance of the other by the same amount at both ends of the scale. The two may now be regarded as ganged in the sense that they can be rotated together, like a single control, when searching for stations, but

"The Wireless World" Band-Pass Superheterodyne.—independent fine adjustment for close tuning is still perfectly possible, for there is no mechanical linking.

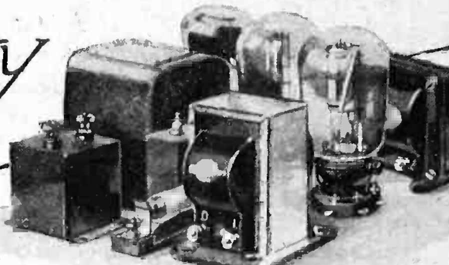
The standard of sensitivity to be expected of the receiver may be gauged from the fact that when using an 18-inch frame aerial Langenberg's lunch-time concert was found, in the heart of London, to deflect a milliammeter in the anode circuit of the second detector by about three-quarters of a milliampere. As a guide to the selectivity, it may be said that a news bulletin from Stuttgart, working on 360 metres, could quite easily be followed, even by one whose German is not too fluent, while the London Regional station was pouring out its 45 kilowatts on 356.3 metres at a range of a dozen miles or so. Interference from the local station took the form of a very noisy background, with London's high-note modulation breaking through intermittently. The London programme could not, of course, be followed. For this the frame was naturally set to minimum on the local station. Algiers, on 363.4 metres, though faintly received, suffered no interference whatever from the local station. The same separation of 18 kilocycles on either side of either of the local transmitters was quite enough to free the received station from interruption. Much higher selectivity than this can be had if one is content to cut off the sidebands in the I.F. amplifier; the results given are those obtained with the I.F. filter adjusted for adequate high-note reproduction in the manner already described.



The connection to the components situated below the baseboard.

Unfortunately, a few minor errors crept into the theoretical diagram included in last week's issue; C10 connects to junction of C11 and R4; the lead from local station switch connects to junction of C21 and R10. R8 and C18 are below the baseboard. The two leads from switch S2 should join to the moving contacts on S3, not to coils L7 and L8, as shown.

The Theory of the Valve Amplifier



Principle of Capacity Coupling.

By S. O. PEARSON, B.Sc., A.M.I.E.E.

(*Continued from page 462 of October 22nd issue*)

IN last week's issue it was pointed out that before a valve can be made to act as a voltage amplifier an impedance must be connected in the anode circuit, and that the properties of the circuit as a whole depend on the nature of this impedance. Let us first consider the simplest case where the added impedance takes the form of a pure resistance. It should always be borne in mind that resistance in an A.C. circuit is actually a special form of impedance where the voltage and current are in phase, and where the power consumed is given by their product in the ordinary way. Dividing the voltage applied to an A.C. circuit by the current in it always gives the impedance (the extent to which the current is impeded) and if the voltage and current happen to be in phase or in step the impedance is in the nature of a pure resistance or its equivalent.

In the circuit of Fig. 1 a non-inductive resistance R is connected in the anode circuit of a valve whose amplification factor will be denoted by μ and its internal A.C. resistance between anode and cathode by R_a. If a small alternating voltage V_g is applied to the grid of the valve it will have the effect of introducing into the anode circuit an alternating voltage of the same frequency, and whose magnitude is μV_g volts. Now the A.C. resistance between the anode and cathode of the valve is constant for all low and moderate frequencies, and is, therefore, equivalent to a simple non-inductive resistance. Hence the total A.C. resistance of the anode circuit is $R + R_a$ ohms. It follows, then, that the effective alternating voltage μV_g in the anode circuit due to the action of the grid will set up an alternating current whose magnitude is $\mu V_g/(R+R_a)$ amperes round the anode circuit. This current is additional to the normal steady direct current taken by the valve, and is, therefore, the alternating component of a more complex current.

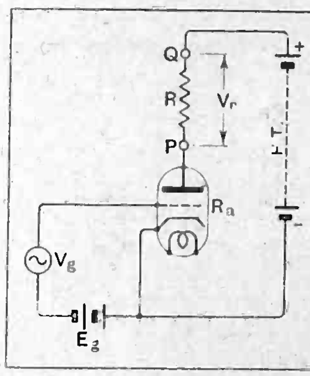


Fig. 1.—When a non-inductive resistance R is connected in the anode circuit of a valve, the theoretical value of the voltage amplification obtained is $\mu \frac{R}{R+R_a}$ where μ is the amplification factor of the valve and R_a is its A.C. resistance.

The D.C. component is merely a necessary evil whose effects have to be eliminated when we come to transfer the amplified alternating voltage to the grid of a succeeding valve. We are, therefore, concerned only with the alternating component of voltage set up across the anode resistance as a result of the alternating component of current, namely, $\frac{\mu V_g}{R+R_a}$ amperes, flowing through it. By Ohm's law this alternating voltage is given by the product of the resistance and the current, its value being, therefore, $V_r = R \times \frac{\mu V_g}{R+R_a}$ volts. Dividing this voltage by the original alternating voltage V_g applied to the grid of the valve we obtain the actual voltage amplification n obtained with the circuit arrangement of Fig. 1. We have then

$$n = \mu \frac{R}{R+R_a} \quad \ldots\ldots\ldots\ldots (1)$$

Now, obviously, $\frac{R}{R+R_a}$ is a quantity which is less than unity for all values of external anode resistance R, and therefore the actual voltage magnification obtained must always be less than μ, the amplification factor of the valve. But if R is made very large compared with the A.C. resistance R_a of the valve, the value of the above fraction will be very nearly unity, and the voltage amplification obtained will be very little less than the amplification factor of the valve.

This simple theory as it stands leads one to the conclusion that the amplification obtained is quite independent of the frequency, and that the higher the value of the anode resistance R is made the greater will be the voltage magnification. But there are other factors which have to be taken into account at high frequencies, or when the added resistance R is very large compared with the internal A.C. resistance of the valve.

Loss of Anode Voltage.

For the present the question of frequency will be ignored. It was mentioned above that the presence of the D.C. component of current was a necessary evil; the particular evil here is that a certain voltage is required to drive this current through the anode resistance R and that, therefore, the actual mean potential of the plate or anode of the valve is less than the high-tension

The Theory of the Valve Amplifier.—

supply voltage by this amount. Thus, if I_a is the mean anode current in amperes, and E the high-tension supply voltage, the voltage at the anode will be only $E - I_a R$ volts. Consequently, if R is made very large, the anode potential may be reduced to such a low figure that the valve ceases to function properly. In practice it is generally safe to employ anode resistances up to five times the A.C. resistance of the valve, but a figure as high as ten times often proves quite satisfactory under certain conditions.

At the present stage, however, we are not concerned so much with the principles of resistance amplification in particular as with the general principles of cascade amplification. Consideration of the case with a simple resistance in the anode circuit merely serves as a good starting point, and gives an illustration of the general principle.

Whatever kind of impedance is connected in the anode circuit of the valve, the same general law applies, namely, that the higher the value of this impedance compared with the A.C. resistance of the valve the greater will be the voltage amplification obtained, although this can never reach a figure as great as the amplification factor of the valve (unless transformer action is resorted to). Whatever form the anode impedance takes, the variations of voltage set up between its ends should be a faithful reproduction of the voltage variations applied to the grid of the valve, and this is obviously the case for a pure resistance whose value is independent of frequency. With certain modifications this is also true for other types of anode impedance.

Coupling the Valves.

Having reproduced the signal voltage with increased amplitude across the added anode resistance or impedance, the next step is to provide a means of transferring this voltage to the grid of the succeeding valve.

This process is not quite so straightforward as it might appear, because only the alternating voltage must be transferred, to the total exclusion of any D.C. component of voltage which might exist across the anode impedance. In the case of resistance coupling the D.C. component is actually larger than the useful alternating voltage.

One of the most important points to be borne in mind is that for the sake of economy and practicability it is essential to employ a common source of high-tension supply for all the valves in the receiver, and the same applies as regards the filament heating supply. These conditions are all-important in determining the nature of the coupling between two successive valves. The use of a common H.T. source makes it essential to connect the anode impedance of each valve between the positive H.T. terminal and the respective anodes, and this means that the added impedance itself is at a high D.C. potential relative to the cathode circuits, and therefore direct connection of an anode impedance to the grid and cathode of a succeeding valve would be impossible.

Referring again to Fig. 1, it will be realised that the end Q of the anode resistance has a constant potential equal to that of the positive terminal of the H.T. battery, but that the end P is varying in potential in conformity with the alternating voltage applied to the grid of the valve. Thus, quite apart from the mean or D.C. potentials, the point Q is at zero alternating potential, whilst P is a point where an alternating potential exists. It is the varying or alternating voltage at P that has to be transferred to the grid of the next valve without allowing the D.C. potential to get across, and the means of doing this is afforded by the properties of a condenser. Although an alternating current can be passed through a circuit with a condenser in series, no direct current can be made to pass (unless the insulation is bad). Thus, by connecting a condenser between the point P and the grid G_2 of the next valve, the desired effect is obtained.

In order to show clearly the successive steps in connecting two valves in cascade, and to explain the precise object of each step, the diagrams of Fig. 2 are included. The two valves 1 and 2 are shown at (a) with their cathodes joined to the negative high-tension terminal. Between the anode of the first valve and the positive H.T. terminal is the external anode resistance R (or possibly some other form of impedance Z). Assuming that the voltage to be amplified is applied to the input terminals at the left, the amplified potential variations set up at P must be made to produce the same variations at the grid of valve 2. Consequently, a

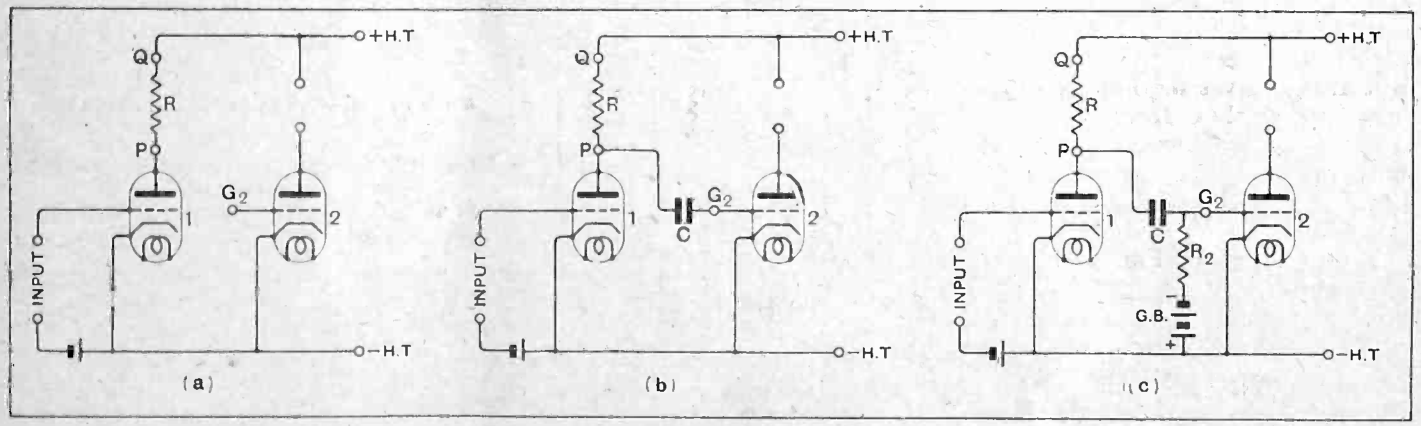


Fig. 2.—Diagrams explaining the process of coupling two valves in cascade.

The Theory of the Valve Amplifier.—

condenser C is connected between P and G_2, as shown at (b) in Fig. 2.

If no grid current flows in valve 2, and if the capacity between the grid and other electrodes is negligibly small compared with that of the coupling condenser C, it follows that the fluctuating voltage on the left-hand side of C cannot possibly cause any alteration in the charge which this condenser might possess in the first instance. A variation of charge can only be produced by a flow of current. Thus, *the potential difference between the plates of the coupling condenser is a fixed quantity, and therefore both plates follow the variations of voltage* at the anode P of the preceding valve. So, although the actual potentials of the plate of valve 1 and the grid of valve 2 may be different, they both vary about their respective mean potentials in the same way and to the same extent.

Necessity for a "Grid Leak."

Whilst the voltage variations at the anode P are faithfully copied at the grid G_2 with the simple circuit arrangement of Fig. 2 (b) when the coupling condenser C has a sufficiently large capacity, there is another important factor to be taken into consideration, which relates to the functioning of the second valve. Although an alternating voltage is applied to its grid, the mean potential of the grid must be maintained at such a value as to make the valve operate over the correct portion of its anode characteristic curve, whether this second valve acts as a detector or a second stage amplifier. In Fig. 2 (b) the grid of the second valve and the condenser plate connected to it are insulated from the rest of the circuit, and, therefore, the grid is free to take up any mean potential as determined by slight leakage or even electrostatic induction; for instance, if the dielectric of the coupling condenser C were not a very good insulator the grid side would tend to take up the same positive potential as the plate of the first valve. The grid of the second valve would thus be given a high positive voltage which would prevent the valve from functioning, and might even cause damage.

Assuming that the second valve required a mean potential negative with respect to the cathode, the next step is to consider how this can be applied without upsetting the transfer of signal voltage variations from the previous valve. If a battery of the correct voltage were to be connected directly between the grid and cathode (positive terminal to cathode and negative terminal to grid) the desired negative *grid bias* would be obtained, but the grid voltage would then be rigidly fixed relatively to that of the cathode, and no voltage variations would be imparted to it from the preceding valve. The voltage at the point G_2 must be free to vary in accordance with the voltage at P, and yet the mean voltage of G_2 must be maintained at a definite negative value. These two requirements are diametrically opposed as regards fulfilment—the one calls for an insulated grid (infinitely great resistance between grid and cathode) and the other for a battery, or the equivalent, to be connected between the grid and the cathode.

The difficulty is overcome by using the battery as suggested, but with a very high resistance connected in series with it. The grid bias battery and the high resistance are denoted by G.B. and R_2 respectively in Fig. 2 (c). The positive terminal of the battery is connected directly to the cathode of the valve and the high resistance comes between the negative terminal of the battery and the grid of the valve.

The high resistance R_2 is generally referred to as a "grid leak," but when used in this manner it does not represent a leak at all. (The term "grid leak" really only applies in the strict sense to a grid-detector valve.) Since no direct current can flow either through the coupling condenser or between the grid and cathode inside the valve (on account of the negative bias) it follows that the resistance R_2 will in normal circumstances carry no direct current, and there will be no D.C. potential difference between its ends. The mean potential of the grid of the valve is, therefore, equal to the potential of the negative terminal of the battery G.B. for any value of R_2 provided R_2 is small compared with the insulation resistance of the grid circuit, the latter resistance being usually of the order of tens or even hundreds of megohms.

Now, as regards the reason for introducing the high-resistance R_2. The essential condition for the transfer of the full voltage variation at the anode of the first valve to the grid of the second is that the charge held by the coupling condenser C shall be the same at all times. Joining G_2 directly to the negative terminal of the battery G.B. would destroy this condition, and yet G_2 must have an *average* potential equal to the negative terminal of G.B. Hence a compromise is adopted, R_2 being made so high that it has only a small disturbing effect on the action of the coupling condenser, but is, nevertheless, quite effective in conveying the necessary negative bias to the grid of the valve. This is a general principle adopted in conjunction with several coupling arrangements.

(*To be continued.*)

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 12th.

Lensbury Radio Society (in conjunction with R.S.G.B.).—At 6.15 p.m. At 16, Finsbury Circus, E.C.2. Lecture-demonstration: "The Latest Developments in Sound Reproduction," by Dr. N. W. McLachlan, M.I.E.E.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture and demonstration, by Mr. Frank Murphy, B.Sc., to include demonstrations of audio-frequency oscillator for checking loud speaker performance.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Sale and exchange.

THURSDAY, NOVEMBER 13th.

Edinburgh and District Radio Society.—Lecture: "Power Amplifiers," by Mr. J. L. Minto.

Golders Green and Hendon Radio Society.—At 8.15 p.m. At Woodstock School, Golders Green Road, N.W.11. Experiences on D.F. schemes, related by members of Golders Green, North Middlesex, and Western Postal District Societies.

Slade Radio (Birmingham).—At 8 p.m. At the Parochial Hall, Broomfield Road, Erdington. Lantern lecture: "Batteries and Their Maintenance," by Mr. O. P. Lockton (of Messrs. Exide).

FRIDAY, NOVEMBER 14th.

Bristol and District Radio Society.—At 7.15 p.m. In the Geographical Theatre, University of Bristol. Lecture: "Modern Mains Receivers," by Mr. E. J. Pound (of Messrs. L. McMichael, Ltd.).

SATURDAY, NOVEMBER 15th.

Tottenham Wireless Society.—Visit to Brookmans Park.

TUESDAY, NOVEMBER 18th.

Bec Radio Society.—At Bec School, Beechcroft Road, S.W.17. At 7.45 p.m. (Beginners' Section). Lecture: "Radio Currents and Their Reception." At 9.10 p.m.: Demonstration of members' apparatus.

WEDNESDAY, NOVEMBER 19th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture, by Mr. J. L. Thompson, to include demonstration of Cossor sets.

BROADCAST BREVITIES

By Our Special Correspondent.

The Orchestra.—Theatres and Licence Surplus.—Cinema Organs.

Secret Name for New Orchestra?

The problem of naming the B.B.C.'s new Symphony Orchestra exercised its sponsors from the very beginning, but publicly, at least, the orchestra still languishes without a title. I understand, however, that a name has already been metaphorically inscribed in copper plate, and now nestles privately in a little back drawer of the Director-General's desk.

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Waiting.

What that name will be, and why, must remain undisclosed until the probable occurrence of an historic event, early in the New Year.

What I can disclose is that the B.B.C. will not use the name suggested by a newspaper correspondent, viz., "broadestra." Neither are they attracted by "Boultestra."

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Interest in America.

The fame of the orchestra has already spread to America. The Columbia system has announced a relay throughout the U.S. of the orchestra's performance at the Queen's Hall on Wednesday, November 19th, when Sir Henry Wood conducts.

The transmission will be picked up from 5SW.

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A Compliment to 5SW.

That the Americans calmly rely on the efficiency of the Chelmsford short-wave station is a real tribute to 5SW. For a trans-American relay elaborate arrangements have to be made with a very large number of small stations, and the U.S. broadcasting authorities do not waste "hook-ups" on items which are doubtful.

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Scotland's Radio Show.

Edinburgh holds a joy week beginning to-day (Wednesday) when Sir John Reith, speaking into a microphone at Savoy Hill, opens the Scottish Radio Exhibition in the Waverley Market.

The chairman on to-day's occasion will be the Lord Provost of Edinburgh, and others present will include Mr. Gladstone Murray, the B.B.C. Assistant Controller, and Mr. Cleghorn Thomson, the Scottish Area Director.

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A Model Studio.

The "star" exhibit will be the B.B.C.'s stand, which takes the form of a model studio surrounded by glass, through which the public will witness broadcast artistes performing before the microphone.

The last occasion on which the B.B.C. gave this very attractive kind of demonstration was, I believe, at the Olympia Radio Show in 1926.

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Hands Off the Licence Surplus!

With that attractive little pile, i.e., the broadcast licence surplus, lying unused at the Treasury, is it any wonder that certain hungry birds are beginning to flutter round in hopes of a free meal?

FUTURE FEATURES.

NOVEMBER 19TH. — Symphony concert from Queen's Hall.

NOVEMBER 20TH.—Gaelic concert from Aberdeen.

NOVEMBER 21ST.—"Pelléas and Mélisande," a lyric drama by Maurice Maeterlinck

NOVEMBER 22ND.—Running commentary on Arsenal *v.* Middlesbrough football match, by Mr. George F. Allison.

London Regional.

NOVEMBER 16TH.—Military band concert.

NOVEMBER 17TH.—Brass band concert from Newcastle.

NOVEMBER 18TH.—"Pélléas and Mélisande."

NOVEMBER 19TH.—"Before the Party," adapted for broadcasting from story by Somerset Maugham.

NOVEMBER 21ST.—Dutch National programme from Holland.

Midland Regional.

NOVEMBER 17TH.—"Stars of the Past." Some melodies of bygone days.

NOVEMBER 18TH. — "Syncopated Pianisms."

West Regional (Cardiff).

NOVEMBER 16TH.—Concert from Park Hall, Cardiff.

North Regional (Manchester and Leeds).

NOVEMBER 17TH.—A Jewish orchestral programme.

Belfast.

NOVEMBER 18TH. — "The Drone," a comedy by Rutherford Mayne.

The British Drama League.

Prominent on the scene is the British Drama League, championed by Mr. Granville-Barker, who is reported as advocating that "a grant from the B.B.C. funds (sic) might be allotted by the Government as a credit for the establishment of a national theatre."

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Pity the Poor Listener.

Doubtless Mr. Granville-Barker actually refers to the licence surplus; the B.B.C. pleads "not guilty" to the accumulation of profits, all the money which reaches the Corporation being spent on programmes.

As a broadcast listener paying my ten shillings per annum, I find it difficult to remain calm in face of a proposal that some of my money should be devoted to a theatre from which I may never derive a ha'p'orth of benefit.

The Stage and the Microphone.

True, the National Theatre might offer broadcasting facilities, but it is a notorious fact that the average stage play is unsuited to the microphone. After much wrangling with the theatre interests the B.B.C. was granted permission to broadcast twenty-six times per annum from various playhouses, but the privilege has not been exercised owing to lack of suitable material.

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Permanent Vaudeville Artistes.

The B.B.C. has decided to start a new experiment in vaudeville on November 24 in the National programme.

A band of regular artists in these programmes will perform under the name of "The Foursome," and it will be their job to link up the performances, announce the "stars," sing choruses and generally keep things moving.

Members of "The Foursome" are Hermione Gingold, Olive Groves, Bernard Clifton and Ernest Sefton.

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Studio Opera Season Ends.

On November 18 and 19 the last of the present series of studio operas, Debussy's "Pelléas and Mélisande," will be broadcast from the Regional and National transmitters.

The studio series started in September, 1929, with "Thais."

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Organs.

The first of a series of talks on pipe organs will be broadcast by Mr. K. W. Anderson from Midland Regional on November 28th.

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Are Cinema Organs Played Out?

How many listeners, I wonder, noticed that the cinema organ recital advertised in the official programme for 1 o'clock on Tuesday of last week never took place? I am not specially interested in the reason why this recital "misfired"—I believe it was due to a forgotten stage rehearsal in the Victoria Theatre. What interests me is the fact that not one listener sent a letter of enquiry to the B.B.C.

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Church Organ Broadcasts in Request

Correspondence received at Savoy Hill seems to indicate that the bleating and hiccoughing cinema organ is no longer in request. On the other hand, real organ music was never more popular, a favourite organ with listeners being the splendid instrument in All Saints, Margaret Street, which gives good results despite the absence of cycle bells, cuckoo clocks, tambourines, alligators' jaws, or even a few homely fly swatters.

READERS' PROBLEMS.

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below.

The Best Anti-interference Circuit.

Due to the fact that interference from electrical circuits is severe, I find that the ordinary type of sensitive receiver with an open aerial-earth system is almost useless for distant reception. In an attempt to overcome this difficulty I intend to carry out some experiments with a frame aerial, and should like to set up the best possible arrangement; a two-circuit input tuner would not be objected to, as it is understood that this complication is well worth while.

Will you please recommend the most promising circuit? A.C. valves are to be used in the receiver, which will have at least two H.F. stages.

N. P.

We think you will find it difficult to better the input circuit shown in Fig. 1, which comprises a tuned centre-tapped

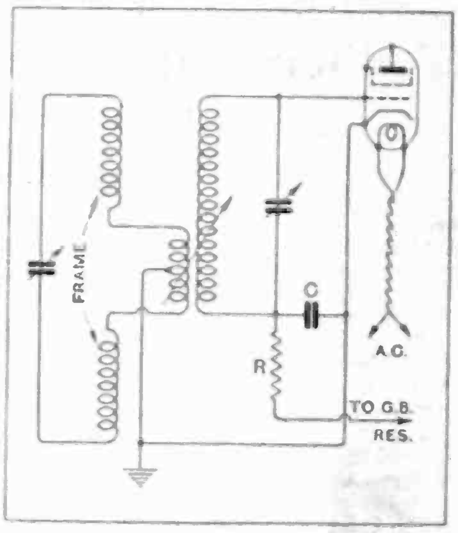

Fig. 1.—A loosely coupled frame aerial circuit with earthed centre point. R is a decoupling resistance, and C is the associated by-pass condenser.

frame, loosely coupled to a secondary circuit. The coupling coil, by means of which energy is transferred from one circuit to another, is inserted at the mid-point of the frame aerial winding, and its centre point is earthed in order to minimise "vertical" pick-up. For reception on the medium waveband a coupling coil with from six to eight turns should be quite adequate, and arrangements should be made to vary its position in relation to the low-potential end of the secondary inductance.

Of course, it will be necessary completely to shield the secondary and other receiver circuits from the frame aerial.

The Effects of Dampness.

I have been agreeably surprised to find that there is very little interference to my broadcast reception from a recently installed high-voltage overhead power line which runs within some thirty yards of the bottom of my garden. On a few occasions, however, "cracklings" have been observed; they generally seem to coincide with rainy weather, and are presumably due to leakages at the insulators.

Of late it has been noticed that this interference is sometimes evident when there is no rain, and, further, that the interference is even more pronounced than formerly. Do you think it is due to the fact that a heavier current is now being passed along the supply wires? If so, I fear that interference is likely to become more serious in the future, as the new system of electrical supply becomes more widely used.

L. B. F.

It is almost certain that the interference you have recently experienced is due solely to the damp weather which we have to expect in this country in the autumn. It has often been observed that "brushing" over insulators takes place more freely in humid weather than when rain is actually falling.

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On the Verge of Self-oscillation.

My set (anode bend detector and two resistance-coupled L.F. stages) works quite well as a receiver of wireless signals, but tends to "motor boat" when a gramophone pick-up is used. I cannot see why this should be, as the circuit is virtually unchanged, except for the fact that the pick-up is inserted in series with the detector grid, and bias is suitably reduced to convert this valve into an L.F. amplifier. Will you please give me an explanation, and, if possible, make a suggestion as to how L.F. oscillation may be prevented?

R. N. D.

When the detector is converted into an amplifier by reducing its grid bias, the impedance of the valve is reduced, and it gives a higher overall magnification. This, in turn, will be responsible for an increased tendency towards instability; it is quite probable that this tendency is present even when the receiver is operating in the normal way, and consequently the set is never working at its best.

We suggest that you should fit suitable decoupling resistances and by-pass condensers, or, if you have already done so, you should increase the values of all the decoupling components.

An Improvised G.B. Eliminator.

In the interests of economy I should like to make use of a quantity of obsolete apparatus already in my possession for the construction of a grid bias battery eliminator. It is intended to use an ordinary triode valve with grid and anode terminals connected together as a rectifier, and, as all A.C. ripple must obviously be avoided, I am thinking of using, as a smoothing choke, an old L.F. transformer with primary and secondary joined in series. Do you consider that this will be satisfactory?

H. D. V.

In this particular case the high D.C. resistance of the transformer windings should not be a serious disadvantage, and so your proposed plan should yield satisfactory results.

Care should be taken to see that the windings are connected together in the correct sense, so that maximum inductance may be obtained.

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Short-Wave Sets and Eliminators.

I am thinking of making one of the short-wave sets described in your journal, but am undecided whether to adopt the circuit of the "Superheterodyne Short-Wave Adaptor" (April 23rd, 1930), or the "S.G. Short-Wave Three" (January 1st, 1930). Of course, the adaptor would be operated in conjunction with my normal broadcast receiver. Which of these sets would be likely to work best with an H.T. eliminator?

L. B. R.

There can be no doubt that the circuit of the "S.G. Short-Wave Three" is the better when anode current is to be supplied by an eliminator. The superheterodyne unit, which includes an oscillating valve, would be definitely unsuitable for your needs, as any remaining traces of "hum" would modulate the oscillations produced by this valve.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."

(3.) Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.

(4.) Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.

(5.) Practical wiring plans cannot be supplied or considered.

(6.) Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.

(7.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.

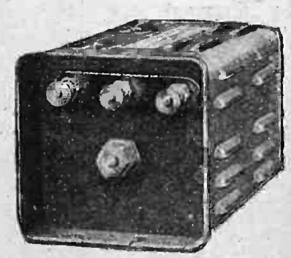
No Chemical Action

whatever.

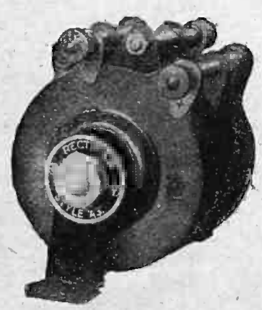
That is the essential difference between the Westinghouse METAL Rectifier, and so-called "metal" rectifiers depending upon electrolytic action which limits their life.

WESTINGHOUSE
METAL RECTIFIERS

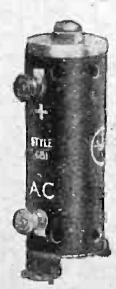
are now obtainable from 15/-, and there is a unit for every form of A.C. mains operation. These are three of them:—



HIGH TENSION



LOW TENSION



GRID BIAS

Full details of all units, circuits, and components required are given in our new book "The All=Metal Way, 1930," 40 pages of valuable information regarding A.C. mains operation.

Send 3d. stamp for a copy.

The Westinghouse Brake and Saxby Signal Co., Ltd.,
82, York Road, King's Cross, London, N.1.

Telephone: North 2415.

FOR VOLUME WITHOUT DISTORTION

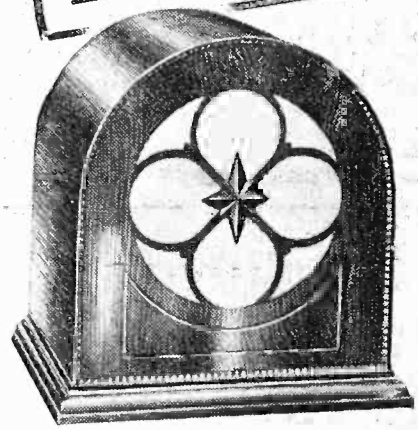
Use the

CAMCO

TRUETONE CABINET

Specially made for

MOVING COIL & DYNAMIC SPEAKERS



Construction of this fine cabinet (its sides and top are in one piece) ensures tone being completely free from resonance. The result is exceptional purity of reproduction. Inside dimensions: 13½" × 15" × 11". Marvellous value at only **38/-**

Visit our Showrooms and see for yourself.

We shall be pleased to send you our 24-page Catalogue free.

CARRINGTON MFG. Co., Ltd.,
24 Hatton Garden, London, E.C.1.
'Phone: Holborn 8202. (Factory: S. Croydon.)

24 pp. Catalogue please!

Name . . . .

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6578

Reduce your H.T. Running Cost 80%—

PROVED AND TESTED

BY TAKING IT FROM THE L.T. ACCUMULATOR—

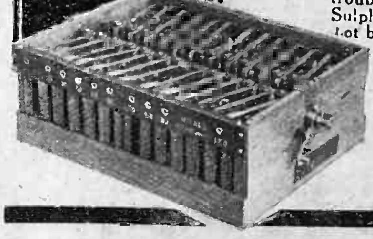
MILNES H.T. SUPPLY UNIT

See Editorial Report—WIRELESS WORLD, Oct. 22nd, 1930.

MANY TESTIMONIALS

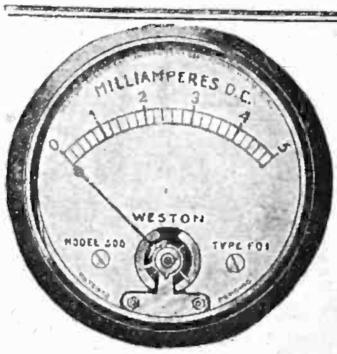
HIGH-TENSION IS FED AUTOMATICALLY FROM THE LOW-TENSION ACCUMULATOR

120 Volts Unit £4-5-0



THE Unit consists of indestructible nickel iron cells which are kept charged automatically from the L.T. accumulator—thus supplying a steady and ample stream of H.T. Current. The L.T. Accumulator will require very little more charging than formerly. It seems too good to be true—but nevertheless, it is. Absolutely abolishes H.T. worries. The "Alklum" nickel and iron plates are entirely free from the trouble customary with lead plates. Sulphation is impossible, and cells cannot be damaged by any rate of charge or discharge. Will supply 40 milli-amps per hour.

Write To-Day for Full Particulars:—
MILNES RADIO Co.
Cottingley Bridge,
BINGLEY — Yorks.
'Phone: Bingley 500.



It requires the accuracy and sensitivity of a Weston Mil-Ammeter to tell you exactly at which particular stage in your receiver distortion begins.

Try it in your H.T. leads in turn. Should the needle kick strongly either backwards or forwards when signal strength varies, it indicates transformer distortion, over-saturation of the valve, incorrect grid bias, filament temperature or H.T. Potential.

A Weston Mil-Ammeter is the only instrument sufficiently accurate to be of any value to you when making readings. Weston Instruments are standard the world over, and since 1888 have been unrivalled for scientific precision, uniform accuracy and unvarying reliability.

Weston Model 506 Mil-Ammeter Price 35/-

TO TRACE DISTORTION

WESTON

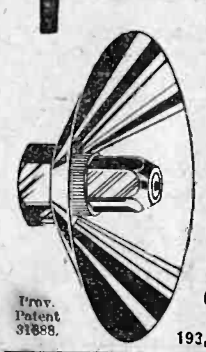
ELECTRICAL INSTRUMENT CO., LTD.,
15, Great Saffron Hill, London, E.C.1.

A.5.

TONAX

The Super Cone Loudspeaker Adaptor.

Sounds the death-knell to Chattering!



Prov. Patent 31888.

You will be amazed at the added purity of your reproduction.

By tightening the front nut the chuck grips the reed *at the back* of the cone, thereby ensuring perfect union between reed and cone and definitely preventing chattering. Fits any size unit. Supplied with specially lined washers.

The "Tonax" Adaptor assures that every sound impulse received by the reed is passed on to the cone *without loss.*

1/- Post paid 1/2.

GARRATT STORES,
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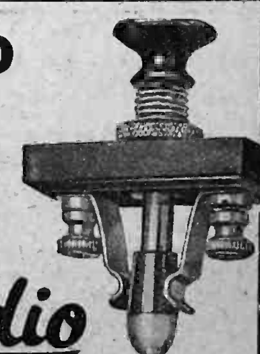
READI-RAD SWITCH

A push-pull on-and-off switch of exceptionally "clean" design and robust construction. Specially designed to maintain constant contact and smooth movement. Price **10d.**

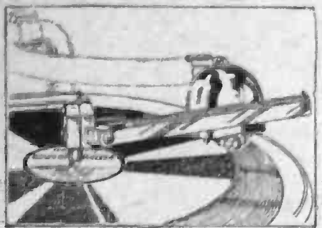


Ready Radio

(R. R. LTD.)
159, Borough High Street, London Bridge S.E.1.
'Phone: Hop 5555. 'Grams: "Readirad, Sedist."

Send for full list post free.

Make your own records



Here is an opportunity to make permanent gramophone records of your children's voices, musical talents, greetings and messages of your relatives and friends or of your own voice. The records are made by a simple device connected up to your radio set and gramophone. Complete apparatus, with six double sided records,

PRICE £4.12.0

Extra records 4d. each.
Parts may be bought separately.

SIMPLE. INEXPENSIVE. FAITHFUL REPRODUCTION.
PERMANENT. ENTERTAINING.

Write for full details and descriptive leaflet, explaining the secret of this wonderful home recording device to:—

CAIRNS & MORRISON, Ltd., 33 Percy St., LONDON, W.1
Telephone - Museum 6564.

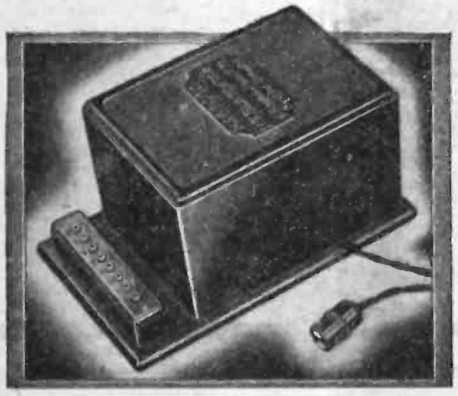
For all Things
WIRELESS

Consulting and
RADIO SERVICE
112 Hope St. Glasgow LTD.

Receiving Sets,
Components and—Service!

HOWATS

HARRODS



Battery A.C. Eliminator

This Eliminator has been entirely re-designed and embodies many new improvements including Harrods' own special Rectifiers covered by provisional patents. Two Rectifiers are used giving full wave rectification, the average life is two years, if refilled, and the cost of renewing is 1/3d. each. The output of 125 volts at 20 milliamperes, is provided with eight different voltage tappings. Assembled in a Walnut finished moulded Bakelite Cabinet measuring 10 ins. x 5 ins. x 5 ins.

Price **£2.10.0**

HARRODS LTD *LONDON SW1*

Dependable Resistances ELECTRAD

You can overcome all your resistance troubles if you specify Electrad when purchasing and ensure that only Electrad units and not imitations are supplied.

Truvolt fixed resistances constructed of Nichrome Wire on asbestos cord and Isolantite tube are thoroughly dependable units, and can be relied upon to give lasting and satisfactory service. Three distinct sizes of Truvolt fixed resistances are available, each unit being provided with a sliding clip so that resistance may be varied if desired.

Type B. 2" long rated at 25 watts.

100-7,500 ohms.	3/6	each.
8,000 ohms.	3/9	,,
10,000-15,000 ohms.	4/3	,,
20,000-25,000 ,,	4/9	,,
30,000-50,000 ,,	5/-	,,

Type C. 4" long rated at 50 watts.

100-5,000 ohms.	5/3	each.
7,000-8,000 ohms.	5/6	,,
10,000-15,000	6/-	,,
20,000-50,000	7/6	,,
100,000 ohms.	8/6	,,

Type D. 6" long rated at 75 watts.

100-5,000 ohms.	7/-	each.
7,000-10,000 ohms.	7/6	,,
15,000-50,000 ,,	8/6	,,
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It will pay you to get the new Electrad Catalogue describing the complete range of Truvolt variable and fixed resistances, grid resistors, Royalty potentiometers and the famous Loftin White direct coupled amplifiers. Write for your copy to-day—it's free.

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DIRECT TO ALTERNATING CURRENT
CONVERTERS.
FROM 50 WATTS UPWARDS.
PRICE, 50 to 100 WATTS, £10-0-0.

In order to show construction, end shields removed.

LANG & SQUIRE LTD.,
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Send for Lists.

REDFERN'S
EBONITE
H.F. Choke Former

A first-class quality Former that worthily upholds the reputation of Redfern's for high-grade components at moderate prices.
For Baseboard Mounting. Base can be removed for Mounting Horizontally.
Specification for Winding.—In each slot wind 162 turns of No. 36 SWG, DSC Wire.

REDFERN'S RUBBER WORKS Ltd.
Hyde - - Cheshire

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Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

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RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain's Radio Doctors.—Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

THOUSANDS of "Wireless World" Readers are Building the Band-pass Three. See advert. under Coils.—Groves Brothers. [2003

PHILIPS 4-valve A.C. Mains Receiver, 210v. 50c., perfect condition, £25, or nearest offer; Philips speaker, type 2007, £3.—Box 8037, c/o *The Wireless World.* [2054

WITHOUT FEAR—

Send your material for credit—where radio part exchange began. A service ruled only by economics, above bargaining or petty gain.

HONOR OMNIA SUPER

Particulars from the Secretary, APPLEBY'S, Chapel St., Marylebone, London

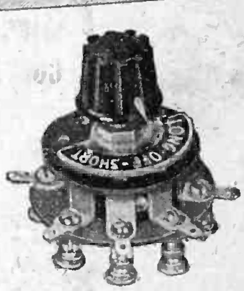
NEW SETS for OLD!

Here is an excellent opportunity for you to exchange your existing Radio Set or Gramophone for a new and up-to-date model. We will make a liberal allowance on your old instrument in part exchange for a new RADIO SET or GRAMOPHONE of any make which we will supply. We gladly offer you, *free*, our expert advice in the choice of a new instrument. Just send us a card giving particulars of your present radio set, or gramophone.

DRAZIN Radio and Gramophone Specialists.

59, HEATH STREET, HAMPSTEAD, N.W.3.

Telephone: Hampstead 8714.



CIRCUITS!

Write to-night for your free copy of our fully illustrated 1931 Catalogue which gives you several useful circuits in which this Double Pole Rotary Switch can be used. All the leading circuit designers are specifying this switch.

Without terminals 3/-.

THE BENJAMIN ELECTRIC LTD., Tariff Road, Tottenham, N.17. Tottenham 1500.

3/6

BENJAMIN

METAL CABINETS

For "W.W." E.M. IV, Kilo Mag IV and Record III. Oak Base and Finish. Sealed with Brass Gauze as specified.

PRICE 57/6 each.

Suitable Cabinets from	£2/6 each.
Standard Screening Boxes from	4/- each.

Coils, Escutcheons and Dials for above.

RIGBY AND WOOLFENDEN, ROCHDALE. *Tel. 2948.*

Receivers for Sale.—Contd.

PHILIPS 2511 Electric Receiver, 4-valve, 240 volts, £21; Philips 2013 moving coil L.S., £7; set and speaker complete, £26; H.M.V. No. 163 gramophone, mahogany, £18.—Saul, 8, Ansdell Rd., S. Ansdell, Blackpool. [1944

£15.—1930 Everyman Four, Rigby and Woolfenden cabinet, highest possible quality components, Mazda valves (new).—Fulton, 40, Kirkland St., Motherwell. [2052

ORGOLA Senior Kit, complete less panel, for "W.W."; deposit.—Bourne, Kabul, Hankham, Westham, Sussex. [2051

BRANDESET III B, with valves, £7; Pye 25 5-valve portable set, £12; Aeonic 5-valve portable set, £7; Veltone 5-valve portable set, £6; Epoch 66E moving coil speaker unit, 6-volt field, £3/10; 2 Marconi P.X.4 valves, 15/- each; 2 Marconi P625 valves, 5/-; all slightly used; reasonable offers accepted.—Atherton, Pensby Rd., Heswall, Cheshire. [2047

B.T.H. R.K. Senior (A.C. mains) Moving Coils and Last Stage Amplifier, pedestal cabinet, perfect condition; cost £45, accept £20.—Morgan, 24, Phœnix Lodge Mansions, Brook Green, W.6. Riverside 2176. [2046

1930 Kilomag Four, built to original specification in Ritherdon metal cabinet; £16.—B. V., 10, Parsifal Rd., Hampstead, N.W.6. [2041

£26 Receiver, mains, Selestion speaker; offers.—May, 31, Montague Av., Hanwell, W.7. [2037

MEGAVOX Chassis, complete, valves, accumulators, £12; Exide H.T. charger, £2; Ediswan L.T. charger, 25/-; Baker 6v. M.C. speaker, £3; Marconi ditto, £3; valves, P.M.4, P.M.24, Philips 506K, half price; all above guaranteed perfect.—Anning, Valley Drive, Ben Rhydding, Yorks. [2035

SILVER Marshall 7-valve Set, 4 screen grid det. power and superpower, extremely selective, band pass filters, several spare valves, £15; Regentone eliminator, 3 variable, 1 fixed, £5; 200v. A.C., all in perfect order; demonstration by appointment.—Colonel Kennard, 2, Adelphi Terrace, W.C.2. Temple Bar 1364. 8 a.m. to 4 p.m. [2034

NEW Kilomag Four, working satisfactory, Borcliff cabinet, Wearite coils, added Ferranti pull-push, with Mazda 2-volt valves; £10/10.—Newton, "Highcroft," Stanneylands Rd., Wilmslow. [2031

PYE 232 2-valve Set, with Mullard valves, shop soiled only; £2.

B.T.H. 2-valve Set, with valves, as new; £1/10.—Vautier, 234, Brixton Hill, S.W.2. [2029

McMICHAEL Super-range Portable Four, very little used, perfect condition; £15 or near offer.—Addey, "Ramzon," Cuckoo Hill Rd., Pinner. [2074

McMICHAEL Super-range Portable Screen Grid Four, latest model, new condition; £16/10.—5, Rugby Mansions, Addison Bridge, Kensington. Fulham 4302. [2076

4-VALVE Set, S.G., Anode bend detector, R.C. coupled to L.F., transformer coupled to super power, choke filter output, best components, fully decoupled, £10; also Met-Vic or Ekco eliminator, 200v. 60 m.a., £5; suit experimenter.—Burbridge, 79, Kingshall Rd., Beckenham. [3404

McMICHAEL Super-range Portable Four, as new; £18 or near offer; delivered free any part of London.—Reply Box 8048, c/o *The Wireless World.* [2096

EVERYMAN FOUR, complete, also wet H.T., in mahogany pedestal cabinet, Marconi cone and moving coil speakers, Phillips trickle charger; lot £12, or nearest offer.—Box 8047, c/o *The Wireless World.* [2095

ENTHUSIASTS!!—Superheterodyne kit: McMichael clock unit complete, set of Mullard 2-volt valves, 0.0003 and 0.0005 Lissen variables and dials, potentiometer, etc.; owner building band-pass superhet.; £4/10, or separately.—Houldsworth, 2, Pemberton Terrace, Cambridge. [2059

LIBERTY Heterodyne Wavemeter, 250 to 3,000 metres, extra valve and tuning charts, 50/-; Victor Three 3-valve receiver, complete valves, 50/-; 1929-30 McMichael Screened Dimic Three, battery model, complete, valves, as new, £15; seen by appointment.—Spice, 20, Dacre Rd., Eastbourne. [3102

SELECTOR Portable 33-guinea Attache Case Model, condition new, perfect working order, makers' guarantee; also Phillips 450 charger (110v.); what offers?—Gallagher, 3, Upper St., Islington, N.1. [2082

3-VALVE All-Mains Receivers, no batteries required, 6 guineas; Marconi A.C. eliminator, £2/10.—Brooks, 3, Anselm Rd., Fulham. [2069

5-VALVE Grebe Neutrodyne, complete with powerful eliminator and L.T. battery, wonderful results on frame or outside aerial; £18.—Mack, 58, Thornton Av., S.W.2. 'Phone: Streatham 2454. [2057

Receivers for Sale.—Contd.

YOUR Old Receiver or Component Taken in Part Exchange for New; write to us before purchasing elsewhere and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226

ACCUMULATORS—BATTERIES.

22 10v. Exide W.J., 2/6 each; 2 6v. 60 actual Rotax, 25/- each.—Birch, 30, Limesford Rd., S.E.15. Seen evenings. [2079

ACCUMULATOR HIRE.

DON'T Buy Dry Batteries, join our service; we keep you continuously supplied with fully charged C.A.V. high tension accumulators, by regular exchanges, anywhere within 12 miles of Charing Cross, for less than the cost of unreliable dry batteries; nothing to buy—no deposit, payment on each delivery or by quarterly subscription; if your dry batteries have been in use for one month or more we definitely guarantee that accumulators will give better and more selective reception; we also give the same service with low tension accumulators or maintain your own at equally advantageous terms from the smallest portable size upwards; over 10,000 satisfied users.—Write or 'phone now to London's largest, most efficient and complete wireless accumulator service, for their interesting folder 32, post free.—Radio Service (London), Ltd., 105, Torriano Av., Camden Rd., N.W.5. 'Phone: North 0823 (3 lines). [1466

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PHILIPSON'S Safety H.T. Supply Units are Famous for Reliability and Silent Working.

OUR New Prices Again Make Them Famous for Value; for D.C. mains model D.C.4 gives 120v. at 15 m.a., 27/6; D.C.5. 150v. at 25 m.a., 1 fixed, 2 var. tappings, 35/-; for A.C. mains model A.C.7. 120v. at 20 m.a., £3; A.C.5. 150v. at 30 m.a., 1 fixed, 2 var. tappings, £3/17/6; A.C.6, for 25 cycle mains, £5.

PHILIPSON'S Safety H.T. Supply Units are Guaranteed for 12 months; write for our booklet, "Radio Power."

PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. 'Phone: 2038. 'Grams: Safety, Bolton. Est. over 50 years. [0318

TANTALUM and Lionium for A.C. Rectifiers, blue prints for inexpensive H.T. and L.T. chargers.—Blackwells Metallurgical Works, Ltd., Garston, Liverpool. [1209

CHESTER BROS.—All types of mains transformers and chokes to any specification.—Chester Bros., 495, Cambridge Rd., London, E.2.

CHESTER BROS.—Type V3 220+220v., 35 ma., 5v. 1.6a., C.T., 4v. 4a. C.T., 27/6.

CHESTER BROS.—Type W.10, for H.T., 3 or 4, output 135v. 50 m.a., and 4v. 4a., C.T.; 23/6.

CHESTER BROS.—Smoothing chokes, constant inductance, type C.B.2, 45 henrys, 25 m.a.; 15/-.

CHESTER BROS.—Write for lists of standard models. Please note change of address. [1477

SAVAGE'S Specialise in Wireless Power from the Mains; reliable apparatus at reasonable prices.

SAVAGE'S Transformer Laminations and Bakelite Bobbins; intending home constructors should write for list.

SAVAGE'S Reliable Smoothing Condensers, 1,500 volts D.C. test, 1 mfd. 2/-, 2 mfd. 3/-, 4 mfd. 5/3; 500 volts D.C. test, 1 mfd. 1/6, 2 mfd. 2/3; 4 mfd. 3/9.

SAVAGE'S Power Chokes for the Power Pentode Two, smoothing L.C.36G, 18/-; output L.C.36P.G., 19/6; many other types available, write for list.

SAVAGE'S Mains Transformers for the New Westinghouse Units; please write for list.

SAVAGE'S New Foreign Listeners' Four Equipment —Transformer, N.F.L.4, 33/-; smoothing choke, C32G, 20/-; output choke C32/O, 20/-.

SAVAGE'S "Wireless World" Four Equipment, mains transformer, W.W.4, 34/-; smoothing and bias chokes, type W.W.4C, 16/- each; centre tapped output choke, L.C.36P.G., 19/6.

SAVAGE'S Mains Transformer, B.T.4, 500-0-500 volts 120 m.amps., 7½ volts 3 amps., 6 volts 3 amps., 4 volts 2 amps., 4 volts 1 amp., 4 volts 1 amp., all centre tapped, specially developed to facilitate automatic bias in all stages; 57/6.

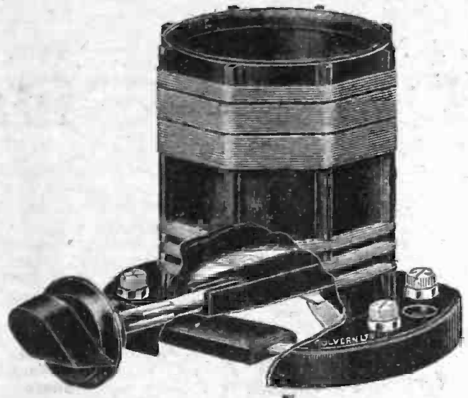
SAVAGE'S Mains Transformer, V.T.37, 250-0-250 volts 60 m.amps., 4 volts 1 amp., 4 volts 1 amp., 4 volts 1 amp., 4 volts 2 amps., all centre tapped, a useful instrument for modern receivers with automatic bias in every stage; 35/-.

SAVAGE'S Mains Transformers and Power Chokes are carefully constructed from first class materials with an exceptionally generous margin of safety; they are truly guaranteed and may be purchased with confidence.

SAVAGE'S Have Moved to Larger Premises; please note new address: 292, Bishopsgate, London, E.C.2. Telephone: Bishopsgate 4297. [1784

REGENTONE W.1 Eliminator, 200-250 A.C., output 200 volts 50 milliamps, in perfect condition; £3/10.—Ross, Elmbank, Friern Lane, N.11. [2084

COLVERN COMPONENTS FOR THE "WIRELESS WORLD FOUR"



4 TGSC Coils, 9/6 each

4 Screens, Type CCS, 3/6 each

WIRE WOUND COLVERSTATS

1 Colverstat 40 ohms	2/6
1 Colverstat 15,000 ohms	2/6
1 Colverstat 25,000 ohms	2/6
1 Colverstat 35,000 ohms	2/6
1 Colverstat 20,000 ohms centre tapped	3/6
1 Colverstat 40,000 ohms centre tapped	3/6
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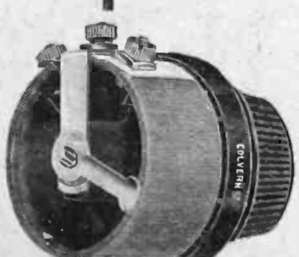

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ELIMINATOR Kits, transformers, choke, condensers, valve, valve holder, resistance, terminals; 36/-; post free.—Fel-Ectric Radio, Garden St., Sheffield. [2049

WESTINGHOUSE H.T.3 Rectifier, nearly new, 12/6.—Chapman, Trillick, Ground Lane, Hatfield, Herts. [2045

PHILIPS Trickle Charger, 215-230v., 30/-; Philips eliminator, A.C. 220v., 60/-; Lotus mains and battery relay, 12/-, all in perfect order.—Moore, Old Rectory, Monks Risborough, Bucks. [2043

RADIELLE D.C.100 (200-250 D.C.), output 200 volts, 100 m.a., and 2 variable tappings; cost £9/10, sell £3; brand new; sent c.o.d.—Priestley, 8, Grosvenor Gardens, Muswell Hill, London, N.10. [1969

HENDERSON H.T. Eliminator, 240v. D.C. mains, fixed and variable outputs, 18/-; also Regentone combined H.T. eliminator L.T. charger, 230-250 A.C. mains, 90/-, cost 117/-.—Box 8050, c/o *The Wireless World*. [2098

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MAINS Transformers, 240+240 80 m.a., 4v. 5a., 4v. 2a., 25/-; special transformers and chokes made in 24 hours; trade enquiries invited.—Challis, 22, Park Rd., Rugby. [2064

BRYCE'S.—Mains transformers experienced constructors recommend, type A.B.64, 250-0-250v, 60 m.a., 4v. 1a. C.T., 4v. 3a. C.T., 6v. 1a. C.T., price 24/6; post 1/-; guaranteed; write for lists.—Bryce's, 54, Dawson St., Bury, Lancs. [2061

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TRANSFORMERS and Chokes for Battery Eliminators.—Chester Bros., 495, Cambridge Rd., London, E.2. [9706

600 and 1,000 ohms Decoupling Resistances, specified for the largest and most important "Wireless World" receivers; 1/6 each, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1732

BAND-PASS Three Coils, 30/- set; slotted formers for winding, 8/6 set; grooved primary supports, 2/- set, all post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1904

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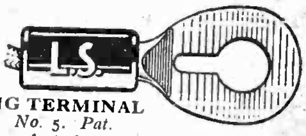

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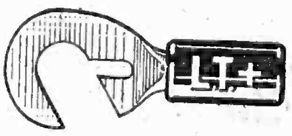

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REALISTIC Speakers true to name, the greatest advance to perfection, not a cone or horn type; write to-day for particulars; Realistic chassis and speakers demonstrated daily.—Realistic Speakers, 72, Penton St., N.1; also 52, Broadwater Rd., Worthing. [1296

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OWING to Change Over from D.C. to A.C., advertiser has Baker moving coil loud-speaker for disposal, new February, 1930; cost £6/15, perfect, accept £3.—"Fenwood," Eastwood Rd., Leigh-on-Sea. [2038

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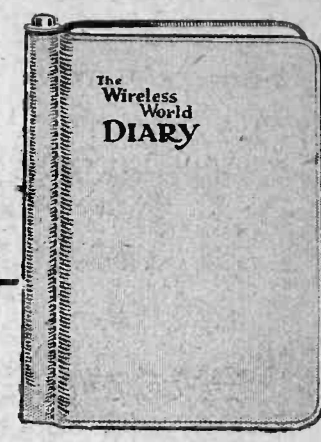

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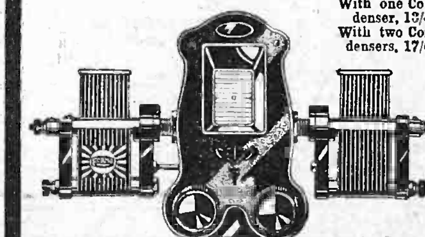

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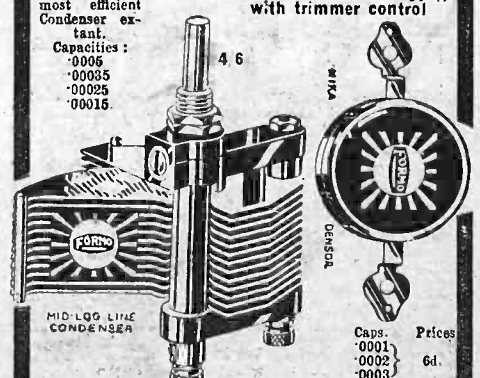

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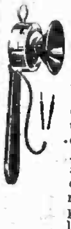

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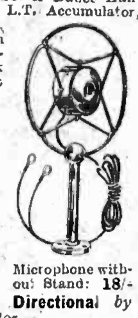

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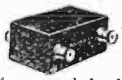

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PART Exchange.—See our advertisement under Receivers for Sale.—Scientific Development Co., 57, Guildhall St., Preston. [0228

66K Blue Spot Unit, 15/-; Colvern D.W. Master Three Star coil, 9/6; Ekco D.C. H.T. unit, 230-250v. 20m. variable, 32/6 (used month); all guaranteed perfect.—Joyce, 3, Newlands Terrace, Queens Rd., S.W.8. [2078

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FERRANTI A.F.5, 15/-; Savage B.T.4, 37/6; 2 U8 valves, brand new, 12/6 each; 10a Garrard motor, 20/-.—Wallis, 58a, Endlesham Rd., S.W.12. [2087

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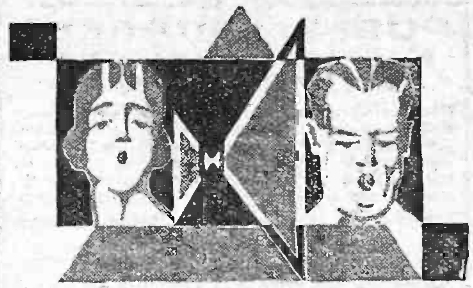

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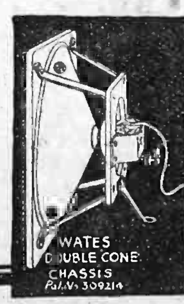

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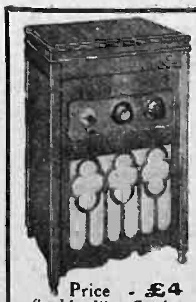

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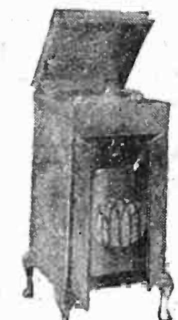

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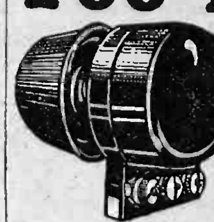

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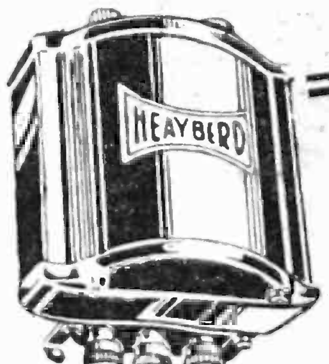

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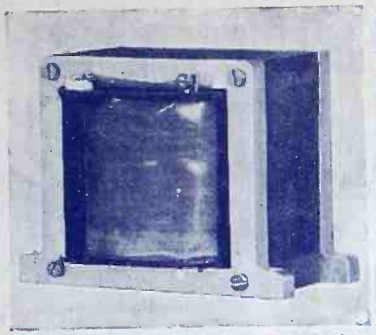

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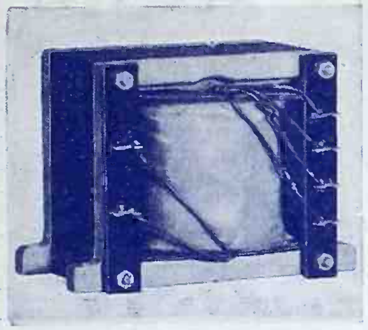

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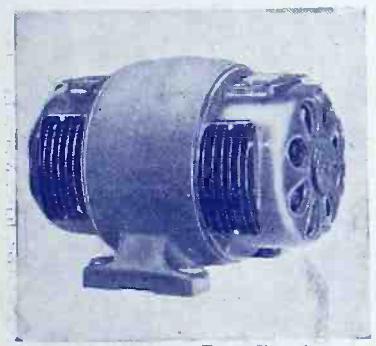

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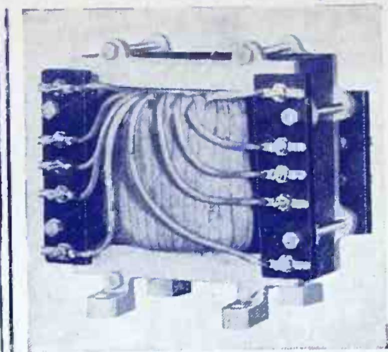

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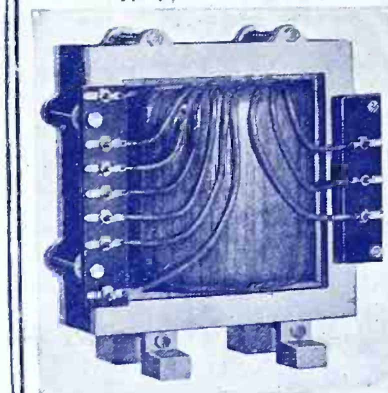

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1931 RADIO RECEIVERS—BUYERS' GUIDE.

The Wireless World

AND RADIO REVIEW

4D

The Paper for Every Wireless Amateur

Wednesday, November 19th, 1930.

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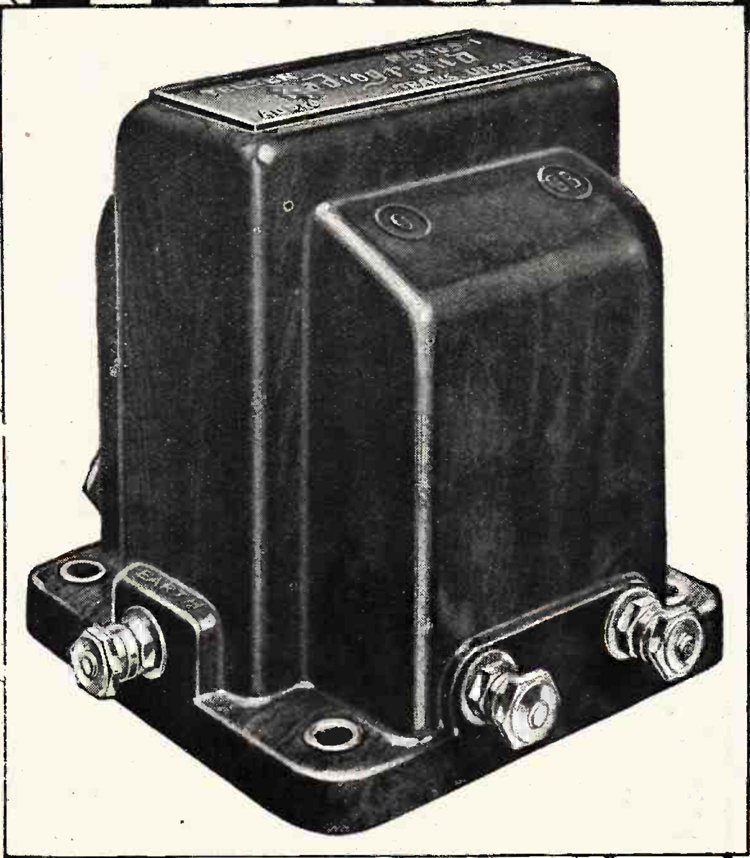

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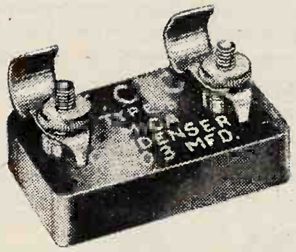

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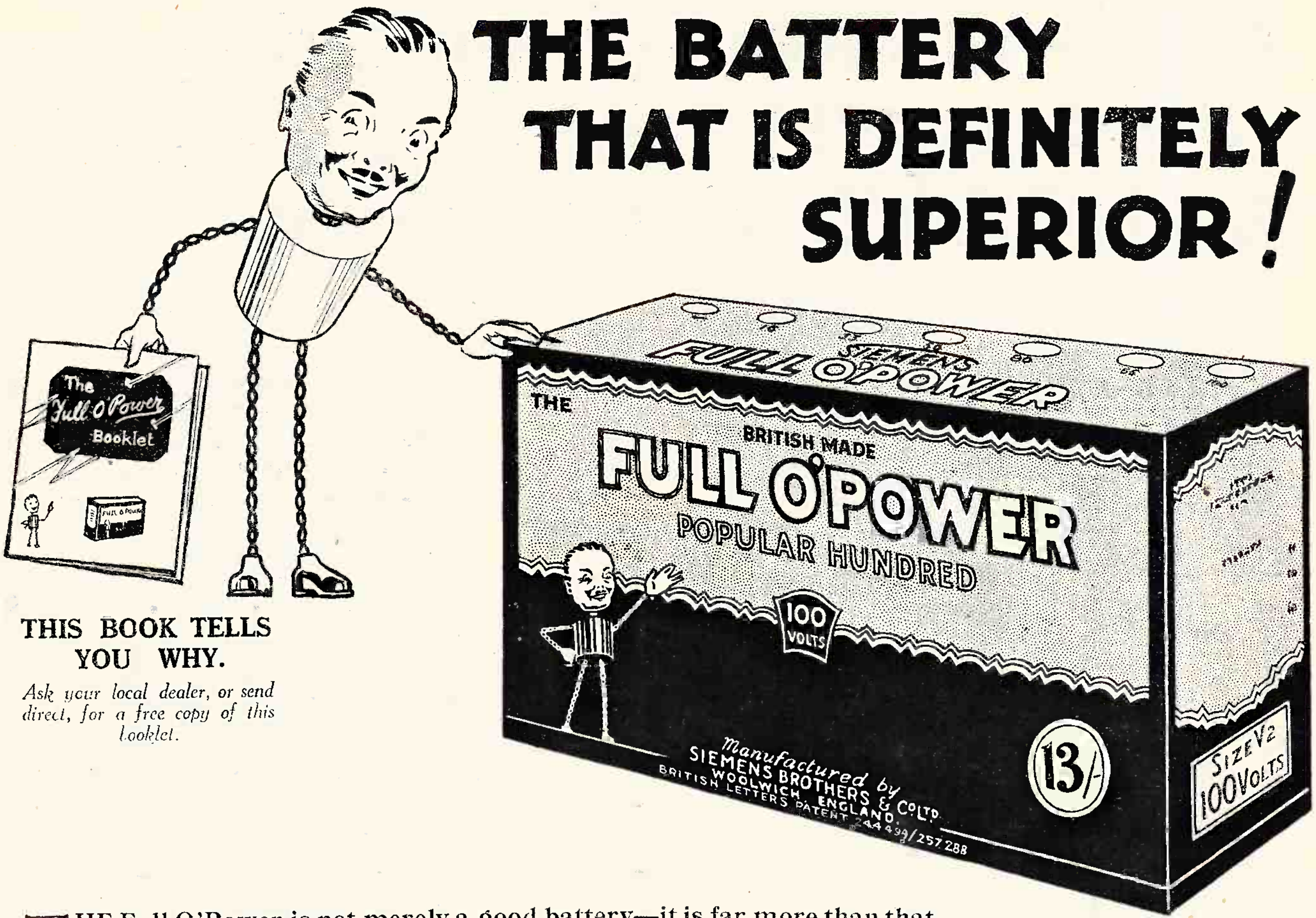

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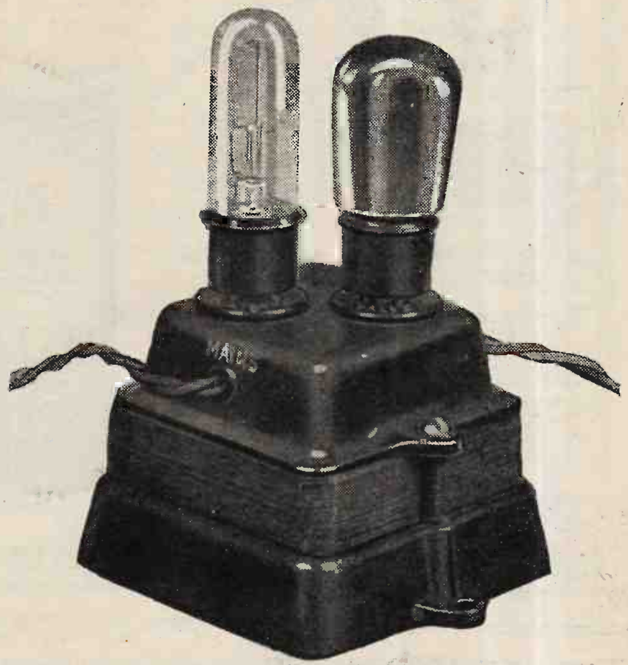

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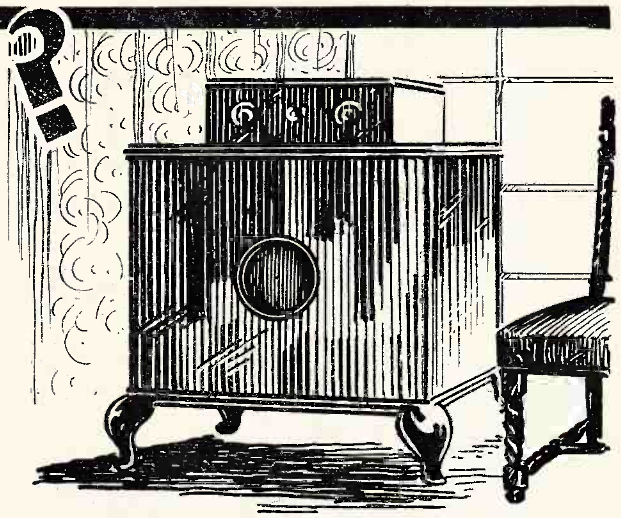

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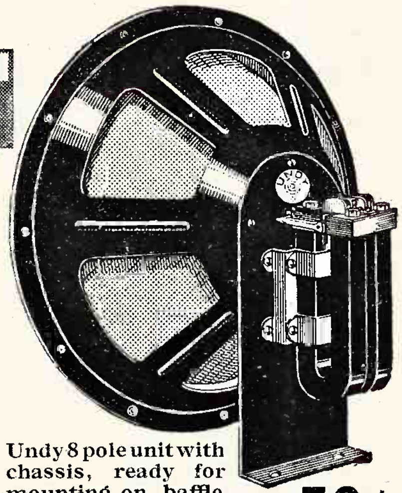

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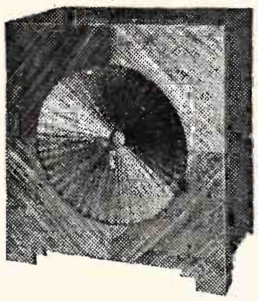

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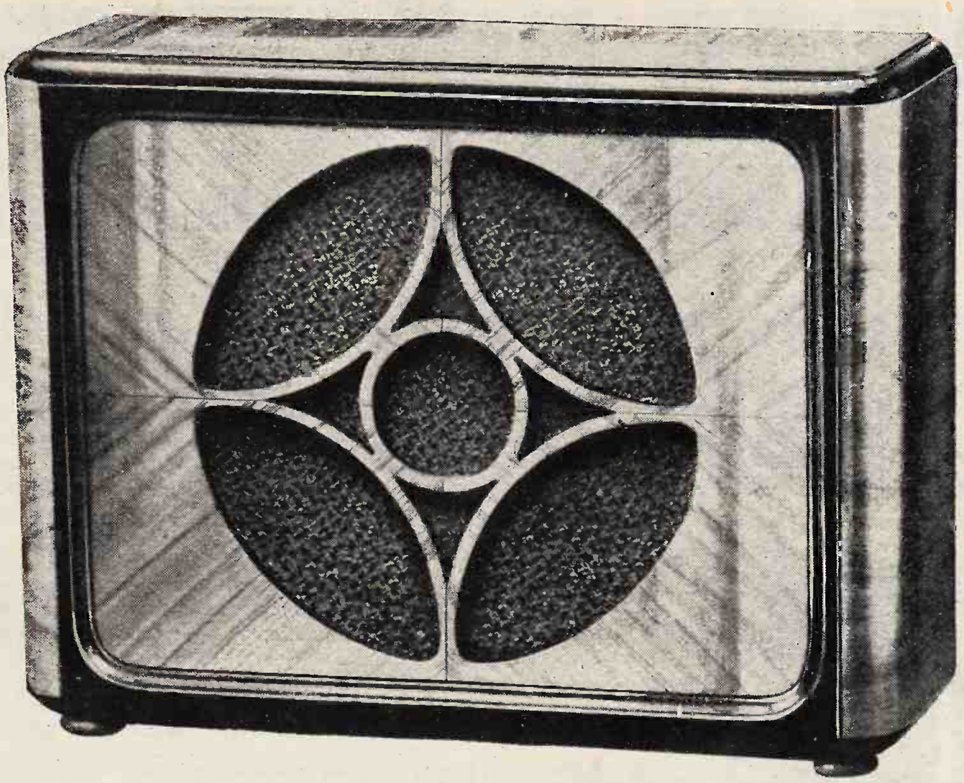

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(18th Year of Publication)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

Editorial Comment

Modern Sets and Circuits.

IN this issue we include the list which we annually compile of receivers, with general information on the nature of the circuits employed and other details to make up an index or reference guide to assist our readers in the selection of sets for any particular requirements.

In view of the number of sets it is necessary that the published information should be condensed and rather brief, but every effort has been made to ensure that all the more important particulars are included.

The work of compilation of this list has served to remind us once again of the growing complexity of the average receiver of to-day, and to emphasise the importance of the proposal which we recently set forth in these columns that every receiver issued should carry with it a circuit diagram for the information of the purchaser and as a guide in the event of service to the set becoming necessary.

In our correspondence columns we publish a letter from a firm of manufacturers who, recognising the importance of our suggestion as an aid to service, have written to us to say that they are taking immediate steps to arrange for circuit diagrams to be supplied with every new receiver issued. We hope that this lead will be followed by all manufacturers who have not already adopted the policy, and we can scarcely believe that there are any manufacturers who will find legitimate reasons for withholding this essential information from the purchasers of their sets.

It is not enough that a circuit diagram should be included with the literature or instruction leaflet accompanying a set, since this information almost invariably goes astray in time, and is seldom available at the critical moment when some defect develops in the set. The circuit diagram should, as we suggested, be positively attached to the set, either in the lid or at the back of the cabinet in some position where it can easily be got at for reference, but from which it is not likely to be removed.

The time has long since passed when tracing out of the circuit of the receiver was only a matter of a few minutes. It is only necessary to study the pages of the present issue, the details of receivers included in the Buyers' Guide section, and the analysis of modern receiver design, to be satisfied on this score, and to realise that the task of tracing out the complete circuit must be, in some cases, a matter of two or three hours' work, even for an expert, and then accomplished only at the risk of completely dismantling some parts of the receiver in order to get access to hidden details.

Again we would urge that every manufacturer should give attention to this point, and that purchasers of receivers should insist upon the supply of a complete circuit diagram when taking delivery of a new receiver.

In This Issue

SMOOTHING.
THE CHOICE OF A RECEIVER.
CURRENT TOPICS.
RECEIVING SETS OF TO-DAY.
BUYERS' GUIDE, 1930-31.
THEORY OF THE VALVE AMPLIFIER.
BROADCAST BREVITIES.
LETTERS TO THE EDITOR.
READERS' PROBLEMS.

SMOOTHING

A Guide to the Choice of Components for Eliminators.

By W. T. COCKING.

SMOOTHING circuits are of many types, but in nearly every case their principles of operation are the same. They depend for their action upon the presence of a high impedance, represented by the choke in the choke-capacity circuit of Fig. 1(a) and by the resistance in the resistance-capacity circuit of Fig. 1(b), in series with a low impedance, which usually consists of a condenser. Since the total circuit impedance to alternating currents is large, only a small current flows through it; and, consequently, only a small output of voltage is set up by the passage of this current through the low reactance condenser.

THE problem of smoothing in A.C. mains sets has been rather overshadowed of late by the attention which has been devoted to the elimination of the filament heating accumulator and the grid bias battery. This is due to the fact that there is no real difficulty in eliminating hum from the H.T. supply by the present methods, and any research into smoothing circuits must have for its object the attainment of a greater economy of apparatus. Attention is given in this article to the problem of progressive smoothing whereby each stage of a set is considered with regard to the amount of subsequent amplification.

The output of a full-wave rectifier consists of a pulsating direct current, which, for the purposes of this article, can be considered as being equivalent to a pure direct current upon which are superimposed a number of alternating currents of various frequencies. The hum which is obtained with an unsmoothed supply is due to these alternating currents; but it is not, as is often supposed, of a single frequency. It consists of a number of different frequencies, all of which bear a definite relation to the frequency of the supply mains. With the usual 50 cycles mains the predominant hum frequency is 100 cycles; but there are also currents of 50, 150, 200, etc., cycles present in the rectifier output. Although the amplitudes of these currents are small compared with the 100-cycles current, they can by no means be neglected, and they must be taken into consideration in the design of the smoothing equipment.

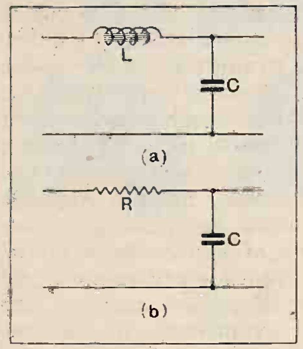


Fig. 1.—The simplest choke-capacity smoothing circuit (a). A resistance-capacity smoothing circuit, more usually known as a decoupling circuit, is given in (b).

It will be seen, therefore, that the smoothing circuits must be operative over a large band of frequencies; it is not necessary, however, to eliminate hum completely, but only to reduce it to a level which is just below audibility. Consequently, the current for the power output stage of a receiver does not require smoothing to such a great degree as that for the earlier stages, as these are followed by a large amount of amplification. It is possible, therefore, to develop proportional smoothing circuits, which give a maximum of smoothing with a minimum of apparatus. In practice, such circuits give excellent results, but it is essential that they should be designed for the particular set with which they are to be used. In general, a proportional smoothing circuit will not work well with sets other than the receiver for which it is designed.

Little data appears to be available for the design of such circuits, and it is the purpose of this article, therefore, to show methods whereby the amount of smoothing necessary in any given case can be determined, and the circuit and values of components chosen. In order to simplify the discussion, the rules and principles underlying the design will be considered in conjunction with the practical design of a filter for a particular receiver. This set will be taken to consist of an AC/HL power-grid detector coupled to a single P.625 output valve by means

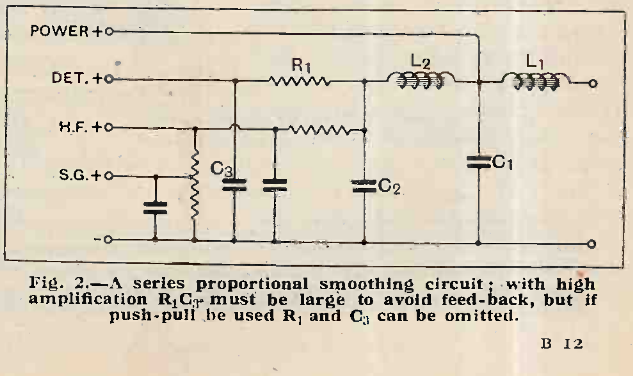


Fig. 2.—A series proportional smoothing circuit; with high amplification R_1C_3 must be large to avoid feed-back, but if push-pull be used R_1 and C_3 can be omitted.

Smoothing.—

of a 3.5-1 ratio transformer, and the detector may or may not be preceded by H.F. stages.

In Fig. 2 is given the circuit of a suitable proportional smoothing circuit for such a set, and the problem becomes one of determining the minimum values for the chokes, resistances and condensers. It will be seen that the first smoothing stage, consisting of the choke L_1 and the condenser C_1, smooths the whole H.T. current to the degree necessitated by the output stage; the second stage, consisting of the choke L_2 and the condenser C_2, provides the additional smoothing necessary for the detector and H.F. stages.

The Detector Circuit.

Let us begin with a consideration of the detector smoothing circuit, which is comprised principally by the choke L_2 and the condenser C_2. This circuit must reduce the hum which remains after the first smoothing stage to a degree sufficient to eliminate audible hum from the detector circuit. Obviously, the amount of smoothing required will depend upon the amplification given by this stage of the set, and will be greater the greater the amplification. If the first smoothing stage reduces the hum to x per cent. of its unsmoothed value, it must be reduced to x/A per cent. for the detector circuit, where A is the amplification between the anode circuit of the detector and the anode circuit of the output valve. This somewhat unusual method of reckoning stage gain is necessary when considering smoothing circuits, and throughout this article the term "stage gain" must be taken to mean the amplification reckoned between adjacent *anodes*.

Since the total hum reduction for the detector is x/A per cent., the hum in the detector circuit must not be more than $100/A$ per cent. of its value in the output valve circuit; that is, the choke L_2 and the condenser C_2 must reduce hum to $100/A$ per cent.

Provided that certain assumptions be made and the effect of the receiver characteristics upon the smoothing be ignored, it can be shown mathematically that the smoothing given by any choke and condenser, the product of whose inductance and capacity is the same, will be identical. Briefly, this means that a 4 mfd. condenser and a 10H. choke will give the same results as a 2 mfd. condenser and a 20H. choke. This leads to a convenient method of expressing the efficacy of various combinations of inductance and capacity; and the curves of Fig. 3 give the approximate amount of hum in the output of a circuit of the type of Fig. 1(a), expressed as a percentage of the input hum. The figures marked against each curve refer to the LC product for that curve, L being taken in henrys and C in microfarads.

The smoothing of the resistance-capacity circuit of Fig. 1(b) can be expressed in exactly the same manner, and the curves of Fig. 4 give this information; different combinations of resistance and capacity whose products are the same give the same results, and the curves are accordingly marked in RC products, R being taken in ohms and C in microfarads.

Now from an inspection of these curves we can readily choose values for the smoothing equipment, provided that the required percentage hum reduction is known. In the example, the stage gain is 21, so the reduction of hum to be given by the second smoothing stage is 100/21 per cent., or 4.75 per cent. An LC product of 56 will give this degree of smoothing at 100 cycles, and since this means a 28H. choke and a 2 mfd. condenser, we should normally choose such convenient values which are standard.

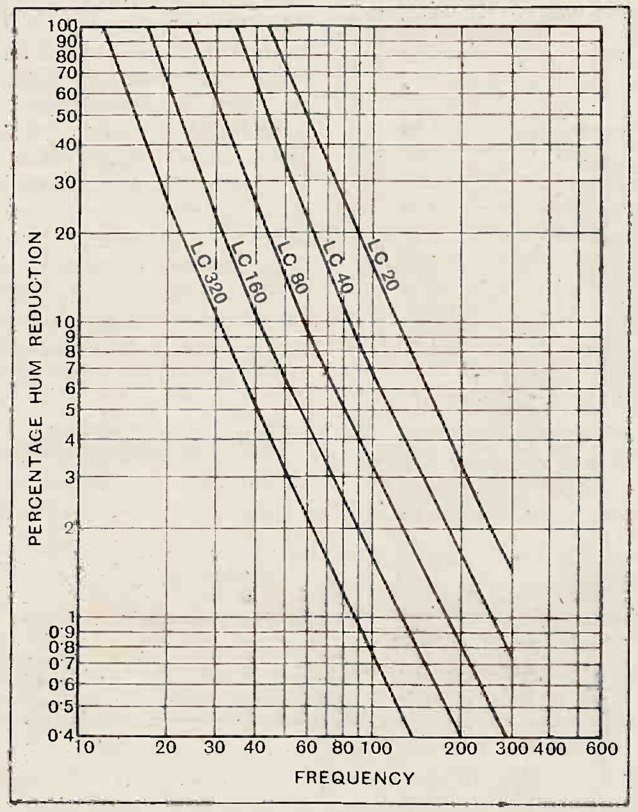


Fig. 3.—The approximate smoothing obtainable with any combination of inductance and capacity can be read off from these curves; the figures marked against each curve refer to the product of inductance in henrys and capacity in microfarads for that curve.

We have now to determine the smoothing necessary for the first stage; and, unfortunately, this can only be done by experiment, for the maximum permissible hum is largely dependent upon the loud speaker employed. It has been the writer's experience that with the output stage mentioned and a good reed-drive type speaker, an LC product of about 30 will give sufficient smoothing. One would usually choose, therefore, a 15H. choke and a 2 mfd. condenser; but when a moving-coil speaker is used greater smoothing may become necessary, and it is unwise to use anything less than an LC product of 60; that is, a 4 mfd. condenser with the same 15H. choke. It will be realised that no alteration of the second smoothing stage should be necessary with this type of proportional smoothing circuit, for increasing the first stage smoothing automatically increases the smoothing of the whole receiver.

No mention has been made of decoupling in the foregoing discussion, but the inclusion of suitable circuits

Smoothing.—

is very important. In general, it may be said that a set of the type mentioned will not work satisfactorily with a proportional smoothing circuit unless thorough decoupling be included. Now the normal resistance-capacity decoupling circuits are in no way different from smoothing circuits, and, as usually connected, they add very considerably to the smoothing. The curves of

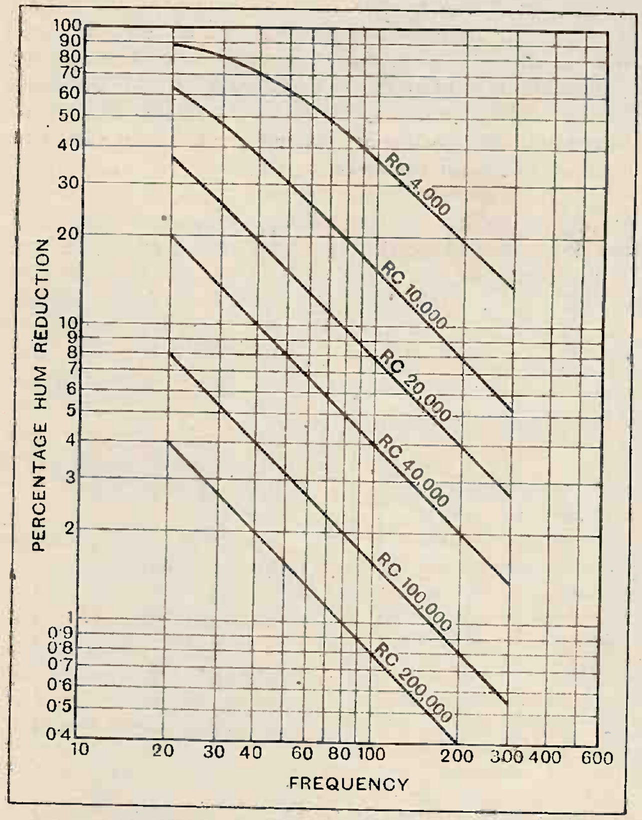


Fig. 4.—The smoothing given by a resistance-capacity circuit can be seen from these curves; the figures marked against each curve refer to the product of resistance in ohms and capacity in microfarads for that curve. The relative efficacy of various decoupling circuits can also be seen.

Fig. 4, therefore, may be used as a measure of the decoupling efficiency of any resistance-capacity combination. Now an inspection of Fig. 2 shows that the second smoothing stage will apparently act as a decoupling device, the only difference from the usual circuit being the use of a choke instead of a resistance. This difference, however, is important, for the choke-capacity circuit has a resonance frequency at which there is no smoothing and no decoupling. This is not serious from the point of view of smoothing, since the usual values of components give a resonance frequency lower than the lowest hum frequency. This resonance frequency usually occurs at a frequency between 10 cycles and 40 cycles, and it is just this range of frequencies which is of most importance from the point of view of feed-back. Unless prohibitively large values of inductance and capacity be used, the choke-capacity circuit will not give immunity from feed-back troubles.

It will be seen, therefore, that it is necessary to include the resistance-capacity decoupling circuit comprised by R_1 and C_3 in Fig. 2. The value of this resistance is determined by the D.C. voltage drop which can be allowed and the steady anode current of the valve; the only control over decoupling, therefore, is that afforded by a variation in the condenser capacity. It is impossible to give values for these components, since the amount of decoupling necessary will be largely dependent upon the method of coupling the loud speaker to the output valve. In the writer's opinion, the RC product of the detector decoupling circuit should not be less than 40,000 when a choke-condenser output feed to the speaker is used. This may lead to an excessively large value of capacity when power-grid detection is used, for a high resistance is often impossible, owing to the D.C. voltage drop.

Practical Details.

It is of interest, therefore, to compare the smoothing necessary for the detector stage with the well-known circuit of Fig. 5, in which the smoothing for the different valves is completely separate. In Fig. 2 the detector smoothing circuit consisted of two choke-capacity circuits with LC products of 56 and 30; these give hum reductions to 4.75 per cent. and 9 per cent. respectively, or a total hum reduction to $0.0475 \times 0.09 = 0.00428$, or 0.428 per cent. In order to obtain this degree of smoothing in a single stage an LC product of about 640 is required, and this would mean a 4 mfd. condenser and a 160H. choke. If, however, the smoothing given by the resistance-capacity decoupling circuit of Fig. 5 be included, the choke inductance can be considerably reduced. An RC product of 40,000 will give a hum reduction to 4 per cent., and the choke-capacity stage need only give a reduction to about 10.7 per cent. An LC product of only 28 will give this degree of smoothing; it would, however, be unwise to use such a low product, and in practice one would employ a 30H. choke, and find by experiment the smallest satisfactory value for the condenser.

With the particular receiver which has been chosen for the purposes of illustration, the smoothing circuit of Fig. 5 is likely to prove more satisfactory than that of

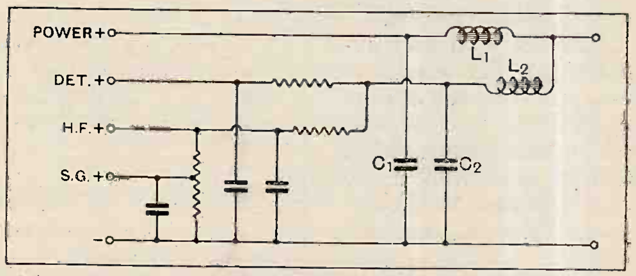


Fig. 5.—A form of smoothing circuit which introduces less feed-back than other types, but which may require more apparatus than the circuit of Fig. 2.

Fig. 2, solely on account of feed-back. The elimination of the final traces of hum, however, may prove more difficult, owing to the fact that the LC products of both smoothing branches must be increased if at any time a reduction of hum becomes necessary. With the circuit of Fig. 2, on the other hand, an increase in the LC product of the first smoothing stage is all that is required.

Smoothing.—

The advantages of push-pull have been often discussed in the pages of this journal, but it does not seem to be generally realised that its use is often a true economy. The smoothing required is only small, and feed-back is almost non-existent. It has been found that with unmatched P.625 type valves an LC product of only 16 for the first filter stage will give sufficient smoothing, while the resistance-capacity decoupling circuit of Fig. 2 can be entirely omitted. It must not be forgotten, of course, that any reduction in the first stage of series smoothing equipment must be compensated for by an increase in the second stage, as otherwise the detector will introduce hum. Sometimes, therefore, the greatest economy is obtained by using a larger LC product for the first stage than is strictly necessary, and a more usual value for the second stage.

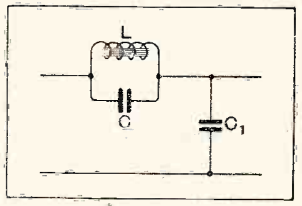


Fig. 6.—A special tuned smoothing circuit; the parallel tuned circuit L and C has a very high impedance at resonance, and at this frequency the smoothing is exceptionally good.

This is the procedure adopted in the Band Pass Four receiver, in which the first smoothing stage consists of a 12H. choke with a 2 mfd. condenser, giving an LC product of 24 and a hum reduction to 11 per cent. This is just about twice as much smoothing as is necessary for the output stage, but it saves using an excessively large choke for the detector stage. The second smoothing choke has an inductance of about 32H., and, with the 2 mfd. condenser, gives an LC product of 64, and a hum reduction to about 4 per cent. The total detector smoothing, therefore, is about $0.04 \times 0.11 = 0.0044$, or 0.44 per cent., which agrees well with an experimentally found figure of 0.475 per cent.

Tuned Smoothing.

The curves of Fig. 4 for a resistance-capacity circuit show that the smoothing given by such circuits can be very high, and a comparison with the curves of Fig. 3 for a choke-capacity circuit is interesting. It will be seen that for the same amount of smoothing at a fairly high frequency the resistance circuit is the more effective at the low frequencies. This is due to the fact that a resistance is constant to currents of all frequencies, whereas the reactance of a choke steadily falls as the frequency is decreased; also, there is no resonance frequency with the resistance-capacity circuit.

The practical result of this better low-frequency smoothing is evident, not so much in a reduction in hum as in a greater freedom from feed-back troubles. It is a true economy, therefore, to use resistance-capacity circuits where the D.C. voltage drop will allow of it. Indeed, it is often of advantage to increase the voltage output of the rectifier solely to allow of their use.

Since the principle of smoothing circuits depends upon there being a high impedance in series with a low impedance, it would appear that much better smoothing would be obtained by tuning the choke in the manner shown in Fig. 6. It will be seen that the choke L and the condenser C together form a parallel resonance circuit, and that at the resonant frequency they will be equivalent to a very high resistance. At this frequency, therefore, the smoothing is extraordinarily good; but unfortunately, at frequencies well removed from resonance, the impedance of the circuit is less than that of the choke alone, and the smoothing is then not so good.

This is shown by the curves of Fig. 7, in which curve A is for the usual circuit of Fig. 1(a), with a 25H. choke and a 2 mfd. condenser, the choke having a resistance of 750 ohms. Curve B is for the circuit of Fig. 6, and for the same value components, the condenser C having a capacity of 0.1 mfd. At 100 cycles, the tuned circuit reduces the hum to 0.3 per cent., as compared with the reduction to 5.5 per cent. for the ordinary circuit—that is, it is just eighteen times as efficient. At 200 cycles,

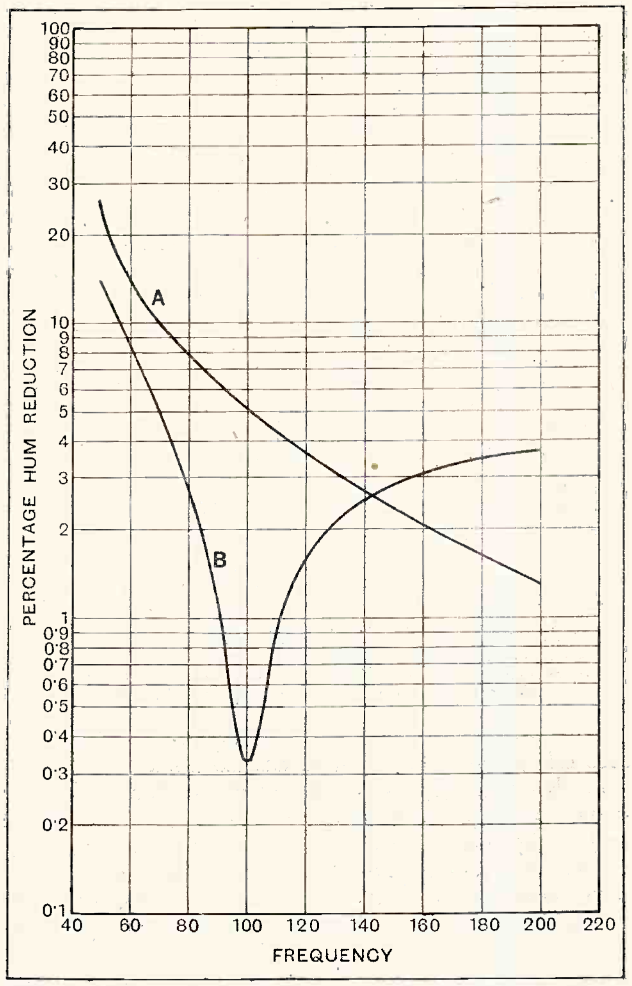


Fig. 7.—Curve A is for an ordinary choke-capacity smoothing circuit, with a choke inductance of 25 henrys, a resistance of 750 ohms, and a 2 mfd. condenser. Curve B is for a tuned smoothing circuit with the same constant as for curve A and the choke shunted by a 0.1 mfd. condenser. Note the high degree of smoothing obtained at 100 cycles.

however, the tuned circuit only reduces the hum to 3.8 per cent., while the ordinary circuit gives a reduction to 1.2 per cent.; that is, at this frequency the usual circuit is about three times as good. At slightly over 140 cycles it will be seen that the curves cross and the two circuits are equally efficient.

Smoothing.—

In practice, the tuned smoothing circuit usually reduces the 100 cycles hum below audibility, but introduces hum of a higher frequency which may easily be more noticeable. When used in conjunction with an ordinary circuit, however, it offers a very simple and inexpensive method of eliminating the final traces of hum from a receiver. In the circuit of Fig. 2 it should always be the second choke which is tuned, for in this position the reduction in high-frequency smoothing is the least serious. It has been the writer's experience that the tuned circuit is of little use with reed-drive type loud speakers, since the principal hum which they reproduce is of fairly high frequency, but that it may be of great value with the moving-coil speaker, which will readily reproduce the lowest hum frequencies, and which are the most difficult to remove with the ordinary circuits.

No definite design rules can be given, beyond saying that the larger the choke inductance and the lower the resistance, the better will be the smoothing at all frequencies. A large choke inductance means a small-capacity tuning condenser, and consequently a small shunting effect upon the high frequencies; while a large ratio of inductance to capacity and a low resistance mean a high effective resistance at resonance. It should be noted that this is opposite to the ordinary circuit, where a large resistance is of advantage in smoothing. Just as with the usual circuits, the smoothing is dependent upon the capacity of the condenser C_1, and an increase in this will always increase the smoothing at all frequencies. In all cases it must be decided by experiment whether this tuned circuit will be of advantage or not; but it is well worth a trial, since when it can be used it is very economical.

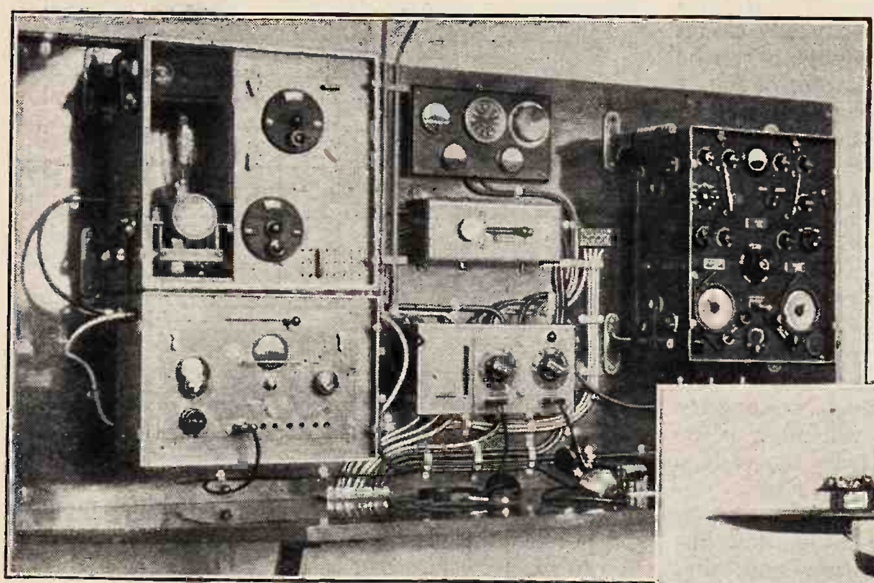
It must be remembered that the methods of computing hum, and the smoothing equipment required for its elimination, which have been discussed in this article, are not strictly accurate. In the first place, the total smoothing given by two series-connected stages is not equal to the product of their individual smoothing, as has been assumed. Provided that the figures are taken at a frequency which is not close to the resonance frequency, however, the discrepancy will not be large. Secondly, in calculating the curves for choke-capacity circuits, no account has been taken of the choke resistance, which increases the smoothing, and it has been assumed that the reactance of the condenser is small compared with the choke reactance, which is nearly true for a frequency of 100 cycles. Probably these two effects nearly balance, so that the curves are more accurate than might at first appear.

The greatest error, however, is that introduced by neglecting the effect of the receiver itself upon the smoothing circuit. It is quite impossible to include this in a general treatment; formulæ could be developed to meet this case, but they would be so complex that the labour involved in working them out would be greater than that necessary to determine the best smoothing circuit experimentally. Apart from circuit analysis, the use of formulæ for circuit calculation is only justified when the labour involved in their solution is less than that required for finding the values experimentally.

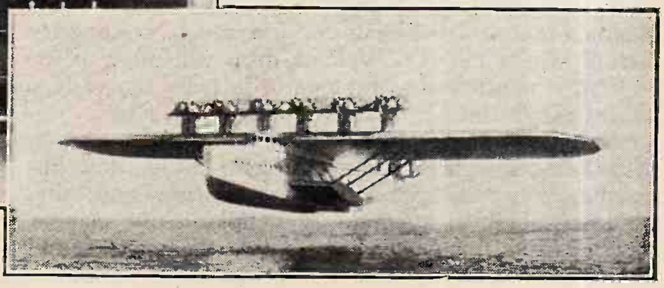
It is thought that the methods and curves given in this article are sufficiently accurate to enable a very fair approximation to the correct values to be obtained in any given case, and it is not intended that the smoothing circuit should be completely designed by their use. Rather is it intended that the approximate values should be found quickly, and used as a basis for the final experimental determination.

WIRELESS ON WORLD'S LARGEST FLYING BOAT.

As befits the world's largest flying boat, the Do.-X is equipped with the latest wireless apparatus covering a wide range of wavelengths. The principal novelty is in the aerial arrangement. Owing to the enormous span of wing it has been found possible to attach a permanent aerial along the wing, thus obviating the necessity for a trailing aerial, which must be drawn in when the machine lands. In the normal size of aeroplane the wing space gives insufficient length for an efficient aerial. The Do.X also carries direction-finding equipment.

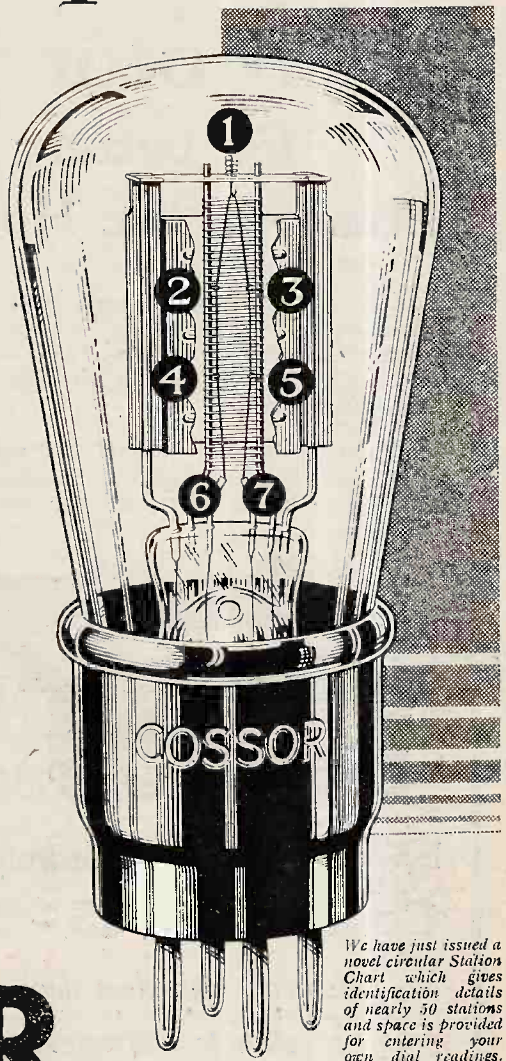


Compactness is a noticeable feature of the wireless gear on the Dornier X flying boat. The apparatus was made by the German firm of C. Lorenz.



Microphonic noises *definitely eliminated by*

Seven point suspension



THE cause of microphonic noises in a Receiving Set is generally to be found in a faulty Detector Valve. Usually it is due to filament vibration. The new Cossor Detector Valve (210 Det.) has been specially designed to overcome this fault. Filament vibration is rendered impossible by a new method of seven point suspension. The diagram shows the four insulated hooks which secure the filament in position and damp out any tendency to vibration. The use of this "steep slope" Cossor Detector Valve not only eliminates microphonic noises, but ensures great volume with exceptional purity of tone.

The New Cossor 210 DET., 2 volts, ·1 amp. Impedance 13,000. Amplification Factor 15. Mutual Conductance 1·15 m.a./v. Normal working Anode Voltage 90-150. *Price* 8/6

THE NEW COSSOR DETECTOR VALVE

We have just issued a novel circular Station Chart which gives identification details of nearly 50 stations and space is provided for entering your own dial readings. Price 2d. each, they are obtainable from any Wireless Shop. In case of difficulty write us, enclose 2d. stamp and head your letter "Station Chart W.W."

DEFINITELY FREE FROM MICROPHONIC NOISES

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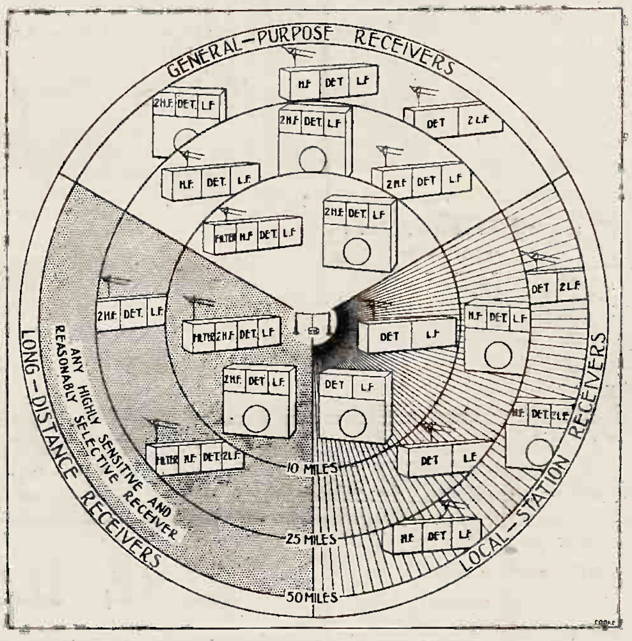
The Choice --- --- of a Set

Factors to be Considered in Selecting a Receiver.

IT is probable that a large number of people—perhaps the majority—buy a particular make and type of receiver as a direct result of personal recommendations. This is an excellent plan, but, unless discrimination is used, it is fatally easy to make a wrong choice. It does not follow that a set capable of satisfying one kind of taste in one locality will prove equally suitable in the hands of another user whose needs and geographical situation—from a "wireless" point of view—may be entirely different.

Before even considering the various types of apparatus, it is as well to attempt to formulate some concrete ideas as to what will be required in the way of programmes. It is safe to assume that every listener wants to receive the transmissions of his local station as well as possible; those who feel the need of nothing more can be placed in a definite category, and, thanks to the excellent distribution of broadcast signals over the country, comparatively simple and inexpensive apparatus will satisfy them, unless exceptional volume is expected. Next come those who like rather more variety, but who do not wish to expend more than is necessary to ensure occasional long-distance reception under fairly favourable conditions. Finally, there is the type of listener who regards the reception of foreign stations as being the most important consideration.



Sets for various localities and requirements. The effects of poor receiving conditions are taken into account by allowing an ample margin of sensitivity.

It would be misleading to suggest that a long-range receiver cannot be suitable for local-station work, but it is hardly economical to buy and to maintain a complicated super-sensitive set when little or no use is to be made of its capabilities. If only for this reason, it is as well to start with a predetermined idea as to what is wanted. Probably the majority of listeners will favour the golden mean, and will place themselves in the second of the admittedly rather arbitrary classifications set forth in the preceding paragraph.

Unfortunately, it is not possible to give, say, a tabulated list of recommended circuit arrangements for these various requirements without taking into consideration the complicating factor of selectivity, the need for which will vary from place to place. By dividing the area around a broadcasting station into zones, as in the accompanying diagrammatic sketch, and by further dividing these zones into sections corresponding to receiver performance classifications, the suitability of various sets can be indicated pictorially. But one should hasten to add that this chart must not be relied upon implicitly as a guide; there is as yet nothing approaching standardisation of sets, and, even if uniform receiving conditions could be postulated, the distribution of signal strength around a broadcasting station is by no means uniform. In spite of the fairly obvious limitations of the chart, its indications may at least serve as indications as to what to look for in a set.

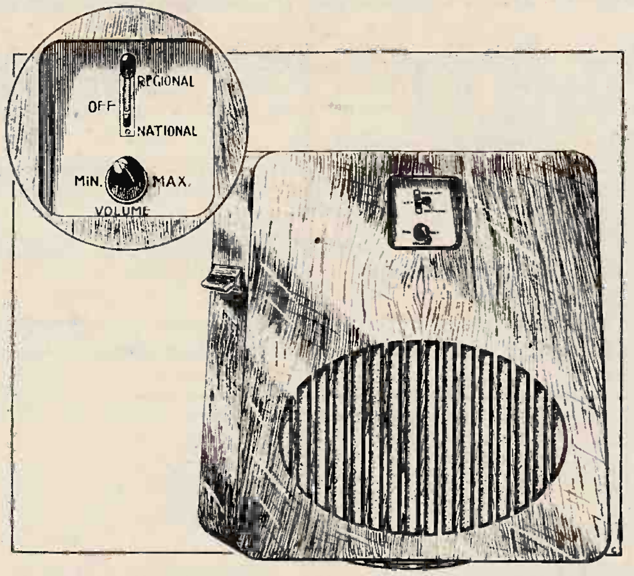
As we have already assumed that the local-station listener will not expect to receive more than one programme—or two programmes if he is blessed with a "Regional" transmitter—it may be said that, for him, the problem of selectivity hardly exists. Two powerful stations can be separated by almost any modern receiver if provision is made for reducing aerial input to a sufficient extent. Accordingly, as shown on the

The Choice of a Set.—

chart, a simple detector-L.F. two-valve set should meet the case within the ten-mile zone; there is not the slightest reason why such a receiver, if fitted with a "power" detector and a suitable output valve, should not provide reception, within its limitations as to range, of a quality that is not to be excelled for fidelity by any other circuit arrangement; at the same time, volume should be more than ample. Signals are usually so strong in this so-called wipe-out area that an outside aerial may well be unnecessary, and a self-contained two-valve set, generally with pentode output to provide extra magnification where necessary, may be regarded as an alternative that is likely to appeal on the score of tidiness, as all external leads are eliminated.

For use in the second zone, up to ranges of 25 miles, the detector-L.F. set is still suitable, though, where receiving conditions are poor, the extra magnification of a pentode may be of advantage. If a self-contained receiver is preferred, an H.F.-det.-L.F. combination with built-in frame aerial will be a safe choice.

At distances up to 50 miles—and even a good deal more, as we are here concerned with the range of high-power stations—the same H.F.-det.-L.F. frame set should still have a fair margin of sensitivity if of good design, but, to be on the safe side, an extra L.F. stage, making four valves in all, may be preferred. In this zone the ever-popular H.F.-det.-L.F. aerial set comes into its own; while, where low cost and simple operation are important, a detector-2 L.F. receiver may be chosen.



Switch change-over for alternative programmes: a type of set likely to increase in popularity among non-technical listeners, as it allows of twin-station reception without complications.

The requirements of the listener who demands occasional long-distance reception in the wipe-out area while the local station is at work are admittedly rather difficult to satisfy. A really good frame aerial set, with two H.F. stages, will afford a reasonable choice of programmes free from interference, as will the simpler and less expensive three-valve H.F.-det.-L.F. type of set, provided it is of an exceptionally selective type. On the chart the need for selectivity of an unusually high order is represented diagrammatically by the inclusion of a filter, but the suitability of other circuit arrangements must be admitted. As interference becomes less acute with increase of range, this favourite circuit combination in its more conventional form will yield sufficient selectivity. Another "general-purpose" set capable of yielding fair results where conditions are good is the detector-2 L.F. receiver with reaction.

For consistent long-distance reception in the wipe-out area, it will be observed that the sets suggested are similar to those recommended for general-purpose work in the same zone, but clearly they should be both more selective and more sensitive if their object is to be fully achieved. Similarly, the receiver indicated for use outside the ten-mile limit should be the best possible examples of their class.

With regard to general considerations, it is not out of place to remind readers that there is no longer any reason why those with electric mains should not use this source of supply for operating their sets; indeed, to depend on batteries, except in cases of necessity, must now be considered as extravagant, except in the matter of initial cost. Similarly, one should not choose a battery-fed portable unless convinced that real portability will be required; if it is merely desired to move the receiver from room to room, it should be realised that the mains-driven transportable is definitely superior in performance, and that its upkeep should be negligible.

Those living in coastal areas should insist on a set which is both selective and sensitive on the long-wave side, as they will depend largely on the long-wave "National" transmitter. Some designers tend to neglect this part of the receiver.

Most receivers nowadays have provision for the use of a gramophone pick-up, but, if it should so happen that the set which seems to be suitable in every other respect is not so fitted, it should hardly be "turned down" on this score alone, as the necessary alterations can almost invariably be made without much difficulty. A radio-gramophone, with built-in record turntable and pick-up, is clearly more convenient than a receiver with adaptor if the apparatus is to be in constant use as a gramophone reproducer, but it is almost certain to be more expensive, due to its more elaborate cabinet-work and the cost of extra components.

VALVE DATA SHEET

NEXT WEEK'S ISSUE will contain an attractively printed Supplement giving detailed working data of over 350 modern valves, together with specially written articles dealing with the application of valves to present-day requirements.

CURRENT TOPICS

Events of the Week in Brief Review.

BROADCAST RECEPTION IN LONDON CHURCH.

An all-mains wireless set has been installed in the church of All Hallows, Barking-by-the-Tower. Each day at 10.15 a.m. the B.B.C. morning service is received for the benefit of visitors.

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MORE ROOM IN PARIS ETHER.

The French Cabinet has sanctioned the removal of two well-known Paris stations to sites outside the city. *Radio-Paris* and *Radio Petit Parisien* will be transferred to Essarts-le-Roi and Molières respectively, both in the Seine-et-Oise department.

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LISTEN FOR VATICAN TESTS.

From a report received *via* Paris we learn that the Pope's new short-wave station in the Vatican City is ready for operation and is merely awaiting the provision of an electric supply by the local authorities. Tests may be expected before the end of the month. Two wavelengths are available, viz., 50.26 and 19.84 metres, and the power is 12 kilowatts.

oooo

NEW TOWER OF BABEL?

An "international publicity station," broadcasting advertisements in all European languages, is the aim attributed to a German company which is seeking powers to control the Luxembourg station when it launches on a new career in eighteen months' time with a power of 100 kilowatts.

The original Luxembourg station, which ceased transmission in January last, has been dismantled, and the masts are stated to be "for sale."

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TROUBLE IN HOLLAND.

Popular discontent in Holland over the Government radio censorship has not been diminished by the decision of the Second Chamber to reject a measure for the withdrawal of the existing system. Recently a seven-mile procession of Dutch listeners filed through the streets of Houtrust, near The Hague, in protest against the alleged unnecessary suppression of politics at the microphone.

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CANADIAN TRAIN-TALK WITH LONDON.

After five months' operation of the commercial two-way telephone service on Canadian National Railway trains between Toronto and Montreal, the authorities are able to declare the experiments a complete success. The quality of transmission has been rated 95 per cent. perfect by the Bell Telephone Co., and on one call placed by a passenger to be connected with London 100 per cent. efficiency was attained.

The "wired-wireless" system is in use, employing the telegraph wires paralleling the railway track, impulses being carried to "pick-up" stations at Morrisburg and Cobourg, Ontario, from which points connection is made to Kingston and with the general system of the Bell Telephone Co. of Canada.

A further development in the use of the radio telephone is foreshadowed by the announcement at Montreal that the new Canadian Pacific liner, s.s. *Empress of Britain*, will be provided with equipment enabling passengers to speak from their staterooms to any desired shore station in North America or in Europe, or to persons at sea on board the New York liners, s.s *Majestic*, *Berengaria and Leviathan*. This new 42,500-ton liner will inaugurate a five-day service between Quebec, Cherbourg and Southampton.

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RADIO RELAYS NOT WANTED.

The West Hartlepool Town Council has rejected the application of Hartlepool Radio Relay, Ltd., to supply broadcast programmes to subscribers in the district from a central exchange.

oooo

ANTI-NOISE DEVICE.

Possibly with the idea of excluding the sound of neighbouring loud speakers, Mr. Hiram Percy Maxim has perfected a device which, installed at an open window, keeps out all external noises without interfering with the ventilation. Mr. Maxim, who is the son of the famous gun inventor, is president of the American Radio Relay League.

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A NEW APPOINTMENT.

Mr. M. M. Macqueen has been appointed to succeed the late Mr. R. B. Weaver as manager of the Wireless Department of The General Electric Co., Ltd.

RADIO GIFTS TO THE BLIND.

A gift of wireless apparatus by the Radio Manufacturers' Association to the Wireless for the Blind Fund includes 500 Exide accumulators presented by the makers.

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LECTURE BY MR. S. G. BROWN.

Mr. S. G. Brown, F.R.S., will lecture (with demonstrations) on "Loud Speakers since their Conception, with Gramophone Pick-ups and Wireless Recording Apparatus" at the ordinary meeting of the Institution of Electrical Engineers, Savoy Place, W.C.2, on December 4th.

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"BROADCASTING HOUSE" FOR DENMARK.

Denmark is copying the examples of Britain and Germany in the construction of an immense palace of broadcasting. The building, already half completed, is in Copenhagen, and will house the State broadcasting administration, studios, and a certain amount of transmitting plant. Adjoining it is the old Royal Theatre, which will form two large studios with accommodation for public audiences.

oooo

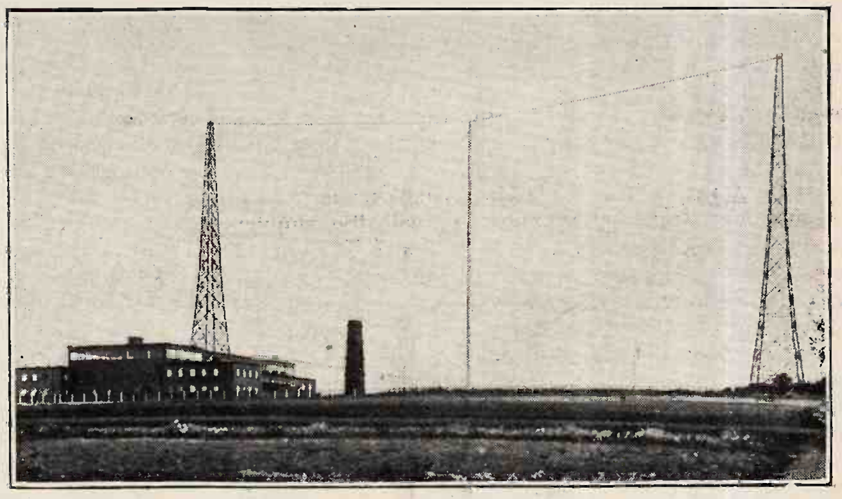
GRADED LICENCE FEES FOR FRANCE?

French crystal users will probably benefit by a lower tax than that required of owners of valve sets. M. Mallarme, French Minister of Posts and Telegraphs, proposes an annual tax of 30 francs (about 5s.) on crystal sets and 70 francs (about 11s. 10d.) on valve sets.

oooo

THE PIRATES' PLAYGROUND.

That Cardiff shelters more wireless "pirates" than any other area in the country was alleged in a statement last week by Mr. A. E. Bailey, the official in charge of the Post Office detector van which has recently been touring Cardiff. The street patrol with the van during the past fortnight is stated to have yielded nearly £800 in increased licence revenue.



"SOUTHERN REGIONAL." Tomorrow (Thursday) will see the opening of Germany's first regional broadcasting station at Muhlacker, near Stuttgart, working on a wavelength of 360 metres. If this Southern Regional station proves successful the German authorities will follow the B.B.C. plan by scrapping existing stations and installing two other giant stations to cover the remainder of the country.

RECEIVING SETS of TO-DAY

The Trend of Modern Commercial Receiver Design.

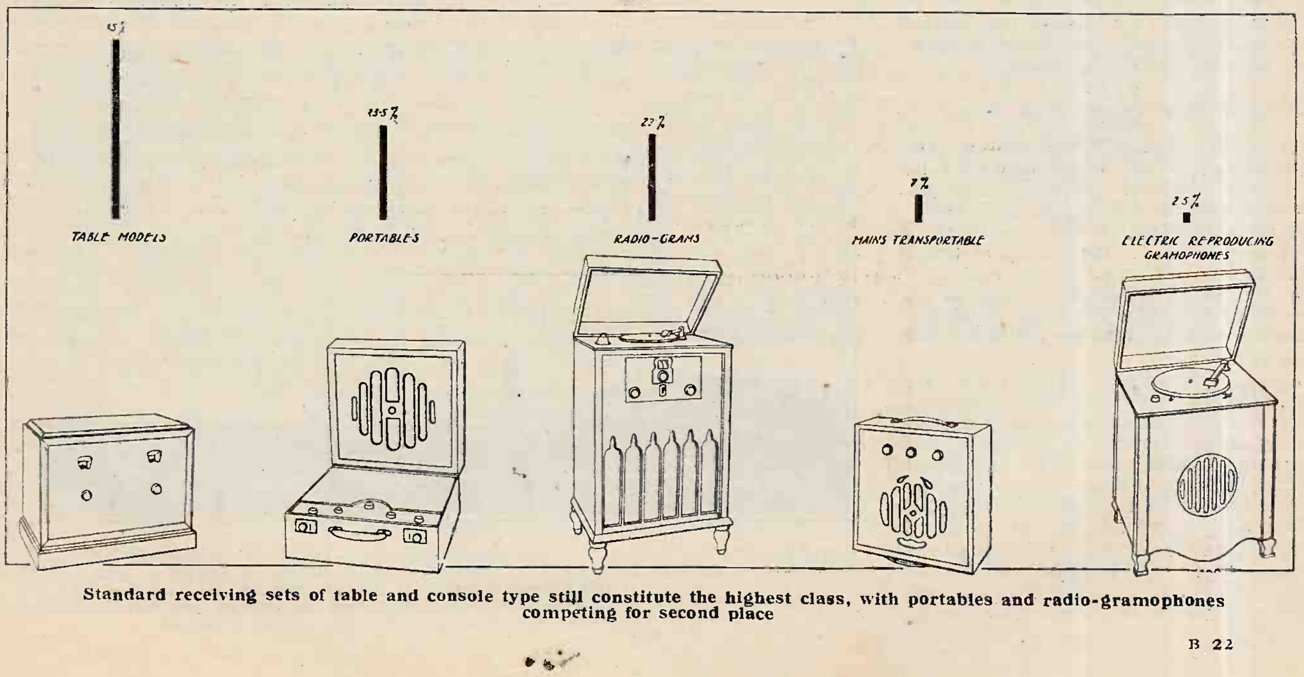
THE British wireless industry offers to the public over 350 individual designs of complete radio receivers at prices ranging from 50s. to £250. While the majority of these fall into well-defined groups in accordance with a few favoured and well-tried specifications, distinctive receivers combining in great variety the best features of all the conventional types are not lacking. The intelligent enthusiast with definite views on the merits of rival methods of H.F. amplification, detection, and power amplification, should therefore have little difficulty in finding at least one receiver which is a practical realisation of his ideal specification. As likely as not his requirements will be satisfied by one of the main groups to which reference has already been made.

Indeed, the numerical strength of any given circuit principle or complete specification, as revealed in the Buyers' Guide, may be taken as a criterion of its intrinsic value. Originality and technical merit are not the only standards by which the value of a new development should be judged. It must remove some obvious deficiency in the general standard of reception, and must be capable of commercial production at a price commensurate with the advantages it confers.

From this point of view it is instructive to compare the outstanding features of the Show, as recorded in the "Trend of Progress," from year to year, with the figures provided by the "Buyers' Guide." Many excellent ideas which have stimulated the imagination at Show time, and perhaps enjoyed a short vogue, have ultimately lapsed into obscurity when put to the acid test of supply and demand. It is hardly necessary to cite specific examples in support of this contention; the figures and graphs speak for themselves, and the reader should have no difficulty in drawing his own conclusions.

Turning first to the leading types at present in vogue, we find that the standard radio receiver, in either table model or console form, constitutes the largest class. Its numerical strength is more than twice that of any other individual type. In the majority of cases (65 per cent. to be precise) provision is made for the attachment of a gramophone pick-up as an accessory, on the assumption that the user is already in possession of a motor and turntable.

Next in order of importance comes the portable. Although hard pressed by the radio gramophone, it still maintains its position as runner-up to the standard domestic receiver. True, there has been some diminution in numbers during the past twelve months, but this is accounted for by the decline of five-valve portables using two H.F. stages with aperiodic coupling. The screen-grid portable with one H.F. stage is as popular as ever, and its position has been strengthened by the



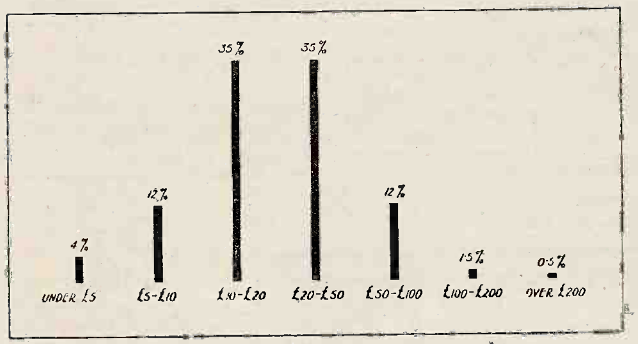
Standard receiving sets of table and console type still constitute the highest class, with portables and radio-gramophones competing for second place

Receiving Sets of To-day.—

advent of H.T. eliminators designed to fit in the H.T. battery compartment. Receivers so fitted are virtually dual-purpose instruments, and, where provision is made for trickle charging the L.T. battery in addition to supplying H.T. current, may be regarded as mains transportables for home use.

The radio-gramophone has enormously strengthened its position, and is now only 1.5 per cent. behind the portable. Combining, as it does, the two principal sources of electrically reproduced music in a single unit of furniture, its compactness and clean exterior make a wide appeal.

Compactness and neatness are also responsible for the establishment of a new class of receiver this year—the mains transportable. In appearance and specification this new type clearly acknowledges its origin to the conventional portable. The weight of the A.C. equipment—for it is essentially an A.C. type—precludes extensive transportation, but it is easily carried from room to room in the same house. With the removal of restrictions on the power supply, which obtain in the case of battery-driven portables, the quality and volume of reproduction have been greatly improved: indeed, there are instances of mains transportables with moving-coil loud speakers as standard items of the specification.



The cost of the majority of sets lies between £10 and £50.

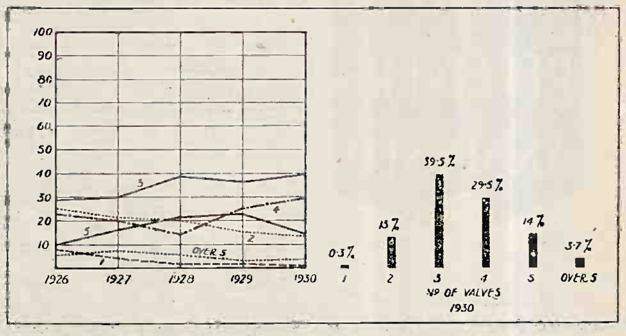
Three-valve sets are still the most popular, and have consistently held the same percentage now for three years. The majority are of the H.F-det.-L.F. type, which gives excellent range and volume at a reasonable price. Credit for the success of this type must be given to the valve manufacturers, for the high performance is undoubtedly due to the efficiency of the modern screen-grid valve and the pentode.

The four-stage set is next in order of importance. The figures showing the proportion of single- and two-stage H.F. amplifiers indicated that the additional valve in this class is generally a low-frequency amplifier, but there are a few cases employing two H.F. stages, a detector and a single L.F. stage.

There is a marked decline this year in five-valve receivers, which is accounted for principally by the discontinuation of a number of five-valve portables with two aperiodic H.F. stages. The majority of the sets in this class are high-class receivers and radio-gramophones with two and sometimes three tuned H.F. stages.

Sets with over five stages show an increase. This class incorporates the majority of the superheterodynes in commercial production, several of which are available in portable form.

The smallest class of all is the single-valve class, and only one receiver of this type is recorded.

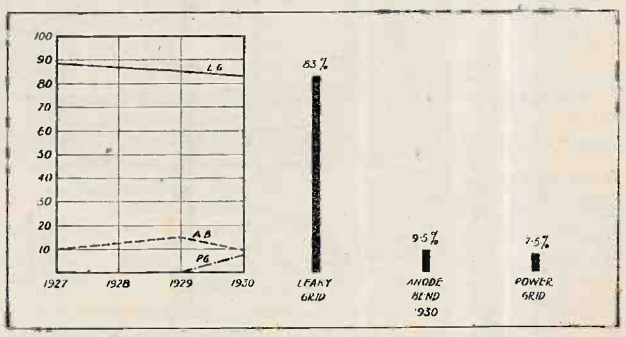


While the three-valve set has maintained its lead now for three years its position is challenged by four-valve sets which show a steady increase.

Nearly three-quarters of the sets on the market to-day employ H.F. amplification. Of these 72 per cent. make use of a single H.F. stage, primarily for economic reasons, as the production costs of screening, ganging, and adjustment associated with two or more H.F. stages are high. The expense of two H.F. stages is justified only where exceptional range or selectivity is required, and, in general, the single stage is quite adequate for foreign station reception outside a 5 to 10 mile radius of a regional station. As the majority of receivers are installed outside this area, the popularity of the single H.F. stage is readily understood.

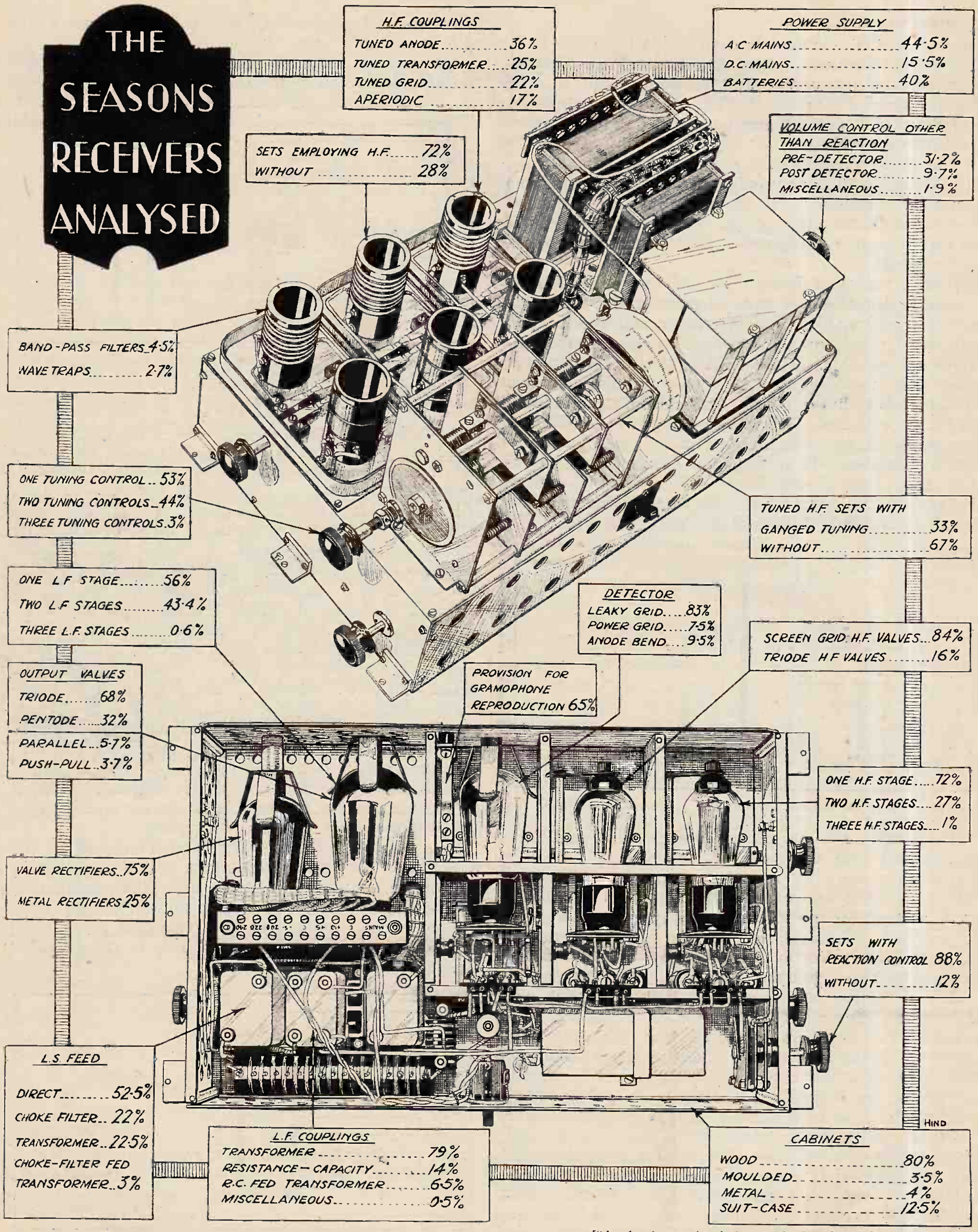
The effect of the decline of the aperiodic-coupled portable is again apparent in the relation between the methods of H.F. coupling. Last year aperiodic coupling constituted the highest class; to-day it is the lowest. Tuned anode is the most favoured individual class of coupling, but it is outnumbered by the combined tuned transformer and tuned grid couplings. The incidental advantages in the matter of the reduction of hum in mains receivers are responsible for the increased popularity of the latter systems of coupling.

It is gratifying to find that more than half of the receivers on the market to-day have only a single tuning control, i.e., excluding reaction and other auxiliaries. Of the single-control sets approximately 60 per cent. employ ganged condensers, the remainder being fitted with side-by-side drum dials which may be rotated either simultaneously or independently.



The introduction of power grid detection has checked the rise in popularity of the anode bend detector.

THE SEASONS RECEIVERS ANALYSED



[The chassis reproduced above is the Gecophone All Mains Four.]

A typical 1930-31 receiver chassis showing the details of specification most favoured by modern practice.

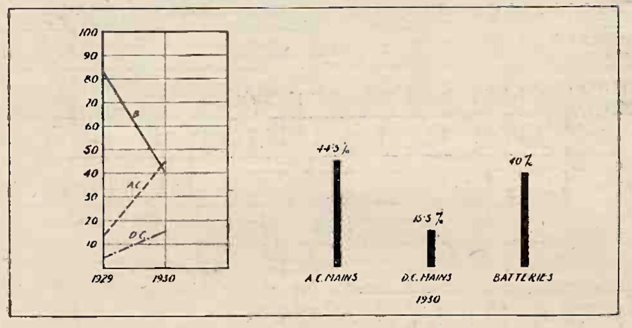
Receiving Sets of To-day.—

The art of manipulating two tuning controls is not difficult to acquire, and we therefore find that nearly all the remaining sets are fitted with two tuning controls. The fact that only 3 per cent. have three or more tuning controls is indicative of the enormous increase in the difficulty of manipulating tuning controls when their number is higher than two.

The leaky grid detector shows no signs of being ousted from the premier position among systems of rectification. Efficiency is essential in the popular three-valve circuit (H.F.-det.-L.F.), to which reference has already been made, and leaky grid rectification is invariably employed in this circuit. The numerical strength of the three-valve set is, therefore, one of the chief reasons for the high percentage of leaky grid detectors. Anode-bend detection shows a decline, owing to the introduction of the new power grid system of rectification. This system has been made possible by the large number of mains-operated receivers in which the necessarily high anode voltage is readily obtainable.

Volume Controls.

Only 12 per cent. of the total number of receivers available are without any form of reaction control. Reaction is still the principal method of volume control, though many receivers employ pre- and post-detector volume controls in addition to reaction. The most popular forms of pre-detector volume control are potentiometer control of the screen-grid voltage, filament dimming in the H.F. stages, and last but not least, the use of a differential condenser in the aerial circuit. The



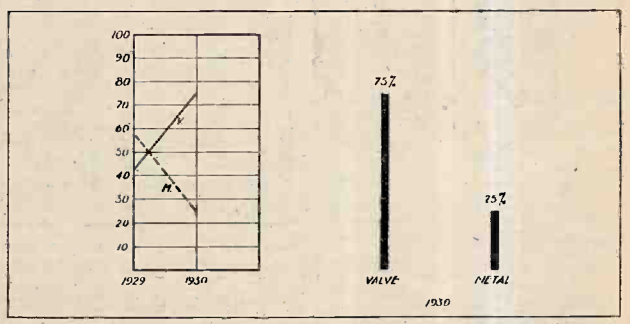
A.C. mains receivers now outnumber battery-fed sets, and D.C. mains receivers show a marked increase.

majority of post-detector volume controls take the form of a potentiometer grid leak (in conjunction with the first L.F. valve, where R.C. coupling is employed) and a variable resistance in parallel with the primary where transformer coupling is employed.

Sets with a single L.F. stage account for slightly more than half the total number available. Again, the popular H.F.-det.-L.F. set is responsible, and the high amplification provided by the pentode should be given due credit.

Less than 1 per cent. are provided with three L.F. stages, and the remainder (43 per cent.) have two L.F. stages. Greater reserve of power and volume is available with two stages, and the circuit lends itself better to the employment of parallel or push-pull valves in the output stage. In the majority of two-valve L.F. amplifiers the first stage is resistance-coupled and the second transformer-coupled.

If L.F. couplings are examined irrespective of the number of stages in the L.F. amplifier it will be found that transformer couplings are responsible for more than three-quarters of the total. Resistance-capacity coupling



The valve is now the most favoured form of rectifier in A.C. power supply units.

accounts for 14 per cent., so that the relation between transformer and resistance-coupling remains practically unchanged from last year.

The advent of small transformers with nickel iron cores is responsible for a new form of coupling, i.e., the resistance-capacity-fed transformer in which the direct component of the anode current is by-passed from the primary winding. These couplings have rapidly risen to 6.5 per cent., while choke-coupling and other miscellaneous forms of coupling are down to 0.5 per cent.

The triode output valve continues to hold its own, and outnumbers the pentode by more than 2 to 1. As yet, however, the new indirectly heated power pentodes have hardly had time to make their presence felt, and there is every reason to believe that in the near future the odds will be shortened. For super-power reproduction paralleled output valves seem more popular than valves arranged in push-pull, and the percentages of both these methods are extremely low owing to the excellent characteristics of single power valves of large power-handling capacity.

Loud Speaker Output Couplings.

With regard to loud speaker feeds, although the direct method of coupling still predominates there is a marked increase both in choke-filter and transformer couplings; this is accounted for by the increase in the number of mains sets now available. Choke-filter-fed transformer couplings are also more numerous, due to the fact that many proprietary makes of moving-coil loud speaker are fitted with a built-in transformer.

Sixty per cent. of the receivers on the market to-day are designed exclusively for mains operation. Of those 44.5 per cent. are designed for the A.C. supply mains, and these constitute the largest class.

Metal cabinets are reduced in numbers from 28 per cent. to 4 per cent., while the wood cabinet, which has always constituted the largest class, has increased from 72 per cent. to 80 per cent. The new-type moulded cases shown at Olympia constitute 3.5 per cent. of the total, and we may safely expect an increase in this percentage during the coming season.

BUYERS' GUIDE, 1930-31.

"The Wireless World" Reference List of Receiving Sets.

Manufacturer.	Type.	Valves and Couplings. H.F.	Coupling.	H.F.	Coupling.	H.F.	Coupling.	Det.	Coupling.	L.F.	Coupling.	L.F.	L.S. Coupling.	Current Supply.	Gramophone Reproduction.	Price. £ s. d.	Remarks.
Adey Radio, Ltd., 99, Mortimer Street, London, W.1.	1-Valve (*P*)	—	—	—	—	—	—	LG	—	—	—	—	D	B	—	3 17 6	Complete. Dimensions, 11×11×4in. Weight, 7 lb.
	2-Valve (*P*)	—	—	—	—	—	—	LG	Tr	P	—	—	D	B	G	8 15 0	,, ,, 12½×12½×7in, ,, 17 lb.
Automobile Accessories (Bristol), Ltd., Sion Road, Bedminster, Bristol.	P.D. Melodia Three	—	—	—	—	SG	—	LG	—	P	—	—	D	B	—	5 12 6	Royalties included. Valves extra.
	P.D. Self-contained Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	7 0 0	,, ,, ,, ,,
E. J. Baty, 157, Dunstable Road, Luton.	Baty Four	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	CF	—	G	36 0 0	A.C., D.C. or battery.
Bel Canto Radio, Ltd., 34/36, Oxford Street, London, W.1.	Type RG4 (*RG*)	—	—	—	—	*SG	TA	*PG	AT	*T	—	—	D	AC or DC	G	37 0 0	Console radio gramophone.
,, ,, ,,	Type RG3 (*RG*)	—	—	—	—	*SG	TA	*LG	AT	*T	—	—	CF	AC or DC	G	48 0 0	Table model radio gramophone.
,, ,, ,,	Type RG2 (*RG*)	—	—	*SG	AT	*SG	AT	*AB	AT	†T	—	—	CF	AC or DC	G	75 0 0	Single dial tuning. De Luxe Console cabinet.
The British Radiophone, Ltd., Aldwych House, Aldwych, London, W.C.2.	"National" Portable	—	—	T	TA	T	TA	LG	Tr	T	Tr	T	D	B	—	12 12 0	Detachable carrying strap. Oak.
	"Symphony" Portable	—	—	T	TA	T	TA	LG	Tr	T	Tr	T	D	B	—	13 13 0	,, ,, ,, Mahogany.
S. G. Brown, Ltd., Western Avenue, N. Acton, London, W.3.	Regional Two	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	6 5 0	Including valves and royalties.
	"A" Set	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	11 5 0	Kit of parts, including loud speaker, £9 10s.
,, ,, ,,	"B" Set	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	11 5 0	,, ,, excluding ,, £6 10s.
,, ,, ,,	AM. AC.	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	D	AC	G	24 5 0	Complete in oak cabinet.
,, ,, ,,	AM. DC.	—	—	—	—	SG	TG	LG	Tr	T	—	—	D	DC	G	23 5 0	,, ,, ,,
,, ,, ,,	BM. AC.	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	D	AC	G	21 5 0	Excluding loud speaker.
,, ,, ,,	BM. DC.	—	—	—	—	SG	TG	LG	Tr	T	—	—	D	DC	G	20 5 0	,, ,, ,,
,, ,, ,,	Dorchester	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	CF	AC	G	47 0 0	Permanent magnet moving coil loud speaker.
,, ,, ,,	Portable	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	G	19 19 0	Provision for external loud speaker.
Brownie Wireless Co. of Gt. Britain, Ltd., Nelson Street, Mornington Crescent, London, N.W.1.	Dominion 3	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	G	8 0 0	Including valves and royalties.
	Dominion S.G.3	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	G	10 15 0	,, ,, ,,
	S.G. 3A	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	G	8 15 0	,, ,, ,,
,, ,, ,,	Dominion Console	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	G	10 7 6	,, ,, ,,
,, ,, ,,	Mainset Two	—	—	—	—	—	—	*LG	Tr	*T	—	—	D	AC	G	12 15 0	,, ,, ,,
,, ,, ,,	Dominion Mains SG3	—	—	—	—	*SG	TA	*LG	Tr	*T	—	—	D	AC	G	18 10 0	,, ,, ,,
Fred Bulmer, 4, Carlton Terrace, Scarborough.	Carlton SG III	—	—	—	—	SG	TT	LG	Tr	P	—	—	Tr	B	G	12 12 0	10–3,000 metres. D.C. model, 18 gns.
Burndept Wireless (1928), Ltd., Eastnor House, Blackheath, S.E.5.	A.C. Receiver de Luxe	—	—	—	—	*SG	TA	*LG	Tr	*P	—	—	Tr	AC	G	34 13 0	L.S. matched to pentode.
	A.C. Radio Gramophone	—	—	—	—	*SG	TA	*LG	Tr	*P	—	—	Tr	AC	G	52 10 0	Needle armature pick-up. With M.C. speaker, 58 gns.
,, ,, ,,	Universal Screened Five	—	—	—	—	SG	TA	LG	RC	T	Tr	T T	Tr	B	G	31 10 0	Ultra short, medium and long waves. Push-pull output. A.C. model, 42 gns.
,, ,, ,,	Universal Radio Gram. de Luxe.	—	—	—	—	SG	TA	LG	RC	T	Tr	T T	Tr	AC	G	99 15 0	10in. R.K. moving coil L.S.
,, ,, ,,	Screened Ethophone	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	—	11 8 0	De Luxe model, £12 17s. 6d.
,, ,, ,,	Screened Portable	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	19 19 0	Super model, £23 10s.
Burne-Jones & Co., Ltd., 296, Borough High Street, London, S.E.1.	Universal Three	—	—	—	—	T	TA	LG	Tr	P	—	—	D	B	—	18 0 0	Range, 15–2,000 metres.
	A.C. Mains Two	—	—	—	—	—	—	*LG	Tr	T	—	—	CF	AC	—	12 10 0	—
,, ,, ,,	Band Pass Four	—	—	*SG	TG	*SG	TG	*LG	Tr	*T	—	—	CF	AC	G	30 0 0	Band pass aerial filter.
,, ,, ,,	Type SG4 (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	18 18 0	Suitcase portable.
,, ,, ,,	Type SG 3 (*MT*)	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	CF	AC	—	25 0 0	Mains transportable.
,, ,, ,,	Radio Gram. (*RG*)	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	CF	AC	G	45 0 0	Mahogany quartered veneered Console.
Catesbys, Ltd., 64/67, Tottenham Court Road, London, W.1.	Phineas S.G. 4 (*P*)	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	D	B	—	12 12 0	Including valves and royalties.
	Orbit (*RG*)	—	—	—	—	SG	TT	LG	Tr	T	—	—	D	—	G	18 10 0	Available for D.C., A.C. or batteries.
Churchmans, Ltd., 79, Maidenburgh Street, Colchester.	New Mascot 230	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	3 3 0	Excluding valves and royalties.
	,, ,, 330	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	—	4 4 0	,, ,, ,,
,, ,, ,,	,, ,, 530 (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	14 14 0	Including ,, ,,
,, ,, ,,	,, ,, Radio Gram.	—	—	—	—	SG	TA	LG AB	Tr	T	Tr	T	Tr	DC	G	—	—
Clarith Reproducers, Ltd., East Street Mills, Leeds.	De Luxe A.C. (*RG*)	—	—	—	—	*SG	TT	*LG	Tr	*P	—	—	T	AC	G	51 9 0	Including valves and royalties.
	D.C. All Mains (*RG*)	—	—	—	—	—	—	*LG	Tr	*T	Tr	*T	T	DC	G	61 19 0	,, ,, ,,
,, ,, ,,	Console All Mains (*RG*)	—	—	—	—	*SG	TG	*LG	Tr	*T	Tr	*T	T	AC	G	94 10 0	,, ,, ,,
,, ,, ,,	Vivid A.C. (*RG*)	—	—	—	—	*SG	TT	*LG	Tr	*P	—	—	T	AC	G	39 18 0	,, ,, ,,
Climax Radio Electric, Ltd., Haverstock Works, Parkhill Road, Hampstead, London, N.W.3.	Type M 22	—	—	—	—	—	—	*PG	Tr	T P	—	—	D	AC	G	9 9 0	Inclusive. Alternative output valves.
	,, M 33	—	—	—	—	*SG	TG	*LG	Tr	P	—	—	D	AC	G	16 16 0	Including valves and royalties.

E. K. Cole, Ltd., Ecko Works, Southend-on-Sea.	Type 312 DC	—	—	—	—	—	—	LG	Tr	P	—	—	CF	DC	G	14 10 0	Including valves and royalties.
,, ,, ,,	,, 312 AC	—	—	—	—	—	—	*LG	Tr	P	—	—	CF	AC	G	14 10 0	,, ,, ,,
,, ,, ,,	,, 313 DC	—	—	—	—	SG	TT	LG	Tr	P	—	—	CF	DC	G	22 10 0	,, ,, ,,
,, ,, ,,	,, 313 AC	—	—	—	—	*SG	TT	*LG	Tr	P	—	—	CF	AC	G	22 10 0	,, ,, ,,
Columbia Graphophone Co., Ltd., Clerkenwell Road, E.C.1.	Model 309	—	—	—	—	—	—	*LG	Tr	P	—	—	D	DC AC	—	12 12 0	Self-contained two-station set.
,, ,, ,,	,, 307	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	D	AC	G	21 0 0	Pedestal model 331, 30 gns.
,, ,, ,,	,, 304	*SG	TT	*SG	TT	*SG	TT	*AB	RC	T	—	—	D	AC	—	27 6 0	Battery model, 24 gns.; D.C. mains, 27 gns.
,, ,, ,,	,, 310 (RG)	—	—	—	—	*SG	TA	*LG	Tr	T	—	—	Tr	AC	G	42 0 0	——
,, ,, ,,	,, 308 (RG)	—	—	—	—	*SG	TA	*LG	Tr	*T	Tr	T	Tr	AC	G	65 2 0	——
,, ,, ,,	,, 302 (RG)	SG	TT	SG	TT	SG	TT	AB	RC	T	Tr	T T	Tr	AC	G	84 0 0	Parallel output valves.
,, ,, ,,	,, 303 (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	——
George Crossby & Son, Ltd., 4, South Street, Manchester.	"Crolectro" All Mains (RG)	—	—	—	—	*SG	TT	*AB	Tr	T T	—	—	Tr	AC	G	65 0 0	R.K. Senior L.S. Three separate metal rectifiers.
,, ,, ,,	"Crolectro" Electric Gramophone.	—	—	—	—	—	—	—	—	*T	Tr	T T	Tr	AC	G	40 0 0	Push-pull output stage.
S. Dagnall, Ltd., 420, Stratford Road, Sparkhill, Birmingham.	Type S.D.L. 2	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	5 10 0	Including valves, batteries and royalties.
,, ,, ,,	,, S.D.L. 3	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	—	7 15 0	——
,, ,, ,,	S.D.L. Screened 3	—	—	—	—	SG	TT	LG	Tr	P	—	—	Tr	B	—	18 18 0	——
,, ,, ,,	S.D.L. Radio Gram.	—	—	—	—	—	—	LG	RC	T	Tr	T	Tr	B	—	25 10 0	——
The Danipad Rubber Co., Ltd., 5/7, Market Street, Finsbury, London, E.C.2.	Popular Regional Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	4 4 0	Including valves and royalties.
,, ,, ,,	Popular Cabinet Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	5 5 0	Wave-trap 10s. extra.
,, ,, ,,	Speaker II	—	—	—	—	—	—	LG	Tr	P	—	—	D	B	—	5 5 0	Including valves and royalties.
,, ,, ,,	Popular Transportable Four	—	—	—	—	T	Ap	LG	Tr	T	Tr	T	D	B	—	10 10 0	,, ,,
Detex, Ltd., 161, Vauxhall Bridge Road, London, S.W.1.	Fireside Five	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	8 8 0	Transportable."
,, ,, ,,	Straight Five (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	8 8 0	——
,, ,, ,,	Gramorad Five (RG)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B, AC or DC	G	16 16 0	Rexine-covered cabinet.
Wm. Dibben, St. Mary's Road, Southampton.	Monarch Minor	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3 7 6	Receiver only.
,, ,, ,,	Monarch III, Type T	—	—	—	—	—	—	—	—	—	—	—	—	—	G	5 5 0	,,
,, ,, ,,	,, ,, TS	—	—	—	—	—	—	—	—	—	—	—	—	—	G	7 7 0	Including cone loud speaker.
,, ,, ,,	,, ,, SG	—	—	—	—	—	—	—	—	—	—	—	—	—	G	8 8 0	Receiver only.
,, ,, ,,	Cromwell III	—	—	—	—	—	—	—	—	—	—	—	—	—	G	7 17 6	,, ,,
,, ,, ,,	,, W.S.	—	—	—	—	—	—	—	—	—	—	—	—	—	G	9 9 0	Including cone loud speaker.
,, ,, ,,	,, All Electric	—	—	—	—	*SG	—	—	—	*P	—	—	—	—	G	36 15 0	M.C. loud speaker.
,, ,, ,,	,, Radio Gram.	—	—	—	—	*SG	—	—	—	*P	—	—	—	—	G	47 5 0	,, ,,
,, ,, ,,	,, Gramo. Unit (EG)	—	—	—	—	—	—	—	—	—	—	—	—	—	G	10 10 0	Amplifier and turntable.
Dubilier Condenser Co. (1925), Ltd., Victoria Road, North Acton, London, W.3.	A.C. 2	—	—	—	—	—	—	*LG	Tr	*T	—	—	D	AC	G	15 0 0	Including valves and royalties.
,, ,, ,,	A.C. 3 and D.C. 3	—	—	—	—	*SG	TT	*AB	Tr	*T	—	—	CF	AC, DC	G	25 0 0	,, ,, ,,
,, ,, ,,	2-Valve Radio Gramophone	—	—	—	—	—	—	*LG	Tr	*T	—	—	D	AC	G	42 0 0	,, ,, ,,
,, ,, ,,	4-Valve Radio Gramophone	—	—	—	—	*SG	TT	*AB	RC	*T	Tr	T	CF	AC	G	80 0 0	M.C. loud speaker, 3 watts output.
Dunhams, Ltd., New Wharf Road, London, N.1.	"Overseas" (P)	—	—	—	—	—	—	—	—	—	—	—	—	B	—	21 0 0	Inclusive.
,, ,, ,,	Five Valve Portable (P)	—	—	—	—	—	—	—	—	—	—	—	—	B	—	17 17 0	,,
,, ,, ,,	All Electric (MT)	—	—	—	—	*SG	—	*LG	—	*P	—	—	—	AC	—	27 6 0	——
,, ,, ,,	S.G. Three	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14 10 0	With valves, batteries, L.S. and royalties.
Dulcetto-Polyphon, Ltd., 2/3, Newman Street, London, W.1.	U 4 A.C. (RG)	—	—	—	—	*SG	TA	*LG	Tr	*T	RC	T	CFT	AC	G	75 0 0	Novotone compensator. Band pass filter
,, ,, ,,	U 4 D.C. (RG)	—	—	—	—	SG	TA	LG	Tr	P P	—	—	CFT	DC	G	70 0 0	Parallel pentodes in output.
,, ,, ,,	4 MC (RG)	—	—	—	—	*SG	TA	*LG	Tr	P P	—	—	CFT	AC	G	75 0 0	D.C. model, £70.
,, ,, ,,	Junior Amplifier (EG)	—	—	—	—	—	—	—	—	*T	Tr	*T	Tr	AC	G	78 15 0	Provision for external microphone or radio.
,, ,, ,,	,, ,, (EG)	—	—	—	—	—	—	—	—	T	Tr	P P	Tr	DC	G	78 15 0	,, ,, ,, ,,
,, ,, ,,	50-Watt Reproducer (EG)	—	—	—	—	—	—	—	—	*T	Tr	T T T	Tr	AC	G	126 0 0	Twin turntables. Three pll. output valves.
Dynic International Radio, Ltd., 5/6, Cork Street, London, W.1.	Sonodyne (RG)	—	—	SG	—	SG	—	LG	—	T T	—	—	—	AC DC	G	—	Junior, £65 to £180. Senior, £80 to £200.
Eagle Engineering Co., Ltd., Eagle Works, Warwick ("Chakophone").	Senior Two	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	6 5 0	Pentode output, 12s. 6d. extra.
,, ,, ,,	All-in Two	—	—	—	—	—	—	LG	Tr	P	—	—	D	B	—	9 9 0	Frame or coil A.T.I.
,, ,, ,,	,, Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	11 0 0	,, ,, ,,
,, ,, ,,	Senior S.G. Three	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	9 15 0	Pentode output, 10s. extra.
,, ,, ,,	Senior Two All Mains	—	—	—	—	—	—	*LG	Tr	*P	—	—	CF	AC	G	13 0 0	Including valves and royalties.
,, ,, ,,	,, ,, ,,	—	—	—	—	—	—	LG	Tr	P	—	—	CF	DC	G	13 0 0	,, ,, ,,
,, ,, ,,	Screened Four Portable	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	CF	B	—	17 17 0	,, ,, ,,
,, ,, ,,	Warwick Portable Five	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	,, ,, ,,

LIST OF ABBREVIATIONS.

Type :
- **RG** = Radio Gramophone.
- **P** = Portable.
- **MT** = Mains Transportable.
- **EG** = Electric Gramophone only.

Valves :
- **T** = Triode.
- **SG** = Screen Grid.
- **P** = Pentode.
- * = Indirectly Heated A.C.
- † = Directly Heated A.C.

Couplings :
- **TA** = Tuned Anode.
- **TT** = Tuned Transformer.
- **TG** = Tuned Grid.
- **Ap** = Aperiodic.
- **AT** = Auto Transformer.

Couplings (contd.) :
- **RC** = Resistance Capacity.
- **Tr** = Transformer.
- **D** = Direct.
- **CF** = Choke Filter.
- **CFT** = Filter-fed Transformer.

Detector :
- **LG** = Leaky Grid.
- **PG** = Power Grid.
- **AB** = Anode Bend.

Current Supply :
- **B** = Battery.
- **AC** = Alternating Current Mains.
- **DC** = Direct Current Mains.

G = Provision for Gramophone Reproduction.

Buyers' Guide, 1930-31.—

Manufacturer.	Type.	Valves and Couplings.											L.S. Coupling.	Current Supply.	Gramophone Reproduction.	Price.	Remarks.
		H.F.	Coupling.	H.F.	Coupling.	H.F.	Coupling.	Det.	Coupling.	L.F.	Coupling.	L.F.				£ s. d.	
Economic Electric, Ltd., 10, Fitzroy Square, London, W.1.	Metropolis (*P*)	—	—	—	—	—	—	—	—	—	—	—	D	B	—	25 4 0	Five-valve super-het. circuit.
Ellison Bell, Ltd., 62, Glengall Road, London, S.E.15.	Faerie (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	14 14 0	Including valves and royalties.
	Pedestal Three	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	G	10 0 0	Including valves and royalties.
	All Mains Pentode Two	—	—	—	—	—	—	*LG	Tr	P	—	—	D	AC	G	14 14 0	,, ,, ,,
,, ,, ,,	,, Three	—	—	—	—	—	—	*PG	RC	*T	Tr	*T	D	AC	G	19 19 0	,, ,, ,,
,, ,, ,,	,, S.G. 3	—	—	—	—	*SG	TT	*AB	Tr	*P	—	—	D	AC	G	25 10 0	,, ,, ,,
,, ,, ,,	No. 1 Junior (*RG*)	—	—	—	—	—	—	*LG	Tr	*P	—	—	CF	AC	G	42 0 0	,, ,, ,,
,, ,, ,,	No. 2 ,, (*RG*)	—	—	—	—	*SG	TT	*AB	RC	*T	Tr	*T	D	AC	G	37 10 0	,, ,, ,,
,, ,, ,,	Senior Radio Gramophone	—	—	—	—	*SG	TT	*AB	RC	*T	Tr	*T	D	AC	G	75 0 0	,, ,, ,,
,, ,, ,,	All Mains Transportable	—	—	—	—	*SG	TA	*AB	Tr	P	—	—	D	AC	G	21 0 0	Battery model, £12 17s. 6d.
,, ,, ,,	Picnic Portable	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	B	—	16 0 0	De Luxe model, £17. All Mains, £24.
Edison Swan Electric Co., Ltd., 1a, Newman Street, Oxford Street, London, W.1.	Three-valve Battery Receiver.	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	9 18 6	Including valves and royalties.
	Four-valve Battery Receiver.	—	—	SG	TA	SG	TA	AB	Tr	T	—	—	D	B	G	16 16 0	,, ,, ,,
,, ,, ,,	D.C. 3	—	—	—	—	*SG	—	*LG	—	*P	—	—	CF	DC	G	21 0 0	,, ,, ,,
,, ,, ,,	A.C. Transportable (*MT*)	—	—	—	—	*SG	TG	*LG	RC	*T	Tr	*T	—	AC	—	27 6 0	,, ,, ,,
,, ,, ,,	Power Pentode 2	—	—	—	—	—	—	*LG	Tr	*P	—	—	CF	AC	G	14 19 6	,, ,, ,,
,, ,, ,,	,, ,, 3	—	—	—	—	*SG	TA	*LG	Tr	*P	—	—	CF	AC	G	21 0 0	,, ,, ,,
Electrical and Radio Products, Ltd., Empire Works, Horley, Surrey.	Type A 302	—	—	—	—	—	—	*LG	Tr	*T	—	—	D	AC	—	15 0 0	Including valves and royalties.
	,, A 353	—	—	—	—	*SG	TA	*LG	Tr	*T	—	—	Tr	AC	—	19 19 0	,, ,, ,,
,, ,, ,,	,, B 454 (*RG*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	G	26 5 0	,, ,, ,,
,, ,, ,,	,, M 454 (*RG*)	—	—	—	—	*SG	TG	*LG	Tr	P P	—	—	Tr	AC	G	68 5 0	Parallel pentodes in output stage.
,, ,, ,,	,, P 205 (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	Including valves and royalties.
,, ,, ,,	,, P 254 (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	17 17 0	,, ,, ,,
,, ,, ,,	,, T 254	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	—	17 17 0	Transportable.
Electrical Reproducers, Ltd., 102, West Regent Street, Glasgow.	"Cressida" Table Model	—	—	*SG	TG	*SG	TG	*PG	AT	*P	—	—	Tr	AC	—	45 0 0	Including valves and royalties.
	Automatic Table Model	—	—	*SG	TG	*SG	TG	*PG	AT	*P	—	—	Tr	AC	G	75 0 0	Eight pre-selected tuning positions, motor driven.
,, ,, ,,	"Cressida" Radio Gramophone.	—	—	*SG	TG	*SG	TG	*PG	AT	*P	—	—	Tr	AC	G	75 0 0	Moving coil loud speaker.
,, ,, ,,	Automatic Radio Gramophone.	—	—	*SG	TG	*SG	TG	*PG	AT	*P	—	—	Tr	AC	G	140 0 0	Plays 20 records without attention.
The Electrocet Radio, Co. Poplar Road Solihull, Birmingham.	Pyramids 2	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	3 10 0	Excluding valves.
	R.G. 1 (*RG*)	—	—	—	—	—	—	*LG	Tr	P	—	—	D	AC	G	18 18 0	Including valves and royalties.
,, ,, ,,	R.G. 2 (*RG*)	—	—	—	—	—	—	*LG	Tr	P	—	—	D	AC	G	24 0 0	,, ,, ,,
,, ,, ,,	Model P.2	—	—	—	—	—	—	*LG	Tr	P	—	—	D	AC	G	15 15 0	,, ,, ,,
Ellancee Radio, Ltd., Shardlow, Derby.	Standard Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	10 12 0	Including valves and accessories.
Elven Mains Receiver Co., 34, Church Street, London, W.8.	A.C. 4 (*P*)	—	—	—	—	*SG	TA	*AB	Tr	*T	RC	*T	—	DC AC	—	31 0 0	Including valves and royalties.
Empress Radio & Electrical Co., Manor Works, Stonehouse, Plymouth.	Empress S.G. 3	—	—	—	—	SG	TG	LG	—	T P	—	—	D	—	G	—	Pentode optional. A.C., D.C. or batteries.
	Screened Four (*P*)	—	—	—	—	SG	—	LG	—	T	—	T	D	B	—	15 0 0	Complete.
The Erskine Silverbell Co., 189, Southfield Road, Chiswick, London, W.4.	"Concert" Model (*RG*)	—	—	*SG	TG	*SG	TG	*AB	RC	*T	Tr	T T	CFT	AC, DC	G	94 10 0	Push-pull output stage.
,, ,, ,,	"Grand" Model (*RG*)	—	—	*SG	TG	*SG	TG	*PG	Tr	T T	—	—	CFT	AC, DC	G	78 15 0	,, ,, ,,
,, ,, ,,	"Boudoir" Model (*RG*)	—	—	—	—	*SG	TG	*LG	Tr	T	—	—	CFT	AC, DC	G	57 15 0	Period cabinet.
Falk, Stadelmann & Co., Ltd., 83/93, Farringdon Road, London, E.C.1.	New Waterloo SG 3	—	—	—	—	SG	—	LG	—	P	—	—	—	B	G	12 0 0	Set only. Complete with valves and batteries, £16.
	Henley All Electric SG 3	—	—	—	—	*SG	—	*LG	—	P	—	—	—	AC	—	23 0 0	Including valves and royalties.
,, ,, ,,	Ascot Screened Four (*P*)	—	—	—	—	SG	—	LG	—	T	—	T	—	B	—	16 16 0	,, ,, ,,
,, ,, ,,	Warwick Five (*P*)	—	—	T	—	T	—	LG	—	T	—	T	—	B	—	17 17 0	,, ,, ,,
,, ,, ,,	Grenville Radio Gram.	—	—	T	—	T	—	LG	—	T	—	T	—	B	G	21 0 0	,, ,, ,,
Faraday Radio Gramophones, Ltd., 8, Bridewell Place, London, E.C.4.	"Faraday" (*RG*)	—	—	—	—	*SG	TA	*LG	Tr	*P	—	—	CFT	DC AC	G	51 9 0	Including valves and royalties.
Ferranti, Ltd., Hollinwood Lancs.	Model 21	—	—	—	—	—	—	*LG	Tr	T	—	—	Tr	AC	G	16 0 0	Calibrated in wavelengths.
,, ,, ,,	,, 22	—	—	—	—	—	—	*LG	Tr	T	—	—	Tr	AC	G	16 0 0	Choice of two stations.
,, ,, ,,	,, 32	—	—	—	—	*SG	TT	*LG	Tr	T	—	—	Tr	AC	G	25 0 0	Rexine-covered metal cabinet.
,, ,, ,,	,, 31	—	—	—	—	*SG	TT	*LG	Tr	T	—	—	Tr	AC	G	27 0 0	Wood cabinet.
,, ,, ,,	Metal Console	—	—	—	—	*SG	TT	*LG	Tr	T	—	—	Tr	AC	G	37 10 0	Magno-Dynamic loud speaker.
,, ,, ,,	Junior Console	—	—	—	—	*SG	TT	*LG	Tr	T	—	—	Tr	AC	G	47 10 0	,, ,, ,,
,, ,, ,,	Senior Console	—	—	—	—	*SG	TT	*LG	Tr	T	—	—	Tr	AC	G	53 0 0	,, ,, ,,
,, ,, ,,	Radio Gram.	—	—	—	—	*SG	TT	*LG	Tr	T	Tr	T T	Tr	AC	G	78 15 0	Two "LS5AS in push-pull."
Gambrell Radio, Ltd., Buckingham Street, Strand, London, W.C.2.	Type C2 AC	—	—	—	—	—	—	*LG	Tr	*T	—	—	CF	AC	—	16 10 0	Including valves and royalties.
	,, C2 DC	—	—	—	—	—	—	LG	Tr	P	—	—	CF	DC	—	13 10 0	,, ,, ,,
,, ,, ,,	,, R3 AC	—	—	—	—	*SG	TA	*LG	Tr	*T	—	—	CF	AC	G	26 15 0	,, ,, ,,

Gambrell Radio, Ltd., Buckingham Street, Strand, London, W.C.2.—*continued.*	Type R3 DC	—	—	—	—	SG	TA	LG	Tr	P	—	—	CF	DC	G	24 0 0	Including valves and royalties.
,,	,, R4 AC	—	—	—	—	*SG	TA	*LG	Tr	*T	RC	T	CF	AC	G	33 0 0	,, ,, ,,
,,	,, R4 DC	—	—	—	—	SG	TA	LG	Tr	T	RC	P P	CF	DC	G	27 0 0	,, ,, ,,
,,	,, FAC	—	—	—	—	*SG	TA	*LG	Tr	*T	RC	T	CFT	AC	G	45 0 0	Moving coil loud speaker.
,,	,, FDC	—	—	—	—	SG	TA	LG	Tr	T	RC	P P	CFT	DC	G	37 0 0	Including eliminator, valves and royalties.
,,	,, RNAC	—	—	—	—	*SG	TA	*LG	Tr	*T	RC	T	CFT	AC	G	73 10 0	"Novotone" compensator.
,,	,, RNFC	—	—	—	—	SG	TA	LG	Tr	T	RC	P P	CFT	DC	G	65 2 0	,, ,,
Garnett, Whiteley & Co., Ltd., Mill Lane, Liverpool	Type RS/70	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	G	12 10 0	Including valves and royalties.
	,,	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	D	AC DC	G	19 10 0	,, ,, ,,
,,	Type TM/110	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	D	AC	G	21 10 0	,, ,, ,,
,,	Type CM/100 (Console)	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	CF	AC	G	33 0 0	,, ,, ,,
,,	All-electric Transportable	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	D	AC	G	24 0 0	,, ,, ,,
,,	Radio Gram Chassis	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	G	12 0 0	,, ,, ,,
,,	,, ,,	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	D	AC	G	19 0 0	,, ,, ,,
The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.	3-Valve S.G. Battery Model	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	12 0 0	Including valves and royalties.
	All-electric 2-valve ,,	—	—	—	—	—	—	†LG	Tr	T	—	—	CF	AC	—	15 0 0	,, ,, ,,
,,	All-electric 3-valve S.G. ,,	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	CF	AC	G	18 0 0	,, ,, ,,
,,	All-electric 4-valve S.G. ,,	—	—	*SG	TT	*SG	TT	*PG	Tr	T	—	—	CF	AC	G	80 0 0	,, ,, ,,
,,	All-electric Radio Gram.	—	—	*SG	TT	*SG	TT	*PG	Tr	T	—	—	Tr	AC	G	70 0 0	M.C. loud speaker incorporated.
,,	All-electric 3-valve Portable (*MT*).	—	—	—	—	†SG	TA	†LG	Tr	P	—	—	CF	AC	—	21 0 0	Including valves and royalties.
,,	S.G. 4-valve Portable	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	CF	B	—	21 0 0	,, ,, ,,
,,	Type BC 3100 (*EG*)	—	—	—	—	—	—	—	—	T	Tr	T	Tr	AC	G	45 0 0	Moving coil loud speaker.
Goodwin Radio, Ltd., 395, St. John Street, London, E.C.1.	"Goodwin" Portable	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	15 15 0	Rexine covered suitcase.
	,, Transportable	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	G	G	15 15 0	Mahogany cabinet and turntable.
Gould, Harper & Co., Fleets Bridge, Upton Road, Poole, Dorset.	Junior Melody Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	3 5 0	Excluding valves and royalties.
	Melody Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	4 15 0	,, ,, ,,
,,	Melodia Four	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	G	8 10 0	,, ,, ,,
,,	Truemelody Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	5 5 0	,, ,, ,,
,,	,, S.G. Three	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	—	6 5 0	,, ,, ,,
,,	,, Self Contained Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	7 5 0	,, ,, ,,
,,	,, ,, ,, SG ,,	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	—	8 5 0	,, ,, ,,
,,	Melody Five (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	G	16 0 0	Including ,, ,,
,,	,, ,, de Luxe (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	G	18 0 0	,, ,, ,,
Graham Amplion, Ltd., 26, Savile Row, London, W.1.	2-valve AC Mains Set	—	—	—	—	—	—	*LG	Tr	P	—	—	D	AC	G	15 15 0	Including valves and royalties.
	2-Screen Grid Cabinet	—	—	SG	TA	SG	Ap	LG	Tr	P	—	—	D	AC	G	39 18 0	,, ,, ,,
,,	D.C. Battery Cabinet	—	—	—	—	SG	TA	LG	RC	T	Tr	T	CF	DC	—	32 10 0	,, ,, eliminator ,,
,,	5-valve AC Mains Cabinet	—	—	—	—	*SG	TA	*LG	RC	*T	Tr	T	CF	AC	G	50 0 0	,, valves and royalties.
,,	Portable	—	—	SG	TA	SG	Ap	LG	Tr	P	—	—	D	B	—	24 15 0	,, ,, ,,
J. G. Graves, Ltd., Westville, Sheffield	S.G. 3-valve	—	—	—	—	SG	TT	LG	Tr	T	—	—	D	B	—	12 10 0	Including all accessories and royalties.
,,	Mains S.G. 3-valve	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	CF	AC DC	G	18 18 0	,, ,, ,,
,,	Mains 2-valve	—	—	—	—	—	—	*LG	Tr	*P	—	—	CF	AC DC	G	12 15 0	,, ,, ,,
A. W. Griffin & Co., Ltd., Bates Hill, Redditch, Worcs.	"Duo Two"	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	2 10 0	Including valves.
	"Popular" S.G. III	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	5 16 0	,, ,,
,,	"Terralto" S.G. III	—	—	—	—	SG	TT	LG	Tr	P	—	—	D	B	G	6 0 0	Excluding valves.
H.S.P. Wireless Co., Langford Works, Weston-super-Mare.	Screened Grid Four (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	19 19 0	Including valves and royalties.
	Supertwin Four (*P*)	—	—	SG	TA	SG	TA	LG	Tr	T	Tr	P	D	B	—	30 9 0	,, ,, ,,
C. Haddon Poupard & Co., Ltd., Thermion Works, Ilford, Essex.	Types ER 3	—	—	—	—	—	—	AB	Tr	T T	—	—	CFT	DC	G	26 5 0	Quality regional receiver.
,,	,, ER 4	—	—	—	—	—	—	AB	Tr	T T	—	—	CFT	AC	G	32 11 0	,, ,, ,,
,,	Portable Five	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	22 1 0	Including valves and royalties.
,,	Super Transportable	—	—	T	Ap	T	Ap	LG	Tr	P	—	—	Tr	B	G	25 4 0	M.C. loud speaker.
,,	,, ,, (*MT*)	—	—	*T	Ap	*T	Ap	*LG	Tr	P	—	—	Tr	AC DC	G	31 10 0	,, ,,
,,	Type R.G.1 (*RG*)	—	—	—	—	—	—	AB	Tr	T T	—	—	Tr	B	G	57 15 0	A.C. model, 84 gns. D.C. model, 69 gns.
,,	,, R.G.P.1 (*RG*)	—	—	*SG	TT	*SG	TT	LG	Tr	*P	—	—	Tr	AC	G	54 12 0	M.C. loud speaker.
The Halcyon Wireless Co., Ltd., 27A, Pembridge Villas, London, W.11.	Super Screened Four (*P*)	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	D	B	—	29 8 0	Including valves and royalties.
	All Mains Four (*MT*)	—	—	—	—	SG	TT	LG	RC	T	Tr	T	D	AC DC	—	42 0 0	Battery model, £33 12s.
,,	Table Radio Gram	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	Tr	AC DC	G	57 15 0	Pedestal 10 gns. extra.

LIST OF ABBREVIATIONS.

Type:
- **RG** = Radio Gramophone.
- **P** = Portable.
- **MT** = Mains Transportable.
- **EG** = Electric Gramophone only

Valves:
- **T** = Triode.
- **SG** = Screen Grid.
- **P** = Pentode.
- ***** = Indirectly Heated A.C.
- **†** = Directly Heated A.C.

Couplings:
- **TA** = Tuned Anode.
- **TT** = Tuned Transformer.
- **TG** = Tuned Grid.
- **Ap** = Aperiodic.
- **AT** = Auto Transformer.

Couplings (contd.):
- **RC** = Resistance Capacity.
- **Tr** = Transformer.
- **D** = Direct.
- **CF** = Choke Filter.
- **CFT** = Filter-fed Transformer.

Detector:
- **LG** = Leaky Grid.
- **PG** = Power Grid.
- **AB** = Anode Bend.

Current Supply:
- **B** = Battery.
- **AC** = Alternating Current Mains.
- **DC** = Direct Current Mains.

G = Provision for Gramophone Reproduction.

Buyers' Guide, 1930–31.—

Manufacturer.	Type.	H.F.	Coupling.	H.F.	Coupling.	H.F.	Coupling.	Det.	Coupling.	L.F.	Coupling.	L.F.	L.S. Coupling.	Current Supply.	Gramophone Reproduction.	Price. £ s. d.	Remarks.
The Halcyon Wireless Co., Ltd., 27A, Pembroke Villas, London, W.11.	Grandola (*RG*)	—	—	—	—	SG	TT	LG	RC	T	RC	T	Tr	AC DC	G	89 5 0	Three L.F. stages. Push-pull output.
Harris, Williams (Mfrs.), Ltd., 5, New Zealand Avenue, Barbican, London, E.C.1.	5/SPS Portable	—	—	T	—	T	—	LG	—	T	—	T	—	B	—	7 19 6	Including valves and royalties.
" " "	5/VSP "	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	11 12 6	" " "
" " "	5/DLS "	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	12 17 6	" " "
" " "	4/SGP "	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	—	17 0 0	" " "
" " "	5/PRG Radio Gram (*P*)	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	B	G	21 7 6	" " "
" " "	4/MSG Portable	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	16 0 0	" " "
" " "	3/VTM "	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	8 15 0	" " "
" " "	5/FVT "	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	13 6 0	Special model, £13 15s.
" " "	3/AXML " (*MT*)	—	—	—	—	—	—	LG	RC	T	Tr	T	—	AC	—	18 15 0	Including loud speaker.
" " "	3/STC "	—	—	—	—	—	—	—	—	—	—	—	—	B	—	5 17 6	Complete.
E. R. Harvey, Son & Co., 27, Hendon Lane, Finchley, London, N.3.	Minstrel Major (*P*)	—	—	T	—	T	—	LG	—	T	—	T	D	B	—	15 15 0	Including valves and royalties.
	Minstrel Minor (*P*)	—	—	—	—	—	—	LG	—	T	—	T	D	B	—	10 10 0	" " "
Hustler, Simpson & Webb, Ltd., 56-57, Tanner Street, London, S.E.1.	Double-Two	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	2 10 0	Including valves.
Ideas Development Syndicate, Ltd., 4, Golden Square W.1.	IDIS	—	—	—	—	SG	—	LG	—	T T	—	—	—	DC AC	G	—	Portable, 18 gns. Console 2[illegible], 3-valve, 16 gns.
Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.	A.C. 2	—	—	—	—	—	—	*LG	Tr	P	—	—	D	AC	—	13 0 0	Including valves and royalties.
" " "	Short Wave Neutrosonic	—	—	—	—	—	—	—	—	—	—	—	D	B	—	28 10 0	Six-valve superhet circuit.
" " "	Neutrosonic Seven	—	—	—	—	—	—	—	—	—	—	—	D	B	G	69 0 0	Seven-valve " "
" " "	Neutrosonic de Luxe (*RG*)	—	—	—	—	—	—	—	—	—	—	—	CF	AC	G	114 0 0	Eight-valve " "
Itonia Gramophones, Ltd., 58, City Road, London, E.C.1.	Autocrat V (*P*)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16 16 0	Including valves and royalties.
	Screen Grid IV (*P*)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21 0 0	" " "
" " "	" " Radio Gram	—	—	—	—	—	—	—	—	—	—	—	—	—	—	39 18 0	" " "
W. H. James, 202, Dale Street, Chatham.	Janellephone	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	G	10 0 0	Including valves and royalties.
" " "	" A.C.	—	—	—	—	—	—	LG	Tr	T	Tr	T	Tr	AC	G	11 0 0	" " "
Kolster Brandes, Ltd., Cray Works, Sidcup, Kent.	K.B. "Pup"	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	5 3 9	Including valves, batteries and royalties.
	Brandeset 3A	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	7 10 0	Including valves and royalties.
" " "	Type KB 163	—	—	—	—	SG	TT	LG	Tr	P	—	—	D	B	G	9 17 6	" " "
" " "	" KB 242	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	D	B	G	18 18 0	" " "
" " "	" KB 240	—	—	—	—	—	—	*LG	Tr	P	—	—	D	AC	G	11 15 0	" " "
" " "	" KB 161	—	—	—	—	*SG	TT	*LG	Tr	P	—	—	D	AC	G	19 10 0	" " "
" " "	" KB 245	—	—	—	—	SG	TT	LG	Tr	P	—	—	CF	DC	G	19 10 0	" " "
" " "	" KB 233	—	—	*SG	TT	*SG	TT	*LG	RC	*T	Tr	*T	D	AC	G	39 0 0	" " "
" " "	" KB 250 (*RG*)	—	—	—	—	*SG	TT	*LG	Tr	P	—	—	Tr	AC	G	45 0 0	Perm. magnet M.C. loud speaker.
" " "	" KB 198 (*RG*)	—	—	—	—	*SG	TT	*LG	Tr	*T	Tr	T T	Tr	AC	G	95 0 0	Push pull output (6 watts).
" " "	" KB 236 (*RG*)	—	—	*SG	TT	*SG	TT	*LG	RC	*T	Tr	*T T	Tr	AC	G	162 10 0	M.C. loud speaker.
" " "	" KB 238 (*RG*)	—	—	*SG	TT	*SG	TT	*LG	RC	*T	Tr	T T	Tr	AC	G	262 10 0	Twin turntables.
" " "	" KB 103 (*P*)	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	D	B	—	19 19 0	Oak or leather case.
" " "	" KB 214 (*MT*)	—	—	—	—	*SG	TT	LG	RC	T	Tr	T	Tr	AC	G	40 19 0	In walnut or mahogany, 42 gns.
S. A. Lamplugh, Ltd., Kings Road, Tyseley, Birmingham.	Popular Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	7 15 0	Including valves and royalties.
	Standard Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	9 5 0	" " "
" " "	Type AC/SG 3	—	—	—	—	*SG	TA	*LG	Tr	*T	—	—	CF	AC	—	21 0 0	" " "
" " "	" AC/SG 4	—	—	—	—	*SG	TA	*LG	Tr	*T	RC	*T	CF	AC	—	33 15 0	Console with inductor L.S., £27.
Eric J. Lever (Trix Ltd.), 8/9, Clerkenwell Green, London, E.C.1.	Regional Portable (*MT*)	—	—	—	—	—	—	*LG	Tr	*T	—	—	D	AC	G	15 15 0	" " " included
	Portable 5	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	—	G	19 2 0	Complete.
" " "	Screen Grid 4	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	D	—	G	23 2 0	Adaptor for mains or batteries.
" " "	Type G.A. 10	—	—	—	—	—	—	—	—	*T	Tr	*P	CF	AC DC	G	—	Power amplifier. Price on application.
" " "	" G.A. 25	—	—	—	—	—	—	*T	RC	*T	Tr	*T	CFT	AC	G	—	" " " "
" " "	" G.A. 60	—	—	—	—	—	—	*T	RC	*T	Tr	*T	CF	AC	G	—	" " " "
Lissen, Ltd., Worple Road, Isleworth, Middlesex.	3-valve Transportable	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	G	10 10 0	—
	2-valve Regional "	—	—	—	—	—	—	LG	Tr	P	—	—	D	B	G	8 8 0	A.C. model, 11 gns.
" " "	Baby Grand (*RG*)	—	—	—	—	—	—	*LG	Tr	P	—	—	D	AC	G	23 2 0	Battery model, 17 gns.
" " "	"Salon" Transportable	—	—	—	—	*SG	TA	*LG	Tr	*T	Tr	*T	D	AC	—	19 19 0	" " 15 gns.
" " "	"Salon" Radio Gramophone.	—	—	—	—	*SG	TA	*LG	Tr	*T	Tr	T	Tr	AC	G	44 2 0	—
Liverpool Radio Supplies, 64, Myrtle Street, Liverpool.	Uniflex (*RG*)	—	—	*SG	—	*SG	—	*LG	—	T	—	—	Tr	AC	G	48 0 0	Complete.
The Loewe Radio Co., Ltd., 4, Fountayne Road, Tottenham, London, N.15.	Type OE 333	—	—	—	—	—	—	AB	RC	T	RC	T	D	B	G	3 3 0	Multiple valve Type 3 NF.
	" RO 433	—	—	—	—	—	—	LG	RC	T	RC	T	D	B	G	3 10 0	" " " RNF 7.
London Electrical Co., 1, Sherborne Lane, London, E.C.1.	Type 31 M	—	—	—	—	SG	—	LG	—	T	—	—	D	B	—	9 15 0	Including valves and royalties.
	" G. 3 (*RG*)	—	—	—	—	—	—	LG	RC	T	Tr	T	Tr	B	G	19 19 0	" " batteries and royalties.

London Electrical Co., 1, Sherborne Lane, London, E.C.4.	Type S.G. 3 (*RG*)	—	—	—	—	SG	TT	LG	Tr	P	—	—	Tr	B	G	22 1 0	Including valves, batteries and royalties.
	,, S.G. 3 A.C. (*RG*)	—	—	—	—	*SG	TT	*LG	Tr	P	—	—	Tr	AC	G	31 10 0	,, ,, and royalties.
The Loud Speaker Co., Ltd., 2, Palmer Street, London, S.W.1.	Type 1-2 P	—	—	—	—	—	—	*LG	—	*T	—	—	Tr	AC	G	12 12 0	Loud speaker incorporated.
	,, AC 3 (*P*)	—	—	—	—	*SG	TG	*LG	—	*T	—	—	Tr	AC	G	31 10 0	M.C. loud speaker.
,, ,, ,,	Convertible Portable	—	—	T	Ap	T	Ap	LG	—	T	—	T	CF	B	G	26 5 0	D.C. model, 30 gns. A.C. model, 35 gns.
M.P.A. Wireless (1930), Ltd., 62, Conduit Street, London, W.1.	Two Station Radio Exchange (*MT*).	—	—	—	—	—	—	*LG	Tr	P	—	—	CF	B AC	—	15 15 0	Including valves and royalties.
,, ,, ,,	Four Valve Transportable (*MT*).	—	—	—	—	*SG	TG	*AB	RC	*T	Tr	*T	CF	AC	G	34 13 0	,, ,, ,,
,, ,, ,,	Three Valve All Mains	—	—	—	—	*SG	TG	*AB	Tr	*P	—	—	CF	AC	G	27 6 0	,, ,, ,,
,, ,, ,,	Ethatrope Minor (*RG*)	—	—	—	—	*SG	TG	*LG *AB	Tr	T	—	—	Tr	DC AC	G	63 0 0	,, ,, ,,
,, ,, ,,	Three Valve All Mains (*RG*)	—	—	—	—	*SG	TG	*AB	Tr	T	—	—	Tr	DC AC	G	66 3 0	,, ,, ,,
,, ,, ,,	Home Model (*RG*)	—	—	—	—	*SG	TG	*AB	RC	*T	Tr	T	Tr	DC AC	G	94 10 0	,, ,, ,,
,, ,, ,,	Ethatrope Radio Exchange (*RG*).	—	—	*SG	TG	*SG	TG	*AB	RC	*T	Tr	T T	Tr	DC AC	G	178 10 0	Twin turntables. Two L.S. 5A's in parallel.
,, ,, ,,	Ethatrope Junior (*EG*)	—	—	—	—	—	—	—	—	*T	Tr	T T	Tr	AC	G	115 10 0	,, ,, ,, L.S. 6A's ,,
,, ,, ,,	,, Cinema (*EG*)	—	—	—	—	—	—	—	—	*T	—	T T	CF	AC	G	231 0 0	Super power model, 270 gns.
L. McMichael, Ltd., Wexham Road, Slough, Bucks.	Super Range Four (*P*)	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	—	23 10 0	Complete.
	,, ,, Table Model	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	—	27 6 0	,,
,, ,, ,,	Battery Three	—	—	—	—	SG	TA	LG	Tr	P	—	—	CF	B	G	14 14 0	Including valves and royalties.
,, ,, ,,	Mains Three	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	CF	AC	G	21 0 0	Complete.
The Mag-Rad Wireless Co., 112A, Warstone Lane, Birmingham.	Universal Three	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	G	2 2 0	Less valves.
Mains Radio Mfg. Co., 49, Green Lane, Thornton Heath, London, S.W.	M.R. Transportable (*MT*)	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	CF	AC	G	29 8 0	Complete, including turntable.
The Marconiphone Co., Ltd., 363, Oxford Street, London, W.1.	Model 221	—	—	—	—	—	—	LG	Tr	P	—	—	D	B	G	8 0 0	Including valves.
	,, 220	—	—	—	—	—	—	*LG	Tr	*T	—	—	D	AC	G	11 10 0	Complete.
,, ,, ,,	,, 39	—	—	—	—	SG	TT	LG	Tr	T	—	—	D	B	G	15 15 0	D.C. model, £17 15s. A.C. model, £21.
,, ,, ,,	,, 47	—	—	—	—	*SG	TG	*LG	RC	*T	RC	*T	D	AC	G	24 0 0	Complete.
,, ,, ,,	,, 56	SG	TT	SG	TT	SG	TT	AB	RC	T	—	—	D	B	G	30 7 0	D.C. model, £32 7s. A.C. model, £35.
,, ,, ,,	,, 560 (Console)	—	—	*SG	TG	*SG	TG	*LG	Tr	P	—	—	Tr	AC	G	39 18 0	M.C. loud speaker.
,, ,, ,,	,, 55 (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	18 18 0	Complete.
R. May, 22, Bunhill Row, London, E.C.1.	Rhapsody-Twin (*RG*)	—	—	*SG	—	*SG	—	—	—	*T	—	T T	Tr	—	G	131 5 0	
Micro Perophone & Chromogram, Ltd., 76/78, City Road, London, E.C.1.	Model A (*RG*)	—	—	—	—	*SG	—	*PG	—	*T	—	—	CF	DC AC	G	36 15 0	Complete.
	,, D (*RG*)	—	—	*SG	—	*SG	—	*PG	—	*T *T	—	—	CF	DC AC	G	78 15 0	Push-pull output.
A. R. Mitchell, 15, Claremont Street, Shrewsbury.	"Albertross" Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	6 10 0	Including valves and royalties.
	,, S.G. Three	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	G	8 10 0	,, ,, ,,
Montague Radio Inventions & Development Co., Ltd., 24, Great College Street, London, N.W.1.	Beethoven Minor (*P*)	—	—	—	—	—	—	LG	Tr	T	Tr	P	D	B	—	10 10 0	Including valves and royalties.
	,, Q.C.R. (*P*)	—	—	T	—	T	—	LG	Tr	T	Tr	T	D	B	—	17 17 0	,, ,, ,,
	,, Twin S.G. (*P*)	—	—	SG	TG	SG	TG	LG	Tr	P	—	—	D	B	—	22 1 0	,, ,, ,,
,, ,, ,,	,, S.G. Super 4	—	—	T	TG	SG	TG	LG	Tr	P	—	—	D	B	—	26 5 0	Transportable.
,, ,, ,,	,, Self-Tuning (*P*)	—	—	T	—	T	—	LG	Tr	T	Tr	T	D	B	—	24 3 0	Station selector switch and alternative variable tuning.
Murphy Radio, Ltd., Broadwater Road, Welwyn Garden City, Herts.	Type B. 4 (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	G	17 17 0	Ganged tuning calibrated in wavelengths.
C. H. P. Nutter, 245, Selhurst Road, South Norwood, London, S.E.25.	Standard Two	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	G	4 4 0	Including valves and royalties.
	Console Three	—	—	—	—	*SG	TG	LG	Tr	T	—	—	CF	AC	G	26 5 0	,, ,, ,,
Ormond Engineering Co., Ltd., Rosebery Avenue, London, E.C.1.	Ormond Five (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	15 0 0	Suitcase or transportable types.
	,, Four (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	16 16 0	,, ,, ,,
,, ,, ,,	Type R/408 (*MT*)	—	—	—	—	*SG	TG	*LG	Tr	P	—	—	CF	AC	—	24 3 0	Complete.
Pandona, Ltd., 184, Aston Road, Birmingham.	Portable Five (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	Including valves and royalties.
	Super Five (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	18 7 6	,, ,, ,,
,, ,, ,,	SG IV (*P*)	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	D	B	—	18 7 6	,, ,, ,,
,, ,, ,,	Standard (*RG*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	CF	B AC	G	30 9 0	Batteries or eliminator extra.
Pegasus, Ltd., 10, Victoria Street, Chapel Allerton, Leeds.	Model 99 (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	9 9 0	Including valves and royalties.
	"Star" (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	15 15 0	,, ,, ,,
Perfectavox, Ltd., Alexandra Works, High Street, Yeadon, Nr. Leeds.	Senior Screen Grid (*RG*)	—	—	—	—	*SG	TT	*AB	RC	*T	Tr	T T	Tr	AC	G	84 0 0	Push-pull output.
Philips Lamps, Ltd., 145, Charing Cross Road, London, W.C.2.	Type 2515	—	—	—	—	—	—	*LG	Tr	P	—	—	Tr	AC	G	12 10 0	Also D.C. model 2523.
	,, 2502	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	—	12 10 0	Including valves.

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Couplings (contd.):
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LG = Leaky Grid.
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Buyers' Guide, 1930–31.—

Manufacturer.	Type.	H.F.	Coupling.	H.F.	Coupling.	H.F.	Coupling.	Det.	Coupling.	L.F.	Coupling.	L.F.	L.S. Coupling.	Current Supply.	Gramophone Reproduction.	Price. £ s. d.	Remarks.
Philips Lamps, Ltd., 145, Charing Cross Road, London, W.C.2.	Type 2524	—	—	—	—	SG	TA	LG	Tr	P	—	—	Tr	DC	G	21 0 0	Including Valves.
,, ,, ,,	,, 2531	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	Tr	AC	G	23 0 0	,, ,,
,, ,, ,,	,, 2802	—	—	—	—	SG	TA	LG	Tr	T	Tr	P	D	B	G	30 0 0	,, ,,
,, ,, ,,	,, 2511	—	—	*SG	TA	*SG	TA	*LG	Tr	P	—	—	Tr	AC	G	35 0 0	Console Type 2601, £45.
,, ,, ,,	,, 2811 (*RG*)	—	—	*SG	TA	*SG	TA	*LG	Tr	P	—	—	Tr	AC	G	80 0 0	Inclusive.
,, ,, ,,	,, 2522 (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	P	D	B	G	25 0 0	,,
,, ,, ,,	Senior Reproducer (*EG*)	—	—	—	—	—	—	*T	Tr	T	Tr	*T	Tr	AC	G	118 10 0	Undistorted output, 15 watts.
Power Equipment Co., Ltd., Kingsbury Works, Hendon.	Powquip (*MT*)	—	—	—	—	—	—	*LG	Tr	P	—	—	D	AC	G	12 10 0	Inclusive.
Pye Radio, Ltd., Paris House, Oxford Circus, London, W.1.	Type A.C. 4D (*MT*)	—	—	*SG	TA	*SG	TA	*PG	Tr	*T	—	—	CF	AC	G	29 8 0	Inclusive.
,, ,, ,,	,, B. 4D (*P*)	—	—	SG	TA	SG	TA	AB	Tr	T	—	—	D	B	G	23 2 0	,,
,, ,, ,,	,, 350/C.	—	—	—	—	*SG	TT	*AB	Tr	*T	—	—	CF	AC	G	25 0 0	,,
,, ,, ,,	,, 232	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	4 17 0	Including royalties only.
Radio Gramophone Development Co., 72, Moor Street, Birmingham.	A.C. S. 6 and D.C. S. 6	—	—	*SG	TG	*SG	TG	*PG	RC	*T	Tr	*T *T	Tr	DC AC	G	80 0 0	Band pass filter. Parallel output valves.
Radio Instruments, Ltd., Purley Way, Croydon.	Madrigal A.C.	—	—	—	—	*SG	TG	*LG	Tr	*P	—	—	CF	AC	G	30 0 0	Pedestal model with M.C. speaker, £48 18s.
,, ,, ,,	,, D.C.	—	—	—	—	SG	TG	LG	Tr	P	—	—	CF	DC	G	30 0 0	,, ,, ,, £45 15s.
Ready Radio (RR), Ltd., 159, Borough High Street, London, S.E.1.	Empire Link S.W. Kit	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	11 11 0	Complete overseas kit, 23 gns.
Rees, Mace Manufacturing Co., Ltd., 39A, Welbeck Street, London, W.1.	Tourist Seven (*P*)	—	—	—	—	—	—	—	—	—	—	—	D	B	—	40 19 0	Seven-valve super-het. circuit.
,, ,, ,,	Gnome IV (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	19 19 0	Complete. Portable or transportable.
,, ,, ,,	Welbeck IV (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	23 2 0	,,
Regent Radio Supply Co., 21, Bartlett's Buildings, Holborn Circus, London, E.C.4.	Four Valve AC	—	—	*SG	TA	*SG	TA	*PG	Tr	*T	—	—	CF	AC	G	31 10 0	Including valves and royalties.
Rialton Radio, 13/14, Golden Square, London, W.1.	"Melva" Transportable	—	—	—	—	—	—	—	—	—	—	—	D	—	G	36 15 0	Five-valve super-het. Battery, A.C. or D.C.
,, ,, ,,	"Super" Radio Gram.	—	—	*SG	TT	*SG	TT	*AB	RC	*T	RC	P	Tr	DC AC	G	84 0 0	Inclusive.
Ricarda Electric Co., 16, Holbein Place, Sloane Square, London, S.W.1.	Type AE 5 (*MT*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	CF	DC AC	G	25 4 0	Including valves and royalties.
Riversdale Radio Co., Ltd., Kingston-on-Thames.	Popular (*P*)	—	—	T	—	T	—	LG	—	T	—	T	D	B	—	8 19 6	Including valves and royalties.
,, ,, ,,	Riversdale Baby (*P*)	—	—	T	—	T	—	LG	—	T	—	T	D	B	—	7 7 0	,, ,, ,,
,, ,, ,,	,, de Luxe (*P*)	—	—	T	—	T	—	LG	—	T	—	T	D	B	—	10 19 6	,, ,, ,,
Rolls Caydon Sales, 77, Rochester Row, London, S.W.1.	Rondo (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	11 4 6	Inclusive.
,, ,, ,,	Ranger (*P*)	—	—	SG	TG	SG	TT	LG	Tr	P	—	—	D	B	—	23 2 0	,,
,, ,, ,,	Phantom Regional (*P*)	—	—	SG	TG	SG	TT	LG	Tr	P	—	—	D	B	—	44 2 0	,,
,, ,, ,,	H.T. All Mains (*MT*)	—	—	—	—	*SG	TG	*PG	Tr	P	—	—	CF	AC	—	21 0 0	,,
,, ,, ,,	T.R. Radio Gram.	—	—	—	—	*SG	TG	*PG	Tr	P	—	—	Tr	AC	G	68 5 0	,,
Rolls Radio, Ltd., 138, St. John's Street, London, E.C.1.	Table Grand (*RG*)	—	—	—	—	*SG	TG	*PG	Tr	P	—	—	D	AC	G	35 14 0	Including valves and royalties.
,, ,, ,,	Radio Gramophone	—	—	—	—	*SG	TG	*PG	Tr	P	—	—	Tr	AC	G	57 15 0	M.C. loud speaker.
,, ,, ,,	Baby Phantom (*P*)	—	—	—	—	SG	TG	LG	RC	T	Tr	T	D	B	—	18 18 0	Including valves and royalties.
,, ,, ,,	Super Phantom (*P*)	—	—	SG	TG	SG	TT	LG	Tr	P	—	—	D	B	G	35 14 0	,, ,, ,,
Rothermel Corporation, Ltd., 24/26, Maddox Street, London, W.1.	Peerless S.G. 8 (chassis)	*SG	—	*SG	—	*SG	—	*LG	—	*T	—	*T *T	Tr	AC	—	38 0 0	Including valves, M.C. loud speaker and royalties.
T. W. Rutter, 3, St. James Road, West Croydon.	Personic V (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	17 17 0	Complete with cover and turntable.
James Scott & Co., Inglis Street, Dunfermline.	All Scott III	—	—	—	—	SG	TG	LG	Tr	P	—	—	D	B	G	13 10 0	Including valves and royalties. A.C. and D.C. mains models, £23 each.
,, ,, ,,	All Scott IV	—	—	SG	TG	SG	TG	LG	Tr	P	—	—	CF	B	G	21 0 0	Including valves and royalties. A.C. and D.C. mains models, £35 each.
,, ,, ,,	Junior Radio Gram.	—	—	—	—	SG	TG	*LG	Tr	*T	—	—	CF	DC AC	G	47 0 0	Indirectly heated valves, A.C. model only.
,, ,, ,,	Standard Radio Gram.	—	—	*SG	TG	*SG	TG	*LG	Tr	*T	—	—	CF	DC AC	G	72 10 0	Electro-dynamic loud speaker.
,, ,, ,,	Super Radio Gram.	—	—	*SG	TG	*SG	TG	*AB	RC	*T	Tr	T T	Tr	AC	G	96 0 0	Push-pull output.
Selectors, Ltd., 204/7, Bedford Avenue, Trading Estate, Slough, Bucks.	Attaché "22"	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	23 2 0	Including valves and royalties.
,, ,, ,,	,, "32"	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	G	33 12 0	Cabinet transportable also 32 gns.
,, ,, ,,	Electric "42"	—	—	—	—	*SG	TA	*LG	Tr	*T	Tr	*T	D	AC	G	44 2 0	D.C. model also 42 gns.
,, ,, ,,	,, "55"	—	—	—	—	*SG	TA	*LG	Tr	*T	Tr	T	CFT	AC	G	57 15 0	M.C. loud speaker.
,, ,, ,,	Selector-Vox (*RG*)	—	—	—	—	*SG	TA	*LG	Tr	*T	Tr	T T	CFT	AC	G	157 10 0	,, ,, Twin turntables.
Standard Battery Co., 184, Shaftesbury Avenue, London, W.C.2.	A.C. 4 (*MT*)	—	—	—	—	*SG	Ap TA	*AB	RC	*T	RC	T	D	AC	G	25 0 0	Including valves and royalties.

Standard Battery Co., 184, Shaftesbury Avenue, London, W.C.2.	A.C. 4 (*RG*)	—	—	—	—	*SG	Ap TA	*AB	RC	*T	RC	T	D	AC	G	50 0 0	Including valves and royalties.
The Strad Gramophone & Radio Mfg. Co., Hutchinson Court, Darwen, Lancs.	A.S.G. 5 (*RG*)	—	—	—	—	*SG	TT	*LG	RC	*T	Tr	T T	Tr	AC	G	49 7 0	Parallel output. D.C. model, 45 gns.
Stratton & Co., Ltd., Balmoral Works, Bromsgrove Street, Birmingham.	Eddystone All-Wave Four	—	—	—	—	SG	TT	LG	RC	T	Tr	P	Tr	B	G	27 0 0	14–2,000 metres. Eliminators available.
Tannoy Products, 1/7, Dalton Street, West Norwood, London, S.E.27.	Type R. 3	—	—	—	—	*SG	TT	*PG	Tr	*P	—	—	CF Tr	AC	G	19 19 0	Complete.
,, ,, ,,	,, R. 3c (*RG*)	—	—	—	—	*SG	TT	*PG	Tr	*P	—	—	CF Tr	AC	G	47 5 0	M.C. loud speaker.
,, ,, ,,	,, R. 4G (*RG*)	—	—	—	—	*SG	TT	*PG	RC	*T	Tr	T	CF Tr	AC	G	57 15 0	,, ,,
Howard Thomas & Co., Ltd., 320, Regent Street, London, W.1.	Fada 44	*SG	—	*SG	—	*SG	—	*LG	—	*T	—	*T *T	CFT	AC	G	48 0 0	Console model.
Tutills, Ltd., 7/9, Swan Street, Manchester.	Tinol Eight	*SG	TG	*SG	TG	*SG	TG	*LG	RC	*T	Tr	*T *T	Tr	AC	—	38 10 0	Including M.C. loud speaker. Push-pull.
,, ,, ,,	,, ,, (*RG*)	*SG	TG	*SG	TG	*SG	TG	*LG	RC	*T	Tr	*T *T	Tr	AC	G	62 10 0	Inclusive.
Ultra Electric, Ltd., 661/663, Harrow Road, London, N.W.10.	A.C. 3 and D.C. 3	—	—	—	—	*SG	TG	*AB	RC	*T *P	—	—	CF	DC AC	G	23 0 0	Inclusive. Alternative output valves.
,, ,, ,,	Air Chrome Five (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	16 16 0	Inclusive.
Universal Gramophone & Radio Co., Ltd., Ryland Road, Kentish Town, London, N.W.5.	Midget Marvel A.C.	—	—	—	—	—	—	*PG	Tr	*T	—	—	D	AC	G	8 0 0	Excluding loud speaker.
	,, ,, D.C.	—	—	—	—	—	—	LG	Tr	T	—	—	CF	DC	G	8 0 0	,, ,,
	Ideal (Battery) (*RG*)	—	—	—	—	SG	TG	PG	Tr	P	—	—	CF	B	G	30 0 0	Exponential horn L.S.
,, ,, ,,	Ideal A.C. (*RG*)	—	—	—	—	*SG	TG	*PG	Tr	*P	—	—	CF	AC	G	40 0 0	D.C. model also available.
,, ,, ,,	Concert Grand (Battery) (*RG*)	—	—	—	—	SG	TA	LG	RC	T	Tr	T	CF	B	G	50 0 0	Including valves and royalties.
,, ,, ,,	,, ,, (Mains) (*RG*)	—	—	—	—	*SG	TA	*LG	Tr	*T	—	—	CF	DC AC	G	65 0 0	,, ,, ,,
Varley, Ltd. (Oliver Pell Control), 103, Kingsway, London, W.C.1.	Junior All Electric A.P. 1	—	—	—	—	—	—	*LG	Tr	*T	—	—	CF	AC	G	15 15 0	Including valves and royalties.
	,, ,, A.P. 11	—	—	—	—	—	—	LG	Tr	T	Tr	T	CF	DC	G	16 16 0	,, ,, ,,
,, ,, ,,	Senior All Electric A.P. 12	—	—	—	—	*SG	TT	*LG	Tr	T	—	—	CF	AC	G	26 0 0	,, ,, ,,
,, ,, ,,	Senior Convertible A.P. 13	—	—	—	—	*SG	TT	*LG	Tr	*T	—	—	CF	DC AC	G	26 0 0	Interchangeable mains units.
,, ,, ,,	Console Radio Gram A.P. 14	—	—	—	—	*SG	TG	*LG	Tr	T T	—	—	CF	AC	G	89 5 0	M.C. loud speaker. Parallel output.
,, ,, ,,	,, ,, ,, A.P. 20	—	—	—	—	SG	TG	LG	RC	T	Tr	T T	CF	DC	G	89 5 0	,, ,, ,,
Vista Continuous Gramophone Co., Ltd., 119, Finsbury Pavement, London, E.C.	Vista (*RG*)	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	CF	B,DC or AC	G	78 15 0	With continuous gramophone mechanism.
	Harlie (*RG*)	—	—	—	—	—	—	*LG	RC	*T	RC	*T	CF	AC DC	G	78 15 0	,, ,, ,, ,,
,, ,, ,,	Peerless S.G.8	*SG	—	*SG	—	*SG	—	*LG	—	*T	—	*T *T	Tr	AC	G	105 0 0	,, ,, ,, ,,
Voltron Electric, Ltd., Queensway, Ponders End, Middlesex.	Type S. 3	—	—	—	—	SG	—	LG	Tr	T	—	—	—	B	—	5 15 0	Less valves and royalties.
	All Electric Screened 3	—	—	—	—	—	—	—	—	—	—	—	—	AC	—	21 0 0	Including valves and royalties.
,, ,, ,,	Voltron Radio Gram.	—	—	—	—	—	—	—	—	—	—	—	—	AC	G	89 5 0	,, M.C. loud speaker.
,, ,, ,,	Dynaplus	—	—	—	—	SG	—	LG	Tr	T	—	—	D	B	—	3 12 9	Kit of parts.
Ward & Goldstone, Ltd., Frederick Road, Pendleton, Manchester.	"Goltone" Portable	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	15 15 0	Including valves and royalties.
	,, All Mains Three	—	—	—	—	—	—	—	—	—	—	—	—	AC	G	21 0 0	,, ,, ,,
	,, SG and Pentode 3	—	—	—	—	SG	—	LG	—	P	—	—	—	B	—	9 0 0	Excluding valves.
Watmel Wireless Co., Ltd., High Street, Edgware, Middlesex.	B. 3	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	5 10 0	Excluding valves and accessories.
	S.G. B. 3	—	—	—	—	SG	Ap	LG	Tr	T	—	—	D	B	—	7 10 0	Including valves and royalties.
,, ,, ,,	A.C. Power Grid Mains	—	—	—	—	—	—	*PG	AT	*T	AT	*T	CF	AC	G	17 17 0	,, ,, ,,
S. E. Whiteley, Ltd., Gartside Street, Manchester. ("Blue Comet.")	Popular Two	—	—	—	—	—	—	LG	—	T	—	—	D	B	G	2 10 0	Valves extra. Royalties included.
	,, Three	—	—	—	—	—	—	LG	—	T	—	T	D	B	G	3 10 0	,, ,, ,,
Whittingham Smith & Co., Portadyn Works, Chase Estate, Park Royal, London, N.W.10.	Portadyne S.G. 4 (*P*)	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	—	23 2 0	Including valves and royalties.
The Wholesale Wireless Co., 103, Farringdon Road, London, E.C.1.	Three-valve All Electric	—	—	—	—	—	—	*LG	Tr	P	—	—	D	AC	G	9 10 0	Kit of parts, less valves.
Yates, Sutton, Ltd., 38/40, York Street, Leicester. ("Stradivox.")	All Mains Transportable	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	D	AC	—	21 0 0	Including valves and royalties.
	Senior Radio Gram	—	—	—	—	*SG	TG	*LG	RC	*T	Tr	*T *T	Tr	AC	G	59 0 0	M.C. loud speaker. Parallel output.

LIST OF ABBREVIATIONS.

Type :
- **RG** = Radio Gramophone.
- **P** = Portable.
- **MT** = Mains Transportable.
- **EG** = Electric Gramophone only.

Valves :
- **T** = Triode.
- **SG** = Screen Grid.
- **P** = Pentode.
- * = Indirectly Heated A.C.
- † = Directly Heated A.C.

Couplings :
- **TA** = Tuned Anode.
- **TT** = Tuned Transformer.
- **TG** = Tuned Grid.
- **Ap** = Aperiodic.
- **AT** = Auto Transformer.

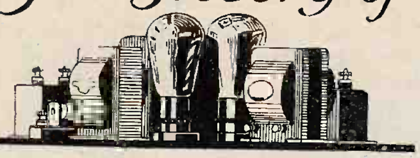
Couplings (contd.) :
- **RC** = Resistance Capacity.
- **Tr** = Transformer.
- **D** = Direct.
- **CF** = Choke Filter.
- **CFT** = Filter-fed Transformer.

Detector :
- **LG** = Leaky Grid.
- **PG** = Power Grid.
- **AB** = Anode Bend.

Current Supply :
- **B** = Battery.
- **AC** = Alternating Current Mains.
- **DC** = Direct Current Mains.

G = Provision for Gramophone Reproduction.

The Theory of THE VALVE AMPLIFIER



Some Aspects of Resistance-Capacity Coupling.

By S. O. PEARSON, B.Sc., A.M.I.E.E.

(*Continued from page 560 of previous issue.*)

HAVING given in outline the general method of coupling two valves in cascade where some form of impedance is connected in the anode circuit of the first valve and where the actual coupling is effected through the medium of a condenser, the next step is to analyse the circuit and resolve it into a simple equivalent A.C. circuit with the object of clarifying the method of calculation with different types of external anode impedance, and of showing the effect of each component on the circuit as a whole.

The general type of circuit referred to is represented by Fig. 1, the impedance in the anode circuit of the first valve being for the present treated as a non-inductive resistance for the sake of simplicity. As pointed out previously, the properties of the amplifier depend to a very large extent on the nature of this anode impedance. The possible alternative arrangements will be treated both theoretically and numerically in due course.

An important fact to be borne in mind is that the current passing between the anode and cathode (or filament) inside the first valve also passes round the external circuits between the same two electrodes. A current always flows round a completely closed loop.

Now, if we examine the circuit of Fig. 1, ignoring for the present the portions of the circuit shown by dotted lines, we find that there are two separate and distinct external circuits between the anode and cathode of the first valve. One passes from the anode P, through the anode resistance R, and then through the H.T. battery back to the cathode. The other circuit passes from P, *via* the coupling condenser C_1, through the grid-leak resistance R_1 and the grid bias battery G.B., and thence to the cathode. It is assumed at the present stage that no current can flow between the grid and cathode of the second valve.

Obviously, then, to all outward appearances, there are two external circuits *in parallel* between the anode and cathode of the first valve. One consists of a resistance (R) and a battery (H.T.) in series, and the other is made up of a condenser (C_1), a resistance (R_1), and a battery (G.B.) in series. Now, under working conditions the current in the lead coming from the anode of the valve is a pulsating one equivalent to the sum of a D.C. component and an A.C. component.

Direct current cannot pass along a circuit with a condenser in series, and therefore the whole of the D.C. component is constrained to flow round the main anode circuit. On the other hand, a condenser does not prevent the passage of an alternating current, but merely opposes it to an extent depending on the frequency of the current and the capacity of the condenser. Therefore, the alternating component of potential difference between the point P and the common "earth" wire to which the cathodes and batteries are connected will drive an alternating current through the coupling circuit C_1R_1 and an alternating component through the main circuit *via* the H.T. battery.

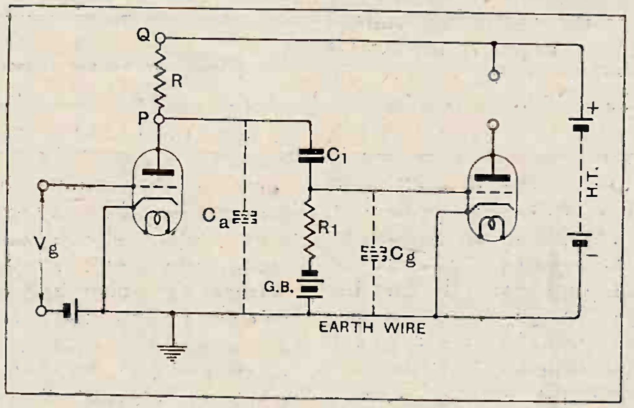


Fig. 1.—Resistance-capacity coupling of two valves in cascade. The imaginary condensers C_a and C_g represent the inter-electrode capacities of the valves as they affect the circuit at high frequencies.

A Simple Equivalent Circuit.

Actually, we are only concerned with the alternating components of current and voltage, and therefore, in developing an equivalent simplified circuit, we can leave out all such items as have no effect whatever on the alternating quantities. For instance, a battery with negligibly small resistance has no influence on the passage of an alternating component of current—it is merely responsible for the D.C. components—and therefore no batteries need to be included in the equivalent circuit as applied to the A.C. components only.

The part of the circuit between the cathode and the anode inside a valve can be represented by a resistance R_a and a source of alternating E.M.F., whose magnitude is μV_g volts, where R_a is the A.C. resistance of the valve, μ is the amplification factor, and V_g is the R.M.S. value of the alternating signal voltage applied between the grid and cathode. At the present stage it will be assumed that

The Theory of the Valve Amplifier.—

any capacity which might exist between the anode and cathode, and any other stray capacities between different parts of the circuits, produce effects which are sufficiently small to be neglected. For low frequencies this is literally true.

In building up the equivalent A.C. circuit we start with the source of alternating electromotive force μV_g, in series with it being R_a, the A.C. resistance of the valve, as shown by the left-hand portion of Fig. 2 (a). The circuit then divides into two branches, one being the external anode circuit resistance R (the H.T. battery is omitted, as it has no effect on the alternating component of current), and the other being the coupling cuit C_1R_1. Both branches lead back to the cathode from whence we started in tracing through the circuit, and therefore these branches come together again, joining the common "earth" wire. We then have the completely closed circuit, as shown in Fig. 2 (a).

The branch C_1R_1, being comprised of a resistance and a condenser in series, has an impedance which depends on the frequency of the current. If the frequency is f cycles per second, the reactance of the condenser is $X_c = 1/2\pi f C_1$ ohms. Now, resistance and reactance in series must always be added together as though they were two quantities represented by two straight lines mutually at right angles (see *Wireless World*, December 11th, 1929, page 654), and the impedance of the branch C_1R_1 is therefore given by $Z_1 = \sqrt{R_1^2 + X_c^2}$ ohms. But, since the alternating voltage applied between the grid and the cathode of the second valve is actually that set up between the ends of the grid leak resistance R_1, it follows that in practice the reactance X_c of the coupling condenser C_1 is arranged to be small compared with the resistance R_1 at the lowest frequency likely to be met with. This is done in order that as little as possible of the available voltage shall be wasted in overcoming the reactance of the condenser. Thus, in all normal cases the reactance X_c may be neglected in comparison with the resistance R_1, and the equivalent circuit can therefore be still further simplified by omitting C_1, as shown at (b) in Fig. 2, the impedance of the branch being simply equal to R_1 ohms.

The circuit of Fig. 2 (b) is the simplest possible equivalent to the circuit between the two valves, being based on the assumption that the effects of the internal valve capacities and other stray capacities are negligibly small, this assumption being justifiable if the frequency is sufficiently low.

Under these conditions Fig. 2 (b) shows that the effective resistance of the external anode circuit is equal to the combined resistance of R and R_1 in parallel. Thus, if R′ is the resultant resistance, $\frac{1}{R'} = \frac{1}{R} + \frac{1}{R_1}$ or $R' = \frac{RR_1}{R + R_1}$ ohms, and the theoretical voltage amplification obtained is given in the ordinary way, as previously explained, by $n = \frac{\mu R'}{R' + R_a}$ very approximately at low frequencies.

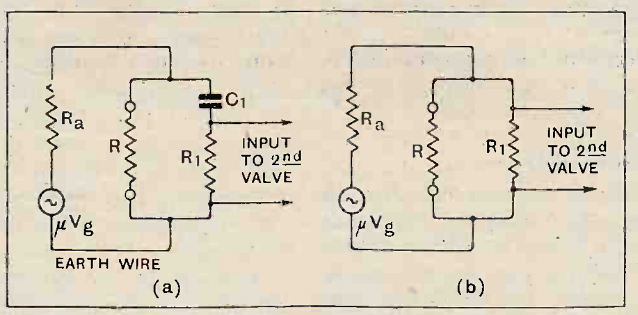


Fig. 2.—A.C. circuits equivalent to the intervalve circuit of Fig. 1 at low frequencies (a) when the reactance of the coupling condenser C_1 is comparable with R_1 and (b) when the reactance of C_1 is negligibly small compared with the grid leak resistance R_1.

Numerical Example.

As a practical case let us assume that the first valve has an amplification factor of $\mu = 35$ and an A.C. resistance of 15,000 ohms. Let the anode resistance R be 200,000 ohms, or 0.2 megohm, and the grid leak resistance be 1 megohm. Then, assuming no loss of voltage due to the coupling condenser, the effective resistance of the external anode circuit will be

$$R' = \frac{0.2 \times 1.0}{0.2 + 1.0} \times 10^6 =$$

167,000 ohms, and the stage gain in voltage is therefore

$$n = \frac{\mu R'}{R' + R_a} = \frac{35 \times 167{,}000}{167{,}000 + 15{,}000} = 32.1$$

If the effect of the grid resistance is ignored the calculated stage gain is

$$\frac{\mu R}{R + R_a} = \frac{35 \times 200{,}000}{215{,}000} =$$

32.56, which is just a little higher than the actual value. Under these conditions the discrepancy is so slight that one would be justified in choosing the shorter and simpler method of calculation, but in cases where the main anode resistance R is of the same order of magnitude as the grid leak resistance R_1, the influence of the latter becomes too great to be neglected, and the stricter method of calculation must be applied.

Effects of Valve Capacities at High Frequencies.

The simplified circuit of Fig. 2 (b) is a combination of three non-inductive resistances, free from capacity; hence the simplicity of the calculation. The results obtained in this manner are quite accurate at low frequencies because stray capacities are then negligible in their effects. But at radio frequencies this is by no means true. In particular, the capacity which exists between the anode and cathode of the first valve and between the grid and cathode of the second valve exerts a considerable influence, causing a reduction of the effective impedance of the external anode circuit as the frequency is raised. These inter-electrode capacities can be represented by an imaginary condenser C_a connected between the anode and cathode of the first valve and a condenser C_g between the grid and cathode of the second valve, as shown by the dotted portions of the circuit in Fig. 1, the valves themselves then being assumed to possess no internal capacity.

Obviously, a condenser connected in such a position as C_a will provide a third branch along which a portion of the high-frequency current will flow between anode and cathode. The higher the frequency the greater will

The Theory of the Valve Amplifier.

be the fraction of the total radio frequency anode current by-passed in this manner, and wasted as far as voltage production across the anode resistance itself, and across the grid-leak resistance, is concerned. Similarly, the condenser C_g will by-pass some of the current, which would otherwise flow through R_1, resulting in still further reduction of the output voltage.

The equivalent A.C. circuit corrected for high frequencies is given in Fig. 3 (a), where C_a represents the anode-to-cathode capacity of the first valve and its associated circuits, and C_g represents the grid-to-cathode capacity of the second valve. Now, in this diagram, C_a and C_g are actually in parallel, and they can therefore be replaced by a single imaginary condenser whose value is $C' = C_a + C_g$. Similarly, R and R_1 are in parallel and can be regarded as a single resistance $R^1 = \frac{RR_1}{R+R_1}$ ohms. Hence the circuit can be still further simplified, as shown at (b) in Fig. 3.

Further Calculations.

The complete numerical calculation of a circuit such as that of Fig. 3 (b) is by no means easy in spite of its appearance, because there are different phase angles to be taken into account. Perhaps the best scheme is to work backwards, assuming, say, 2 volts (R.M.S.) to be developed across R^1, which will be supposed to have the same value as before, namely, 167,000 ohms. The current in R^1 is, therefore, $A_1 = \frac{2}{167} = 0.012$ milliamps, and is *in phase* with the voltage V between the ends of R^1. Supposing the total stray capacity C^1 to be 10

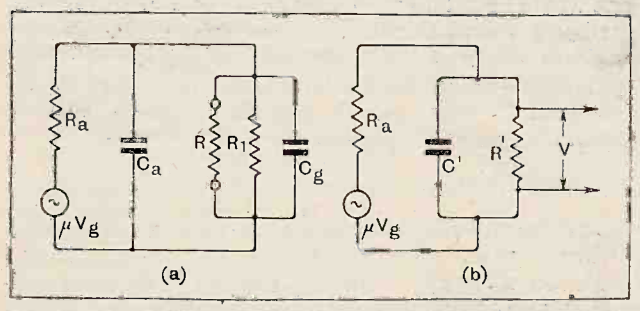


Fig. 3.—A.C. circuits equivalent to the intervalve circuit of Fig. 1 at high frequencies, showing the effect of the internal valve capacities. In (b) C^1 stands for C_a and C_g in parallel and R^1 for R and R_1 in parallel.

micro-microfarads, the reactance of C^1 at 10^6 cycles per second (corresponding to a wavelength of 300 metres) will be $\frac{1}{2\pi f C^1} = \frac{10^{12}}{2\pi \times 10^6 \times 10} = 15{,}900$ ohms. The lost current due to unwanted capacity is therefore $A_2 = \frac{2}{15.9} = 0.126$ mA., and this *leads the voltage by a quarter of a cycle,* as we are dealing with a condenser.

The individual currents A_1 and A_2, being a quarter of a cycle out of phase, can be represented by two straight lines or vectors mutually at right angles, as in Fig. 4. The resultant or total current A is therefore given by :—

$$A = \sqrt{A_1^2 + A_2^2} = \sqrt{0.012^2 + 0.126^2} = 0.1266 \text{ milliamps.}$$

The total effective impedance of the external anode circuit is equal to the ratio of the voltage developed across it to the current in it, namely,

$$Z^1 = \frac{V}{A} = \frac{2 \times 1000}{0.1266} = 15{,}800 \text{ ohms,}$$

which is very little more than the A.C. resistance of the valve itself.

Thus at a frequency of a million cycles per second the effective impedance of the external portion of the anode circuit is reduced to about one-eleventh part of the value at low frequencies, namely, 167,000 ohms, although the stray capacity responsible for the reduction was assumed to be only 10 $\mu\mu$F. In fact, with resistance-capacity coupling, the inherent capacities of the valves are the controlling factors in determining the anode circuit impedance at radio frequencies.

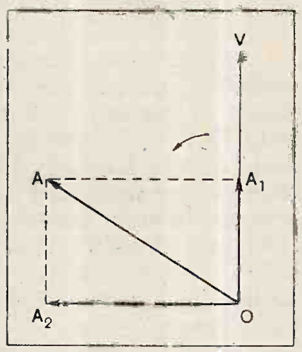


Fig. 4. — Rotating vectors showing the phase relationships of the currents in the circuit of Fig. 3 (b).

The result of the last calculation provides sufficient evidence to show clearly that resistance-capacity amplification is not a practical proposition at radio frequencies. Under the circumstances, no useful object will be served by calculating the actual voltage amplification obtained, this being fortunate because the different phase angles in the external and internal parts of the anode circuit render the process rather involved.

(*To be concluded.*)

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FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 19th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture by Mr. J. L. Thompson, with demonstration of Cossor sets.

North Middlesex Radio Society.—At St. Paul's Institute, Winchmore Hill, N.21. Lecture: "Short Wave Work," by Mr. A. J. Hall (of Messrs. Philips Lamps, Ltd.).

Tottenham Wireless Society.—At 10, Bruce Grove, N.17. Film, "Radio Record," shown by Messrs. Ensign, Ltd

THURSDAY, NOVEMBER 20th.

Edinburgh and District Radio Society.—At 8 p.m. Lecture: "Grid Power Detection," by Mr. J. N. Fordyce.

Ilford and District Radio Society.—At the Wesleyan Institute, Cleveland Road, High Road. Visit of the Southend and District Radio Society. Demonstration of radiogram apparatus by the Chairman, Mr. A. Newman.

Slade Radio (Birmingham).—At 8 p.m. At the Parochial Hall, Broomfield Road, Erdington. Analysis of design and operation of an S.G. detector and power-stage receiver, conducted by Mr. N. B. Simmonds.

FRIDAY, NOVEMBER 21st.

Radio Society of Great Britain.—At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture by Mr. Woodhall, of the M-L Magneto Co., Ltd.

Bristol and District Radio Society.—At 7.15 p.m. In the Geographical Lecture Theatre, University of Bristol. Lecture and Film: "Metal Rectifiers," presented by the Westinghouse Brake and Saxby Signal Co., Ltd.

Golders Green and Hendon Radio Society.—At 8.15 p.m. First Club Dance.

TUESDAY, NOVEMBER 25th.

Bec Radio Society (Streatham).—At 7.30 p.m. At Bec School, Beechcroft Road, S.W.17. Lantern Lecture: "All Mains Working," by Mr. F. Youle, B.Sc., of the Marconiphone Co., Ltd.

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(*It is regretted that, under "Forthcoming Events" in our last issue, Dr. N. W. McLachlan's demonstration before the Lensbury Radio Society was inadvertently announced for November 12th instead of November 13th, the actual date of the event. We apologise to all who may have been inconvenienced by the mistake.*)

BROADCAST BREVITIES

By Our Special Correspondent.

"Broadcasting House" from Within.

From the seventh floor of Broadcasting House the view is good, both horizontally and vertically. Vertically because, at present, there is no eighth floor, and the sky looks cleaner than from the pavement, 100ft. below.

My arrival on the seventh floor was the climax to a delightful upward pilgrimage a few days ago from the basement 60ft. below ground level, in company with Mr. Tudsbery, the B.B.C.'s civil engineer.

oooo

Is the Place Big Enough?

A confession must be made. Viewed from the street the building conveys the mischievous impression that it will not be quite big enough for its job. But the illusion—for surely it is an illusion—is more or less dispelled when one visits the interior and notes that Broadcasting House is built under, as well as on, the site.

oooo

Artificial Ventilation.

One descends 60 feet into the catacombs, where already two huge boilers and a number of oil-fuel tanks are in place and preparations are being made for the installation of the ventilation plant which will force refrigerated air throughout the sound-insulated portion of the building. Air conduits, specially lined with felt to subdue the roar of the forced draught, already coil around the corridor ceilings like sea serpents, and are beginning to rear up the central tower, which will house the studios.

oooo

Independence.

One imagines that the place is being built to withstand a siege, for not only has a 600ft. artesian well been sunk to provide an independent water supply, but room has been found in this basement for a Diesel lighting plant which in an emergency will render the B.B.C. independent of the electricity mains. And a floor higher, stowed away beneath the sloping auditorium of the large studio, will be the canteen which could surely sustain a multitude for weeks.

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The Large Studio.

The design of the large studio is already apparent. In floor area it is slightly smaller than the temporary studio at Big Tree Wharf, but being much loftier (two floors, in fact), it has a greater cubic capacity; and it is not difficult to imagine that the tiers of the seats could hold a thousand visitors with ease.

Below the level of the street are a number of echo rooms, placed side by side, with special sound resisting walls.

oooo

The Studio Tower.

To avoid the transmission of unwanted sounds the central tower contains no vertical steelwork, and is therefore constructed of extra strong and heavy brick. Climbing from floor to floor among the girders one can still distinguish the tower, but it is being rapidly surrounded by the outer shell containing the offices for the staff.

The Problem of the Niche.

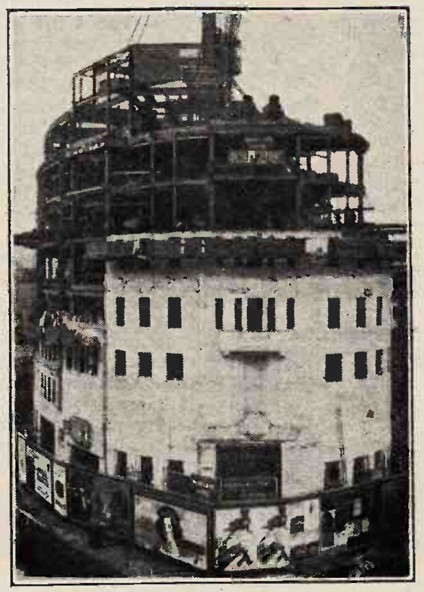
Sir John Reith's room was pointed out to me. The "D.G." will have an inspiring view down Regent Street from the window just above the niche which crowns the main entrance. By the way, the filling of this niche seems to be arousing some controversy; at least one very "daring" piece of statuary has already been declined with thanks.

oooo

Almost a Ship.

Just outside Sir John Reith's window is a balcony almost analogous to the captain's bridge on a ship.

"The building is almost a ship," Mr. Tudsbery told me. "The foundations were surrounded by water, so we constructed a hull of concrete."



"BROADCASTING HOUSE" TAKES SHAPE. A new photograph, showing the main entrance viewed from the south.

oooo

"For this Relief, Much Thanks."

Apropos the alarms of last week regarding the declaration that the Government had been asked to consider the use of the broadcasting licence surplus for the provision of a National Theatre, the Postmaster-General has given a reassuring answer in the House of Commons. In a reply to Lt.-Com. Kenworthy, Mr. Lees-Smith stated that no scheme had been submitted to his department for subsidising a national theatre from the wireless licence surplus.

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The Royal Broadcaster.

Listeners will again hear the Prince of Wales at the microphone on December 16th when His Royal Highness will broadcast a speech following the banquet of the Incorporated Sales Managers' Associations.

oooo

Radio Drama.

"A play a week" seems to be the New Year motto of the B.B.C.'s dramatic department.

The first week of January will witness a broadcast performance of "The Key of the Situation," a play by Lance Sieveking, to be followed a week later by "The Path of Glory," the work of L. du Garde Peach. "Mackintosh," a radio play adapted from a story by Somerset Maugham, will figure in the programmes for the third week of January, and in the last week of the month Shakespeare's "Richard II" will be broadcast.

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A "G.B.S." Play.

Early in the spring Bernard Shaw's "You Never Can Tell" will be produced at the microphone under the direction of Cecil Lewis.

"You Never Can Tell" takes an hour and three-quarters to perform, but I understand that an appropriate interval will be introduced to ease the strain on the listener's attention.

oooo

The Troubles of Tatsfield.

Mysterious interference on Daventry's long wave has recently been troubling the engineers at Tatsfield. They were asked to find the culprit, but the difficulty lay in identifying him while Daventry was transmitting; always when the B.B.C. station was silent the foreigner was also off the ether.

oooo

An Offender in Turkey.

A suitable opportunity seemed to be available during the B.B.C.'s silent period on Sundays between 6.15 and 8 p.m., so a watch was kept on November 2nd, but without result. On November 9th, however, a distant transmitter was picked up during the silent period, working almost on Daventry's wavelength, viz., 1,554 metres. The culprit was identified as Angora (Ankara) in Turkey, which has no business on any other wavelength but 961 metres.

The Union Internationale de Radiofusion is chastising Angora together with several other recent offenders, including Kosice, Limoges, Tallina, Falun and Turin.

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Northern Regional Soon Testing.

The B.B.C. engineers report that constructional work on the Northern Regional station at Slaithwaite is now complete. The erection of the Diesel engines, motor generator sets and both transmitters is expected to be completed by the end of November, so we may expect preliminary tests before Christmas.

Letters to the Editor.

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

CIRCUIT DIAGRAMS AND SERVICE.

Sir,—Whilst reading the November 5th issue of your valuable Journal the writer was particularly struck by the contents of your Editorial. Certainly there is no reason why Circuit Diagrams should not be attached to the lids, or the backs of receivers. This omission in the past, cannot, as you remark, be easily explained. There is nothing to hide, and much to gain, and the manufacturer ought to have used this method of service assistance.

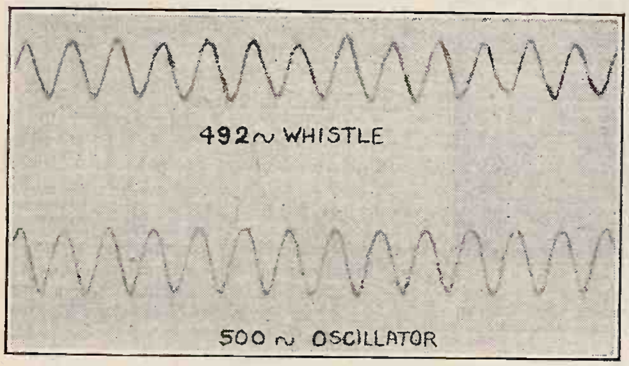
As you are aware, we manufacture yearly many thousands of receivers, and do all our servicing by correspondence, sending circuit diagrams when requested, but your remarks have awakened us to the fact that many a customer could get valuable assistance from a technical, or semi-technical, friend, if a circuit diagram were immediately available. Many people would no doubt value a diagram if they had it, but would not trouble to send for it, preferring to return the receiver.

Thanks to your bringing this matter to our notice, again we must mark against ourselves the fact that these diagrams should never have been omitted. We are now printing suitable diagram cards, which, when ready, will be attached to all new receivers.

For J. G. GRAVES, LTD.,
Wireless Manufacturing Dept.,
G. BAGSHAW,
Sheffield. Engineer and Manager.

PITCH OF THE HUMAN WHISTLE.

Sir,—From recent correspondence in *The Wireless World* it would appear that the future of the nation depends largely upon the lowest frequency of the human (male!!) whistle. Messrs. Coombs, Fleming and Pile have obtained the correct answer (except for a few cycles) by "beat" methods—using pure tones. It only remains to give an oscillograph record which shows the wave form and enables the frequency to be found accurately.



Oscillogram showing frequency and wave form of lowest whistled note obtained by G. A. V. Sowter, B.Sc., A.M.I.E.E.

A representative record was made by G. A. V. Sowter, B.Sc., and is reproduced herewith. To assist in producing the lowest frequency, a 500∼ note was *faintly* sounded by a L.S. just behind the soloist. This prevented him from whistling sharp! The whistle was simultaneously recorded alongside a 500∼ valve produced oscillation calibrated by a 500∼ fork. The whistle is 492∼, *i.e.*, 20∼ below upper C. Mr. Sowter can whistle slightly below this, but he is then barely audible. The wave form is substantially sinusoidal, showing the pure and flute-like warble of the performer.

The difficulty in obtaining beats with the pianoforte is due to a preponderance of overtones, as explained by the above writers. I find, however, that beats can be secured with C^{111} (2048∼) where overtones are less powerful. Whistling down the scale one stops about C^1 (512∼).

The question of "foundation" given by lower frequencies is of great importance in orchestral and organ music. During demonstrations of the "Novotone" to the I.E.E. at Liverpool, the R.S.G.B. at Savoy Place in 1929, and at the Physical Society Exhibition in 1930, I showed the effect of reproducing separately the registers below 150∼ and above 400∼. With the lower register alone, music had no character, and a conversation could be conducted with ease near the L.S. With the upper register alone conversation was difficult and the reproduction decidedly irritating. Although the greater acoustic energy resides in the lower register, the upper register causes a more acute mental effect. Rough tests approximating to the above can be made as follows: Eliminate the upper register by shunting a large condenser across the primary of the L.S. transformer; eliminate the lower register by putting a small condenser in series with the speaker.

Referring to the letter by Mr. Coombs. Since a pure note of 16∼ is inaudible, it would not be reproduced audibly by a L.S. It may be of interest to state that sound radiation of 1 watt at 32∼ from a flat disc 8in. diameter requires a total axial excursion of about 7 cm. At 16∼ the excursion is about 28 cm. No commercial M.C. speaker can emulate this. Large excursions of the M.C. due to low frequencies are accompanied by overtones caused by (a) restriction of amplitude by, and inelastic restoring force of the surround or centering device, or both; (b) reduction of the field inside and outside the magnet. The variation in magnetic field will be treated in a forthcoming article. Close study of the M.C. speaker enhances one's scientific interest, but destroys one's sense of musical enjoyment!

N. W. McLACHLAN.

London, S.W. Nov. 6th.

RADIO SERVICING.

Sir,—In connection with your editorial on the subject of servicing in a recent issue of *The Wireless World*, we wish to point out that we have been running courses of instruction for radio-gramophone dealers, salesmen and service men for over twelve months. These courses were started last September at the request of the Gramophone Company, but, of course, they are open to anyone who is qualified to benefit by the instruction given.

The course consists of lecture-demonstrations and practical work in the electrical and wireless laboratories, and lasts from September to April.

The lectures are given with the idea of presenting to the student the basic principles underlying the working of much of the apparatus found in an electrical radio-gramophone model, with particular reference to methods of testing and to the answering of questions likely to be asked by prospective customers.

The practical laboratory work is designed to suit the needs of the service man in particular, and here the student works through a carefully graduated series of experiments with the view to familiarising him with electrical circuits, measuring instruments, and methods of testing. Our aim is to educate rather than the student should learn by mere usage.

With reference to the last paragraph of your article, there is not at present any certificate of competence awarded by a recognised external examining body, except those awarded in Radio Communication by the City and Guilds of London Institute, which require a fuller course of study extending over a period of three years.

W. H. DATE,
Head of Wireless Section.

The Polytechnic, Electrical Engineering Department, 309, Regent Street, W.1.

READERS' PROBLEMS

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below: these must be strictly enforced in the interest of readers themselves. A selection of queries of general interest is dealt with below.

A Use for "End Cells."

My 100-volt house-lighting battery is already being used (in conjunction with H.T. accumulators) for the supply of anode current, and I am now wondering whether it would not be possible to use it conveniently for recharging my 2-volt L.T. accumulator. The lighting plant has a total of fifty-two large cells, but only fifty are in regular use; the remaining two end cells are intended for regulating purposes. Would it not be possible to use these cells (which normally do no work) for charging the accumulator, and if so, what value of resistance should be connected in order to give a charging rate of 1 ampere? T. C. W.

This is quite a practical suggestion, and good rather than harm should be done to these extra cells by using them for charging. A resistance of 2 ohms will be required.

○○○○

Replacing Old Valves.

Emphasis has recently been laid on the fact that the new season's valves are considerably improved in detail as compared with those of last year: does not this mean that instability might well be produced by fitting 1930-1931 S.G. high-frequency valves, in place of those produced in 1929, in a receiver of the same date? D. R. McD.

It is fortunate for all users of "H.F." sets that your assumption is incorrect. If manufacturers had merely improved the mutual conductance of their new screen-grid valves, there would be a risk that uncontrollable self-oscillation would result if they were used in receivers designed for less efficient valves. But the important point is that improvements in mutual conductance have in nearly every case been accompanied by a corresponding reduction in residual inter-electrode capacity; consequently, the latest valves can in most cases be used in place of their less-efficient predecessors with an actual improvement in results.

○○○○

Power Grid Detection.

Is it likely that the performance of the "Band-Pass Three" would be adversely affected by modifying the detector so that it may act on the "power grid" principle? I intend to use battery valves, but the anode circuit will be from 200-volt D.C. mains. T. L. R.

The detector-L.F. portion of this receiver can be modified to almost any desired extent, and the use of a power grid detector is certainly permissible. But we should draw your attention to the fact that special problems are likely to be encountered when an attempt is made to put this system of detection into operation in conjunction with a comparatively low-voltage source of H.T. supply; suggestions for overcoming these difficulties will be given in an article to be published very shortly in the pages of this journal.

○○○○

At the Low-potential End.

I intend to connect permanently a milliammeter (reading 0-10) in the detector-anode circuit of my Band-Pass Four receiver, as I am told that this is a useful help in adjusting and tuning the receiver. Will it be correct to insert the meter in the lead between the choke CH_3 and the resistance R_8. D. S. O.

Although a detector anode milliammeter is by no means essential, it is certainly a useful aid when making initial adjustments, and subsequently when operating the receiver. The instrument would probably operate quite satisfactorily if connected in the position you describe, but it would be much better to insert it at the point of lowest signal potential; this means that it should be joined between the resistance R_8 and the H.T. positive bus-bar (as shown in Fig. 1). In this position it is impossible for it to cause instability.

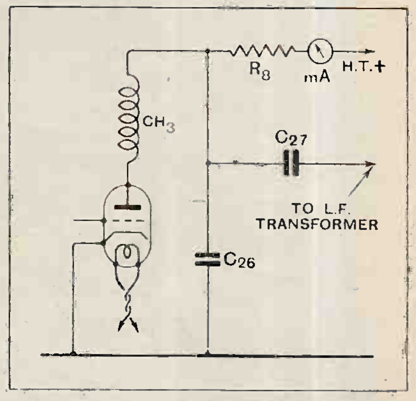


Fig. 1.—The "Band-Pass Four": correct position for a detector anode milliammeter.

Suitable for Eliminator Feed.

My set, built in the days when neutralisation was popular, has a balanced triode H.F. valve, anode bend detection, and a single resistance-coupled L.F. stage. I have now moved to a district where D.C. mains are available, and am thinking of trying to modify the set so that this source of supply may be used for anode current.

The set has been operated with a common anode voltage of from 120 to 130 volts, but I believe that when an eliminator is used it is best to provide separate feeds for each valve. Will you please tell me if this is so? H. H. A.

A set such as you describe is inherently free from interaction troubles, and it would probably yield satisfactory results if it were connected to the mains through a smoothing system without any voltage-regulating devices. But to be on the safe side, it would perhaps be as well to insert a decoupling resistance of, say, 10,000 ohms in series with the H.F. valve anode, thus incidentally bringing down the applied voltage to approximately the usual rating. A 20,000 ohm feed resistance might be joined in series with the detector anode, and in this case a by-pass condenser of 2 mfds. should be provided; a considerably lower capacity would be sufficient for the H.F. stage.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(3.) *Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(4.) *Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(5.) *Practical wiring plans cannot be supplied or considered.*

(6.) *Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.*

(7.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.*

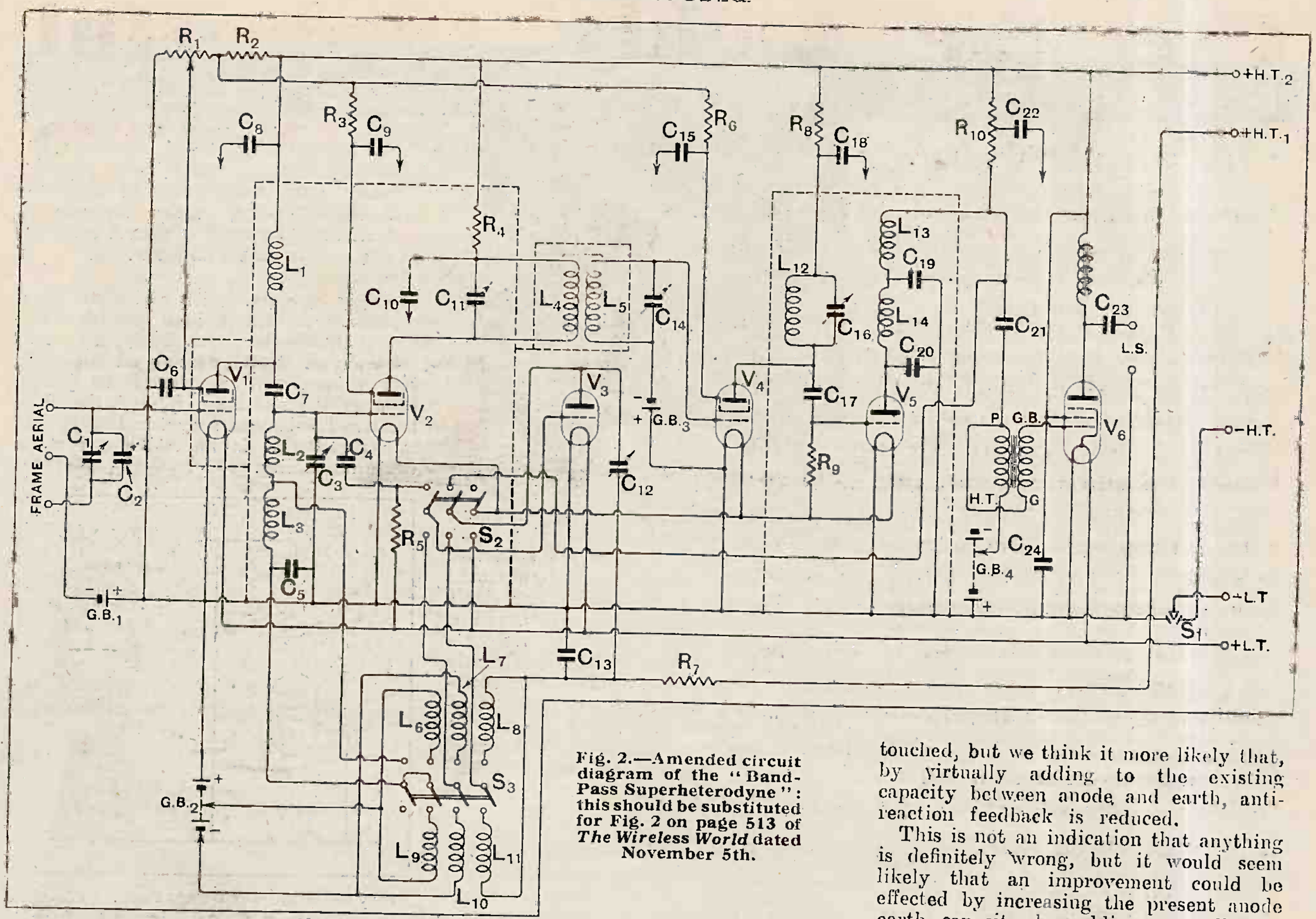


Fig. 2.—Amended circuit diagram of the "Band-Pass Superheterodyne": this should be substituted for Fig. 2 on page 513 of *The Wireless World* dated November 5th.

The Superheterodyne.

There seems to be an error in the theoretical diagram of the Band-Pass Superheterodyne in your issue of November 5th; at any rate, I cannot follow the switching connections. Please tell me if any corrections should be made.

S. T. W.

It is regretted that there were one or two errors in this circuit diagram; we would point out that they were corrected last week in the second part of the constructional article.

We give herewith (Fig. 2) an amended diagram showing the correct connections.

oooo

Balancing Out Capacity Coupling.

I am thinking of fitting A.C. valves in my receiver (which includes a neutralised triode H.F. valve), and am wondering whether it would be worth while to shield the valve from the H.F. transformer? In any case, extra screening will be fitted in order to minimise the chances of instability being brought about by the improved characteristics of the new H.F. valve.

S. S. M.

In an H.F. amplifier of this kind, where stray electrostatic couplings may be balanced out by suitable adjustment of the neutralising condenser, there would be little point in providing extra shielding for the valve. It should be made clear, however, that no ill effects would result.

Home-made Output Choke.

Will you please tell me if the L.F. choke, of which the construction was described in your issue of October 29th, would be suitable for use in an output filter circuit when a power pentode is used? I assume that there is nothing against the addition of a centre tap to the winding?

D. T. B.

This choke, which has an inductance, under working conditions, in the order of 20 henrys, would be quite suitable for connection in the anode circuit of a power pentode, and there is no objection to adding tappings as required. While you are about it, it would perhaps be as well to bring out several tappings, so that the component can be used for experimental purposes.

oooo

Effect of Body Capacity.

It is noticed that when I touch the detector anode terminal of my set (det.—2 L.F.) that signal strength rises appreciably. Can you give an explanation of this effect, and also say whether it indicates that something is wrong with the receiver?

P. R.

It is possible that your body capacity tends to increase the normal coupling between detector plate and grid circuits in such a way that reaction effects are increased when the anode terminal is touched, but we think it more likely that, by virtually adding to the existing capacity between anode and earth, anti-reaction feedback is reduced.

This is not an indication that anything is definitely wrong, but it would seem likely that an improvement could be effected by increasing the present anode earth capacity by adding a small condenser of, say, 0.0001 mfd.

FOREIGN BROADCAST GUIDE.

TOULOUSE

(France).

Geographical position: 43° 36′ N., 1° 26′ E.

Approximate air line from London: 550 miles.

Wavelength: 385 m. Frequency: 779 kc. Power: 8 kW. (temporarily).

Time: Greenwich Mean Time.

Standard Daily Transmissions.

G.M.T. 12.30 (Sunday): Sacred service (Roman Catholic); 13.45 (Protestant); 13.00, records (week-days); 17.00, concert; 18.00 sponsored concert (Sunday); 20.00 continuous broadcasts until midnight; picture transmission (Sunday); news bulletin (week-days).

Man announcer.

Opening call: *Allo! Allo! Ici radio Toulouse, émissions de la radiophonie du Midi.* Abbreviated, between items to *Allo! Radio Toulouse.*

Interval signal: Gong (about 50 beats per minute)

Closes down with usual French "Good-night," formula followed by La Marseillaise (vide Radio-Paris, etc.).

Use the highly successful Six-Sixty A.C. Mains Valves

Practically any battery-operated set can be converted to all-mains with the Six-Sixty A.C. All-Mains Conversion Equipment.

Don't scrap your battery set. Scrap the *batteries*. Bring your set right up-to-date and make it all-mains with the new Six-Sixty All-Mains Conversion Equipment. These already famous Six-Sixty Mains Valves will add range and power to your set . . . . more stations, bigger volume, better quality! Nothing to run down just when you want to listen—even grid-bias is taken from the mains!

No alterations to set-wiring. All necessary connections are made inside the special Six-Sixty Valveholder Adaptors. Just plug them into the existing four-pin Valveholders, then fit the 5-pin A.C. Valves into the Adaptors—simple, isn't it?

Price. Main Unit only (H.T., L.T. & G.B.)
£6 : 6 : 0
A.C. Mains Conversion Equipment complete with specially selected Six-Sixty A.C. Valves, etc., from
£8 : 5 : 0
Dimensions 13" x 5½" x 4"

Write for FREE Booklet giving full and interesting information on how to bring your set up-to-date.

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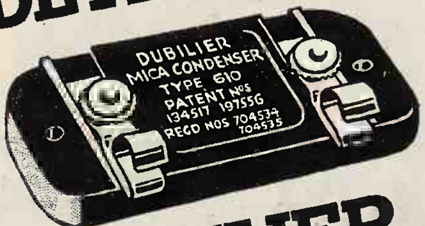
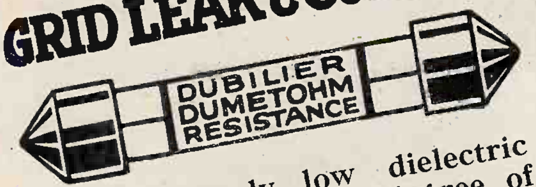


DUBILIER GRID LEAK & CONDENSER!



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These qualities make them invaluable in any radio frequency circuit and especially so in the grid circuit of a cumulative grid detector where very minute high frequency currents are dealt with and where even small losses have an appreciable effect.

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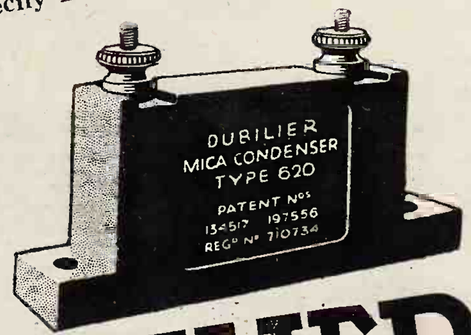

DUBILIER CONDENSERS

Dubilier Condenser Co. (1925) Ltd., Ducon Works, Victoria Road, N. Acton, W.3.

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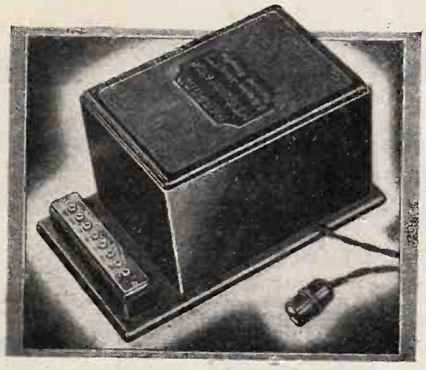

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THE Service is as Follows: We can supply practically all the leading lines of radio apparatus on the market at current list prices; if so desired we can accept in part exchange the reputable makes of the following apparatus: Receivers (domestic and portable), radio-gramophones, loud-speakers (cone and moving coil), cone units and chassis, battery eliminators and mains equipment components, battery chargers, remote control equipment, pick-ups and carrier arms, electric gramophone motors, H.F., L.F., and power chokes, condensers (variable, reaction, by-pass and smoothing), measuring instruments (high grade), L.F. transformers, slow motion dials (high grade), modern miscellaneous components; valves and tuning coils cannot be accepted in part exchange except by special arrangement.

IN View of the Difficulty of Making Fair and Definitely Offers for Material that we have not inspected, it is requested that apparatus tendered for part exchange be kindly forwarded to us for valuation; no business can be proceeded with in connection with part exchange until material tendered has been examined; in this connection there need be no fear, material is sent to us from all over the world, not a single item of customers' property has ever been lost or mislaid; rejected offers from Xmas last amount to only 3.

IN Order to Furnish a Guide, the part exchange allowance may be gauged as approximately 50% of the list price of the article or articles tendered; for some articles the allowance will be more, and for others somewhat less; the allowance is entirely determined by the demand for individual articles, considering also their condition and production age: amateur constructed receivers cannot be accepted in part exchange as receivers, their value lying wholly in the components contained in them; only modern apparatus in good condition is accepted in part exchange; material cannot be purchased by us for cash.

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SCOTT SESSIONS and Co., Great Britain's Radio Doctors.—Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

McMICHAEL Super-range Portable Four, as new; £18 or near offer; delivered free any part of London.—Reply Box 8048, c/o *The Wireless World.* [2096

PHILIPS 2511 Electric Receiver, 4-valve, 240 volts, £21; Philips 2013 moving coil L.S., £7; set and speaker complete, £26; H.M.V. No. 163 gramophone, mahogany, £18.—Saul, 8, Ansdell Rd., S. Ansdell, Blackpool. [1944

CLIMAX A.C. All Mains Electric Receiver, as new, guaranteed; £7/10.—Barrington, 186, St. James' Rd., Croydon. [2108

Receivers for Sale.—Contd.

"WIRELESS World" Four, Foreign Listener's Four, or any other "Wireless World" circuit built to specification by experienced staff, components as specified; work and results guaranteed.—Matlock Radio Manufacturers, Matlock House. Woodberry Grove, Finchley, N.12. 'Phone: Finchley 2837. [2135

GRAMOPHONE Amplifier, 3-valve, R.C., with 6 volt valves; £2.—47. Meadowside Rd., Cheam, Surrey. [2134

PHILIPS 4-valve All Mains Receiver, as new, and Blue Spot loud-speaker; cost £40, accept £25; can be tested by appointment.—1, Oakhill Rd., East Putney, S.W. [2127

COMPLETE 2 H.F. Everyman Four Receiver, in polished mahogany finished bureau, full wave mains eliminator and 2 60 ampere accumulators being housed in lower compartment of cabinet, first class workmanship and finish; price £20, or offer; may be heard in operation any time by appointment.—Box 8062, c/o *The Wireless World.* [2115

BURNDEPT Ethophone V Receiver (only), double door mahogany cabinet, as new; £8/10.—Redway, Point, Exmouth. [2113

LATEST Ekco Electric 3-valve Set, as new, in makers' carton; first cheque £17/10 secures.—Bullock, 25, Romney St., Nelson, Lancs. [2143

LATEST 7-valve Igranic Neutrosonic and Frame Aerial Set, Radielle H.T. eliminator, 2 L.T. accumulator; ordinary cost over £60, price £25, or nearest; absolute perfect condition.—BM/FZS, London, W.C.1. [2111

PHILIPS 4-valve A.C. Mains Receiver, 210v., 50c., perfect condition, £26; speakers, Hegra 30/-, Blue Spot 35/-.—Ridley, 420, Clapham Rd., Clapham, S.W.9. [2147

MEGAVOX Three, with super capacity batteries and Amplion Lion loud-speaker; £12.—Murgatroyd, "Riddlesden," Elm Av., Crosby, Liverpool. [2150

5-VALVE Set, 120-volt accumulator, loud-speaker, all stations, best components; £12.—Ford, 5, Fair Green, Mitcham. [2151

PREMIER.—Part exchange; every radio set in stock; Columbia, Philips, K.B., Ekco, Pye, G.E.C., Cossor, Mullard, Lotus, Ediswan, Lissen, Marconi, McMichael, R.I., Selector, Dubilier, Ultra, Rolls, Caydon, Amplion, Burndept, Dunham, Ormond, H.M.V. and Columbia gramophones and radiogramophones; cash or H.P.

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HOURS of Business, 9-8, Saturdays 9-9 p.m., Wednesdays, 9-1 p.m. [2182

"WIRELESS World" Record III and 200 to 240 A.C. eliminator, perfect; £9.—Heard evenings at 71, Burbage Rd., Herne Hill, S.E. [2178

PERFECT Quality All Mains Set, A.C. push-pull, output 65 milliamps., separate R.K. speaker, suit large room or hall, may be heard by appointment: £36.—J., 58, Beechwood Av., Thornton Heath. [2166

GECOPHONE 1930 All-electric Three, 200-250 volts A.C., mahogany cabinet, superb reception, complete with valves; £15.—29, Thornbury Av., Southampton. 'Phone: 4496. [2161

4-VALVE Screened Grid All Mains Receivers, all Europe on loud-speaker; 16 guineas cash.—Brooks, 3, Anselm Rd., Fulham. [2159

SIMMONDS BROS. are Specialising on "Wireless World" Four and Other Modern Receivers; superb workmanship guaranteed; exchanges.—38, Rabone Lane, Smethwick. [2155

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NEW Osram Music Magnet Four, less valves, £5; 2 P.X.4: 11/6 each; eliminator D.C., 60 m.a. (Savage) 6 output, 60/-; Epoch D.C. public address M.C. speaker, 50/-.—Newth, 31, George St., Hanover Sq., London, W. [2137

ACCUMULATORS—BATTERIES.

NINE 10-volt 5,000 milliamp, Exide H.T.; £1, carriage forward; guaranteed good.—Hill, 82, Castle Rd., Bedford. [2138

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DON'T Buy Dry Batteries, join our service; we keep you continuously supplied with fully charged C.A.V. high tension accumulators, by regular exchanges, anywhere within 12 miles of Charing Cross, for less than the cost of unreliable dry batteries; nothing to buy—no deposit, payment on each delivery or by quarterly subscription; if your dry batteries have been in use for one month or more we definitely guarantee that accumulators will give better and more selective reception; we also give the same service with low tension accumulators or maintain your own at equally advantageous terms from the smallest portable size upwards; over 10,000 satisfied users.—Write or 'phone now to London's largest, most efficient and complete wireless accumulator service, for their interesting folder B2, post free.—Radio Service (London), Ltd., 105, Torriano Av., Camden Rd., N.W.5. 'Phone: North 0623 (3 lines). [1466

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PHILIPSON'S Safety H.T. Supply Units are Famous for Reliability and Silent Working.

OUR New Prices Again Make Them Famous for Value; for D.C. mains model D.C.4 gives 120v. at 15 m.a., 27/6; D.C.5. 150v. at 25 m.a., 1 fixed, 2 var. tappings, 35/-; for A.C. mains model A.C.7, 120v. at 20 m.a., £3; A.C.5. 150v. at 30 m.a., 1 fixed, 2 var. tappings, £3/17/6; A.C.6, for 25 cycle mains, £5.

PHILIPSON'S Safety H.T. Supply Units are Guaranteed for 12 months; write for our booklet, "Radio Power."

PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. 'Phone: 2038. 'Grams: Safety, Bolton. Est. over 50 years. [0318

M.L. Mains Unit, 50-volt supply D.C., giving anode potentials 80v., 120v., 150v., maximum anode current 40 m.a., in perfect order, owner now has company's power; offers invited.—Box 8107, c/o *The Wireless World*. [2169

TANTALUM and Lionium for A.C. Rectifiers, blue prints for inexpensive H.T. and L.T. chargers.—Blackwells Metallurgical Works, Ltd., Garston, Liverpool. [1209

CHESTER BROS.—All types of mains transformers and chokes to any specification.—Chester Bros., 495, Cambridge Rd., London, E.2.

CHESTER BROS.—Type V3 220+220v., 35 m.a., 5v. 1.6a., C.T., 4v. 4a. C.T., 27/6.

CHESTER BROS.—Type W.10, for H.T., 3 or 4, output 135v. 50 m.a., and 4v. 4a., C.T.; 23/6.

CHESTER BROS.—Smoothing chokes, constant inductance, type C.B.2, 45 henrys, 25 m.a.; 15/-.

CHESTER BROS.—Write for lists of standard models. Please note change of address. [1477

H.T. Eliminator Kit, incorporating Westinghouse H.T.5 rectifier, kits consist of transformer, choke, Westinghouse rectifier; required condensers, resistance, safety plugs and sockets, and baseboard; output 20 milliamps at 120 volts, 47/6, post free; metal case for same, 3/9 extra.

ELIMINATOR Kits, transformers, choke, condensers, valve, valve holder, resistance, terminals; 36/-; post free.—Fel-Ectric Radio, Garden St., Sheffield. [2049

SAVAGE'S Specialise in Wireless Power from the Mains: reliable apparatus at reasonable prices.

SAVAGE'S Transformer Laminations and Bakelite Bobbins; intending home constructors should write for list.

SAVAGE'S Reliable Smoothing Condensers, 1,500 volts D.C. test, 1 mfd. 2/-, 2 mfd. 3/-, 4 mfd. 5/3; 500 volts D.C. test, 1 mfd. 1/6, 2 mfd. 2/3; 4 mfd. 3/9.

SAVAGE'S Power Chokes for the Power Pentode Two, smoothing L.C.36G, 18/-; output L.C.36P.G., 19/6; many other types available, write for list.

SAVAGE'S Mains Transformers for the New Westinghouse Units; please write for list.

SAVAGE'S New Foreign Listeners' Four Equipment. —Transformer, N.F.L.4, 33/-; smoothing choke, C32G, 20/-; output choke C32/0, 20/-.

SAVAGE'S "Wireless World" Four Equipment, mains transformer, W.W.4, 34/-; smoothing and bias chokes, type W.W.4C, 16/- each; centre tapped output choke, L.C.36P.G., 19/6.

SAVAGE'S Mains Transformer, B.T.4, 500-0-500 volts 120 m.amps., 7½ volts 3 amps., 6 volts 3 amps., 4 volts 2 amps., 4 volts 1 amp., 4 volts 1 amp., all centre tapped, specially developed to facilitate automatic bias in all stages; 57/6.

SAVAGE'S Mains Transformer, V.T.37, 250-0-250 volts 60 m.amps., 4 volts 1 amp., 4 volts 1 amp., 4 volts 1 amp., 4 volts 2 amps., all centre tapped, a useful instrument for modern receivers with automatic bias in every stage; 35/-.

SAVAGE'S Mains Transformers and Power Chokes are carefully constructed from first class materials with an exceptionally generous margin of safety; they are fully guaranteed and may be purchased with confidence.

SAVAGE'S Have Moved to Larger Premises; please note new address: 292, Bishopsgate, London, E.C.2. Telephone: Bishopsgate 4297. [1784

MUSIC Magnet Four, special Radielle D.C.100 eliminator for this set, output 180-200 volts at 60-80 m.a., 2 variable and S. grid tappings; cost £9/10, sell £3.—Priestley, 8, Grosvenor Gardens, Muswell Hill, London, N.10. [2152

Chargers and Eliminators.—Contd.

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VORTEXION No. 4 Bobbins, 1in.×1½in., 1/3, post 2d.; 1in.×1in., 1/-, post 2d.; cast aluminium end plates, 2/3 per pair, post 2d.; No. 4 laminations for 1½in. bobbins, 6/2, post 9d.; for 1in. bobbins, 4/2, post 6d.

VORTEXION, 72, Merton Rd., Wimbledon, S.W.9. Tel.: Wimbledon 2814. [0439

EKCO 1v. 20 A.C. Eliminator, 150 volts 20 milliamperes output; £3/7/6 or nearest; fortnight old.—Grenfell, 8, Beacontree Rd., E.11. [2180

25 Cycle Mains Apparatus, transformers, chokes, complete eliminators, etc., for all outputs up to 500 volts; 50 cycle apparatus of all outputs also in production; hum-free guaranteed products; D.C. resistances available for "Wireless World" receivers; lists free of all goods.—Postlethwaite Bros., Kinver, Stourbridge. [2177

BRAND New Westinghouse Rectifier, H.T.1, and 220-volt Savage transformer, low tension windings; bargain, 70/-.—Whiteside, Gillinggate, Kendal. [2175

EKCO Eliminator, all-power (L.T., H.T. and G.B.), for D.C. 200-250, as new; cost £6/7/6, approval £3/5.—Singleton, Summerlands, Yeovil. [2162

EKCO 3F.20 Model A.C. Eliminator; cost £3/19/6, bargain, £3.—Gledhill, 30, Elsie St., Goole.

BRYCE'S.—Mains transformers are included in all De Luxe eliminators, type A.B.604, output 200-0-200v. 80 m.a., 2-0-2v. 1 a., 2-0-2v. 3 a., 3-0-3v. 1 a., price 22/6, post 1/-; guaranteed.—Bryce's, 54, Dawson St., Bury, Lancs. [2145

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ARTCRAFT Cabinets, illustrated list free; radiograms, from 79/6; unbeatable value.—Artcraft Works, Grant Rd., Croydon. Established 1925. 'Phone: 1981. [1814

DIGBY'S Cabinets.—Table models in solid oak and mahogany; from 11/6 to 71/-.

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DIGBY'S Cabinets.—Pedestal model, with separate battery components; from 56/- to £12.

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DIGBY'S Cabinets.—Write for new 16-page art catalogue.—F. Digby, 9, The Oval, Hackney Rd., E.2. 'Phone: Bishopsgate 6458. [0128

CABINETS for All Requirements.—F. W. Ramsey, 63, Shaftesbury St., London, N.1. Clerkenwell 7139. [1479

KAY'S Cabinets.—Exclusive practical models in radio and radiogram cabinets, 50% cheaper than elsewhere, used and recommended by the most distinguished and discriminating radio experts; a range of 60 designs to select from; illustrated price lists free.—H. Kay, Wireless Cabinet Manufacturer, Mount Pleasant Rd., London, N.17. 'Phone: Waltbamstow 1626. [1789

COILS, TRANSFORMERS, ETC.

TRANSFORMERS and Chokes for Battery Eliminators.—Chester Bros., 495, Cambridge Rd., London, E.2. [9706

600 and 1,000 ohms Decoupling Resistances, specified for the largest and most important "Wireless World" receivers; 1/6 each, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1732

BERCLIF Coils, the finest made, for all receivers; get our list (post free) before buying; trade supplied.—Simmonds Bros., 38, Rathbone Lane, Smethwick. [2156

BAND PASS Three.—Set of coils, best materials, strictly to specification; 31/6, post free.—Woodfall, 1, Clark's Buildings, High St., London, W.C.2. [2179

COILS.—Band Pass Four, 25/-; Band Pass Three, 35/- per set; "Wireless World" Four, complete, screens, switches, 52/-; c.o.d.—Smith, 3, Park Parade, Harlesden, N.W.10. [2148

GRAMOPHONES, PICK-UPS, ETC.

B.T.H. Pick-ups and Tone Arms, cranked, 22/6 each; send for list.—G2VM, 27a, Bridget St., Rugby. [1834

H.M.V. No. 163 Gramophone, mahogany; cost £35, price £17.—Sauf, 8, Ansdell Rd., S. Ansdell, Blackpool. [2129

PICK-UP, Marconiphone, as new; £2.—Pattinson, 44, Eighth Av., Newcastle-on-Tyne. [2110

GAMBRELL Novotone, Type H, for Marconiphone pick-up, as new; £3/3.—V. B. Shelley, Meadowcroft, Trentham, Stoke-on-Trent. [2176

LOUD-SPEAKERS.

BAKER'S SELHURST RADIO 36-page Booklet, "Sound Advice is Yours for the Asking"; write now for new edition; see displayed advertisement on this page. [0231

REALISTIC Speakers, true to name, the greatest advance to perfection, not a cone or horn type; write to-day for particulars; Realistic chassis and speakers demonstrated daily.—Realistic Speakers, 72, Penton St., N.1; also 52, Broadwater Rd., Worthing. [1290

BROWN Power Speaker, perfect condition.—For particulars write Box 8101, c/o *The Wireless World.* [2139

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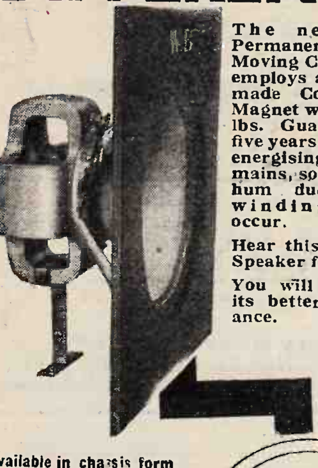

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Hear this new W.B. Speaker for yourself.

You will appreciate its better performance.

Available in chassis form with 14 in. baffle. £6 : 6 : 0

OAK CABINET MODEL £8 : 8 : 0

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Whiteley Electrical Radio Co., Radio Works Ltd., Nottingham Road, Mansfield, Notts.

SCREW THIS FIRST CLASS MODERN MICROPHONE

Patent applied for.

into any TORCH or other FLASHLAMP (as illustration below), then connect it to your Valve Amplifier or Wireless Set through a Microphone Transformer, and you can immediately use the instrument for all the following purposes :

PUBLIC ADDRESS, SPEECH AND MUSIC TRANSMISSION, ANNOUNCEMENTS THROUGH LOUDSPEAKER, WIRELESS TRANSMISSION, BABY ALARM or INVALID CALL from Bedroom through distant Loudspeaker, electric SOUND DETECTION, HOME - RECORDING of GRAMOPHONE RECORDS, EXPERIMENTS.

SCREW MICROPHONE inclusive a 9 ft. silk connecting cord - - - - - - **18/-**

TORCH, inclusive Battery lasting 200 working hours - - - - **5/6**

Microphone Transformer for the above Instrument - - - - - **6/-**

NO OTHER ACCESSORIES NEEDED.

Full Directions and Diagram of Connections Free.

FREDK. ADOLPH, Actual Maker, 27, Fitzroy Street, London, W.1. 'PHONE: Museum 8329.

Loud-Speakers.—Contd.

BAKER'S Permanent Magnet Model Moving Coil Speaker; cost £6/5, accept £3/5; perfect condition; bargain.—Forwood, Limpsfield, Surrey. [2126

AMPLION Public Speech P.S.1, horn type, complete with wall bracket, will work off 2v. power valve or L.S.6A, perfect order, make good demonstration speaker; cost 11 guineas, price £6.—Box 8092, c/o *The Wireless World.* [2121

FERRANTI A.C. Moving Coil Speaker Chassis, £11/15 model, perfect condition, suit 240v. 50 cycles; £7/10.—Box 8059, c/o *The Wireless World.* [2109

SOUND SALES.—'Phone number Archway 3871 for Magnavox speakers, new and reconditioned.

SOUND SALES.—A.C. Magnavox speakers, 200 to 240 volts, must be advertised as recent models, nearly 50% off list prices, all standard models, used only on test, results as new, complete with mains transformer, dry rectifier and input transformers; only £4/15.

SOUND SALES are Getting Repeat Orders for the Above Speakers, they will get yours when you've tried a speaker.

SOUND SALES Specialise in Magnavox Speakers, and can allow you the highest figure possible for your old speaker (any make) in part exchange for a new 1931 Magnavox.

SOUND SALES Designed the Longwave Attachment for the Peerless Eight. the wonder set.

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BEST Quality Irish Linen for Loud-speakers, 20×20 1/6, 22×22 1/9, 24×24 2/-, post free; established 30 years.—Irish Linen Warehouse, Hotel St., Bolton. [2158

A LOUD-SPEAKER of any Make Demonstrated in Your Home; no obligation: see our advert under Miscellaneous.—Radio Doctors and Services. [2173

VALVES.

AMPLIFIER Valve.—If you require power you cannot do better than one of these (or matched in pairs if required).

FILAMENT Volts 6, plate volts 400 (maximum). grid bias 84 volts (approx.), impedance 800 ohms, amplification factor 3.8, mutual conductance 4.35 m.a./volts; price now reduced to £5; see article "The Wireless World," 24th July, 1929, then send to North London Valve Co., Ltd.. 22½, Cazenove Rd., Stoke Newington, London, N.16. [0341

SOLE Agent for Diatron Tubes (American); send for prices.—Perry Co., 32, Dawes Rd., Fulham. [2118

FULL Emission, A.C.S.G., 10/-; A.C. Red Spot. 7/6; P625A, 8/6; P.M.4, 4/-; 2 P.M.24s, 10/- each; S.G.215, 8/-; A.C.R., 5/-; £2 lot.—1, Crosby. Claygate, Surrey. [2107

MULLARD S4V. 154V, Philips 506, 506K, new, half price; 4DX, 154V, little used, third price. —McFarlane, 365, Bilsland Drive, Glasgow. [2132

COMPONENTS, ETC., FOR SALE.

BELLING-LEE Panel Fittings are designed to give an expert finish to any home-constructed set; catalogue post free.—Belling and Lee, Ltd., Queensway Works, Ponders End. Middlesex. [0018

COMPONENTS Lent on Hire.—Details from Alexander Black, Wireless Doctor, 55, Ebury St., S.W 1. Sloane 1655. [0329

AMMETERS.—Hot wire, 0-1, 4/-; new moving coil milliammeters. 0-5 upwards, 15/-; portable micro ammeters, 5in. scale, 0-200 upwards, 105/-; double range voltmeters, 3/6; instrument repairs and alterations of every description; send for list.—The Victa Electrical Co., 47, High St., Battersea, S.W.11. [1552

VALVE Screen, 3/-; coil screens, 2/9; choke screens, 2/6; as specified in "Wireless World" Radio Gramophone and other circuits.—The Loud Speaker Co., Ltd., 2, Palmer St., Westminster, S.W.1. [1801

M.C. Speakers, pick-ups, cone speakers, microphones, transformers, etc.; send for list.—G2VM, 27a, Bridget St., Rugby. [1833

"WIRELESS World" Four, complete, as specified, with valves and coils, £24; Garrard motor, Blue Spot 66R., chassis, pick-up, cabinet, £15 extra; any part sold separate; send particulars.—Smith, 3, Park Parade, Harlesden, N.W.10. [1976

MATLOCK RADIO MANUFACTURERS Specialise in the Supply of all "Wirelss World" Sets and Their Components; work and results guaranteed; any set overhauled and brought up to "Wireless World" standard; not wireless doctors, but skilled wireless constructors.—Matlock House, Woodberry Grove, Finchley, N.12. 'Phone: Finchley 2837. [2136

AMATEUR'S Surplus.—Novotone, £2/10; Igranic pick-up, 8/-; Marconi ideal transformer, 6 to 1 and 2 to 1. 10/- each; Crompton voltmeter, 2-15-150v., 12/-; 2 pairs of Brown's earphones, 5/- each; milliameter 0 to 100, 7/-; 2 Exide, large size, H.T. accumulators, 60 volts, 10/- each; several sets complete, and a large quantity of valves, resistances, condensers, coils, etc.; can be seen after 8 p.m. or by appointment. —Kidner, Burleigh House, West Heath Rd., N.W.3. [2141

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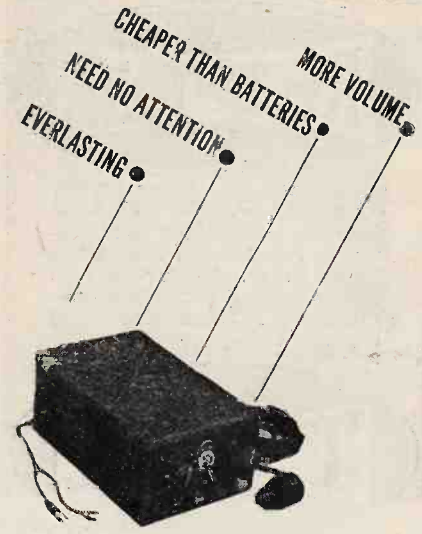

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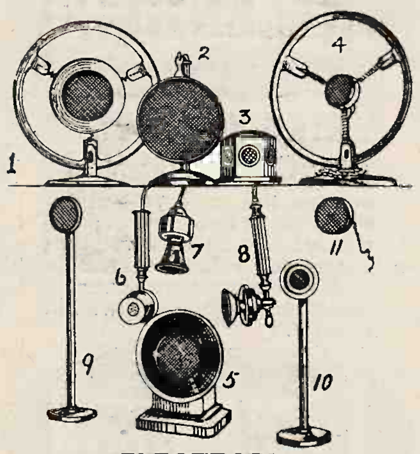

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GOVERNMENT Surplus Mark II 2-valve Transmitters, 10/6; B.T.H. generators, H.T.950, 37/6; Mark III 2-valve sets, 17/6; Veeder counters, 1/-; headphone cords, 6d.; hot wire ampmeters, 3/6; Rotax 8-way switchboards, 2/6; Amplion units, A.R.58, 7/6; 3-valve amplifiers, 17/6; 2 M.F. condensers, 1/6; plus carriage.—Camden Surplus Mart, 25, King St., Camden Town, N.W.1. [2114

LARGE Amateur Sale.—Edison Bell and Marconiphone ideal transformers, cost £1/5, sell 16/-; pick-ups, coils, chokes, etc., all perfect and cheap; stamp for list, or state requirements.—J. Harding, Oaklands, Longton Av., Sydenham. [2112

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CYLDON Short Wave Condensers, 0.00015 and 0.0002; 6/6 each.—Buchanan, 392, Maryhill Rd., Glasgow. [2144

SALE.—Amateur's surplus: 4 Marconi P625 valves, 10/- each; 1 Cosmos A.C./G, with adaptor, 7/6; 1 P.M.5X, 5/-; 1 Cossor 610 H.F., 5/-; all as new; 2 Marconi transformers, 4:1 and 6:1, 12/6 each; 1 Webster pick-up, with arm and volume control, £2/2, cost £4/4; 1 B.T.H. pick-up, £1.—Jackson, Hillcrest, Larkhall, Lanarkshire. [2184

FREE Set Construction.—Buy your parts from Blakey, Holborn St., Rochdale. [2171

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R.I. Varley Pick-up, 17/6; with Meltrope arm, 27/6; Ediswan cone unit and chassis, 15/6; 25:1 Ferranti output transformer, 10/6; P.X.650 valve, 7/6; all as new.—136, Hildaville Drive, Westcliff-on-Sea. [2146

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RECORDING Stylus Cutters, special sapphire point to fit any pick-up or sound box; 2/2, post free.—Cairns and Morrison, Ltd., 33, Percy St., London, W.1. [1885

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WANTED, quantity Exide W.J.60 high tension accumulators; cheap for cash.—Box 8036, c/o *The Wireless World.* [2053

Wanted.—Contd.

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WANTED, 3-valve set complete; reasonable.—Jones, Tyddyn-Yr-Ynn, Gellilydan, Festiniog. [2130

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EXCHANGE Ferranti A.F.5 (new) for A.F.6.—Jas. Blake, Wingate, Durham. [2143

RADIO DOCTORS and SERVICES Will Accept Your Old Set or Gramophone in Part Exchange for any New Radio Set; our engineer will call and demonstrate any make in your home; no obligation; cash or deferred (See our advert. under Miscellaneous).—Radio Doctors and Services. [2172

PART Exchange.—Let us know what you have and your requirements, and we will make you an amazing quotation; all-mains receivers and portables our speciality; balance payable on deferred terms if desired.—Radio Co., 24, Vestry St., N.1. [2163

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GUARANTEED Repairs by Experts.—Loud-speakers, headphones, cone units, pick-ups, any type, rewound, remagnetised and adjusted post free 4/-; transformers from 4/-.—Howell, 91, Morley Hill, Enfield, Middlesex. [9555

LOUD-SPEAKERS, headphones, cone units, any type, rewound, remagnetised and overhauled; 3/6 post free; repairs guaranteed; 24 hours' service; terms to trade.—Walters, 1 Durns Terrace, Lower Compton, Plymouth [1912

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WANTED, fully experienced service man for high class radio, must be expert at fault finding and repairing, and have thorough knowledge of up-to-date receivers and radio gramophones.—Please state experience and salary required to Box 8055, c/o *The Wireless World*. [2104

MAN, with knowledge of radio, and modern factory methods, required as chaser.—Apply Pye Radio, Ltd., Radio Works, Cambridge. [2128

IMPORTANT British Radio Company Requires a Highly Qualified Chief Engineer, with thorough knowledge and long and successful practical experience of manufacturing and marketing loud-speakers, amplifiers, battery and all mains sets and radio gramophones, gentleman preferred with a good knowledge of German, familiar with technique of radio patents, who has written articles, and who has been engaged as a consulting engineer.—Applicants should forward complete details of their age, experience and copies of testimonials, together with a photograph, to Box 8063, c/o *The Wireless World*. [2116

VACANCY, with unusual prospects, occurs in development laboratory near London, for well educated junior assistant of good personal address, who is prepared to work hard.—Full details of scientific and engineering training and experience to Box 8093, c/o *The Wireless World*. [2122

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HARRODS Require a Radio-gramophone Salesman; good technical and practical knowledge of all-mains amplifiers essential; must be of good appearance.—Apply personally, Staff Controller, 44, Hans Crescent, S.W.1. [2153

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WANTED, chief tester, to take charge of test rooms; portables and all-mains; able to design special apparatus; first class man only.—Fullest details, experience, salary, etc., Box 8098, c/o *The Wireless World*. [2131

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ADVERTISER (30), P.M.G. certificate, 12 years' practical experience, good technical knowledge modern radio, seeks position, run wireless department in progressive firm; prepared invest.—Dulas, 13, College Rd., Bangor, N. Wales. [2106

WIRELESS Operator, engineer, seeks situation, 14 years' experience, testing, fitting, repairs, service work.—Box 8106, c/o *The Wireless World*. [2165

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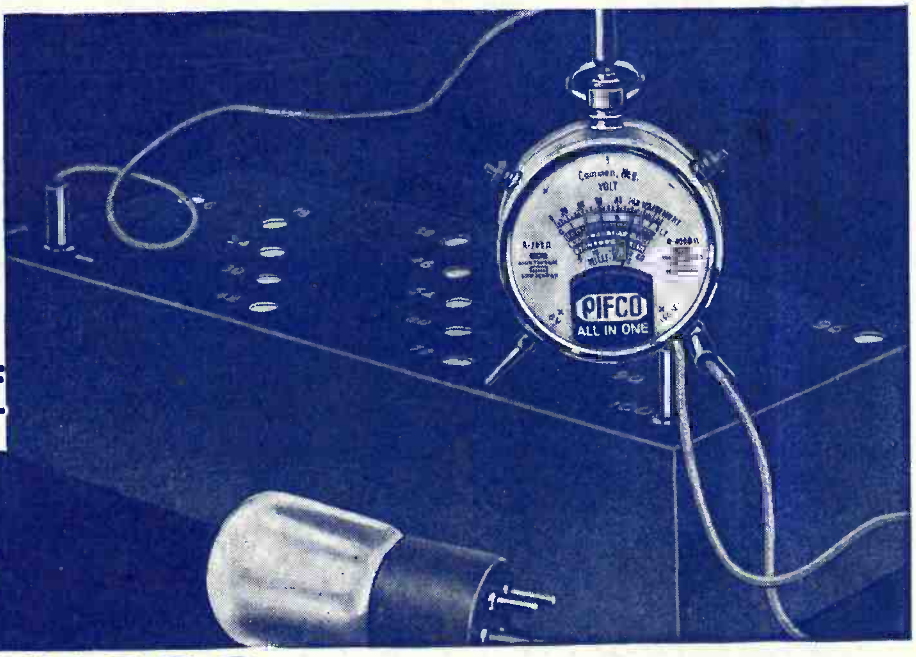

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4D

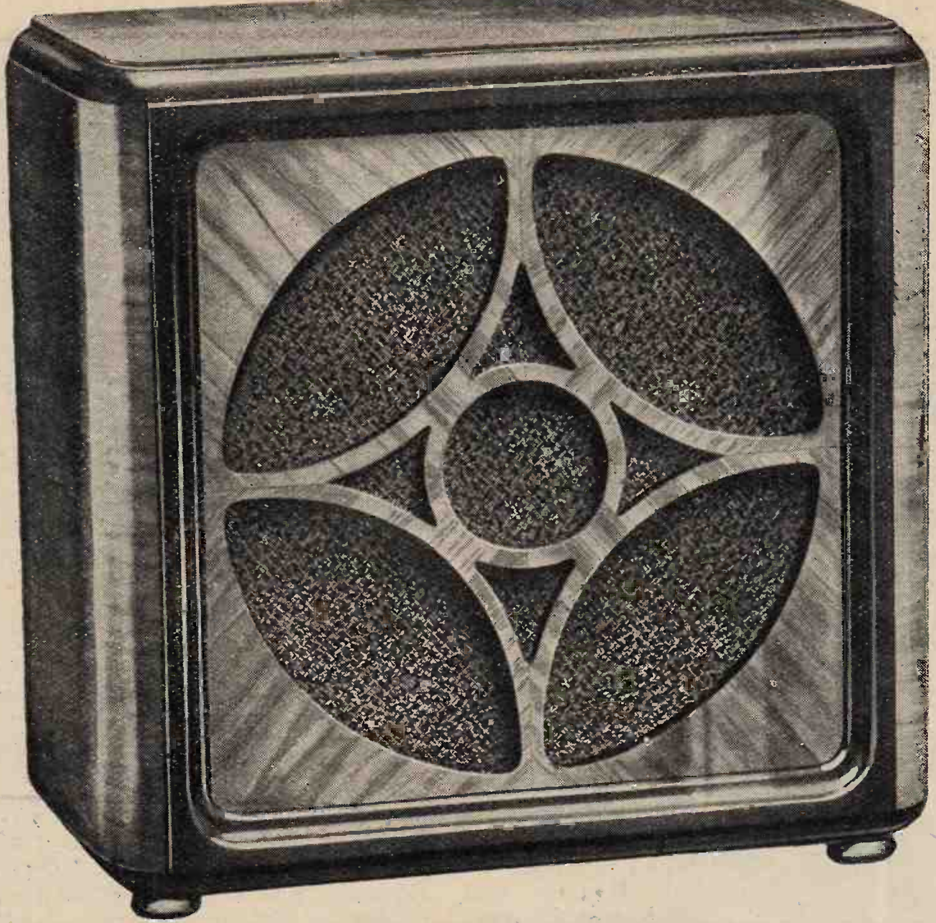
The Wireless World

AND RADIO REVIEW

The Paper for Every Wireless Amateur

Wednesday, November 26th, 1930.

No. 587. Vol. XXVII. No. 22



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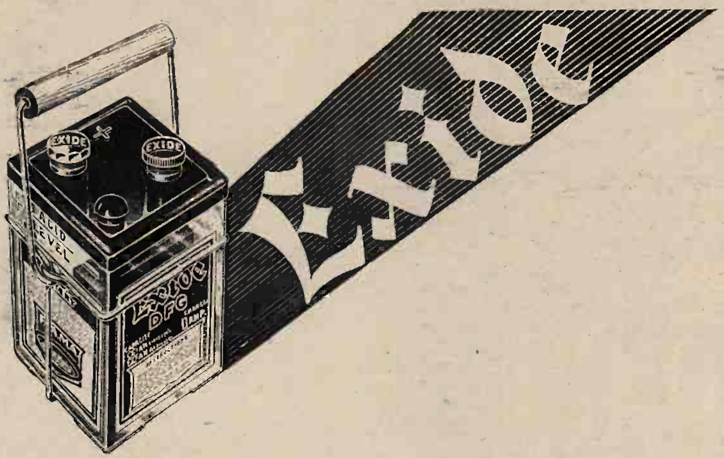

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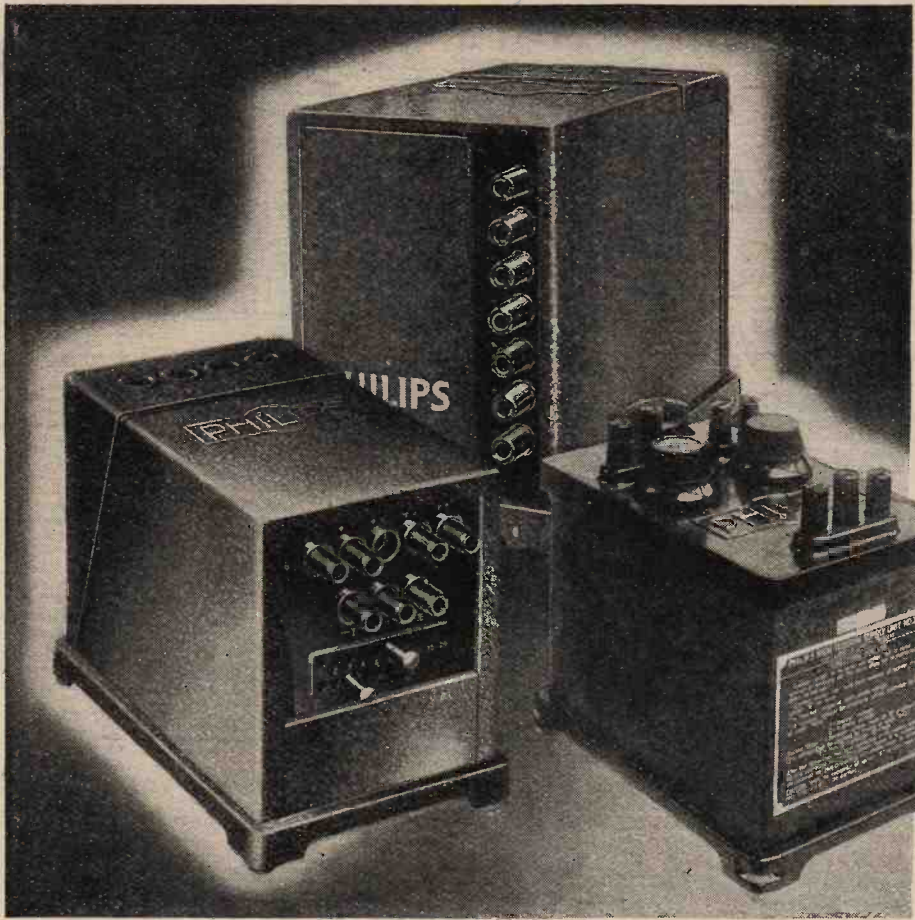

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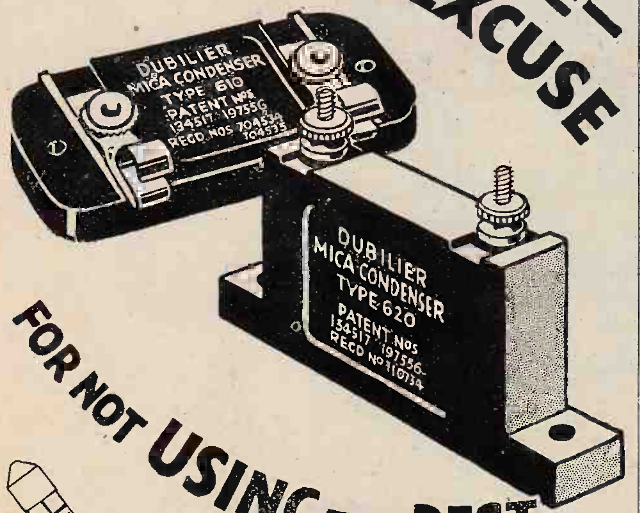

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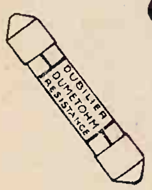

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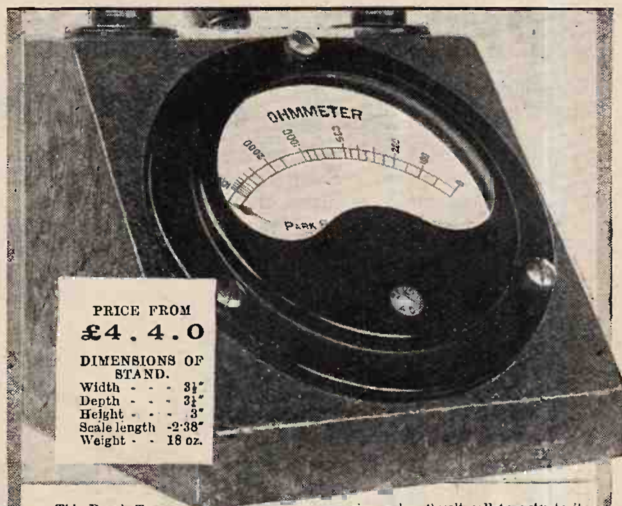

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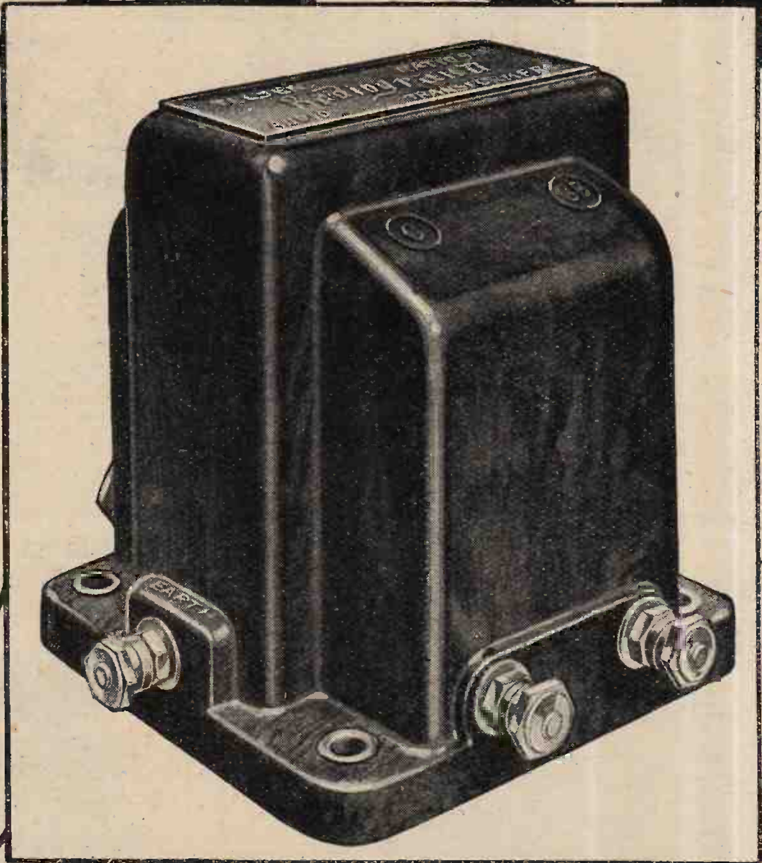

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The Wireless World AND RADIO REVIEW

(18th Year of Publication)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

Editorial Comment

Valve Classification.

As long ago as March, 1925, our sister journal, *Experimental Wireless*, put forward a plea for the standardisation of markings for valves so that the classification or type designation by which the valve was known should provide an indication of the characteristics of the valve itself. Proposals put forward later were adopted by some valve manufacturers, and certainly served to clear up the confusion to some extent. If we look back to 1925 we find that the number of different types of valves being manufactured then was small as compared with the total of to-day, so that, if a good case could be made out in 1925, the arguments in favour of some satisfactory scheme of classification have gained force to-day.

An inspection of the Valve Data Sheet, published as a supplement to this issue, will disclose at once that type numbers have been allotted to valves with very little consideration of how this classification is to be interpreted by the user. The British Valve Manufacturers' Association has done useful work in many directions, and has helped to bring about a desirable amount of uniformity amongst manufacturers, but what we regard as the very important question of nomenclature appears to have been neglected.

Manufacturers have adopted type numbers of their own to suit their convenience, and even their attempts at intelligent classification seem to have broken down in many instances by the addition of an X, an A, or a B, in type numbers, the precise significance of these letters being in most cases only appreciated by the individual manufacturers themselves.

To put forward a constructive proposal as to what new classification might be adopted would require that we should be in possession of much detailed information as to the specifications to which manufacturers work, and we think it better that we should make no attempt at the moment to put forward suggestions of our own, but rather leave it to the valve manufacturers and the B.V.M.A. to give the matter their attention and see whether it is not possible to agree on some classification which will be uniform and at the same time informative from the user's point of view. In days gone by the operating voltage of the filament was one of the most important details to include in the type number, but to-day there are other particulars which are really of much greater importance which should be indicated in the classification.

In *The Wireless World* of July 17th, 1929, an article appeared entitled "Valve Selecting Charts," where an attempt was made to group valves under their general characteristics, and we believe that a new classification of valves along these lines might prove to be the ideal scheme. It would be interesting to have constructive suggestions from readers who may have originated some fresh ideas on the subject.

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CHOOSING A DETECTOR VALVE.
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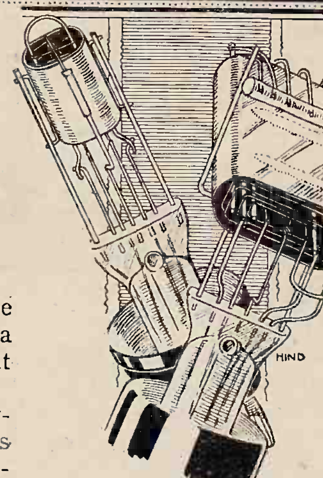
PENTODE V TRIODE

Their Relative Advantages Compared.

By

A. L. M. SOWERBY, M.Sc.

IT will probably come as a surprise to many readers that the high-voltage pentode, when fed into a suitable moving coil speaker, can give a better frequency response than the best that the power triode can produce. The conditions for distortionless reproduction with both types of valves are carefully examined, and attention is given to the design of compensating devices for pentodes when moving-iron speakers are employed. The author puts forward some interesting figures of merit for output valves in which sensitivity is expressed in terms of milliwatts undistorted output per volt grid swing.



WHEN the pentode valve was first introduced, now more than two years ago, it was freely stated that it was quite incapable of giving reproduction of good quality when used with any speaker other than a moving coil. We were told in print that with any type of moving-armature speaker the highest notes would be badly over-emphasised, and that the bass notes would be missing altogether. Those of us who doubted the statements made a practical trial—and found exactly what had been predicted.

At that time the reason for this over-accentuation of high notes was not as fully realised as it now is, so that a suitable correcting device did not suggest itself. With the greater familiarity with the ways of the pentode that two years of experience has brought us, the cause of this poorly balanced reproduction has become evident, and this knowledge has, in turn, resulted in the ability to apply a correction which, if on paper imperfect, is yet amply good enough to deceive that most gullible organ, the human ear.

At the present time the position is that even with a moving-iron speaker, in which category is included every speaker in common use, save those of the moving-coil type, it is possible to attain equally excellent quality with either a triode or a pentode in the output socket of a set. One more perplexity is thus added to the difficulties of receiver design—we have to decide between the conflicting claims of the super-power valve, on the one hand, and the pentode on the other.

Both pentode and triode, being output valves, have to draw power, in the form of direct current, from the H.T. battery or eliminator, and to convert as much of this power as possible into sound-waves through the medium of the loud speaker. This general statement at once suggests that the valve, as a unit, does not interest us; we are concerned, instead, with the combined behaviour of valve and loud speaker.

There are three points of view from which the performance of the valve loud speaker combination may be judged. It is evidently desirable, in the interests of economy of power, that the greatest possible proportion of the power drawn from the anode-current supply should be passed to the loud speaker for conversion into sound. For the sake of economy in amplification, it is desirable that the greatest possible power should be handed to the loud speaker in response to each volt of audio-frequency signal applied to the grid of the output valves. And, finally, it is required that the speaker should be given the same power per signal volt no matter what may be the frequency, or musical pitch, of the signal, in order that no part of the musical scale may be accentuated or suppressed in comparison with the rest. There is, of course, a fourth requirement, which is that the amount of noise from the loud speaker should be adequate to our needs; that, however, is ensured by choosing a valve, whether pentode or triode, of suitable power-handling capabilities. Since both pentodes and super-power valves of different power ratings can be had, this question hardly enters into a comparison between the two types, since a valve can be chosen from either class to do the work required of it.

We will take, first, the relative efficiencies of super-power and pentode valves as measured by the relation between the power drawn from the battery or mains unit and that eventually handed to the speaker. In order to get a fair basis of comparison, we shall have to assume that the valve is supplied with signals just not strong enough to cause overloading, and that the loud speaker is correctly matched to the valve.

Analysis of the figures for undistorted power output, and comparison of these with the anode current and voltage, leads to the result that with the average pentode 21.5 per cent. of the D.C. power drawn is passed to the speaker in the form of signals, while with the average triode of low impedance only 16.3 per cent. of the power is usefully employed.[1] Thus, for the same consumption of anode-circuit power a pentode may be

[1] At the time of writing, the Valve Data Sheet accompanying this issue is not available; recent minor changes have, therefore, necessarily been neglected.

Pentode v. Triode.—

expected to make appreciably more noise than a triode before distortion begins.

The word average has carefully been used, for the variations from one individual valve to another are surprisingly large. The highest efficiency found for pentodes is 29 per cent., and the lowest 14.1 per cent., while for super-power valves the corresponding figures are 24.8 and about 11 per cent. These variations are very largely due to differences in filament voltage and permissible anode voltage, for in both classes valves with six-volt filaments, or operating on anode potentials greater than 200 volts, show marked superiority.

Defining Sensitivity.

It is found that two-volt super-power valves average 15.3 per cent., for example, as against 19.1 per cent. for high-voltage triodes, while two-volt pentodes have an efficiency of 17.5 per cent., as compared with 26.4 per cent. for pentodes that will take anode voltages greater than 200 volts. From this the interesting fact emerges that in the two-volt class the superiority of the pentode is little more than 10 per cent., while the high-voltage pentode is over 50 per cent. more efficient than triodes of similar type. Probably the enormous popularity of the two-volt triode as an output valve for small sets has resulted in special attention being paid to its design in the last few years; the highest efficiency in high-voltage triodes is found in valves the design of which has remained unaltered for a very much longer time.

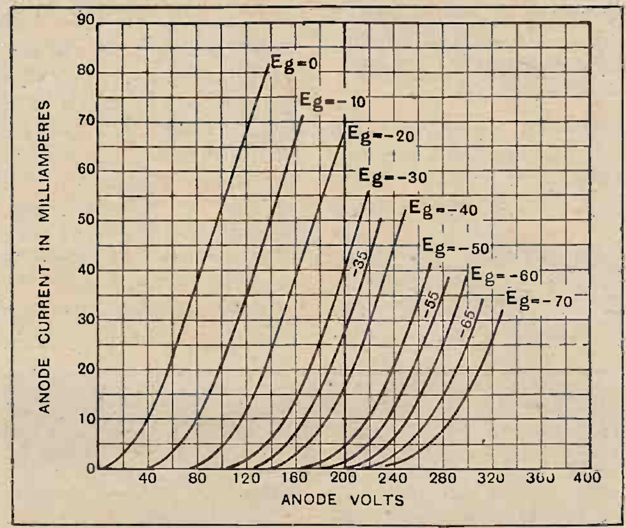


Fig. 1.—Curves connecting anode voltage and anode current in a triode. Current changes rapidly with changes in voltage. As the impedance in the anode circuit rises the voltage developed across it climbs slowly towards μ times the voltage applied to the grid.

It would appear safe, from the figures that have been quoted, to draw the conclusion that the listener whose supply of anode-circuit power is limited either in voltage or current—that is, the user of either dry batteries or D.C. mains—will be compelled to use a pentode if he wishes to obtain the maximum possible volume from his installation. If, on the other hand, unlimited anode current is available, the lesser efficiency of the triode ceases to be a matter of any importance.

This question of the efficiency of a valve as a converter of D.C. into A.C. power has been gone into at some length, for the reason that, so far as the writer knows, it has never before been discussed in print. As a result of this, the total anode-circuit consumption of power has quite fallaciously been taken as a measure of the power that the valve can deliver to the loud speaker.

The second point that we decided was desirable in an output valve was its ability to pass considerable power to the speaker on the strength of a small signal applied to its grid. The valve should, therefore, be "sensitive," or should have a high amplification factor. We can obtain a numerical expression for the sensitivity of an output valve by dividing the power obtainable from it by the signal voltage necessary to induce it to deliver that power; we thereby obtain the sensitivity in milliwatts per volt.

Everybody knows that the pentode requires a far smaller input than a triode of equivalent power to load it up fully with signals. Accepting the grid-bias required by the valve as a measure of the signal voltage it requires to develop maximum output, we find that an average figure for the sensitivity of a triode is 25.4 milliwatts per volt, the corresponding figure for a pentode being 66.2 milliwatts per volt. It may be said at once that, owing to the fact that overloading with a pentode will often occur in the anode circuit before it takes place in the grid circuit, the difference in sensitivity is noticeably greater than these figures, which are not really fair, would suggest. But without taking full curves of all the pentodes, and subjecting them to a searching analysis, it is not possible to obtain a more accurate numerical expression of the average sensitivity of the pentode. One might guess it as not more than 50 per cent. higher than the figure just quoted.

In sensitivity, as in efficiency, it is found that the two-volt valves are in nearly all cases less attractive than their six-volt brethren; a usual sensitivity for a two-volt super-power valve is about 20, though one very popular valve in this class has a sensitivity of only 11.8 milliwatts per volt. (Once again, these figures are not from the latest Data Sheet, and it is in this class of valve that some of the greatest advances of the last twelve months will be found.)

The Pentode, a Constant Current Device.

The greater sensitivity of the pentode has generally led to the recommendation that it should be used to follow the detector valve without the interposition of a low-frequency amplifying stage. The implication that, as it takes the place of both the output valve and the intermediate stage, it can therefore do the work of two valves and a step-up intervalve transformer, is seen by the figures given to be quite unjustified. The L.F. stage would yield an amplification of twenty times at the very least—more probably fifty times—and the figures arrived at for sensitivity show that the pentode will certainly not be satisfied with even one-twentieth of the signal input required by a triode of equivalent output. Although the advice to use the pentode immediately after the detector must not be allowed to hypno-

Pentode *v.* Triode.—

tise us into the belief that it gives the amplification of two valves, it is, nevertheless, sound enough. A detector of any type, coupled to a pentode (by a step-up transformer, if necessary), will be working with a

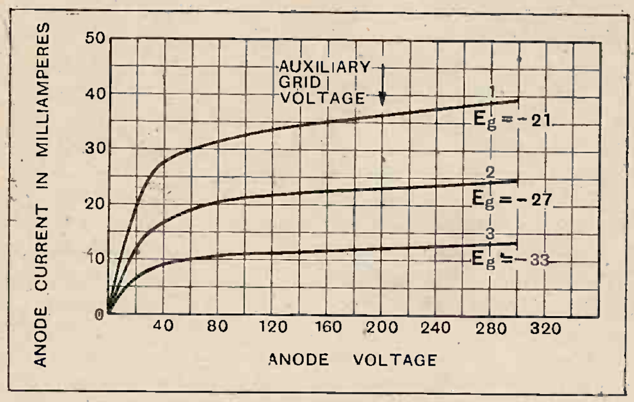
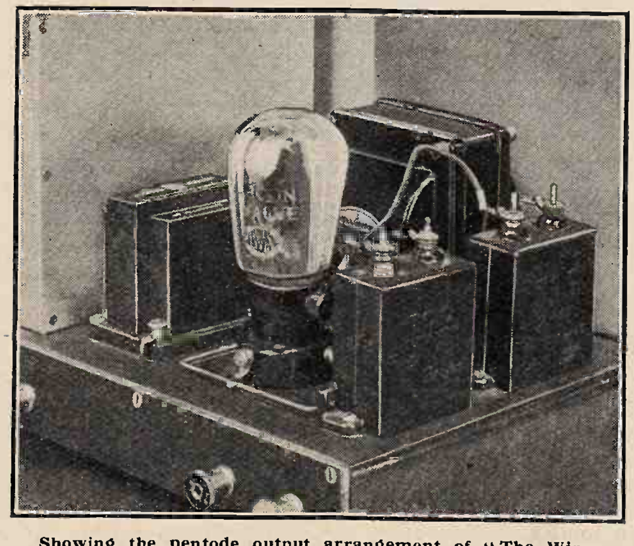


Fig. 2.—Curves connecting anode voltage and anode current in a pentode. The current changes very slowly with changes in voltage within the working range (nearly horizontal part of the curve). The voltage developed across a variable impedance in the anode circuit is nearly proportional to the value of the impedance; in other words, the A.C. current is nearly constant.

signal voltage on its grid, which is about right for efficient and distortionless detection when the pentode is fully loaded. In this way the use of a pentode, rather than a triode, tends in many cases to improve quality by indirect means.

The third desideratum of an output stage, that equal power should reach the speaker for each volt of signals on the grid, irrespective of frequency, is rather more difficult to attain with a pentode than with a triode. With either type of valve this can be assured only by suiting the loud speaker to the valve with which it is to be used.

To do this on a single-frequency is easy, but, since the impedance of the loud speaker, especially one of the moving-iron type, varies considerably with frequency, it is very difficult to get the relationship between valve and loud speaker correct for all notes. With a triode the general tendency is for the valve to develop much the same voltage across the speaker-windings at all frequencies, provided only that the impedance of the loud speaker is always appreciably greater than the internal resistance of the valve. As the frequency is raised, the impedance of the average speaker rises, too, and for the highest audible notes it may become as much as twenty times its value at the lowest end of the musical range. This means that the power handed to the loud speaker is much less for high notes than it is for low; and, although this seems quite wrong, it is just about what the average moving-iron needs to enable it to give well-balanced reproduction.



Showing the pentode output arrangement of "The Wireless World" Band-Pass Superheterodyne, a set recently described in this journal.

With the pentode, on the other hand, the general tendency is for the valve to deliver the same current, no matter what may be the value of the impedance in its anode circuit. Reference to the characteristic curves of a pentode will show this at once; the anode current is almost the same over quite wide ranges of anode voltage. With a constant current, the higher the impedance of the loud speaker becomes the greater is the power developed within it. Thus more power is given to the speaker at high notes than at low, which is an exact reversal of the conditions making for good quality from a moving-iron speaker. Used with a pentode, such a speaker sounds high-pitched, shrill, and tinny.

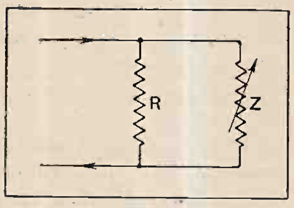


Fig. 3.—In this simplified diagram Z stands for the varying impedance of a moving-iron loud speaker while R is a compensating resistance.

There is, however, an easy cure. If we connect in parallel with the loud speaker a resistance of a value about equal to the impedance of the loud speaker at a frequency towards the middle of its range, we get conditions which can be visualised from a consideration of Fig. 3. The variable resistance, marked Z, is intended to represent the variable impedance of the speaker, while the fixed resistance R is the added resistance just mentioned.

For low notes Z is small, so that the constant current supplied by the pentode will flow through it rather than through R. As the frequency rises, and with it the value of Z, more and more of the constant current will be diverted through R, until, for the very highest notes, for which Z is very high, R may carry two or three times the current taken by Z. In this way the excessive strength of the high notes is avoided, the power not needed being deliberately wasted in the form of heat in the resistance R.

In practice it is usually best to put a condenser, of capacity about 0.005 to 0.01 mfd., in series with R, as shown in Figs. 4 and 5. By this means the by-passing effect of R on the loud speaker at low frequencies is avoided, so that no loss of signal strength results from its introduction. Further, owing to the fact that the pentode requires an anode-circuit load higher than that provided by the average loud speaker, it is necessary, if the full power is to be

Pentode v. Triode.—

developed in the loud speaker, to use a step-down transformer or tapped choke as coupling between it and the valve. Although one might carry out a suitable calculation to settle the best ratio, in practice it is usual to buy a multi-ratio transformer or a choke with several tappings, and find by experiment which ratio is best with the particular valve and loud speaker in use. Those who may wish to go a little more deeply into this aspect of the question are referred to an article entitled "Matching Valve and Loud Speaker,"[2] and for a more thorough and scientific exposition to a series of earlier articles by Dr. McLachlan.[3]

For feeding a moving-coil speaker, which requires the current through its coil to be the same, irrespective of frequency, the pentode valve is undoubtedly better than a triode. With the latter valve, neither the highest nor the lowest notes are reproduced with quite their full intensity; with the pentode, however, these variations disappear at once. Most moving-coil speakers have been designed for use with a triode; the cone is, therefore, usually constructed of a paper which tends to accentuate the high notes enough to make up for their natural deficiency. When a pentode is connected to such a speaker, this accentuation shows up in its true colours, and makes the music unpleasantly shrill. At the same time, the bass is not missing, being, in fact, better reproduced than with a triode. By changing the cone for another made of softer paper, or even of linen, this excess of high notes, which appears to be due to resonances of some kind in the cone, can be avoided. Comparing a speaker so altered, and driven by a pentode, with another having a cone of hard paper, and driven by a triode, the comparison is all in favour of the former. Not only is the bass more fully represented in comparison with the middle register, but the high notes are far more like those of the original instruments, for they are now due to impulses received by the coil from the wireless set instead of being due to resonances in the paper. So far as the top register is concerned, therefore, one hears the harmonics of the orchestra rather than those of the loud speaker diaphragm.

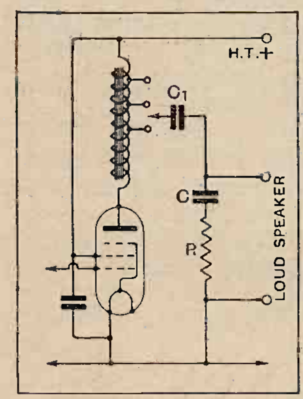


Fig. 4. — Output circuit (tapped choke) for pentode with moving-iron speaker. C_1 = 2 mfd., R = 10,000 ohms, C = 0.01 mfd. These last two values are subject to considerable variation to suit the speaker.

For the sake of extracting the maximum power from the pentode, it is usual for a loud speaker coil for use with it to have a larger number of turns than would be put on for a triode. This, however, does not detract to any audible extent from the quality if the number of turns is not raised too much; the usually accepted number of 2,500 is perfectly satisfactory in practice.

With a coil proportioned for a triode, a step-down transformer or tapped choke should be used just as suggested with a moving-iron speaker.

Summing up, the writer would give as his opinion that a pentode, in conjunction with a moving-coil speaker designed to work with it, forms the output stage that every listener with a critical ear would wish to have. With a moving-iron speaker, the quality of reproduction with a pentode in the last stage can be made, if one cares to take the trouble, as good as that from a triode, while the higher efficiency and higher sensitivity of the pentode offer distinct and undeniable advantages. If there are no very rigid limitations on anode current, and the receiver has plenty of amplification, these special advantages of a pentode cease to carry so much weight, and it is possible that a triode will be used in preference.

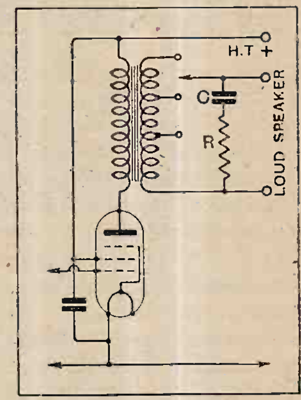


Fig. 5. — An equivalent circuit to that of Fig. 4, using a multi-ratio transformer in place of a tapped choke.

[2] *The Wireless World*, May 28th, 1930, p. 548.
[3] *The Wireless World*, Vols. 23 and 24.

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BOOK REVIEW.

The Talkies. By John Scotland. Published by Crosby, Lockwood and Son.

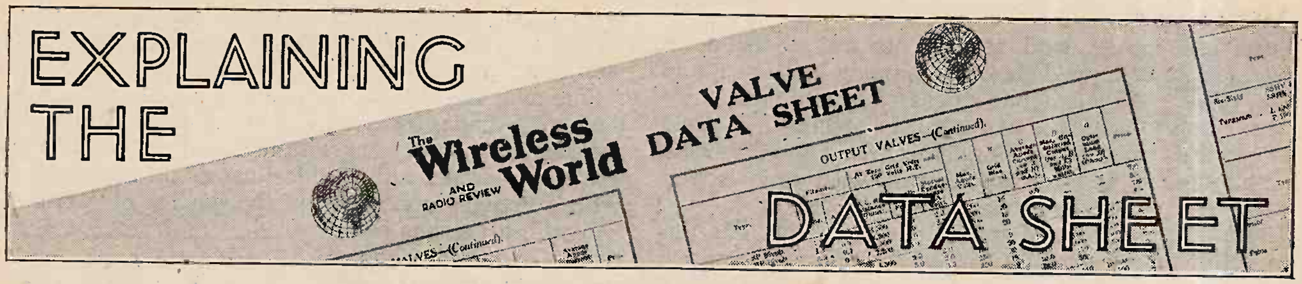
The subject of the talkies is so new that, apart from scattered articles, mostly to be found in the technical or semi-technical periodicals, comparatively little has been written on the subject, so that a complete "story" of the talkies is a particularly welcome addition to the library bookshelf.

The publication under review has obviously been written as the result of a close study of the art of the talkies from the earliest days up to the present time, and, whilst the book has been written in such a way that no technical knowledge is necessary in order to be able to absorb the contents, yet in reading it one is conscious all the time that the author is in command of very complete information, both technical and general, covering the whole subject.

The first chapters are devoted to the early history of the sound film, and many interesting facts are disclosed which are probably not generally known, even by those who have studied the subject, indicating to whom we are indebted for the gradual development of the talking film in the early stages. The book proceeds to give a general description of the technique of the talking film, both from the point of view of recording and reproduction, whilst the final chapters deal principally with the technical side of the apparatus, though expressed in language which the layman can understand. The book concludes with a collection of opinions on the talkies and their future.

In reading the book one of the most interesting sections to us was the description of the revolution in picture making which the talkies have brought about. Almost everything appertaining to the taking of silent films had to be changed in order to fit in with talkie requirements. The noise of the silent film studio during the taking of a picture has been replaced by almost deathly silence necessitated in order that there should be no interruption or extraneous sounds recorded and reproduced. Even the lighting arrangements had to be scrapped and new installations fitted up so as to insure that neither electrical interference nor any sounds such as were formerly produced by arc lights would intrude upon the background of dead silence, which talkie recording demands.

We can confidently recommend "The Talkies" as an excellent introduction and résumé of the position of the new art as it stands to-day.



Hints on the Choice of Valves and their Couplings.

IN the separate sheet of valve data accompanying this issue no fewer than 340 valves are classified under five main headings, arranged in such a manner that speedy comparison is possible, and the reader can judge for himself which valves are likely to yield the best results in his particular case. Of considerable importance is the inclusion for the first time of load figures or loud speaker impedance values for all output and pentode valves. This should prove helpful in selecting a suitable loud speaker for the last valve, or, vice versa, choosing for the loud speaker the correct valve and transformer ratio.

The following notes are intended to assist in the choice of the best valve for the various functions of a receiver, and refer to the different types of valve in the order in which they appear on the supplementary sheet.

Screen Grid Valves.

Owing to the extensive research that has taken place in internal screening, and into the application of screening grids in cascade, staggered and cross-mesh screens, the interelectrode capacities have been reduced to such small limits—an average of about 0.003 $\mu\mu$F.—that it has been found possible in this section to dispense with stage amplification figures for threshold instability. Provided that external screening and decoupling are carried out with meticulous care, the maximum stage gains before oscillation takes place due to the valve are higher than are likely to be aimed at in practice with the type of intervalve coupling now in vogue. Accordingly, it is left to those who wish to work out threshold instability figures to refer to the explanation and formulæ given in the article which accompanied last year's valve data sheet (December 4th, 1929), making use of this year's anode-grid capacity values. Neither does it appear necessary to quote optimum transformer ratio, for with the screen-grid valve this usually works out at one-to-one, but the inordinate lack of selectivity with such a transformer renders it necessary to sacrifice amplification for selectivity by reducing the number of primary turns. Perhaps the most useful formula, therefore, is that which gives the stage gain with a non-optimum ratio transformer. It is $\frac{N\mu R}{R+N^2R_0}$ where N is the step-up turns ratio found necessary to give adequate selectivity, R is the dynamic resistance of the tuned circuit, R_0 the A.C. resistance of the valve, and μ the amplification factor.

There are four important factors which govern the choice of a screen-grid valve; the first is low residual capacity so that uncontrollable oscillation is avoided, the second a high amplification factor with medium A.C. resistance not exceeding about 500,000 ohms, and the third the greatest possible grid swing acceptance not curtailed by the early flow of grid current so that the bugbear of cross modulation and beat interference is minimised. The fourth consideration applies to A.C. screened valves only, and is that the cathode and heater should be able to withstand a difference of potential when automatic bias is derived from the voltage dropped across a resistance. The figures in the average anode current column are useful when it is desired to reduce the voltage from an H.T. eliminator. They are calculated assuming that the maximum anode and the optimum screen voltages are applied, and that with battery-fed and A.C. valves, 0.9 volt and 1.5 bias volts respectively are used, these potentials being the lowest which can be safely employed before grid current is met. Screen current is not published, as it differs somewhat widely from sample to sample, and little reliance can be placed on an average figure.

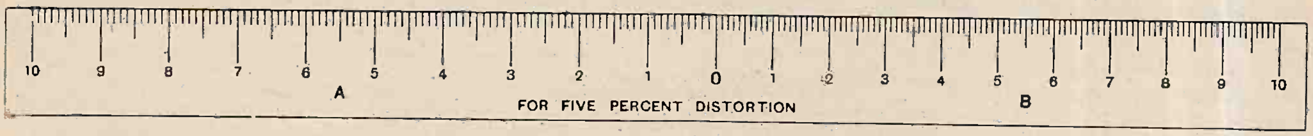


Fig. 1.—The five per cent. distortion scale in which the divisions on the right of zero are 9/11th of those on the left.

Miscellaneous Valves.

This section contains valves with A.C. resistances over 7,000 ohms suitable for intermediate L.F. stages and the three forms of detection—anode bend, leaky grid and power grid. The grid bias of column B is for amplifying conditions, and has to be increased for anode bend detection. There are a number of special leaky grid detectors of non-microphonic construction now available of which mention might be made of the Marconi and Osram H.2, the Cossor 210 Det., and the Mazda H.L.210. In A.C. sets power grid detection is to be recommended, as the distortion can be reduced to about 1 per cent. or 2 per cent. For this purpose the indirectly

Valve Data Sheet Explained.—

heated valves having A.C. resistances between 11,000 and 16,000 ohms should be chosen. Such valves are the Cossor 41 M.H.F., the Marconi and Osram M.H.4, the Mazda AC/HL, the Mullard 354V, and the Six-Sixty SS.4GP.A.C.

Although, according to the work of P. K. Turner, it is impossible to find an anode bend detector on the market giving less than 7 per cent. second harmonic distortion, this method of rectification suggests itself where anode current is limited and where the very minimum of damping of the preceding tuned circuit is desired. Suitable valves for inputs up to 10 volts are those having A.C. resistances of about 7,500 to 9,000 ohms. These can be followed directly by an L.F. transformer, provided that the primary inductance is 100 to 150 henrys. Where this type of detector is followed by resistance coupling, valves with a higher A.C. resistance up to about 35,000 ohms are desirable, but the input grid swing must be restricted to 2 or 3 volts. For power-grid detection in battery-fed sets the L class of valve in the Cossor, Lissen, Marconi, and Osram and Mazda series, and the D type in the Mullard and Six Sixty series are suitable, as it has been ascertained that the watts dissipation limit is not reached at zero grid volts and 150 volts H.T. Considerable information can be obtained as to the best application of valves in this section from an article elsewhere in this issue, entitled "Choosing a Detector Valve," by W. T. Cocking.

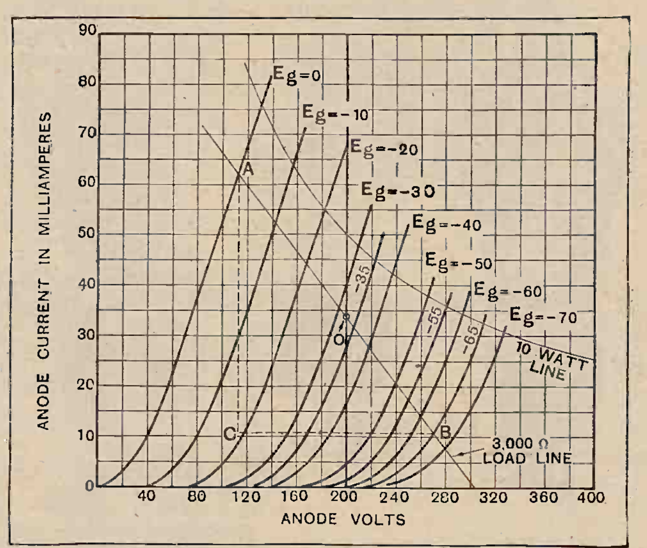


Fig. 2.—Anode volts-anode current curve of a typical power output triode where the watts dissipation limit is 10. If the zero of the distortion scale is placed on 0 (−32½ grid volts) the same reading in the scale is obtained at zero and −65 grid volts. From the points A, B and C, the optimum load and undistorted output can easily be calculated.

Output Valves.

The valves under this heading are triodes, with A.C. resistances less than 7,000 ohms. The grid bias figures (column B) are for amplifying conditions, but it is pointed out by the makers that they should not be rigidly adhered to and are only a guide. The correct functioning of the valve cannot be guaranteed unless the anode current figures in column C are maintained at the right value. It is regrettable that the manufacturers have been unable to agree to a standardised method of calculating undistorted power output and optimum load. These constants are undoubtedly of vital importance for the correct design of an L.F. amplifier and for the choice of a suitable loud speaker; in fact, without them the amateur may find himself in the position of a person buying a car without knowing the horse-power. Column D shows the greatest output that can be obtained with the maximum of 5 per cent. second harmonic distortion, whilst column G gives the optimum load or loud speaker impedance for which the output has been calculated. Measurement has been carried out by the graphical method, making use of the anode volts-anode current curves now willingly supplied by most valve manufacturers.

A special 5 per cent. distortion scale on celluloid, illustrated in Fig. 1, is then pressed into service. This has been designed for *The Wireless World* and can be obtained from Messrs. H. K. Lewis, of Gower Street, London, W.C.1. To exemplify its use the curves of a typical power valve are given in Fig. 2. The zero of the scale is pivoted on the makers' grid bias point marked *O*—in this case minus 32½ volts—and when the readings on the scale for zero grid volts and minus 65 volts (twice the bias value) are the same, the load line for a maximum of 5 per cent. second harmonic is located. This line, which represents the best loud speaker impedance, is shown in the illustration as AOB, and its value in ohms is got by dividing CB by AC. It is generally found that the load works out to be about twice the A.C. resistance of the valve taken under working conditions, but when there is a maximum watts dissipation curve limiting the anode current it will be realised that the load line may have to be tilted towards the horizontal to avoid intersecting it. With most of the large output valves, therefore, we find, on examining column G, that the optimum load must be three or even four times the valve's resistance, and should it be higher than, say, 5,000 ohms—the average impedance of a high-resistance moving-coil speaker—a suitable output transformer ought to be employed. The maximum undistorted output in milliwatts is equal to $\frac{AC \times BC}{8}$ where AC is expressed in milliamperes.

An interesting development in output valves is the *directly heated* A.C. series with 4 volt 1 amp filaments. Owing to the absence of subsequent amplification they are quite free from hum, and can be designed to give greater output than is possible with an independently heated cathode.

Pentode Valves.

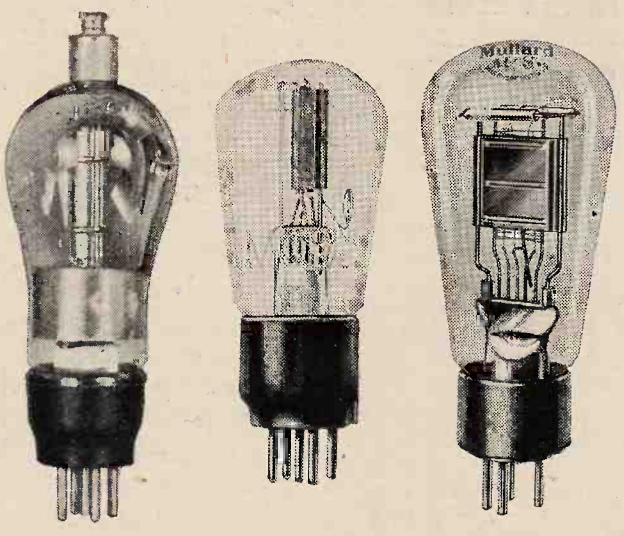
The increasing popularity of the pentode is reflected in the augmented range available for this season. While the battery-heated type in the 2-volt series do not show much advantage over the 240-type of triode, the high-voltage pentode is a remarkably efficient valve when its sensitivity is measured in terms of A.C. milliwatts output per volt grid swing. Furthermore, if the correct load is used—unfortunately the pentode is much more sensitive to mismatching of speaker than the triode—a frequency

Valve Data Sheet Explained.—

response can be obtained in which the highest and lowest notes are more faithfully reproduced than is possible with a triode. For a further discussion of this point reference should be made to an article by A. L. M. Sowerby, entitled "Pentode versus Triode," elsewhere in this issue. A moving-coil speaker with special speech coil and a cone of soft material gives with a power pentode a quality of reproduction which can hardly be challenged by the most critical, provided, of course, that the rest of the receiver does not introduce appreciable distortion. The pentode, which is of comparatively recent origin and until lately little understood, has been blamed for the shrill and tinny reproduction that a moving-iron speaker sometimes emits, when actually the fault lies in the design of the coupling device between valve and speaker. A compensating arrangement of condenser and resistance, to limit the impedance of the speaker, should be used, and in most cases a tapped output choke is required, since the majority of moving-iron speakers on the market are designed to follow output triodes of about 2,000 ohms A.C. resistance and are, therefore, of about 4,000 ohms impedance at middle C. To raise artificially the speaker impedance to the load figures given in column G a step-down ratio is required, otherwise low notes will be lost.

The characteristics given omit the A.C. resistance and amplification factor of pentodes, as these vary so much under working conditions, and further, the nominal A.C. resistance given generally as 50,000 or 60,000 ohms has no useful meaning, in view of the fact that the valve behaves like a 4,000- or 5,000-ohm triode. Columns C and F, giving average anode and screen current, assist in the choice of the correct value of voltage dropping and decoupling resistances. The maximum undistorted output figures (col. D) and the optimum loads (col. G.) are calculated according to the method described in a recent article.[1] They refer to a maximum of 5 per cent. distortion, whether this be second or third harmonic, and although somewhat approximate they can be taken as a useful guide. Pentodes lend themselves better to tone control than triodes, and can be made to compensate for high-note loss due to sideband cutting. That power pentode output is now favoured is evident from the data sheet, which shows that there are no fewer than eight of these valves, with A.C. outputs between one and three watts.

[1] "Pentode and Power Output" *The Wireless World*, July 23rd. 1930.



(a) (b) (c)

Typical H.F., detector and power output valves. (a) Mazda AC/SG with low interelectrode capacity, medium A.C. resistance and comparatively large grid swing acceptance which minimises cross-modulation. (b) Marconi and Osram MH4—an excellent power-grid detector giving less than 2 per cent. harmonic distortion. (c) The Mullard ACO44 directly heated A.C. power valve with 4.0 volt 1.0 amp. filament and an A.C. output of over 1 watt.

Rectifying Valves.

The classification here includes, besides the maximum R.M.S. volts which may be applied to the anodes of the rectifying valves, two columns devoted to D.C. output. The conditions under which the D.C. voltage figures are taken have been standardised by the makers as the average voltage, measured by a moving-coil meter, developed across a 4 mfd. condenser when the maximum load (shown in the column next to the price) is applied. The use of a smaller capacity directly across the output of the valve would result in poor rectification efficiency, whilst a much larger condenser is inadvisable. Some confusion arises as to whether the outputs as quoted can be termed "smoothed" or "unsmoothed." Actually they are smoothed with regard to the valve and most certainly unsmoothed as regards the receiver; accordingly, "unsmoothed" has been adopted on the data sheet. The general characteristics given are a sufficient guide to the purchase or construction of a mains transformer, as the filament and anode requirements and type of rectification of each valve are given. To obtain fuller details of outputs below the maximum, the makers' voltage regulation curve must be used. When choosing a suitable rectifying valve the total load of the receiver and the voltage required for the last valve must be known, also a knowledge of the D.C. resistance of the smoothing chokes is of importance. The load is the sum of the anode, screen, and potentiometer currents of the set, whilst the total voltage required is the sum of the automatic bias volts (if any), the volts dropped across the smoothing chokes and the H.T. volts for the last valve.

For further details of calculation the reader is referred to an article entitled "Mains Rectifiers," in the issue dated February 19, 1930. It is better to err on the side of generous D.C. voltage output, as the absorption of surplus pressure by resistances is a simple process and tends to assist in decoupling the set. In no circumstances may the adjustment of rectified output be carried out by dimming the filament, as this ensures the early demise of the valve. Full-wave rectification is undoubtedly the most popular for voltages up to 500, because it is more efficient, and less smoothing is required than when the half-wave method is employed. For higher voltages, insulation difficulties in the valve suggest the use of two large half-wave rectifiers arranged to give full-wave rectification. For those rectifiers with indirectly heated cathodes the claim of lengthened life and increased overload capacity is made.

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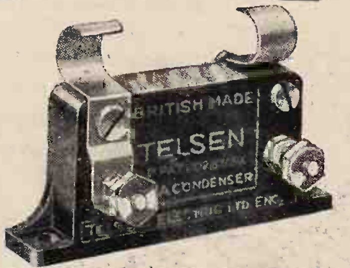

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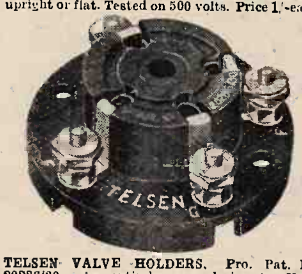

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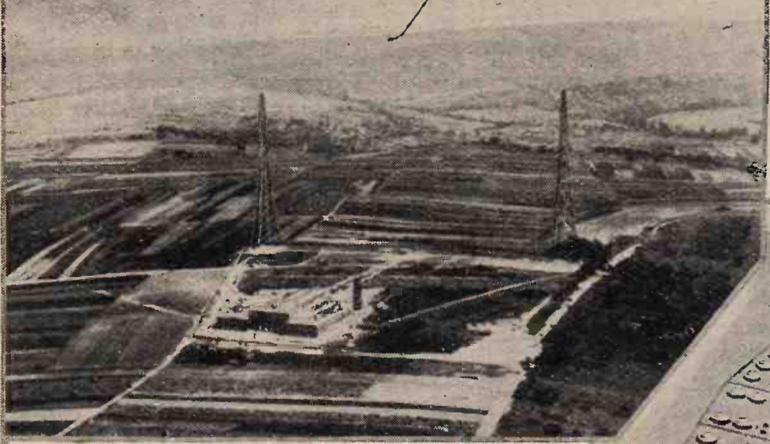
Germany's First Regional

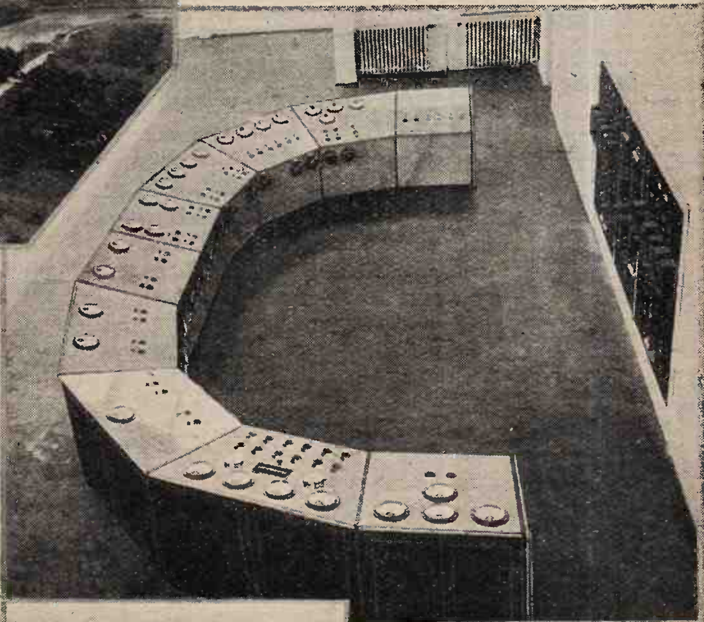
With an aerial output of 70 kW. and provision to double this if necessary, the station which opened at Muhlacker, near Stuttgart, on Thursday last, is one of the most powerful in Western Europe.

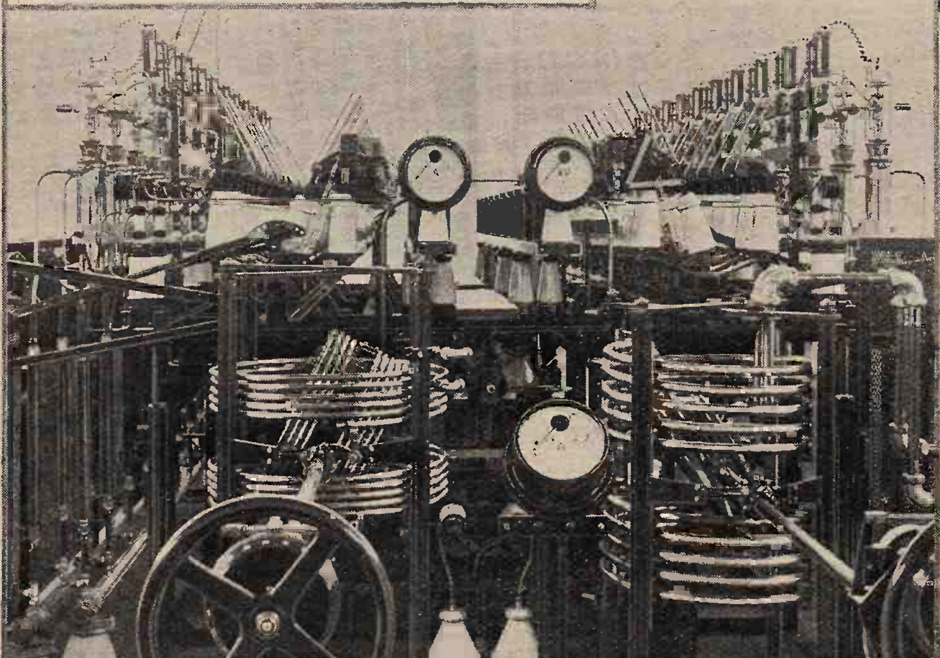


GERMANY paid a compliment to Great Britain on Thursday last, November 20th, by opening a high-power station modelled on the lines of the B.B.C. regional transmitters, and intended, if successful, to introduce a regional scheme similar to our own throughout the Fatherland.

Situated at Muhlacker, a small town midway between Stuttgart and Karlsruhe, this 70-kilowatt transmitter acquires the 360.1 metre wavelength formerly used by Stuttgart. The manufacturers are the Telefunken Company, who have embodied in the new transmitter the experience gained in the construction of the 60-kW. station at Oslo.

The masts, each 330ft. high, bear a strong resemblance to those at Brookmans Park.





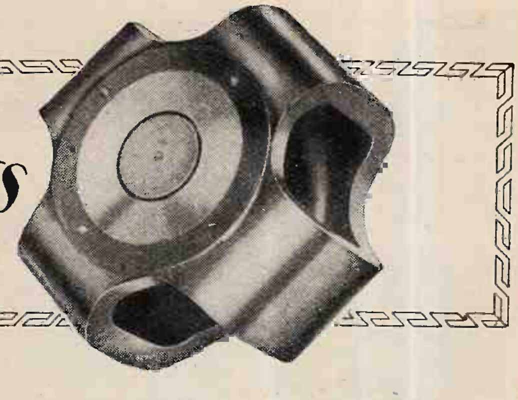
Unlike Brookmans Park station, Muhlacker does not generate its own power. All current is drawn from the local mains, a rotary converter changing the 50 cycle A.C. 15,000 volts supply to direct current for the anodes.

The transmitter is valve-controlled by the master-oscillator system with a secondary coupling in the final power stage, which contains twelve water-cooled valves each capable of dissipating 20 kilowatts.

If Muhlacker should meet the expectations of the authorities, the proposed regional scheme will be completed before the end of 1933 by the construction of a station at Heilsburg, near Königsburg, to cover the northern region, while the central districts will be served by Königswusterhausen.

Uppermost is an aerial view of Muhlacker. The middle photograph shows the semi-circular control desk, while below are the oscillator couplings.

Magnets for Moving Coil Speakers



By N. W. McLACHLAN, D.Sc., M.I.E.E., F.Inst.P.

Flux Measurement and Performance Criterion.

THE moving-coil loud speaker has occupied a prominent position in the pages of this journal for several years. Writers on the subject have been concerned mainly with the acoustical, electrical and mechanical properties of the coil and diaphragm. But the structure which supplies the steady magnetic field has been neglected. In view of the enhanced popularity of the moving-coil type of speaker and the interest it generally arouses about the time of the National Radio Exhibition, it seems appropriate to discuss a feature of the instrument concerning which little or nothing has been published.

The conventional design of electromagnet is illustrated diagrammatically in Fig. 1. The so-called lines of magnetic force (or magnetic flux) are indicated by the arrows. In the language of our forefathers, the central pin is a south pole and the outer ring a north pole, or vice versa. Part of the flux traverses the air gap and is disposed radially, as shown in Fig. 1. This is the useful or working flux. The remainder of the flux "leaks" out of the gap and follows the dotted paths inside and outside the magnet. Fig. 2 is a photograph of leakage flux taken by placing a piece of sensitive paper in front of the magnet, sprinkling iron filings on it, and exposing to sunlight. In this case the field is very weak[1] and the magnetic flux paths are clearly visible. Fig. 3 refers to full field and the flux paths have now disappeared since the attractive force was strong enough to overcome the friction between the filings and the paper over quite a wide area. Moreover, all the filings within this area were drawn to the magnet and can be seen adhering to the pole pieces.

Early in 1928 experiments were being conducted to measure the motional capacity and accession to inertia of a loud speaker identical with that I designed for the Science Museum in 1926[2]. This necessitates an accurate knowledge of the *useful* flux in the air gap. Moreover, a series of measurements were made on the magnet of this loud speaker, also upon several other magnets having comparable dimensions. Details of these are given later in this article.

There are several methods of ascertaining the value of the magnetic flux in the air gap of an electromagnet. A special search coil can be con-

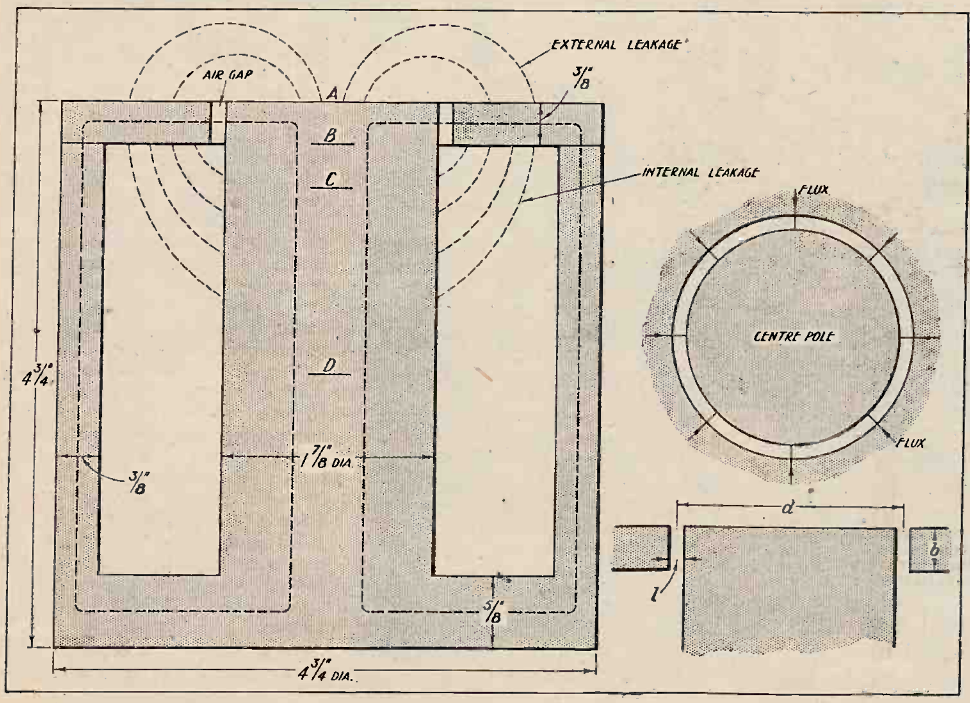


Fig. 1.—Dimensional drawing of a typical electromagnet such as was used for the measurement of flux density.

[1] This was done in May, 1928, and to the best of my recollection it represents the remanent magnetism; *i.e.*, magnetising current zero.

[2] See *The Wireless World*, March 30th, 1927.

Magnets for Moving Coil Speakers.—
nected to a flux-meter and the current in the field winding reversed. Due to reversal the meter reads double the total flux. Another method which applies to the electro- and permanent magnets consists in pulling the search coil quickly out of the field and observing the flux-meter reading. The search coil consists of two sections, A and B (Fig. 4a), both having the same number of turns and connected up in opposition (hence the nomenclature *differential* search coil). Considering Fig. 4a, if the complete coil is pulled out axially in the direction of the arrow, section A cuts all the leakage flux outside the magnet, whereas section B cuts the useful gap flux plus the external leakage flux. Since the gap flux only is required, it is imperative that sections A and B should be connected in opposition. In constructing differential search coils several points are to be noted.

Precautions in the Use of the Flux-meter.

(1) The radial depth and the length of the coil should be as small as possible.

(2) The resistance must not exceed about 15 ohms, but the smaller the better.

(3) All leads must be carefully flexed to avoid pick-up.

(4) From 5 to 15 turns per section will usually be found quite satisfactory.

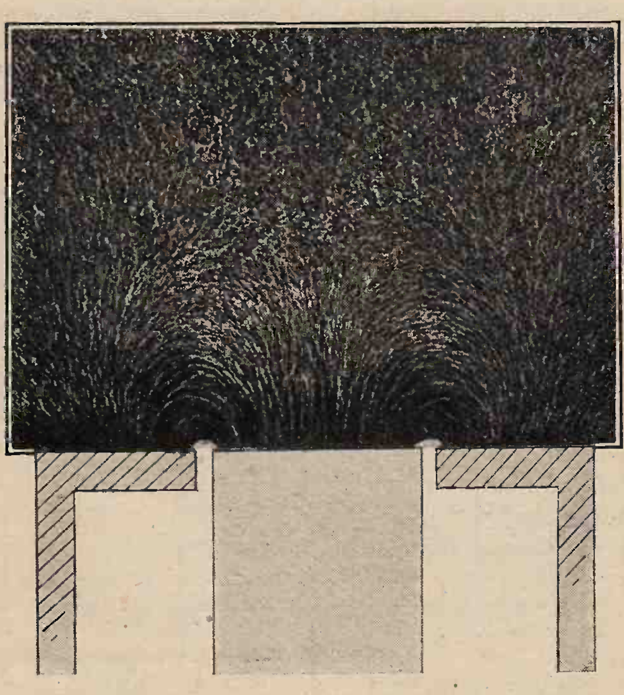


Fig. 2.—Photograph showing the external leakage and flux distribution of the magnet given in Fig. 1. The gap is ⅛in. and the field distribution obtained is that which results before applying excitation.

(5) Care should be exercised to ensure that the flux-meter coil has no short-circuited turns. I had a meter which showed that some magnets under test were really marvellous. On checking the flux by weighing with a steady current in the moving coil, also by a ballistic galvanometer, the readings were 32 per cent. high—due to short-circuited turns.[3]

(6) The torsional control on the meter should be really minute when on open circuit. It should have a very low natural frequency and will take a very long time to settle.

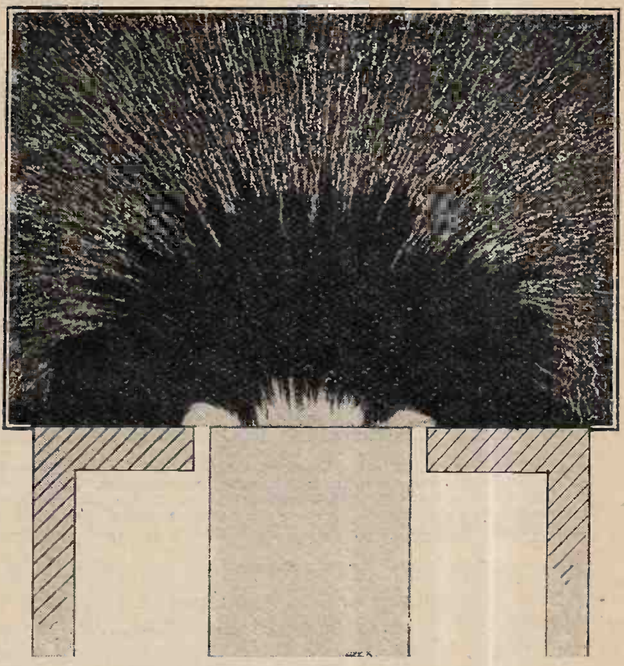


Fig. 3.—External leakage flux distribution with full excitation.

To measure the external leakage flux coil A should be used alone and drawn out of the field. If other coils C and D (or a movable coil) are provided, as shown in Fig. 4a, they can be used to read the internal leakage flux at various positions. For example, by connecting B and C in opposition the whole leakage flux between them can be measured.

The following example may be useful:—

Turns on differential coil (same on A and B) .... = 5
Flux-meter reading .... = 65.4 divisions.
Each flux-meter division .... = 12,000 line turns.
Total useful flux through 5 turns ... = 65.4 × 12,000.
= 785,000 line turns.
Total useful flux per turn ($A_g B_g$) ..... = 785,000/5 = 157,000 lines.
Mean area of air gap = Axial length × mean circumference.
= $1 \times \pi \times 5$.
A_g = 15.7 square centimetres.
Useful flux density in air gap....... = 157,000/15.7.
i.e., B_g ...... = 10,000 lines per sq. cm.

This is a *mean* or average value, because the flux is not quite uniformly distributed throughout the gap. The flux at any particular section can be found by placing a narrow differential coil there (A and B close together) and pulling it out, as before. Tests of this type gave the field distribution shown in Fig. 5. This diagram also indicates the internal is a little greater than the external leakage. The radial field is only uniform

[3] The fewer the turns on the *meter* coil, the greater the reading.

Magnets for Moving Coil Speakers.—
over 70 per cent. of the gap width, and suddenly falls away outside the outer pole faces. This is concomitant with distortion under the conditions stated later on.

The leakage flux is quite large, being about 30 per

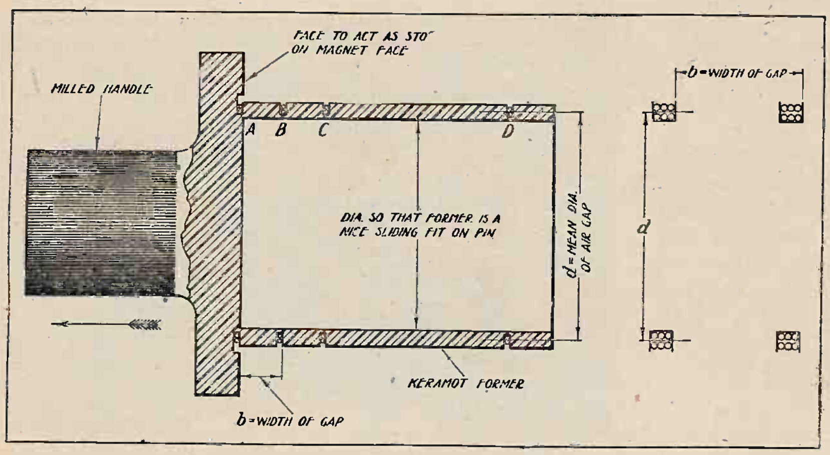


Fig. 4(a).—Diagrammatic sketch of differential search coil. The leads from the coils are flexed and brought out through the handle. They may be taken to terminals or to a switch which enables coils to be used separately or any pair connected in opposition. Greater accuracy accrues when the axial length of the coils is as small as possible. This is due to the flux density not being uniform.

cent. to 50 per cent. of the total flux, according to the length of the air gap and the material of the magnet. In the case of an electromagnet the leakage, however, is not always a criterion of the efficacy of the device. This will be seen more clearly from the data of Table I. Although the leakage is 30 per cent. or more with 2,000 ampere turns and an ⅛in. gap, 84 per cent. of these ampere turns are usefully employed (due to the leakage paths being in parallel with the air gap).

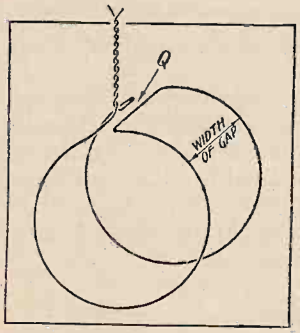


Fig. 4(b).—Alternative form of single turn differential coil. The space Q is left merely to show the construction of the coil.

As the ampere turns, and therefore the flux, increases, the reluctance of the magnet and the leakage become of greater importance, *i.e.*, the ampere turns usefully employed decrease to 73 per cent. (at 3,000 ampere turns). The effect of magnetic reluctance in the case of cast iron is especially marked (see last column of Table I).

TABLE I.

Total Ampere Turns on Magnet.	Per cent. of Total A.T. used on Gap.		
	Steel Magnet ⅛ inch Gap.	Steel Magnet 3/32 in. Gap.	Cast Iron Magnet, 7/64in. Gap.
1,000	86	88	40
2,000	84	82	35
3,000	73	68	29

Table 1 showing percentage of total excitation in ampere turns usefully employed in creating gap flux. The difference between 100 per cent. and the tabular data gives the percentage wasted on overcoming the magnetic reluctance of the magnet and in creating leakage flux.

A certain degree of leakage can be regarded as a boon, since it extends the useful width or axial length of the gap (see Fig. 5). This is essential when the coil movement at low frequencies is large. When the coil moves out of the uniform field harmonics are generated. Also, with a non-uniform field, when the amplitude exceeds a certain value, there is a unidirectional component tending to push the coil out of the magnet.[4] In public address work, cinemas, etc., there is no doubt that the coil moves out of the uniform field and generates harmonics due to this and to the inelastic constraint of the diaphragm surround. To give some idea of the axial motion, the total excursion of a diaphragm of 8 inches in diameter to radiate 1 watt at 50 cycles is no less than 1 inch.

The results of measurements on the magnet of Fig. 1 are set forth graphically in Fig. 6. Here we have the total useful flux, the (partial) leakage and total flux plotted against the excitation in ampere turns.

The measurements on total flux were made with one search coil pulled out from position C. The flux exceeds this value farther down the pin, e.g., at D, but as there was very little clearance between the magnetising coil

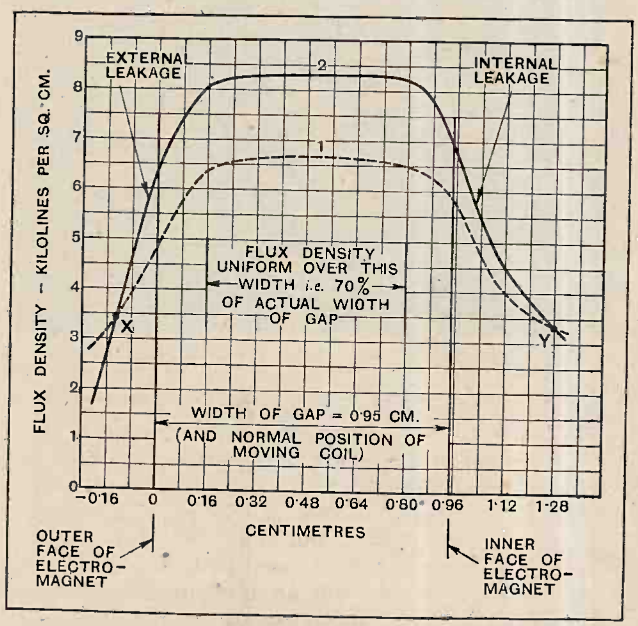


Fig. 5.—Diagram showing actual distribution of flux in air gap of electromagnet of Fig. 1. Curve 1 is for a gap of ⅛in. (0.32cm.) and curve 2 for a gap of 3/32in. (0.24cm.). It should be observed that the leakage with the smaller gap falls below that for the larger gap at the points XY.

[4] If the coil is centred by three threads it comes right out of the magnet into the weaker part of the field.

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and the pin, the search coil could not be placed there. It will be seen that the leakage exceeds 30 per cent. of the total flux as measured with the coil at C. Doubtless the leakage will be about 40 per cent. if the coil is situated farther down the pin.

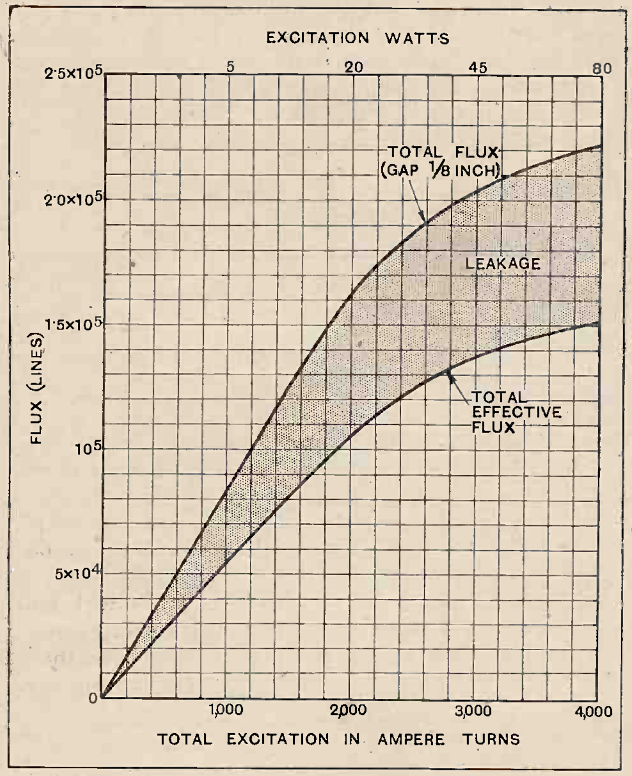

Fig. 6.—Total useful flux compared with the total flux plotted against excitation in ampere turns.

The curves of Fig. 7 show the great advantage of reducing the air gap from $\frac{1}{8}$in. to $\frac{3}{32}$in. (25 per cent.). At normal working excitation the effect is to increase the useful flux by 25 per cent., making it 10,000 lines per square centimetre. A further decrease in gap to $\frac{1}{16}$in. would probably yield about 12,500 lines per sq. cm. The lowest curve shows the futility of using cast iron for magnet construction. The major part of the ampere turns are spent on leakage and cast-iron reluctance.

Permanent Magnets and Electromagnets Compared.

Coming now to the case of permanent magnets, the method of measuring the useful and the leakage flux is identical with that given above. The design and theory of permanent magnets is a very special problem which is well beyond our present purview. We can, however, deal with several points associated with the permanent magnet problem from an elementary point of view. There are two main classes of magnet steel (a) with a percentage of tungsten; (b) with a percentage of cobalt. Magnets having the latter ingredient are superior (bulk for bulk) to those with tungsten. The percentage of cobalt in the magnet steel varies up to 35. Since cobalt is an expensive metal, a 35 per cent. steel must be used in moderation where economy is concerned. The object to be attained is to produce a magnet of suitable strength and dimensions at a reasonable price. With this end in view it is customary to employ magnet steel containing 9 to 15 per cent. of cobalt, although 35 per cent. is used in certain cases.

The leakage in a permanent magnet is somewhat higher[5] than that for an electromagnet of good steel or wrought iron working under identical conditions—i.e., gap density, radial and axial length the same in both cases. Consequently the area, and therefore the weight, of the magnet have to be increased to supply the requisite number of lines of force in the air gap.

What the reader now expects is a comparison between permanent and electromagnets. When flux densities of 10,000 to 12,000 lines per sq. cm. in a gap of 2 inches mean diameter, $\frac{1}{16}$in. radial width, and $\frac{3}{8}$in. long are required, the only economical arrangement is an electromagnet. If one is content with a reduction in output, a permanent magnet will give satisfaction. It is, however, quite impossible to make a comparison of magnets without an investigation into the meaning of flux density with relation to the sound output from a loud speaker.

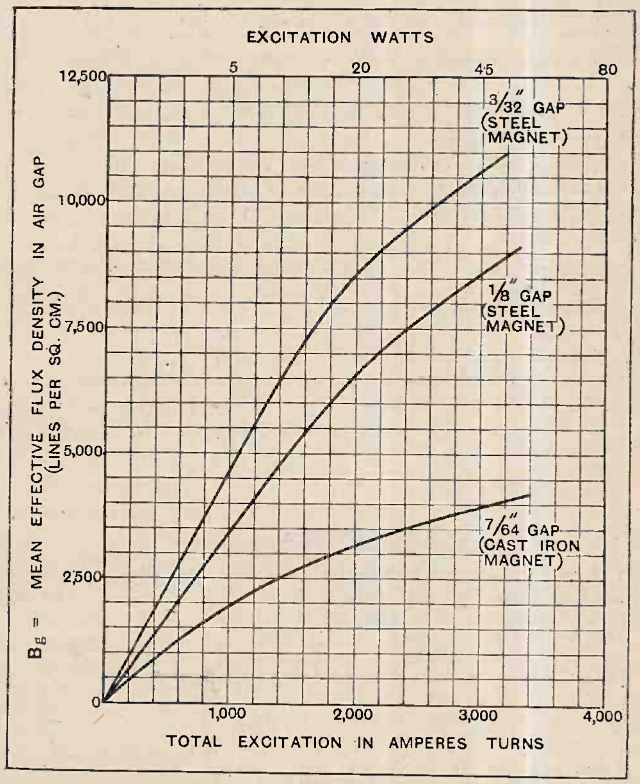

Fig. 7.—The effective flux density obtained in the air gap plotted against the excitation in ampere turns showing how the flux density varies with reduction in the length of the gap. Remanence has been neglected.

A mathematical investigation of the problem is beyond the scope of the text but is given in an appendix. The results will be treated now. If we assume a fixed size of wire on the moving coil, and a definite length of air gap, *the power output or performance criterion depends*

[5] The leakage flux is about 60 per cent. of the total flux, but the exact amount depends upon the shape and general design of the magnet.

Magnets for Moving Coil Speakers.— *on the product* $A_gB_g^2$. A is the mean area of the gap, i.e., mean circumference times axial length, and B_g is the *effective* flux density (lines per square centimetre) in the gap. Since $A_gB_g^2 = A_gB_g \times B_g$ the sound output depends upon the product of total effective flux (A_gB_g) and flux density (B_g).

We are now in a position to make a direct comparison of the sound output from different magnets. In the magnet in Fig. 1 it is possible with a 0.16 cm. gap to obtain $B_g = 11{,}000$ with a normal excitation. The area of the gap is about 15.7 sq. cm., so that the performance criterion $A_gB_g^2 = 1.9 \times 10^9$.

The following data illustrate a fairly large permanent magnet weighing 15 lb.:—

Mean diameter of gap	= 4 cm.
Radial length of gap	= 0.16 cm.
Width of gap	= 0.64 cm.
B_g in gap	= 9,000

Mean area of gap $= \pi \times 4 \times 0.64$
$= 8$ sq. cm.

Thus $A_gB_g^2 = 6.5 \times 10^8$, so that the sound output would be about $\frac{1}{3}$ that from the electromagnet.

Moreover, the flux density by itself is no criterion of the magnet performance, since by reducing the diameter of the central pin and the axial length of the gap it can be augmented appreciably without a proportionate increase in output.

The great advantage of a large value of $A_gB_g^2$ is immunity from overloading the power valve. With the electromagnet the grid swing of the power valve is $\frac{1}{\sqrt{3}} = 0.58$ that for the permanent magnet, the output being the same in each case. Hence, with the electromagnet there is an ample margin of grid swing to allow for a sudden increase in intensity of output.

Apart from the question of quality, experimental evidence indicates that if moving-coil loud speakers are to compete in *loudness* with the better types of reed-driven instruments, the value of $A_gB_g^2$ should not be less than 7×10^8. In making calculations of $A_gB_g^2$ it is assumed that the effective air gap flux B_g is measured, and that leakage is excluded, i.e., a differential search coil is used. By using a single coil and drawing it out of the magnet from some such position as C of Fig. 1, amazingly good permanent magnets will result.

Appendix showing Derivation of the Criterion Factor AB_g^2.

Sound output from speaker $\propto$ [Force on moving coil]^2
i.e. $W \propto$ [Current $\times$ wire on coil $\times B_g$]^2
or $W \propto i^2 (\pi dn)^2 B_g^2$ .... (1)
where d is the mean diameter of the coil and n the number of turns.

For any given power valve the coil current $i \propto s$ where s is the ratio of the turns of the output transformer (assumed perfect) and $s \propto [\rho/z]^{\frac{1}{2}}$ where ρ is A.C. valve resistance and z is coil impedance.
Since Z varies with the frequency we shall take its value at the electromechanical resonance frequency when the reactance is zero.

Thus $s \propto [\rho/r]^{\frac{1}{2}}$ where r is the coil resistance.
Also $r \propto dn$ provided the size of wire is constant.
$\therefore \quad s \propto [\rho/dn]^{\frac{1}{2}}$ and $i \propto [\rho/dn]^{\frac{1}{2}}$ .... (2)

Substituting in (1) for the current i and dropping ρ since it does not concern the magnet and merely affects numerical values:

$W \propto \pi^2 dn\, B_g^2$ .... (3)

For any particular gap the layers on the coil are fixed and therefore n varies as the axial length (b), so that

$W \propto \pi^2 db\, B_g^2$. But $\pi\, db$ is the mean area of the gap, whence neglecting the multiplier π, we find that

$W \propto A_gB_g^2$ .... (4)

CURRENT TOPICS.

THE UNLICENSED TRANSMITTER.

A scale of punishments with a maximum of two years' imprisonment has been drawn up by the sponsors of a Bill to prevent the use of unlicensed wireless transmitters in Italy.

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WHERE PORTABLES ARE FORBIDDEN.

A new police order forbids the use of loud speakers by picnickers in the parks and promenades of Paris and the Seine Department. Trippers to the Bois de Boulogne will have to leave their portables at home.

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35 PER CENT.

The British "Wireless for the Blind" Fund has received £50 from the Dundee Outdoor Mission as a thank-offering for 270 sets supplied to the local blind. The total amount received by the Fund to date is £23,800, which will allow for only 35 per cent. of the sets required.

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THE WIRELESS LEAGUE.

Members of the Wireless League are cordially invited to attend the annual general meeting of members, which will be held at 12, Grosvenor Crescent, Hyde Park Corner, London, S.W.1, on Friday, December 5th, at 3.15 p.m. Sir Arthur Stanley will be in the chair.

NEW ITALIAN BROADCASTER.

The construction of the 9-kW station at Trieste is progressing rapidly, and we understand that the Italian broadcasting authorities will inaugurate transmissions at the end of February.

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BUYERS' GUIDE.

Messrs. Geo. Crossley and Son, Ltd., of 4, South Street, Manchester, draw our attention to the mis-spelling of their name in the Buyers' Guide on p. 577 of our last issue.

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IRISH RADIO TRADERS.

A meeting will probably be held in Dublin in the next few weeks to consider the proposal for an Irish Radio Trade Association.

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WIRELESS ON BRITISH TRAINS.

"Head Telephones: Hire Charge 1s. per Journey" runs the inscription on the sealed package handed to the first or third class passenger who pays his shilling to the attendant on the L.N.E.R. express train between London and Leeds. He tears open the package, "plugs in" to an inconspicuous socket behind him and listens.

That such an escape from boredom is at last possible on a British train is due to the enterprise of the London and North-Eastern Railway. The wireless-equipped train is the dining car express which leaves King's Cross at 10.10 a.m. for Leeds and returns the same afternoon from Leeds at 5.30 p.m. The apparatus, installed under the direction of Mr. H. N. Gresley, the chief mechanical engineer, by Messrs. L. McMichael, Ltd., comprises a standard McMichael Mains Three fitted in the brake van and deriving energy from a rotary converter coupled to the train 24-volt lighting set.

Once tuned in to the Daventry National transmitter, the receiver needs no skilled attention; the responsible attendant has merely to touch a switch controlling the rotary converter to put the set into operation.

Good reception was obtained during a test run between King's Cross and Hertford on Thursday last, though at high speeds a crackle developed, possibly attributable to varying earth potential caused by axle play. When a remedy for this defect has been found, the only other adjustment which might be called for would be the addition of a means of volume control for the individual listener.

Broadcast Brevities

By Our Special Correspondent.

The King's Speech.

Reports from nearly all parts of the world show that the broadcasting of H.M. the King's speech at the opening of the Round-table Conference was successfully received in the Dominions and Colonies, though, unfortunately, atmospheric conditions somewhat interfered with the reception in India of some of the opening sentences.

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Another Royal Broadcast.

The Prince of Wales, as announced in these columns last week, will be heard again on December 16th, when his speech at the annual banquet of the Incorporated Sales Managers' Associations will be relayed from the Guildhall to the National transmitters. The voice of His Royal Highness is now familiar to all listeners, and he has recently given two broadcast speeches within a week, one at Savoy Hill and the other at the Albert Hall. All who have heard his speeches must have been struck with the clearness of his utterance and the admirable punctuation.

oooo

Care and Method.

The care taken by the Prince in the delivery of his broadcast speeches is shown in the preparation of his manuscript, which he always brings with him. This is arranged in lines of varying length, some short and some long, each line representing the sentence to be spoken in one breath.

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No Unnecessary Ceremony.

When the Prince goes to Savoy Hill scarcely any difference is made in the manner or method of his reception from that of any other eminent person. He is met at the entrance by one or two high officials and conducted to the drawing-room—yes, the B.B.C. offices boast a quite lavishly furnished drawing-room—where he sometimes partakes of light refreshment before the time arrives for him to step into the lift and be transported to the studio above. During his broadcasting the B.B.C. officials who have received him remain with him in the studio.

oooo

Political Broadcasting.

The B.B.C. has found some difficulty in finding a suitable speaker to reply to Lord Beaverbrook's talk this evening on "Trade Within the Empire." According to some accounts each of the three political parties felt shy of nominating official spokesmen to reply to him on later dates. I understand, however, that the Corporation has succeeded in enlisting the services of Sir William Beveridge, who will deliver his talk on December 4th.

oooo

The Interval Signal.

It is often somewhat tantalising when tuning in a station to hear no sound and to be left wondering whether one has happened upon a rather prolonged interval or whether the fault lies in the tuning. The B.B.C. has experimented with various types of preliminary tuning signal, starting with piano scales, going on to oscillating valves, and then to the tuning fork, but has hitherto turned a deaf ear to the suggestion that the Continental practice should be adopted of marking the intervals between the items by the use of a metronome or other device which will assure listeners that the station is working and that their sets are in order.

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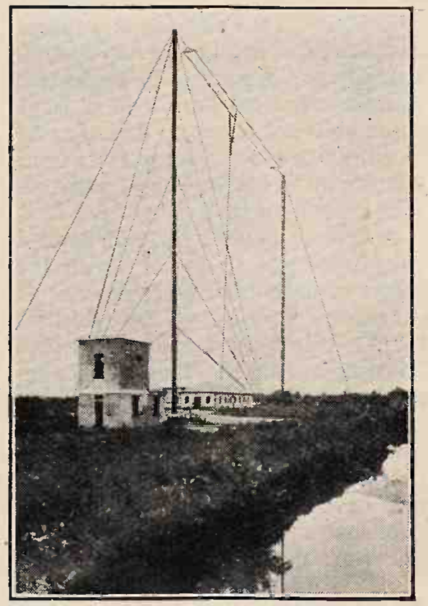
A Good Example.

Hamburg, for example, intimates by strokes on a gong the number of minutes still to go before the next item on the programme, and other Continental stations take care that their listeners shall not be kept unduly in suspense.

The B.B.C. has now decided to adopt a method of "keeping the ball rolling" during the intervals but, to begin with, it will be used somewhat sparingly. If, for example, the announcer states that there will be a short interval of three or four minutes before the next part of the programme begins, the interval signal will not be used, but if the length of time is uncertain a device will be brought into operation consisting of strokes on metal giving out a sound resembling a muffled cymbal at about half-second intervals. Perhaps this tentative signal may eventually develop into something more musical, such as the chimes of Cologne or the sleigh bells of the Polish stations.



"EIAR RADIO MILANO."—The picturesquely situated station which works in close association with Radio Turin and is like that station in having a lady announcer. It can readily be heard in England, working on a wavelength of 501 metres with an aerial output of 8 kW.

oooo

Is the Millenium Approaching?

Seldom has the B.B.C. encountered a more resolute opponent, in his professional capacity, than Mr. C. B. Cochran, and it is, therefore, especially gratifying to find that he is to take the chair on December 8th at a studio discussion between Mr. Hugh Walpole and Mr. Osbert Sitwell on "What's Wrong with the Theatre."

The lion is indeed lying down with the lamb, though the lamb has always had a special regard for this particular lion in spite of his alleged hostility during the past eight years, while Mr. Cochran has not always roared against the B.B.C. and, in fact, stated in a friendly manner when asked by a newspaper to take part in a symposium of views on the B.B.C.'s failings that, in his opinion, they were performing a difficult task as well as could be expected of them. The time may even arrive when a relay from the Adelphi Theatre will be a possibility.

oooo

The New Opera Scheme.

Another lion has also become tame, and it seems as if Sir Thomas Beecham is to be permanently associated with the B.B.C. in connection with the amalgamation of the Imperial League of Opera, the Covent Garden Opera Syndicate, Ltd., and the Corporation under the title of the Covent Garden Opera Syndicate (1930), Ltd. This amalgamation has been so freely discussed in the daily Press of late that I should not have brought up the subject were it not for the fact that many listeners are still fearful lest the B.B.C.'s contribution towards the working expenses may come out of funds which would otherwise be expended on their programmes. I am assured that this is not the case, and that the income of £30,000 which has been guaranteed from various sources will not encroach upon the Corporation's proportion of the licence revenue, but that the B.B.C.'s share will come from that part of the licence fees which would otherwise be retained by the Treasury.

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Licence Figures.

The number of wireless licences in Great Britain on September 30th had reached a total of 3,205,633.

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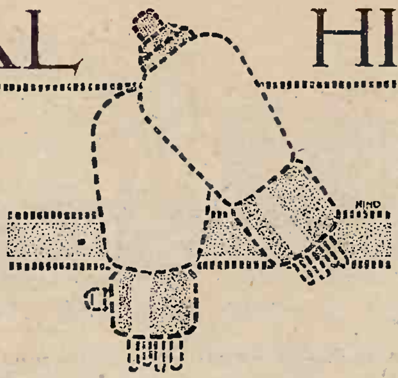
Health Talks for Scottish Listeners.

The B.B.C., in co-operation with its Scottish Advisory Committee on Public Health, has arranged a series of talks on health matters in Scotland, which it hopes will arouse widespread interest. Sir W. Leslie Mackenzie, in the first talk, gave a résumé of the state of affairs in public health as he sees them to-day; but in the next talk, which is to be given on December 9th by the Under-Secretary of State for Scotland, Mr. Thomas Johnston, M.P., Scottish listeners are to hear a specialist's views on a special question—"Health and Housing."

PRACTICAL HINTS & TIPS



Simplified Aids to Better Reception.

PROTECTION FOR VALVE FILAMENTS.

Valves have become cheaper, but are still expensive enough to make it worth while to observe all reasonable precautions against accidents. Short-circuits of the H.T. battery are generally blamed for the untimely burning-out of filaments, but in actual fact the risk of damage through this cause is comparatively slight, provided that H.T.-L.T. interconnections and switches are arranged in the manner which has been consistently advocated in this journal. Damage to the battery or H.T. rectifier is, of course, another matter.

Although the possibility of doing serious harm is minimised by adopting the correct system of wiring, complete immunity cannot be ensured, and so, to avoid all risk, it is wise to disconnect the source of H.T. supply before carrying out any internal adjustments or alterations to the receiver. But it is not always convenient to do so, particularly when the need arises of making a quick change so that the effect of alterations may be accurately observed, and it may sometimes be desirable, particularly when dealing with a battery, to make provision for interrupting the high-tension supply as well as switching off the L.T. accumulator.

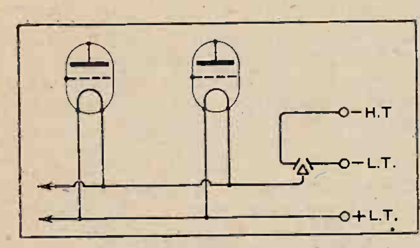


Fig. 1.—Connections of a three-point switch: both H.T. and L.T. battery circuits may be interrupted.

This may conveniently be done by using a three-point switch, as in the "Band Pass Superheterodyne" recently described in these pages. The switch should be connected as in Fig. 1.

Incidentally, it may be pointed out that when an H.T. switch is not fitted, and when the anode battery is not disconnected, it is always safer to leave the L.T. switch "on" when carrying out adjustments. This is because the accumulator acts as a low-resistance shunt, and prevents any great rise of voltage across the filaments in the event of an accidental contact between an H.T. positive lead and the positive L.T. busbar.

○○○○

GANGED CONDENSERS AND GRID BIAS.

So much attention is now being paid to the development of mains-driven receivers that the amateur who must, in the absence of an electric supply, depend on batteries, may possibly feel himself to be neglected. Actually, he has had such a large share of attention up to date that he has little cause for complaint, and, being still in the majority, will certainly not be forgotten.

A case in point is that of ganged condenser assemblies, of which the rotors of individual units are almost invariably joined together electrically. When these are used in the construction of a "mains" set no great difficulty is found in devising means whereby each valve may be given any desired value of negative bias, and to do so seldom introduces any extra complication, as by-pass condensers and decoupling resistances are generally required in any case. With regard to battery sets, the fact that each rotor is not isolated electrically from its neighbours is often a source of embarrassment, as consideration will show that the usual practice of taking a lead from the low-potential end of each tuned circuit to the appropriate negative terminal of the grid bias battery would merely bring about a short-circuit. Of course, this plan would work if it were desired that each grid circuit tuned by the ganged condenser should operate at the same potential, but such a condition rarely arises in practice. Even if it did there remains the need for insulating the condenser frame from the metallic screens, which are almost bound to be employed.

Fortunately, there is no need to abandon the use of up-to-date components and methods of tuning on this account, as there are various subterfuges by means of which the handicap of connected rotors may be overcome.

The simplest and most obvious way of connecting the bias battery is to insert it at the high-potential end of the circuit, between the grid and the condenser stator, as shown in Fig. 2 (*a*). At first sight it seems rather brutal to suspend a mass of metal at a point of high oscillating potential, and, indeed, such a procedure is wrong unless care is taken. It must be remembered, however, that when dealing with an H.F. valve, a single dry cell only is needed, and that it may be supported by the wiring so that no dielectric losses need be introduced. The cells used in batteries for so-called "fountain-pen" flash-lamps are particularly small, and so are highly suitable for this method of biasing.

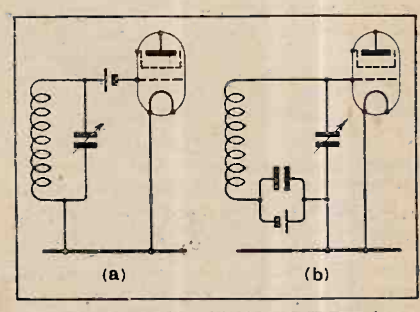


Fig. 2.—Methods of biasing an H.F. valve.

Another way out of the difficulty

is suggested in Fig. 2 (*b*); here the bias cell is inserted directly in the tuned oscillatory circuit, and is shunted by a fixed condenser to avoid the introduction of undesirable resistance. A non-inductive condenser of a good make should be used; its capacity may be about 1 mfd., although a much lower value is generally adequate. This plan is especially suitable for an anode bend detector, but, if the battery is unshielded, or if its connecting wires are long, decoupling resistances should be joined in each lead if there is any sign of instability.

It follows almost as a matter of course that, when band pass filters are used, the circuits will be tuned by ganged condensers. In designing battery sets of this kind it would seem wise to adopt the methods which have proved successful in mains-driven receivers. At the least, constructional difficulties will be minimised by doing so, and the extra cost of components will be negligible.

The skeleton diagram of Fig. 3 shows how the filter and coupling components of an H.F.-detector combination may be arranged when the rotors of all three tuning condensers (C_1, C_2, C_3) are joined together and also connected to the earthed busbar. In this case bias is fed to the H.F. valve grid through a resistance R, which may have a value of 10,000 ohms or so; C_m is, of course, the filter coupling condenser.

With regard to the detector, it will be seen that grid potential is determined by the connection of the lower end of the leak. From the point of view of D.C. voltages, the grid is completely isolated by the condenser in series with it; for this reason it is immaterial whether the variable condenser rotors are interconnected or not. There is little reason why a grid isolating condenser, with a suitably connected leak, should not be used in conjunction with a second H.F. valve or with an anode bend detector; this plan affords an easy way out of our difficulties, and it may be regarded as additional to those shown in Fig. 2.

The reader may be reminded that the circuit arrangements discussed above are equally applicable when separately controlled tuning condensers are mounted with their frames and rotors in metallic contact with screening boxes or any other earthed metal work. In this way the need for insulating the fixing bushes may be avoided.

ELIMINATOR VOLTAGE.

In designing an H.T. battery eliminator it is always as well, if it can be managed without incurring any appreciable extra expense, to aim at an output voltage considerably in excess of the maximum anticipated requirements. If there is a large surplus voltage it follows automatically that the series resistances through which the earlier stages of the receiver are customarily fed will be of higher value than would otherwise be employed, and in consequence they will be all the more effective in preventing unwanted interstage couplings. At the same time, feed resistances of high value will contribute at least something towards smoothing.

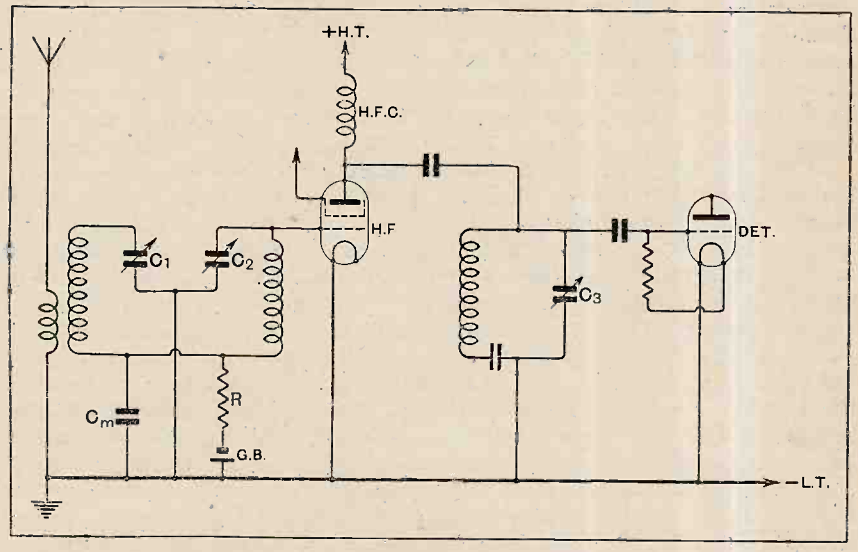


Fig. 3.—Arrangement of grid circuit components which allows a triple-ganged condenser to be used in a battery-operated receiver.

POWER TRANSFORMER LEAKAGES.

When hum in an A.C. "all-mains" receiver is definitely traced to the output valve, the trouble may often be ascribed to a leakage between the power transformer secondary windings. This leakage is sometimes caused by faulty insulation, but more often it is due to the existence of an excessively high capacity between the secondary which supplies low-tension current for the output valve filament and the high-tension winding which feeds the rectifier.

Although the greatest capacity that can possibly exist between these windings will act as an extremely high reactance to alternating current of commercial frequency, it must be remembered that any leakage that may be present will develop an A.C. voltage across the automatic bias resistance, and that this voltage will be transferred to the output valve grid; in consequence, it will be amplified.

It is not difficult to determine whether hum is due to this cause: if it disappears when the output valve filament is temporarily heated from an entirely separate step-down transformer it may be assumed that inadequate insulation or excessive capacity between windings is definitely responsible for the trouble.

Is it a "W.W." Diary?

"Make sure you purchase *The Wireless World* Diary," compiled by the staff of *The Wireless World*, is a piece of advice to which we would add the mere hint that the demand for the 1931 edition already suggests that readers would be well advised to obtain copies for themselves and their friends without delay.

UNBIASED.

By FREE GRID.

I HAVE been looking through manufacturers' catalogues recently in search of the latest developments in a matter in which I am particularly interested, namely, remote control of wireless receivers, and am thoroughly disgusted to note that apparently no progress has been made whatever. Although there may be some components which have escaped my notice—and I apologise willingly to the makers of them if this is so—so far as I can see there is not a single new component on the market, while those who made these devices in previous years have not improved upon them.

At the moment I have quite a simple arrangement so that Mrs. Free Grid can, as the spirit moves her, switch in any one of three stations at will by the simple manipulation of an ordinary bell-push. The set is mounted in a suitable position near to the aerial lead-in, and in every room I have a loud speaker plug point and a bell-push. The first prod switches the receiver on—it is, of course, entirely mains-driven—and brings in the London National. Prodding the push again causes the London Regional to appear, while a third prod brings in the Midland Regional station, the fourth switching all off, when the whole cycle is repeated again. The apparatus was home-made for a very small sum, and the cost of running is infinitesimal, as the relay takes power only momentarily when the button is depressed. The power taken is about five watts, it being operated from a five-shilling "bell" transformer. It is perfectly safe, as only low-voltage wires are taken about the house.

Improved Remote Control.

This scheme possesses the merit that when it is desired to switch off there is no need to return for this purpose to the same room in which it was switched on. It is my invariable custom when retiring to indulge in the two thoroughly reprehensible habits of listening—using 'phones with volume control—and also smoking the pipe of peace and contentment in bed, and I do not have to bother about going downstairs again to switch off. It is impossible, however, so far as I tried, to buy any manufactured equipment which will reproduce the aforementioned operations. Only two wires are needed for this system in any case, and I have reduced it to one by using one lead of the ordinary electric bell wiring in the house as my "return."

I am now experimenting with a still more serviceable system of remote control, which consists of a small 4-volt electric motor coupled through a suitable reduction gear (Meccano) to the shaft of the tuning condenser of a well-known commercial detector and L.F. set which, by reason of its smooth action, lends itself peculiarly to my experiments. Another motor works the reaction control, which is equally smooth. The motors are also of the Meccano type, with permanent magnet, so that they will reverse by merely changing the direction of the current through the armature windings. Needless to say, the motors are operated from a distance by suitable switches, and they operate the tuning and reaction controls. The first "snag" which I had to overcome was noise due to the commutator of the motor. This was eradicated by suitably disposing fixed condensers across the brushes and by completely enclosing the small motors in cocoa tins. The mechanical problem of mounting them on the outside of the panel was easily solved.

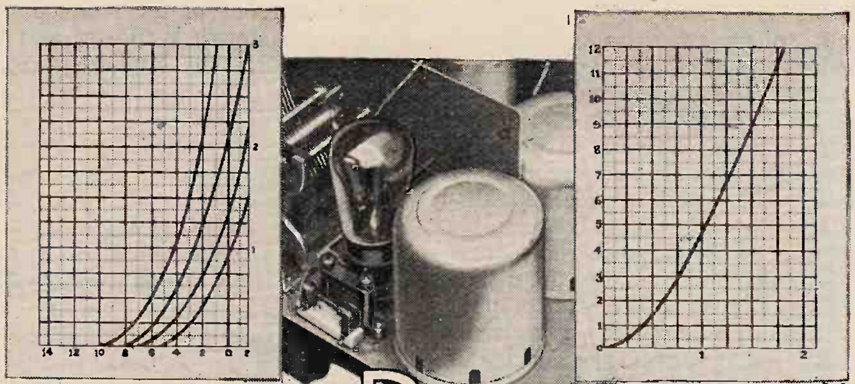
"Good-night, everybody, good-night."

"Time, Gentlemen!"

As far as I am able to judge, electric control clocks have more or less disappeared from the market this year—at least, I was unable to find any at Olympia, and I only know definitely of one survivor. One of last year's models, I remember, was capable of switching on or off in five-minute intervals, but possessed the disadvantage that it only had a thirty-hour movement. Yet another had an eight-day movement but could only be adjusted to control the programme at half-hourly intervals. A marriage between these two would have produced an ideal arrangement. It is hard to say why these devices never became really popular, but undoubtedly high price was one of the main causes. The makers of them had evidently never heard of the teaching of Rowland Hill. Had they halved their price, which in my opinion was easily possible, they could have quadrupled their sales. Some mechanism of this type is certainly desirable if only to put a check on the "indiscriminate listening" in which so many people indulge. I have been informed on quite reliable authority that in some households, more especially those in which all power is taken from the mains, the wireless set is switched on at the commencement of the morning programme and simply left to burble away till midnight. It is little wonder that people get surfeited with the aurally indigestible mass which they thus receive into their systems, and then blame the B.B.C.

"Indiscriminate Listening."

Surely it is literally impossible for all the items in an average day's programme to have an appeal to each individual listener, and for those who are incapable of switching off when an unpalatable item comes along a control clock set for 24 hours in consultation with the day's programme should be of great use. It would be still better if some horological genius could arrange enough peg-holes on the clock so that programmes could be arranged for a week in advance. We would then have not even the slenderest cause for indulging in indiscriminate listening, and the net result would probably be a considerable lightening of the B.B.C.'s daily post bag which is at present, so I understand, largely made up of moans from musical dyspeptics.



CHOOSING A DETECTOR VALVE

A Comparison of Anode and Grid-circuit Rectification.

By W. T. COCKING.

THE selection of an H.F. or L.F. valve for a receiver is fairly simple, for the method of calculation of circuit constants is well-defined. The most satisfactory rectification scheme, however, is always difficult to choose since there are so many conflicting factors which do not lend themselves well to simple mathematical treatment. In the accompanying article the relative merits of anode bend, power-grid, super power-grid and push-pull power-grid detection are given, and much useful information on the choice of suitable valves will be found.

THE detector stage is often one of the most critical parts of a receiver, and the one which most repays a careful selection of components. Its design is essentially a compromise between conflicting factors, and upon the attainment of the correct balance between these factors depends the success or failure of the whole receiver. Although the detector circuit must always be designed to suit the valve, good results cannot be obtained unless the valve itself is suitable for rectification.

Before choosing a valve, however, it is necessary to decide which of the two alternative methods of rectification is to be used, anode bend or grid-circuit detection. The latter, if of the power type, is the superior, since it is not only more sensitive but is inherently freer from distortion than anode rectification. It has the disadvantage, however, of requiring a high anode voltage, and the steady anode current is usually some 6 mA. or 7 mA. This is of little moment in a mains-operated set. but may easily prohibit its use in a receiver whose H.T. supply is taken from dry batteries.

Anode Bend Rectification.

There are then the leaky-grid and anode bend detectors; the latter has the advantage of taking a steady anode current of only about 0.1 mA. to 0.25 mA. It is true that during rectification this current increases somewhat, but it is not usually greater than 1 mA. These figures apply to the case where a valve of moderate anode A.C. resistance is used with transformer coupling and with an H.F. input of some 10 volts peak. Where a fairly high resistance valve is used with resistance coupling the current may be considerably less, and this is obviously advantageous for portable sets.

In all cases the anode voltage should not be less than 120 volts and preferably greater. Negative grid bias must be applied, and the best voltage for this should always be found by experiment, but a value equal to twice the voltage which would be used were the valve acting as an amplifier will usually give good results. This high negative bias increases the anode A.C. resistance of the valve, and the working resistance is higher than the maker's figure.

When a large input is applied to a medium resistance valve, the working resistance may be only some 25 to 40 per cent. higher than the makers' nominal rating. In this case transformer coupling is perfectly satisfactory, provided that the component has an actual primary inductance of not less than 100H. In cases where the input H.F. voltage is comparatively small, however, the working A.C. resistance of the valve may be three or four times the nominal figure, and there is then no alternative to resistance coupling. In order to secure high efficiency, the coupling resistance R, Fig. 1, should have a value not less than three times the working valve resistance. This immediately lands us in difficulties, since this resistance is shunted by the valve capacities and the input impedance of the succeeding valve, and, in addition, a by-pass condenser must be connected between the anode and cathode. The total capacity across the resistance, therefore, may be quite large and cause a considerable loss of high notes.

It will be seen, therefore, that, even with resistance coupling, the valve cannot have a very high internal resistance, and a valve with a nominal resistance of some 20,000 ohms, or 35,000 ohms at the most, is the highest which can be recommended. The coupling resistance should have a value of about 100,000 ohms, and the by-pass condenser can have a capacity of not

Choosing a Detector Valve.—

more than 0.0005 mfd.; these values represent probably the best compromise between efficiency and quality.

The amplification factor, of course, should always be as high as possible, and it is desirable to choose a valve with a fairly low inter-electrode capacity, in order to reduce the damping imposed upon the tuned grid circuit by anti-phase feed-back. The degree of amplitude distortion introduced by anode rectification is considerable and is due to the curvature of the valve characteristics. With a 100 per cent. modulated H.F. input, the distortion may be as high as 25 per cent., and with only 50 per cent. modulation it is rarely less than 10 per cent. Distortion of this order is readily noticeable, and it can be seen, therefore, that anode detection is not very good where the best quality is desired.

Power-Grid Detection.

It so happens that the grid characteristics of most valves are much more suited to rectification than the anode characteristics, since they have not only sharper bends close to the zero current axis, but also a much longer straight portion. The action of the grid detector is that of a diode rectifier followed by an L.F. amplifier, and a high anode voltage is necessary to avoid distortion in this amplifying action. When such distortion occurs the valve is really acting both as a grid detector and as an anode bend detector; rectification in the two cases is in opposite phase, and a reduced output results, together with distortion.

The first requirement for a suitable grid detector valve, therefore, is that it will give a sufficiently large undistorted output. In this connection the following rule is of considerable use: The maximum undistorted *voltage* output of a power grid detector with a 100 per cent. modulated H.F. input is approximately one-half of that

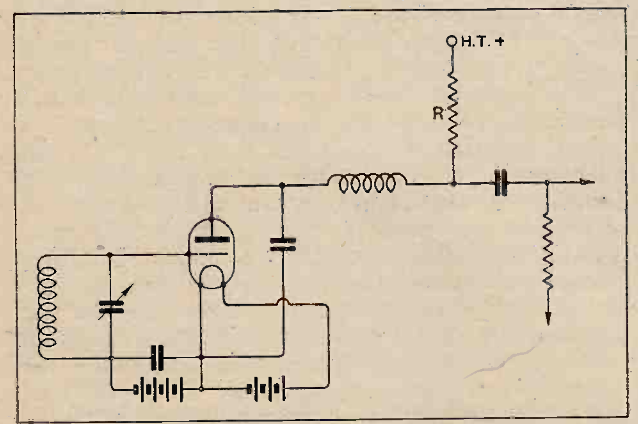


Fig. 1.—The anode detector has the merit of needing only a small anode current, and there is also little risk of hum. It does not give the best quality, however.

given by the same valve with the same anode voltage when acting as an amplifier with suitable negative grid bias.

It has been found that the most suitable valve is one having a working anode A.C. resistance a little over 10,000 ohms, and with as high an amplification factor as possible. The high mutual conductance and the equipotential cathode of the indirectly heated A.C. valves make them superb rectifiers, and valves such as the Mazda AC/HL, the Mullard 354v., and the Marconi-

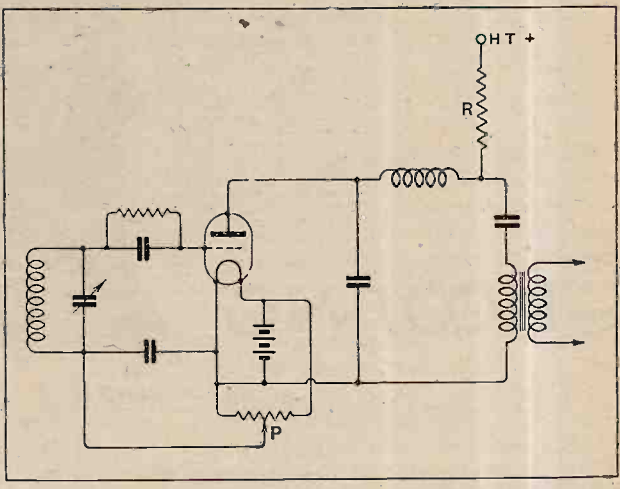


Fig. 2.—The correct grid potential is important with battery-type valves; this can be adjusted by the potentiometer P, which should have a resistance of some 400 ohms. If the grid be insufficiently positive distortion will occur, but if it be too positive the tuned circuit will be highly damped.

Osram M.H.4, which have a nominal resistance of between 11,000 ohms and 16,000 ohms, are the most satisfactory. They can be used with potentials up to 200 volts actually on the anode, and a very large output can then be obtained. Usually, however, the output is ample with about 150 volts anode potential, and the anode current is then about 8.5 mA.

The battery-type valve does not make such a good power detector, due partly to the lower mutual conductance and partly to the voltage drop along the filament. In general, it is advisable to choose a valve with a somewhat lower anode resistance, and the best value usually lies between about 8,000 ohms and 12,000 ohms nominal rating. Valves which come into this class are the Mazda L.210, the Mullard P.M.DX type, and the Marconi-Osram L type, and all of these should prove satisfactory. In general, however, the output, the efficiency, and the quality are all not quite so good as with the A.C. mains valves.

The selection of a suitable value for the coupling resistance R, Fig. 2, is of great importance; it has been found experimentally that the best results are obtained when it has a value equal to twice the working valve resistance; that is, some 20,000 ohms for the A.C. valves. A higher value than this results in greater efficiency, but in a reduced output unless the H.T. voltage can also be increased to compensate for the greater voltage drop in the resistance.

With indirectly heated cathode-type valves, the grid return lead should be taken directly to the cathode, but with battery valves it is necessary to connect it to a source of positive potential. With 2-volt valves it is sufficient to take the grid return lead to positive L.T., but with higher voltage valves it is advisable to fit a potentiometer across the filament, as shown in Fig. 2. The grid condenser, of course, should have a capacity

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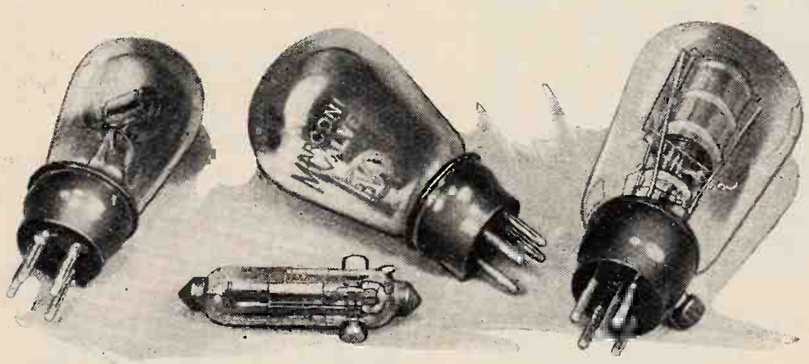
of 0.0001 mfd., while the grid leak can have a value of from 0.15 meg. to 0.25 meg. according to the degree of high-note reproduction desired.

Super Power-Grid Detection.

Power-grid detection, however, need not be used solely to give a voltage output for feeding an output stage; it can itself be used to provide the power necessary for operating a loud speaker. All low-frequency amplification can then be eliminated, with a great simplification in the smoothing and decoupling circuits.

At the present time, however, the maximum undistorted power output is limited, and so the scheme is only useful where very large volume is not required. The maximum power output of a power-grid detector with a 100 per cent. modulated H.F. input is approximately one-quarter of that obtainable from the same valve with the same anode voltage and loud speaker load impedance when acting as an ordinary power valve with suitable negative grid bias. A large output, therefore, cannot be obtained at present, since as a detector the valve is worked with a grid bias only slightly negative, and there is a grave risk of the maximum anode watts dissipation limit being exceeded.



The Marconi-Osram QX, seen in the foreground, was one of the earliest special detector valves designed for anode rectification, and is shown in contrast with the Mazda A.C./Pen., a recently developed valve suitable for super power-grid detection. The DER and DE5B valves, also shown in the illustration, were other very popular types used for rectification.

The high-voltage pentode is undoubtedly the most suitable valve for super power detection, as it may conveniently be called. There are a number available which, as amplifiers, will give an output between 1,000 and 3,000 milliwatts; therefore, according to the above rule, they will deliver some 250 to 750 milliwatts to the loud speaker when used as a power detector. This rule, however, only applies strictly to triodes, and it is found that the output of a pentode may be as high as 1,000 milliwatts. An output of this order is often sufficient where very large volume is not required, and the arrangement is highly satisfactory, economical, and free from background noise.

With every method of detection so far discussed it is necessary to connect a by-pass condenser between the anode and cathode of the valve. With grid rectification this is essential in order to reduce anti-phase feed-back to within reasonable limits, but considerable care must be exercised in the choice of capacity. Owing to the low valve resistance and to the low values of coupling resistance a large capacity can be used without a high note loss. Too large a capacity, however, tends to introduce amplitude distortion by reducing the straightening effect of the load resistance upon the valve characteristics. This is very undesirable, and must be avoided at all costs; the by-pass condenser, therefore, should not have a capacity greater than about 0.002 mfd. On the other hand, this capacity must not be less than 0.001 mfd., unless reaction be used, or the load upon the tuned grid circuit will be excessive.

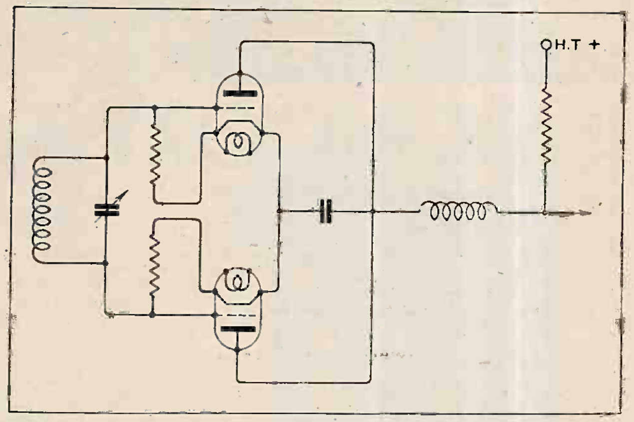


Fig. 3.—The push-pull power-grid detector. The two valves should be of the same type and preferably a matched pair. The two grid leaks should have the same value, and a resistance of 0.25 megohm or 0.5 megohm is suitable.

Push-Pull Power-grid Detection.

In an effort to avoid this state of affairs, the push-pull method of detection has been evolved, and is used in the Science Museum receiver. The circuit is shown in Fig. 3, and it will be seen that no grid condenser is required, and that the H.F. currents should balance out in the anode circuits; feed-back should be absent, therefore, and the tuned circuit should be only lightly damped. The usual anode circuit filter is needed, because the higher harmonics of the H.F. input do not balance out.

For a more detailed treatment of the problems of rectification the reader is referred to the following Wireless World articles:

Anode Rectification.

"The Valve as an Anode Bend Detector," by W. I. G. Page, B.Sc., March 13 and 27, 1929.

"Improving Detector Efficiency," by W. B. Medlam B.Sc., A.M.I.E.E., May 22, 1929.

Power Grid Detection.

"Power Grid Detection," by W. T. Cocking, May 7, 1930.

"Detector Damping," by W. T. Cocking, July 30, 1930.

Super Power Detection.

"Single Valve Loud speaker Set," by W. I. G. Page, B.Sc., August 6, 1930.

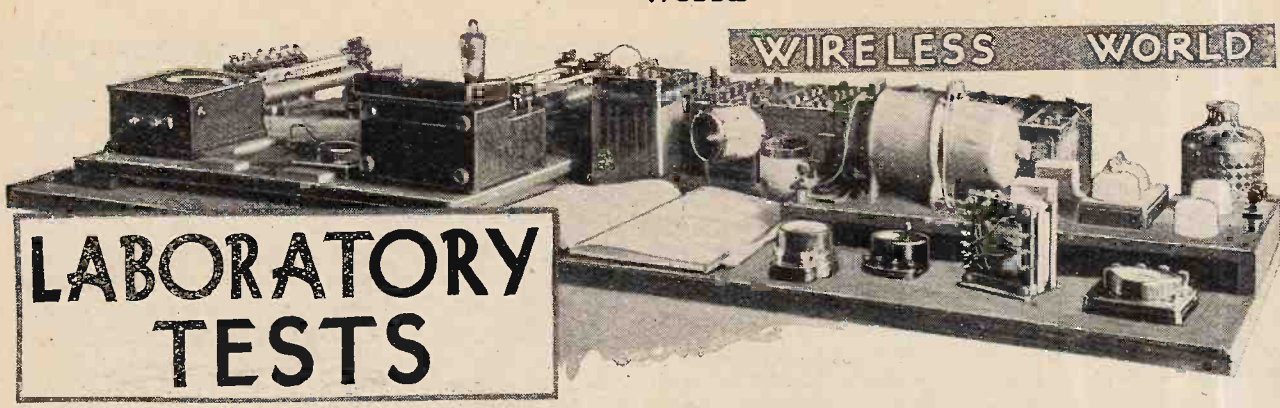
"Pentode as Detector Amplifier," by E. Yeoman Robinson, September 10, 1930.

Push-Pull Detection.

"Science Museum Receiver," by R. P. G. Denman, A.M.I.E.E. and A. S. Brereton, M.A., July 30 and August 6, 1930.

and also:

"Grid or Anode Rectification?" by P. K. Turner, M.I.E.E., *Experimental Wireless*, July, 1930.



LABORATORY TESTS

A Review of Manufacturers' Recent Products.

"SINGALDROP" ACID TESTER.

A novel method of testing the strength of the acid, and consequently the state of charge, in an accumulator has been evolved by A. E. Bawtree, 20, Manor Park Road, Sutton, Surrey. Its function is based on the reaction of chemically prepared paper when a drop of acid is applied to its surface. Acid changes the colour of this paper, the tints varying according to the strength, or specific gravity, of the acid.

This tester is available in two forms; a "Singaldrop Battery Blotter" which indicates full charge, half charge, or total discharge of the battery, and a more comprehensive outfit, designated the "Singaldrop Acid Tester," by means of which the strength of the solution can be gauged to less than one per cent. of acid.

Bawtree's "Singaldrop Acid Tester."

The first mentioned is suitable for ordinary use and the blotters cost 4½d. each. The comprehensive tester may be used as a substitute for the ubiquitous hydrometer and is quite simple to operate. A drop of acid is applied to the sensitive paper and after a minute or so the colour of the wetted portion can be compared with a chart of colours from which the strength of the solution is determined. Two books of sensitive paper are supplied, a red book for use with strong solutions and a green book for use with weak solutions.

A test was made using acid solutions of known specific gravity. The first had an Sp.G. of 1225, this produced a tint on the red paper which, when compared with the chart, showed the acid strength to lie between 1200 and 1250, these being the two nearest to the actual solution employed. The second test with acid of 1200 Sp.G., also with the red paper, gave a tint which matched with the colour for acid of 1200 Sp.G.

The third test was made with acid of 1130 Sp.G., the colour was about midway between Nos. 5 and 6 on the chart. No. 5 indicates acid strength of 1150 and No. 6 1100. Fifteen different shades are given on the chart so that the acid strength can be very closely judged.

The complete tester with two books of sensitive paper, a colour chart, and a special viewing holder costs 2s.

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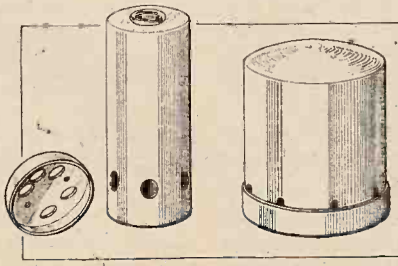
COMPONENTS FOR THE WIRELESS WORLD FOUR.

Valve and coil screens exactly conforming to the specification given for The Wireless World Four have been produced by B. & J. Wireless Company, 2 and 3, Athelstane Mews, Stroud Green Road, London, N.4.

Many points of detail are to be found in the screening compartments that will prove helpful to the constructor. The valve screens, for instance, are supplied with a drilled base so that a large and perhaps irregular hole can be made in the tin base plate, thus removing the one difficulty which might be met with by way of making clean holes in the tin plate. Six ventilating holes have been made in the base of the tube, so that a free current of air can circulate round the valve and keep it cool. These holes, of course, in no way mar the effectiveness of the screening. It is to be noted also that a small insulating ring is fitted at the top of the screen, this preventing accidental contact with the anode of the valve.



B. and J. valve and coil screens for The Wireless World Four.

A good appearance is given to the coil screens by producing a slightly domed top. The screens are manufactured by spinning and the aluminium used is of adequate thickness. The price of the valve screen is 2s. 9d., and the coil screen 3s.

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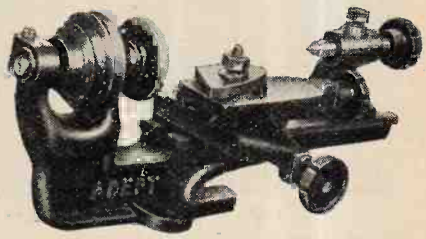
"ADEPT" MINIATURE LATHE.

This lathe has been introduced chiefly for the use of model makers and is quite a serviceable tool at a very reasonable price. In every respect it follows orthodox practice, having a compound slide rest fitted with "V" type slides and adjustable tool holder. The tail stock is fitted with a sliding barrel held in position by a hexagonal-headed set screw.



"Adept" 1 5/8in. centre lathe with compound slide rest.

The mandrel bearings are adjustable and the mandrel nose threaded to take a catch plate and a removable centre is fitted. The mandrel is driven by a two-speed pulley with "V" grooves to accommodate a round-section driving belt.

The height from centre to the top of the bed is 1⅝in., so that it will just take a piece of work 3in., in diameter. A gap is provided which increases the height of the centre to 2¼in. There are numerous occasions when a small lathe of this kind would prove very useful to the set constructor. Such functions as cutting slots in ribbed formers, winding coils, H.F. chokes, L.F. choke bobbins of small size, winding H.F. decoupling resistances, etc., are within its scope, to mention a few only of the possible uses to which it can be put.

The price of the lathe, with slide rest as illustrated, is £1, and with a hand rest in place of the slide rest, the cost is only 12s. 6d. A wood stand with heavy fly wheel is available at £1. Other accessories such as a 3-jaw chuck costs 4s. 6d., a face plate 3s., and a set of three tools 1s. 6d. Round driving belt costs 3d. per foot.

The "Adept" lathe is British made and marketed by Fel-Ectric Radio, 56, Garden Street, Sheffield.

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FRANKLIN COMPONENTS.

A small and compact variable condenser in which ebonite is used as the dielectric has been placed on the market by the Franklin Electric Co., Ltd., 187-189, Ilford Lane, Ilford, Essex. The feature of special interest is the method adopted for driving the moving vanes. They are not fixed to the spindle in the usual manner, the spindle passing through clearance holes to position them. The driving force is applied to the periphery by a crank attached to the back end of the spindle. The movement is smooth, entirely free from "lumpiness," and requires no more pressure than an average air-dielectric type. A single-hole fixing bush is fitted, also a ¼in. spindle.

A sample 0.0005 mfd. size was measured, its maximum capacity being 0.000585 mfd., while its minimum capacity was 3 micro-mfds. only and the price is 3s.

Among other components handled by this firm is a range of fixed resistances of the composition type. These are retailed at 1s. each. The resistance rods are capped with copper contacts and the overall size is 1¾ × ¼in. diameter.

Franklin ebonite-dielectric 0.0005 mfd. variable condenser and composition resistance rods.

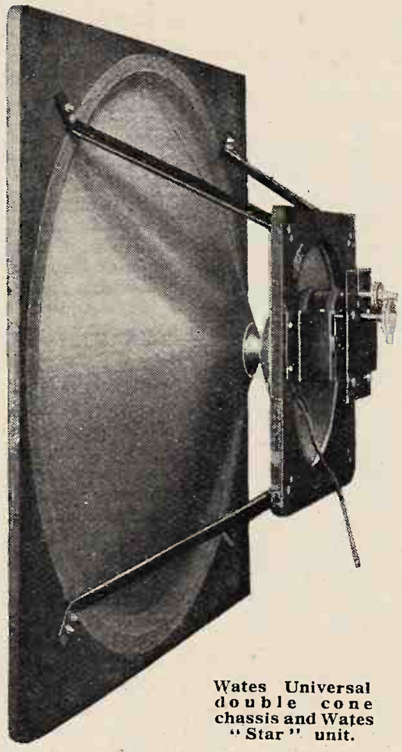
A silicium carbide preparation is used which is mechanically strong and will withstand considerable heat. These are rated to dissipate one watt, under which conditions the temperature rises slightly above 100° F. in the smaller values. A sample 10,000-ohm resistor was measured, its actual value being 11,300 ohms. A current of 14 mA. was passed through the resistance, and after half an hour the resistance was again measured. Its value was found to be 10,600 ohms while hot, but after cooling the resistance returned to its original value.

These rods should find a useful application in mains units where the current is within their capacity, for which purpose they would appear to be highly satisfactory.

oooo

WATES UNIVERSAL DOUBLE CONE CHASSIS.

The object of the designers in using two cones of different diameters is to give equal facilities for the production of high and low frequencies. Further, the arrangement of two cones joined at the apex, as shown in the photograph, gives better mechanical stability, and there is less likelihood of the equilibrium position shifting with changes in atmospheric conditions. This effect is still further reduced in the Wates chassis by the employment of special oiled parchment in the 12in. and 14in. cones, and of chemically treated paper in the 20in. model. An interesting feature of all models is the spiral joint in the material forming the cone.



Wates Universal double cone chassis and Wates "Star" unit.

The Double Cone Chassis is now fitted with a universal unit fixing bracket designed to accommodate all the leading makes of cone units at present on the market.

Tests with the 20in. model, fitted with a Wates "Star" unit, revealed that the double diaphragm is capable of reproducing all frequencies from 100 up to 5,500 cycles.

The prices of the three models available are as follow :—12in., 11s. 6d.; 14in., 12s. 6d.; 20in., 17s. 6d. The unit is made by the Standard Battery Co., 184-8, Shaftesbury Avenue, W.C.2.

ELLISON FILAMENT TRANSFORMER.

Although this component is required to deliver some 20 watts output, it embodies a very generous iron core; the windings likewise following safety-first practice. This is all to the good, since one might reasonably expect good voltage regulation.

Ellison filament heating mains transformer for A.C. valves.

Some measurements were made of the output A.C. voltage on loads of from 1 to 5 amps., using a 250-volt, 50-cycle supply. These are recorded below :—

Current (R.M.S.).	A.C. voltage (R.M.S.).
1 amp.	4.3 volts.
2 amps.	4.2 "
3 "	4.1 "
4 "	4.0 "
5 "	3.9 "

The low voltage winding is centre-tapped; the primary is tapped, also, to suit mains voltages of 200, 230, and 250. The core laminations are clamped tightly together by means of special cast end-plates, projections on which serve as feet for fixing purposes. The transformer is perfectly silent in use, not a trace of hum or buzz being noticed during test. This model is priced at 19s. 6d.

The makers are the Ellison Manufacturing Co., Ltd., Dragon Works, Harrogate, who make, also, a wide range of mains transformers for use in H.T. battery eliminators and L.T. trickle chargers.

Factory Electrification for Works Directors and Managers.

A pamphlet by the well-known consulting engineer, Mr. W. J. Crampton, M.I.E.E., of 73, Queen Victoria Street, London, E.C.4, has come to hand, setting down briefly the points to be considered in the negotiations between the consumer and the supply authority when installing electrical power in factories, with a discussion on the comparative merits of the three tariff systems in general use.

Letters to the Editor.

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

POWER DETECTION.

Sir,—I note that Mr. P. K. Turner claims to be the pioneer in this country of power detection and to have had some influence over the designers of the new South Kensington receiver.

I am sure many readers would be very interested if more details were forthcoming regarding the detector stage of this most interesting receiver. As I understood the position, the diode was regarded as distortionless and impossible to overload, its drawbacks being its relative lack of sensitivity and the load thrown on the aerial-grid circuit. Has recent investigation led to a revision of the claims originally made for the diode detector? On the face of it it appears that a comparatively straightforward detector stage has been replaced by a complicated push-pull system, entailing elaborate decoupling precautions and the consumption of a fairish anode current. Had the intention of the builders of the new set been to design a highly selective long-range receiver I should not have been so puzzled; but the new quality receiver is still limited to the local stations, why then the break away from the diode which, in Mr. Turner's view, was "unnecessary"? In short, is the new push-pull detector stage an interesting laboratory "stunt"? I ask this question with diffidence, knowing only too well my own technical limitations. At the same time, I would add that I am interested in the best reception obtainable for home consumption, and that until recently my "local" consisted of a four-valve set incorporating one H.F. followed by a diode. Since the advent of Brookmans Park I have found it possible to dispense with the H.F. without loss of quality, and therefore it seems to me that for straightforwardness a local receiver, consisting of a diode followed by two L.F.—the output being as generous as one's purse will permit—is difficult to beat. In my own locality I have no difficulty in separating the two transmissions by the use of ordinary home-made plug-in coils separately tuned and loose-coupled, the strength being all that is required

Whilst on the subject of detectors, is it not a matter for considerable surprise and regret that the old formula of a 0.0003 condenser and 2-megohm leak is still the standard practice in so many receivers, both manufactured and designed for home construction? I presume that Mr. Turner is not prepared to claim that such arrangements—however sensitive they may be—are superior from the point of view of quality to a well-designed anode-bend detector stage. E. H. PALM.

Ilford.

ANODE BEND AND LEAKY GRID.

Sir,—In your description of the Berlin Radio Show (*The Wireless World*, September 10th, 1930), you state on p. 224: "An interesting novelty was the set shown by the Mende Co. This set is fitted with a knob whereby one may employ either anode-bend . . . or leaky grid detection."

The Megavox Three designed by the writer, published in *The Wireless World*, September 12th, 1928, and exhibited at the National Radio Exhibition, was the first receiver to be fitted with a change-over switch for this purpose. In this receiver the quality with leaky grid rectification was definitely superior to anode bend. N. W. McLACHLAN.

London, S.W.1.

[We believe that the incorporation of this switch in the Megavox Three was then a novelty. The only novelty in the use of the idea in the Mende Co.'s receiver appears to be in the application to a *commercial* receiver.—ED.]

TELEVISION.

Sir,—In your issue dated November 5th Mr. J. Owen Harries described the use of Graduated Definitions in Television. It should be pointed out that Baird standard "Televisor" receivers employ this principle. Six of the lines at the edge of the picture are one and a half times as broad as the lines in the centre of the picture. By this means greater clarity of definition is obtained in the centre.

This system of graduated exploration is covered by Baird Patents, Nos. 303771 and 329664. Short extracts from these are as follows :—

"It is a characteristic of human vision that it provides an area of acute vision surrounded by an area of more or less indistinct vision, and an object of this invention is to provide a similar effect in the reproduction of pictures, and particularly in reproductions effected by television. The benefit of this is that when reproducing the picture the centre of interest can be shown with greater emphasis and clarity than the remainder of the picture."

One of the claims is as follows :—

"A system of transmission of pictures by telegraphy (for example, by phototelegraphy or by television) wherein the bands within which the picture is explored and the image of it is reproduced are narrower at some parts of the picture than at others."

One of the claims in connection with the second Patent reads as follows :—

"In or for television or like apparatus an exploring disc for a spirally arranged series of apertures characterised in that the width of the apertures radially of the disc is greatest at the ends of the spiral and least at the mid-point of the spiral."

London, N.W.7. H. J. BARTON CHAPPLE.

THE POST-OFFICE MONOPOLY.

Sir,—The correspondence in your journal *re* the statutory powers the Postmaster-General may, or may not, have in preventing radioelectric interference with broadcasting recently attracted my attention.

It was stated that the P.M.G. enjoyed a monopoly only in so far as communication was concerned, but Article Two of the General Regulations annexed to the International Radiotelegraph Convention of Washington, 1927, contradicts this statement. To quote the first paragraph of the Article :—

"No Radioelectric *Sending* Station shall be established or worked by an individual person or by a private enterprise without a special licence issued by the Government of the country to which the station in question is subject."

Note that *Sending* station is specified, not *Telegraph* station, which would constitute a station for communicating messages.

Article One of the regulations defines "station" as follows :— "The term 'station' means any station whatever *without regard to its purpose*."

A receiver in an oscillating condition which is capable of emitting wireless waves constitutes a radioelectric sending station within the meaning of the regulations, and since Great Britain was one of the signatories to them, it would seem that the P.M.G. would be perfectly within his rights in prosecuting the owner of such a set, in the event of him not possessing a transmitting licence. GEORGE E. FRICKER.

London, S.E.16.

GRAMOPHONE BROADCASTS.

Sir,—Radio and gramophone alike give us canned music, but when gramophone records are transmitted the result is recanned-canned music, which is beneath contempt. The prestige of radio will suffer and the small advertisement columns of *The Wireless World* will be flooded with announcements of used inductances, tuning condensers and H.F. valves for sale.

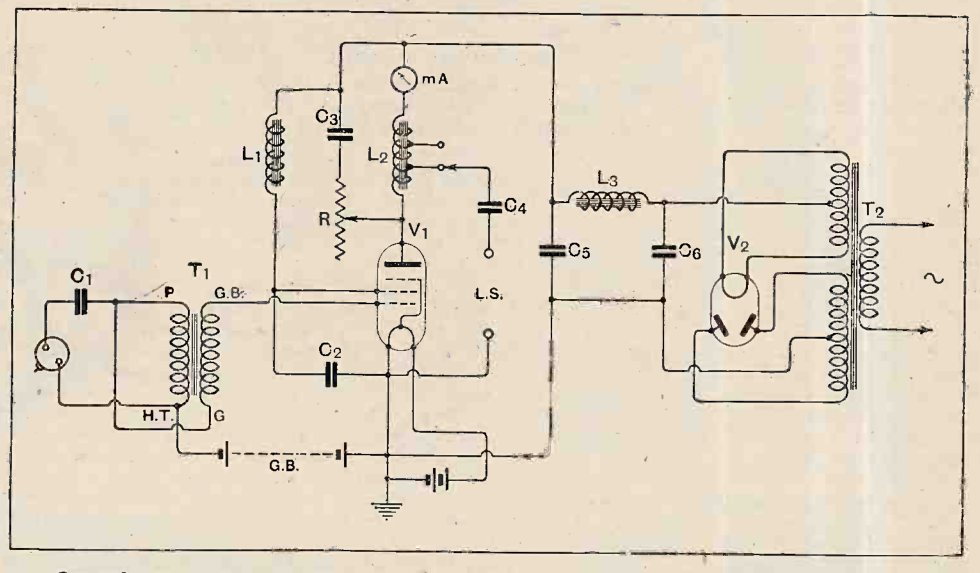
For once in five years I heartily disagree with you.

Southport. "Since 1925."

[Our correspondent refers, we believe, to the Editorial comment in our issue of November 12th. In our remarks, however, we did not sponsor gramophone broadcasts, but suggested that their apparent popularity was due to other causes, such as brevity of items, etc.—ED.]

ONE-VALVE GRAMO-AMPLIFIER.

Sir,—It has occurred to me that some of your readers may be interested in the following description of a single-valve gramophone amplifier capable of good quality reproduction with a volume of sound at least equal to the average gramophone.



One-valve gramophone amplifier circuit on the lines of the Regional-One receiver. C_1, 0.05 mfd.; C_3, 0.01 mfd.; R, 30,000 ohms; C_4 8 mfd.; G.B., 22 volts negative; V_1, PM24A and V_2, U5.

The use of a pentode as a single-valve loud speaker set for radio reception has recently been described in your excellent journal, and I am sure the subject is of interest to the economist because of the relatively large power output—voltage input ratio obtained when a reasonably strong signal is applied to the grid of the valve.

With the Regional-One receiver as the nucleus, the arrangement of a single-valve amplifier for the reproduction of gramophone records is shown in the accompanying circuit diagram.

While a volume control of high resistance may be connected directly across the pick-up, the average output of the latter, particularly in the region of the higher frequencies, is greater when the load due to the volume control is absent.

The condenser C_1 tunes the pick-up transformer primary circuit to the lower frequencies, thus giving a useful degree of compensation where it is needed. The resonant frequency of this acceptor circuit is given by

$$f = \frac{159}{\sqrt{L \times C}}$$

where f = cycles per second, L = the open-circuit inductance of the transformer primary, in henrys, and C = the capacity of the condenser C_1 in microfarads.

While this is not the most accurate formula for the calculation of the natural frequency of this circuit, it is sufficiently accurate for all practical purposes.

With a capacity of 0.05 mfd. for this condenser a considerable increase in the reproduction of the bass notes results, while the input transformer and the pentode accentuate the higher frequencies to a degree which makes the filter C_3R a necessity if serious overloading and high-voltage surges across the output choke are to be avoided. With the filter across the choke this is not likely to happen, and the reproduction from the loud speaker is both pleasing and powerful.

To track down distortion, which is generally of the third harmonic in pentodes, a plate milliammeter must be inserted as in the diagram. If the needle flickers noticeably on strong passages in the record, the loud-speaker feed condenser should be connected to a tap on the choke, giving a lower step-down ratio. After this the connections to the A.F.6 may be altered. Used as a normal double-wound transformer, it has a step-up ratio of 1 : 7, while a step-up of 1 : 8 may be obtained when it is auto-coupled, with the secondary assisting the primary.

In the circuit diagram the transformer T_1 is auto-coupled, with the secondary opposing the primary, giving a step-up of 1 : 6, and this method further reduces distortion with the type of loud speaker in use.

DAVID REES.

South Wales.

RADIO SERVICING.

Sir,—I have read with great interest your leading article and also the correspondence on the subject of "Radio Servicing," and it may interest you to learn, in this connection, that the Council of this Institute have been giving this, together with the technical status of wireless traders, their careful consideration.

As a result it has been decided to issue (in addition to the revised general syllabus, to come into force very shortly) a special syllabus particularly applicable to owners of retail wireless establishments, managers of wireless departments in retail stores, and salesmen and maintenance engineers in wireless establishments.

Special attention has been given to the broad problems of servicing as outlined in the fifth paragraph of your leading article.

I may add that we have quite a number of members who are first-class engineers engaged in the retail wireless business, and it is my experience that there are a considerable number of very competent men among the members of the retail trade.

I should just like to mention that we have on our Examining Board men of wide knowledge in the field of wireless science and engineering who have had considerable experience in the various problems met with in setting examination papers, and who are therefore in a position to set up standards and act in a judicial capacity in connection with the drawing up of examinations and the application of practical and theoretical knowledge to this end.

It is an undoubted fact that the time has come when the wireless retailer must be in a position to indicate, in the same manner that opticians and pharmacists do, that he is a fully qualified practitioner, and it is to this end that the Council have been working.

Our new syllabus will be available within the next week or so, and those interested may obtain full information if they care to communicate with me.

HARRIE J. KING, Secretary.

Institute of Wireless Technology, 71, Kingsway, W.C.2.

THE PITCH OF THE HUMAN WHISTLE.

Sir,—Mr. Coombs suggests a comparison with the organ piccolo stop, and mentions some results. Similar experiments with a flute showed that the lower limit of pitch is undoubtedly "upper C."

Most books on the organ will confirm Mr. Coomb's opinion that the longer organ pipes produce almost pure tones. A note of 16 cycles is below the limit of audibility for some persons, and will sound weak to many others. Standing directly in front of a moving-coil speaker reproducing a pure tone of 25 cycles is not too pleasant—even for one of Mr. Munn's "low-note fans." The sound does not seem intense, but can be "felt" physically. My experience put me in mind of standing on the platform of a high-speed stationary engine!

Penrith. A. C. WILDSMITH.

READERS' PROBLEMS.

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below.

Parallel-feed Choke.

In the published description of the "Band-Pass Superheterodyne" in your issues of November 5th and 12th no mention is made of the inductance coil L_1 in the theoretical diagram. Is this an H.F. choke, and what is its function? T. M.

As shown in the practical wiring plan, this component is a Burndept H.F. choke. It is connected in the signal-frequency H.F. valve anode circuit, which is coupled to the first detector by the conventional parallel-feed method.

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Interdependent Eliminator Outputs.

I have seen a statement to the effect that the voltage output across any one tapping of an A.C. eliminator is dependent to some extent on the current actually being taken from other tappings of the unit. It seems to me that when variable series resistances are used for controlling voltage, as is usual nowadays, each voltage output should be independent of the others. Will you please explain? N. B. M.

The statement which you quote is quite correct. If each output terminal were fed through a separate resistance, and if there were no other resistances in circuit, the voltage existing at any one terminal would be unaffected by the current drawn from other terminals. But in practice there is always some resistance—generally that of a smoothing choke, and inevitably that of the rectifier itself, which will be common to all circuits. Currents for the various outputs will produce an additive voltage drop across this common resistance.

o o o o

Step-up or Step-down.

A tapped choke is often used as a form of step-down transformer, particularly in receivers where a pentode output valve is used; I believe that it is also possible to employ a choke as a step-up transformer, as might be necessary when a high-impedance loud speaker is operated in conjunction with a low-impedance valve. Will you please give me a diagram of connections for the latter arrangement? S. W. P.

By making suitable connections to the tapping points, a choke can be used as either a step-down or as a step-up transformer. The first arrangement is shown in Fig. 1(a), while the second condition is obtained by connecting the choke as in Fig. 1(b). Referring to this second diagram, the step-up ratio will obviously be increased by moving the anode connection towards the end of the choke which is joined to H.T. positive.

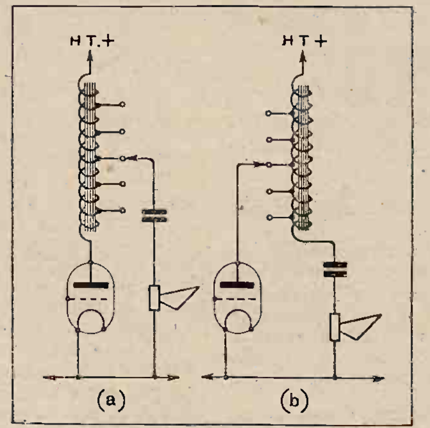

Fig. 1.—A tapped choke may be arranged as (a) a step-down or (b) a step-up coupling between the output valve and the loud speaker.

Smaller Inductances.

Tuning condensers of 0.00035 mfd. are specified for the "Band Pass Three," as described in "The Wireless World" for September 17th. Would it be possible to substitute components with a maximum capacity of 0.0005 mfd.? A. R.

Larger condensers than those originally used in the receiver could be substituted, provided they are of suitable design, but, to avoid difficulties in ganging, it would be desirable to reduce the inductance of the coils. We suggest that you should remove about eight turns from each of the medium-wave coils, and six turns from each section of the long-wave windings.

o o o o

Queries arising out of the construction of the Wireless World Four are to form the subject of a further article on the set to be included in an early issue.

Two Circuits Compared.

I am undecided whether to construct a 2-v-1 set with simple tuned circuits, or a 1-v-1 combination with filter input. In this locality interference from the local station is a serious problem, and I should be glad of your advice as to which of these two circuits is likely to be most satisfactory. Extreme long range is not desired, but I should like to be able to receive some of the more powerful Continental stations when conditions are good. J. W. C.

It is none too easy to make a direct comparison between these two sets. With regard to the 2-v-1 arrangement it will almost certainly be necessary to sacrifice a good deal of the available aerial input in order to get sufficient selectivity, as an input filter is not to be included. Further, it is unlikely that anything approaching maximum stage gain will be obtainable from the H.F. stages, for the same reason. On the other hand, an H.F.-det.-L.F. set of good design could probably be operated with optimum coupling between its various circuits, but even so it is almost certain to give less overall magnification than the other. There will not be any great difference in cost, as both sets employ the same number of variable condensers and coils, but probably a 1-v-1 set would be slightly cheaper and easier to construct, and should be sensitive enough for your needs.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."

(3.) Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.

(4.) Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.

(5.) Practical wiring plans cannot be supplied or considered.

(6.) Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.

(7.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.

FOREIGN BROADCAST GUIDE.

LVOV

(Poland).

Geographical position: 49° 50′ N., 24° E.

Approximate air line from London: 1,055 miles.

Wavelength: 381 m. Frequency: 788 kc. Power: 2.2 kW. (temporarily).

Time: Central European (one hour in advance of G.M.T.).

Standard Daily Transmissions.

Relays: Warsaw, Wilno and Posen.

Man announcer. Opening call: *Rhalo! Polskie radjo Lvov* (pron: L.voof).

Closes down with Polish National Anthem (Dombrovski mazurka).

Note: In pre-war maps Lvov is indicated as Lemberg.

ENGINEERING "ORMOND" COMPANY LTD.
Registered Trade Mark

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how much it does how little it costs

IN OAK 29/6

Whatever the power, this amazing Ormond Loudspeaker will hand'e it with an ability unexcelled by any other speaker of its class. From deepest bass to highest treble—throughout the whole musical range—perfect! It is by far the most wonderful value ever given and it's ORMOND.

Fitted with the famous Ormond "Four Pole Adjustable Loudspeaker Unit" and a cone of specially selected material and mounted in handsome figured Oak Cabinet.

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Telephone:
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Telegrams:
"Ormondengi, Smith."

MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is:

12 words or less, 2/- and 2d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue: 13 consecutive insertions 5%; 26 consecutive, 10%; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to FIRST POST on THURSDAY MORNING (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on WEDNESDAY MORNING at the Branch Offices, 19, Hertford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham; 260, Deansgate, Manchester; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box ooo, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. ooo, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller; but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain's Radio Doctors.—Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

LATEST Ekco Electric 3-valve Set, as new, in makers' carton; first cheque £17/10 secures.—Bullock, 25, Romney St., Nelson, Lancs. [2143

CLIMAX A.C. All Mains Electric Receiver, 200-250v., as new, guaranteed; £6/10.—Barrington, 186, St. James Rd., Croydon. [2208

WITHOUT FEAR—

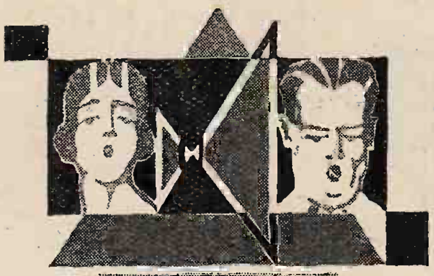
Send your material for credit—where radio part exchange began. A service ruled only by economics, above bargaining or petty gain.

Particulars from the Secretary,

HONOR OMNIA SUPER

APPLEBY'S,

Chapel St., Marylebone, London



WATES

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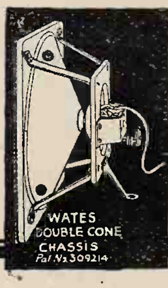

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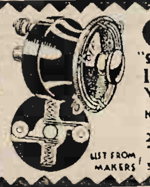

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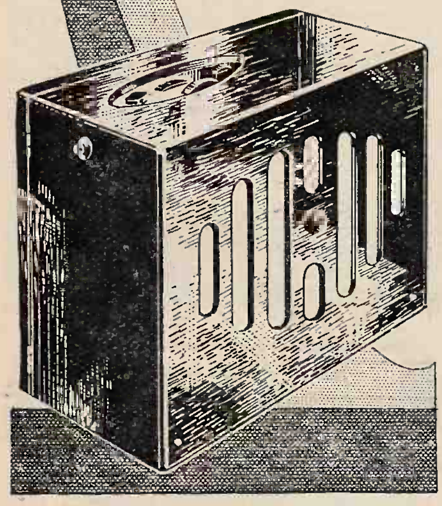

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Weston Electrical Instrument Co., Ltd.	Cover iii.

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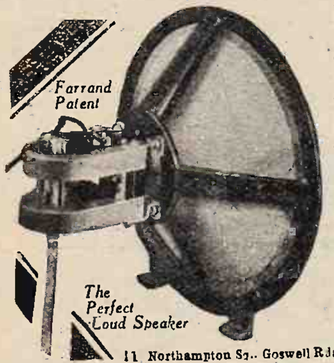

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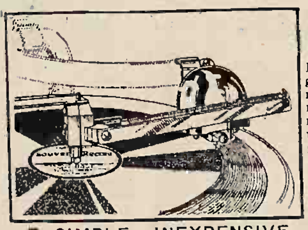

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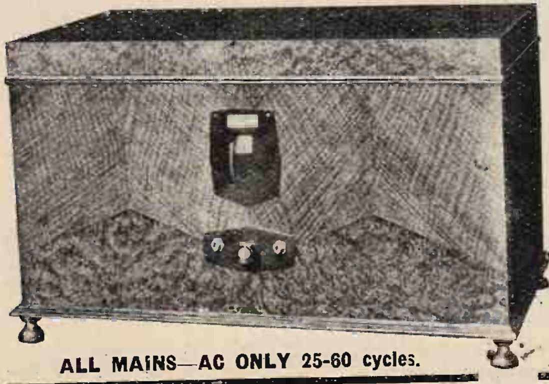

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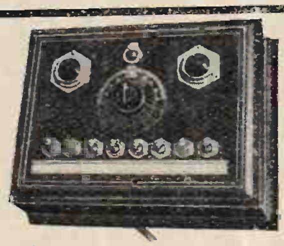

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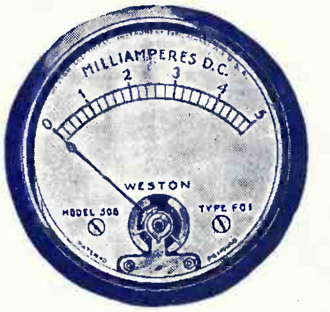

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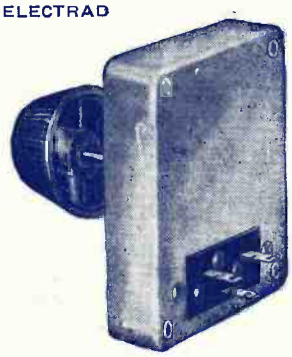

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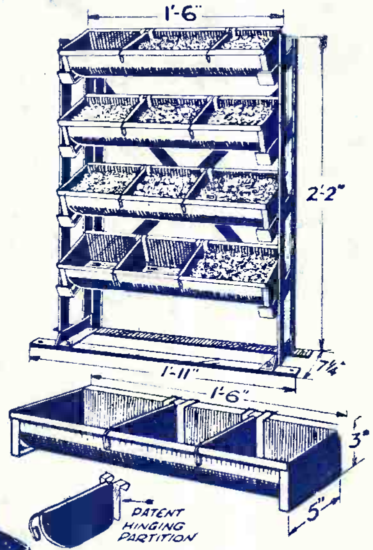

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SCREEN GRID VALVES.

Type.		Filament. Volts.	Filament. Amps.	Max. Anode Voltage.	Optimum Screen Voltage.	Average Anode Current (mA.).†	Amplification Factor.	A.C. Resistance (Ohms).	Anode-Grid Capacity (μμF.).	Price.
Cossor ..	215 SG	2.0	0.15	150	70	2.5	330	300,000	0.001	20/–
	220 SG	2.0	0.2	150	70	1.5	320	200,000	0.001	20/–
	410 SG	4.0	0.1	150	70	3.0	200	200,000	0.001	20/–
	610 SG	6.0	0.1	150	70	3.0	200	200,000	0.001	20/–
	41 MSG*	4.0	1.0	200	70	0.5	1,000	400,000	0.001	25/–
Dario	SG Bivolt ..	1.8	0.15	200	80	2.0	250	250,000	0.005	12/6
	SG Forvolt ..	3.5	0.075	200	80	2.0	250	250,000	0.005	15/6
	AC 1.4091* ..	4.0	1.0	200	80	1.5	1,000	1,000,000	0.0045	18/6
Fotos	BC 150	2.0	0.3	150	90	3.0	170	170,000	—	15/6
	C 150	4.0	0,15	150	90	3.0	170	170,000	—	15/6
	S 4150*	4.0	1.0	200	80	3.0	400	125,000	—	22/–
	P 4150*	4.0	1.0	200	80	3.5	250	125,000	—	22/–
Lissen .	SG 215	2.0	0.15	160	70	1.5	180	200,000	0.005	12/6
	SG 410	4.0	0.1	160	70	1.0	180	200,000	0.005	12/6
Marconi and Osram.	S 215	2.0	0.15	150	80	2.5	180	300,000	0.014	20/–
	S 410	4.0	0.1	150	80	4.0	180	200,000	0.014	20/–
	S 610	6.0	0.1	150	80	4.5	210	200,000	0.014	20/–
	S 625	6.0	0.25	180	80	2.5	110	170,000	0.022	22/6
	MS 4*	4.0	1.0	200	60	2.4	550	500,000	0.0025	25/–
	S 8**	0.8	0.8	150	80	3.0	160	200,000	0.013	25/–
Marconi ..	S 2/C	2.0	0.15	150	60	1.75	330	300,000	0.001	20/–
Mazda.. ..	215 SG	2.0	0.15	150	60	2.6	300	270,000	0.005	20/–
	AC/SG*	4.0	1.0	200	75	4.2	1,200	400,000	0.003	25/–
Mullard ..	PM 12	2.0	0.15	150	75	2.0	200	212,000	0.005	20/–
	PM 14	4.0	0.075	150	75	2.0	200	230,000	0.005	20/–
	PM 16	6.0	0.075	150	75	2.3	200	200,000	0.005	20/–
	S 4 V*	4.0	1.0	200	75	0.85	1,000	909,000	0.005	25/–
	S 4 VA*	4.0	1.0	200	75	0.6	1,500	430,000	0.0015	25/–
	S 4 VB*	4.0	1.0	200	75	3.5	900	257,000	0.0015	25/–
Six-Sixty ..	SS 215 SG.. ..	2.0	0.15	150	75	2.1	190	220,000	—	20/–
	SS 4075 SG ..	4.0	0.075	150	75	2.4	190	220,000	—	20/–
	SS 6075 SG ..	6.0	0.075	150	75	2.3	190	210,000	—	20/–
	SS 4 SG AC* ..	4.0	1.0	200	75	0.75	1,000	1,000,000	—	25/–
	SS 4 X SG AC*..	4.0	1.0	200	75	1.0	1,600	485,000	0.0015	25/–
Triotron ..	SC 2	2.0	0.12	200	75	4.5	200	300,000	0.005	17/6
	SC 4	4.0	0.07	200	75	2.5	250	300,000	0.005	17/6
	SCG 4 (for DC)..	4.0	0.1	200	75	4.0	350	350,000	0.005	17/6
	SCN 4*	4.0	1.0	200	75	2.2	500	400,000	—	18/6
	CWN 4*	4.0	1.0	200	75	6.5	150	150,000	—	18/6
Tungsram ..	S 210	2.0	0.12	200	100	1.5	300	430,000	0.01	13/–
	S 407	4.0	0.07	200	100	1.75	350	400,000	0.01	13/–
	AS 4100*	4.0	1.0	200	100	7.5	900	600,000	0.004	16/–

* With indirectly heated cathodes. ** Directly heated A.C. Valve. † Assuming max. H.T. voltage, optimum screen voltage and 0.9 volts bias for battery valves and 1.5 volts for A.C. screened valves.

MISCELLANEOUS VALVES.

(A.C. resistances above 7,000 ohms.)

Type.		Filament. Volts.	Filament. Amps.	At Zero Grid Volts and 100 Volts H.T. A.C. Resistance (Ohms).	At Zero Grid Volts and 100 Volts H.T. Amplification Factor.	At Zero Grid Volts and 100 Volts H.T. Mutual Conductance (mA./volt).	*A* Max. Anode Volts.	*B* Grid Bias (*for A*).	Average Anode Current (*for A and B*) (mA.)	Price.
Cossor.. ..	210 RC	2.0	0.1	50,000	36	0.72	150	1½	1.3	8/6
	210 HF	2.0	0.1	20,000	22	1.1	150	3	2.3	8/6
	210 LF	2.0	0.1	12,000	10	0.83	150	4½	5.5	8/6
	210 Det.	2.0	0.1	13,000	15	1.15	150	—	—	8/6
	410 RC	4.0	0.1	60,000	40	0.66	150	1½	1.2	8/6
	410 HF	4.0	0.1	20,000	20	1.0	150	4½	1.5	8/6
	410 LF	4.0	0.1	8,500	15	1.76	150	4½	3.3	8/6
	610 RC	6.0	0.1	60,000	50	0.8	150	1½	1.0	8/6
	610 HF	6.0	0.1	20,000	20	1.0	150	4½	1.5	8/6
	610 LF	6.0	0.1	7,500	15	2.0	150	4½	3.6	8/6
	680 HF	6.0	0.8	20,000	27	1.35	400	6	8.0	25/–
Dario	Univ. Biv. ..	1.8	0.1	10,000	10	1.0	200	1½	3.0	5/6
	RC Biv.	1.8	0.1	60,000	30	0.5	160	1½	0.25	5/6
	HF Biv.	1.8	0.15	21,000	25	1.2	200	3	2.0	5/6
	S. Det. Biv. ..	1.8	0.15	7,500	15	2.0	200	4½	3.0	6/6
	Univ. Forv. ..	3.5	0.075	10,000	10	1.0	200	1½	3.0	5/6
	RC Forv.	3.5	0.075	60,000	30	0.5	160	1½	0.25	5/6
	HF Forv.	3.5	0.075	21,000	25	1.2	200	3	2.0	5/6
	S. Det. Forv. ..	3.5	0.075	7,500	15	2.0	200	4½	3.0	6/6

Type.		Filament. Volts.	Filament. Amps.	At Zero Grid Volts and 100 Volts H.T. A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance (mA./volt).	A Max. Anode Volts.	B Grid Bias (for A).	Average Anode Current (for A and B) (mA.)	Price.
Cossor.. ..	210 RC	2.0	0.1	50,000	36	0.72	150	1½	1.3	8/6
	210 HF	2.0	0.1	20,000	22	1.1	150	3	2.3	8/6
	210 LF	2.0	0.1	12,000	10	0.83	150	4½	5.5	8/6
	210 Det.	2.0	0.1	13,000	15	1.15	150	—	—	8/6
	410 RC	4.0	0.1	60,000	40	0.66	150	1½	1.2	8/6
	410 HF	4.0	0.1	20,000	20	1.0	150	4½	1.5	8/6
	410 LF	4.0	0.1	8,500	15	1.76	150	4½	3.3	8/6
	610 RC	6.0	0.1	60,000	50	0.8	150	1½	1.0	8/6
	610 HF	6.0	0.1	20,000	20	1.0	150	4½	1.5	8/6
	610 LF	6.0	0.1	7,500	15	2.0	150	4½	3.6	8/6
	680 HF	6.0	0.8	20,000	27	1.35	400	6	8.0	25/–
Dario	Univ. Biv. ..	1.8	0.1	10,000	10	1.0	200	1½	3.0	5/6
	RC Biv.	1.8	0.1	60,000	30	0.5	160	1½	0.25	5/6
	HF Biv.	1.8	0.15	21,000	25	1.2	200	3	2.0	5/6
	S. Det. Biv. ..	1.8	0.15	7,500	15	2.0	200	4½	3.0	6/6
	Univ. Forv. ..	3.5	0.075	10,000	10	1.0	200	1½	3.0	5/6
	RC Forv.	3.5	0.075	60,000	30	0.5	160	1½	0.25	5/6
	HF Forv.	3.5	0.075	21,000	25	1.2	200	3	2.0	5/6
	S. Det. Forv. ..	3.5	0.075	7,500	15	2.0	200	4½	3.0	6/6
Fotos	BC 9	2.0	0.15	9,000	9	1.0	150	6	3.0	5/6
	BC 18	2.0	0.15	20,000	16	0.8	200	3	2.0	5/6
	BC 40	2.0	0.15	50,000	36	0.7	200	1½	2.0	5/6
	C 9	4.0	0.07	9,000	9	1.0	150	6	3.0	5/6
	D 40	4.0	0.15	30,000	36	1.2	200	1½	2.0	5/6
	D 15	4.0	0.15	7,500	15	2.0	150	3	3.0	6/6
Lissen.. ..	H 210	2.0	0.1	58,000	35	0.6	150	1½	0.5	5/6
	HL 210	2.0	0.1	21,000	18	0.85	150	1½	1.0	5/6
	L 210..	2.0	0.1	10,000	10	1.0	150	6	5.0	5/6
	H 410	4.0	0.1	60,000	40	0.66	150	1½	0.5	5/6
	HLD 410	4.0	0.1	21,000	25	1.2	150	1½	1.0	5/6
	L 410..	4.0	0.1	8,500	15	1.8	150	4½	6.0	5/6
	H 610	6.0	0.1	60,000	40	0.66	150	1½	0.5	5/6
	HLD 610	6.0	0.1	21,000	25	1.2	150	1½	1.0	5/6
	L 610..	6.0	0.1	8,000	16	2.0	150	4½	5.0	5/6
Marconi and Osram.	H 210	2.0	0.1	50,000	35	0.7	150	1½	1.0	8/6
	H 2	2.0	0.1	35,000	35	1.0	150	1½	1.5	8/6
	HL 210	2.0	0.1	23,000	20	0.87	150	3	1.5	8/6
	L 210..	2.0	0.1	12,000	11	0.9	150	6	4.0	8/6
	H 410	4.0	0.1	60,000	40	0.67	150	1½	0.7	8/6
	HL 410	4.0	0.1	30,000	25	0.83	150	1½	2.2	8/6
	L 410..	4.0	0.1	8,500	15	1.77	150	4½	3.9	8/6
	H 610	6.0	0.1	60,000	40	0.67	150	1½	0.6	8/6
	HL 610	6.0	0.1	30,000	30	1.0	150	1½	1.9	8/6
	L 610..	6.0	0.1	7,500	15	2.0	150	4½	3.6	8/6
Mazda. ..	H 210	2.0	0.1	59,000	47	0.8	150	0	2.0	8/6
	HL 210	2.0	0.1	21,000	26	1.25	150	3	1.4	8/6
	L 210..	2.0	0.1	10,000	15.5	1.55	150	4½	3.8	8/6
	H 610	6.0	0.1	66,000	40	0.6	150	0	1.6	8/6
	HL 610	6.0	0.1	20,000	22	1.1	150	3	1.4	8/6

The Wireless World and Radio Review

MISCELLANEOUS VALVES—(*Continued*).

Type.		Filament: Volts.	Filament: Amps.	At Zero Grid Volts and 100 Volts H.T.: A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance mA./volt).	*A* Max. Anode Volts.	*B* Grid Bias (*for A*).	Average Anode Current (*for A and B*) (mA.)	Price.
Mullard ..	PM 1 A	2.0	0.1	51,000	36	0.7	150	1½	0.85	8/6
	PM 1 HF	2.0	0.1	22,500	18	0.8	150	3	1.5	8/6
	PM 1 LF	2.0	0.1	12,000	11	0.9	150	7½	3.4	8/6
	PM 2 DX	2.0	0.2	10,700	13.5	1.25	150	6	2.7	8/6
	PM 3 A	4.0	0.075	55,000	38	0.66	150	1½	0.65	8/6
	PM 3	4.0	0.075	13,000	14	1.05	150	6	2.8	8/6
	PM 4 DX	4.0	0.1	7,500	15	2.0	150	6	2.5	8/6
	PM 5 X	6.0	0.075	14,700	17.5	1.2	150	3	2.8	8/6
	PM 5 D	6.0	0.075	20,000	26	1.3	150	3	1.2	8/6
	PM 5 B	6.0	0.075	53,000	40	0.75	150	1½	0.6	8/6
	PM 6 D	6.0	0.1	9,000	18	2.0	150	4½	2.5	8/6
Six-Sixty ..	SS 210 HF ..	2.0	0.1	25,000	19	0.75	150	3	1.9	8/6
	SS 210 LF ..	2.0	0.1	12,500	10.6	0.85	150	7½	3.75	8/6
	SS 210 RC ..	2.0	0.1	55,500	39	0.7	150	1½	0.8	8/6
	SS 217 D	2.0	0.17	10,700	13.5	1.25	150	6	2.5	8/6
	SS 4075 HF ..	4.0	0.075	12,500	13.5	1.1	150	6	4.0	8/6
	SS 4075 RC ..	4.0	0.075	58,000	37	0.64	150	1½	0.7	8/6
	SS 410 D	4.0	0.1	7,250	14.5	2.0	150	4½	3.0	8/6
	SS 6075 HF ..	6.0	0.075	15,200	17	1.1	150	4½	2.0	8/6
	SS 6075 RC ..	6.0	0.075	58,000	42	0.7	150	1½	0.5	8/6
	SS 610 D	6.0	0.1	9,250	18.5	2.0	150	4½	2.5	8/6
Triotron ..	WD 2	2.0	0.07	67,000	43.5	0.65	150	1	1.0	7/–
	HD 2	2.0	0.07	24,000	16.7	0.7	150	3	2.0	7/–
	TD 2	2.0	0.07	14,400	10.8	0.75	150	6	3.5	7/–
	SD 2	2.0	0.14	10,500	21	2.0	150	3	4.0	7/–
	WD 4	4.0	0.07	33,300	40	1.2	200	2	1.5	7/–
	AD 4	4.0	0.07	13,500	13.5	1.0	150	4½	4.0	7/–
	SD 4	4.0	0.14	9,100	18.2	2.0	150	3	4.5	7/–
	RD 4	4.0	0.07	7,500	9	1.2	150	7½	6.0	7/–
D.C. Mains Valves.										
	WG 4	4.0	0.1	31,700	38	1.2	200	2½	2.5	7/–
	SG 4	4.0	0.1	9,000	18	2.0	150	3½	4.0	7/–
Tungsram ..	R 208	2.0	0.1	50,000	35	0.7	200	1½	1.75	5/6
	H 210	2.0	0.1	25,000	25	1.0	200	3	2.0	5/6
	LG 210	2.0	0.1	10,000	10	1.0	150	4½	6.5	5/6
	H 407	4.0	0.07	25,000	35	1.4	200	3	1.5	5/6
	R 406	4.0	0.07	18,000	25	1.4	150	3	2.0	5/6
	G 409	4.0	0.09	7,000	16.5	2.4	150	6	3.5	5/6
	HR 607	6.0	0.07	15,000	30	2.0	200	3	1.25	5/6
	LG 607	6.0	0.07	9,000	16.5	1.8	200	7½	3.5	5/6
	R 150	1.0	0.5	18,000	25	1.4	200	3	2.0	7/9
	G 150	1.0	0.5	20,000	10	0.5	150	1½	4.0	7/9
INDIRECTLY HEATED A.C. VALVES.										
Cossor ..	41 MRC	4.0	1.0	20,000	35	1.75	180	3	3.2	15/–
	41 MHF	4.0	1.0	14,000	32	2.3	200	3	5.0	15/–
	41 MLF	4.0	1.0	7,900	15	1.9	180	5.5	8.0	15/–
Dario	HF AC I 4078 ..	4.0	1.0	20,000	40	2.0	150	3	3.0	10/6
	S. Det. AC I 4076	4.0	1.0	7,500	15	2.0	150	6	6.0	10/6
Fotos	S 440	4.0	1.0	7,500	15	2.0	200	6	3.0	15/–
	S 415	4.0	1.0	20,000	40	2.0	200	1½	3.0	15/–
	T 425	4.0	1.0	8,000	24	3.0	200	1½	3.0	15/–
Marconi and Osram.	MH 4	4.0	1.0	16,000	35	2.19	200	3	3.0	15/–
	MHL 4	4.0	1.0	8,000	20	2.5	200	6	7.0	15/–
Mazda	AC/HL	4.0	1.0	11,700	35	3.0	200	3	6.5	15/–
Mullard ..	354 V	4.0	1.0	11,700	35	3.0	200	4	4.0	15/–
Six-Sixty ..	SS 4 GP AC ..	4.0	1.0	12,000	36	3.0	200	5	1.5	15/–
	SS 4 Det. AC ..	4.0	1.0	7,000	16	2.3	200	10½	5.0	17/6
Triotron ..	WN 4	4.0	1.0	33,300	50	1.5	200	2	2.0	10/–
	AN 4	4.0	1.0	14,000	28	2.0	200	3	4.5	10/–
	SN 4	4.0	1.0	8,000	22	2.75	150	3½	7.0	10/6
Tungsram ..	AR 4100	4.0	1.0	17,000	33	2.0	200	4½	3.0	9/6
	AG 4100	4.0	1.0	8,000	16	2.0	150	4	5.0	9/6

DIRECTLY HEATED A.C. VALVES.

INDIRECTLY HEATED A.C. VALVES.

Cossor	41 MRC	4.0	1.0	20,000	35	1.75	180	3	3.2	15/-
	41 MHF	4.0	1.0	14,000	32	2.3	200	3	5.0	15/-
	41 MLF	4.0	1.0	7,900	15	1.9	180	5.5	8.0	15/-
Dario	HF AC I 4078	4.0	1.0	20,000	40	2.0	150	3	3.0	10/6
	S. Det. AC I 4076	4.0	1.0	7,500	15	2.0	150	6	6.0	10/6
Fotos	S 440	4.0	1.0	7,500	15	2.0	200	6	3.0	15/-
	S 415	4.0	1.0	20,000	40	2.0	200	1½	3.0	15/-
	T 425	4.0	1.0	8,000	24	3.0	200	1½	3.0	15/-
Marconi and Osram.	MH 4	4.0	1.0	16,000	35	2.19	200	3	3.0	15/-
	MHL 4	4.0	1.0	8,000	20	2.5	200	6	7.0	15/-
Mazda	AC/HL	4.0	1.0	11,700	35	3.0	200	3	6.5	15/-
Mullard	354 V	4.0	1.0	11,700	35	3.0	200	4	4.0	15/-
Six-Sixty	SS 4 GP AC	4.0	1.0	12,000	36	3.0	200	5	1.5	15/-
	SS 4 Det. AC	4.0	1.0	7,000	16	2.3	200	10½	5.0	17/6
Triotron	WN 4	4.0	1.0	33,300	50	1.5	200	2	2.0	10/-
	AN 4	4.0	1.0	14,000	28	2.0	200	3	4.5	10/-
	SN 4	4.0	1.0	8,000	22	2.75	150	3½	7.0	10/6
Tungsram	AR 4100	4.0	1.0	17,000	33	2.0	200	4½	3.0	9/6
	AG 4100	4.0	1.0	8,000	16	2.0	150	4	5.0	9/6

DIRECTLY HEATED A.C. VALVES.

Marconi and Osram.	H 8	0.8	0.8	55,000	40	0.73	150	1½	1.0	15/-
	HL 8	0.8	0.8	17,000	17	1.0	150	4½	2.0	15/-
	D 8	0.8	1.6	21,000	14	0.67	150	+1½	6.0	15/-

OUTPUT VALVES.

(with A.C. resistances less than 7,000 ohms).

The max. undistorted output which is for 5 per cent. second harmonic and the optimum load or loud speaker impedance figures have been worked out by "The Wireless World" as explained in the issue dated November 26th, 1930.

Type.		Filament.		At Zero Grid Volts and 100 Volts H.T.			A	B	C	D	G	Price.
		Volts.	Amps.	A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance (mA./Volt).	Max. Anode Volts.	Grid Bias (*for A*).	Average Anode Current (*for A and B*) (mA.).	Max. Undistorted Output (*for A, B and C*) (Milliwatts).	Optimum Load (*for D*) (Ohms).	
Cossor	215 P	2.0	0.15	4,000	9.0	2.25	150	7½	10.0	140	9,000	10/6
	220 P	2.0	0.2	4,000	8.0	2.0	150	9	11.0	170	9,000	10/6
	230 XP	2.0	0.3	1,500	4.5	3.0	150	18	22.0	450	3,500	13/6
	410 P	4.0	0.1	4,000	8,0	2.0	150	9	11.0	170	9,000	10/6
	415 XP	4.0	0.15	1,500	4.5	3.0	150	18	22.0	450	3,500	13/6
	425 XP	4.0	0.25	2,000	7.0	3.5	150	13½	11.0	330	5,000	13/6
	4 XP	4.0	0.6	1,100	3.0	2.75	200	40	35.0	1,000	2,800	22/6
	610 P	6.0	0.1	3,500	8.0	2.3	150	9	8.0	150	8,000	10/6
	610 XP	6.0	0.1	2,000	5.0	2.5	150	15	23.0	400	4,500	13/6
	625 P	6.0	0.25	2,500	7.0	2.8	200	15	17.5	650	6,000	13/6
	680 P	6.0	0.8	6,000	5.5	0.92	400	40	25.0	1,000	12,000	25/-
	680 XP	6.0	0.8	2,750	3.0	1.1	400	125	25.0	2,500	5,700	25/-
	620 T	6.0	1.6	1,400	3.2	2.3	400	70	50.0	4,000	3,300	30/-
	660 T	6.0	4.0	900	2.25	2.4	500	120	120	11,000	2,400	105/-

VALVE DATA SHEET

OUTPUT VALVES—(*Continued*).

Type.		Filament. Volts.	Filament. Amps.	At Zero Grid Volts and 100 Volts H.T. A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance (mA./Volt).	*A* Max. Anode Volts.	*B* Grid Bias (*for A*).	*C* Average Anode Current (*for A and B*) (mA.).	*D* Max. Undistorted Output (*for A, B and C*) (Milliwatts).	*G* Optimum Load (*for D*) (Ohms).	Price.
Dario	SP Bivolt ..	1.8	0.18	4,500	9.0	2.0	200	15	9.0	—	—	7/6
	HP Bivolt ..	1.8	0.3	2,200	5.0	2.3	200	20	18.0	—	—	8/–
	SP Forvolt ..	3.5	0.1	4,500	9.0	2.0	200	15	9.0	—	—	7/6
	HP Forvolt ..	3.5	0.15	2,200	5.0	2.3	200	20	18.0	—	—	8/–
Fotos	BD 9	2.0	0.3	4,500	9.0	2.0	150	9	10.0	150	9,500	7/6
	BD 5	2.0	0.3	2,500	5.0	2.0	150	25	18.0	250	5,500	9/–
	F 5..	4.0	0.5	1,500	5.0	3.5	250	30	30.0	1,000	4,000	20/–
	F 10	4.0	0.5	1,800	10.0	5.5	250	18	30.0	1,000	4,500	15/–
	D 9	4.0	0.15	4,500	9.0	2.0	150	9	10.0	170	9,500	7/6
	D 5	4.0	0.15	2,500	5.0	2.0	150	25	18.0	350	5,500	9/–
Lissen ..	P 220	2.0	0.2	4,700	7.0	1.5	150	13½	6.0	140	10,000	7/3
	PX 240 ..	2.0	0.4	2,000	4.0	2.0	150	24	14.0	350	4,500	8/–
	P 410	4.0	0.1	4,000	8.0	2.0	150	10½	7.0	160	8,500	7/3
	P 425	4.0	0.25	1,600	4.5	2.8	150	21	16.0	380	3,500	8/–
	P 610	6.0	0.1	3,200	8.0	2.5	150	10½	9.0	160	7,000	7/3
	P 625	6.0	0.25	2,500	7.5	3.0	200	16½	18.0	650	5,500	8/–
	P 625 A.. ..	6.0	0.25	1,500	4.5	3.0	200	36	20.0	750	5,000	8/–
Marconi and Osram.	P 215	2.0	0.15	5,000	7.0	1.4	150	12	8.5	160	12,000	10/6
	P 240	2.0	0.4	2,500	4.0	1.6	150	24	17.0	400	5,500	13/6
	P 410	4.0	0.1	5,000	7.5	1.5	150	10½	9.0	170	12,000	10/6
	P 425	4.0	0.25	2,300	4.5	1.9	150	16½	17.0	300	5,000	13/6
	PX 4	4.0	0.6	1,050	3.5	3.3	200	33	50.0	1,100	2,800	22/6
	P 610	6.0	0.1	3,500	8.0	2.3	150	9	9.5	160	8,000	10/6
	P 625	6.0	0.25	2,400	6.0	2.5	250	26	24.0	900	6,400	13/6
	P 625 A.. ..	6.0	0.25	1,600	3.7	2.3	200	39	25.0	800	6,000	13/6
	LS 5	5.25	0.8	6,000	5.0	0.8	400	40	26.0	1,000	12,000	25/–
	LS 5 A	5.25	0.8	2,750	2.5	0.9	400	112	33.5	2,600	5,800	25/–
	LS 6 A	6.0	2.0	1,300	3.0	2.3	400	91	63.0	5,000	3,700	30/–
	DA 60	6.0	4.0	835	2.5	3.0	500	135	120	12,000	2,300	140/–
Marconi ..	LP 2/C	2.0	0.2	4,000	8.0	2.0	150	10½	9.0	160	9,000	10/6
	P 2..	2.0	0.2	2,300	6.5	2.8	150	10½	17.0	300	5,000	13/6
Mazda.. ..	P 220	2.0	0.2	3,700	12.5	3.4	150	7½	4.5	140	8,000	10/6
	P 220 A.. ..	2.0	0.2	1,850	6.5	3.5	150	15	12.0	330	5,000	13/6
	P 240	2.0	0.4	1,900	7.0	3.7	150	13½	11.0	350	5,600	13/6
	P 425	4.0	0.25	1,950	3.5	1.8	150	27	13.5	360	4,000	13/6
	625 A	6.0	0.25	1,600	4.0	2.5	200	30	19.0	800	4,700	13/6
	625 B	6.0	0.25	2,500	7.0	2.8	200	17	17.0	550	5,500	13/6
	P 650	6.0	0.5	1,300	3.5	2.7	200	40	23.5	1,100	3,500	18/–
	PP 3/425 ..	7.5	1.25	2,900	2.9	1.0	425	100	28.0	3,000	10,400	30/–
Mullard ..	PM 2	2.0	0.2	4,400	7.5	1.7	150	12	6.6	150	9,000	10/6
	PM 2 A ..	2.0	0.2	3,600	12.5	3.5	150	6	8.0	270	8,000	10/6
	PM 252 ..	2.0	0.3	2,600	5.4	2.1	150	15	16.0	320	6,000	13/6
	PM 4	4.0	0.1	4,450	8.0	1.8	150	12	7.0	170	9,500	10/6
	PM 254 ..	4.0	0.18	2,000	4.2	2.1	150	22½	12.0	400	4,500	13/6
	PM 6	6.0	0.1	3,550	8.0	2.25	150	9	9.5	160	8,000	10/6
	PM 256 ..	6.0	0.25	1,850	6.0	3.25	250	26	20.0	800	5,000	13/6
	PM 256 A ..	6.0	0.25	1,400	3.6	2.6	200	33	30.0	900	3,600	13/6
	DO/20	7.5	1.3	2,000	5.0	2.5	425	66	40.0	3,000	6,000	30/–
	DO/25	6.0	1.8	1,150	3.0	2.6	400	95	63.0	5,000	3,100	30/–
	DO/60	6.0	4.0	1,000	3.5	3.5	500	95	120	12,000	2,900	150/–
Six-Sixty ..	SS 220 P ..	2.0	0.2	4,800	7.2	1.5	150	12	6.5	150	9,000	10/6
	SS 230 SP ..	2.0	0.3	2,750	5.5	2.0	150	15	18.0	320	6,000	13/6
	SS 410 P ..	4.0	0.1	4,200	7.7	1.9	150	12	6.0	170	9,500	10/6
	SS 420 SP ..	4.0	0.2	2,000	4.0	2.0	150	22	12.5	400	4,500	13/6
	SS 610 P ..	6.0	0.1	3,400	7.8	2.3	150	9	8.0	160	8,000	10/6
	SS 625 SPA ..	6.0	0.25	1,500	3.9	2.6	200	33	25.0	900	3,600	13/6
	SS 625 SP ..	6.0	0.25	1,780	5.8	3.25	250	24	27.0	800	5,000	13/6
	SS HV 6/5 ..	6.0	1.8	1,200	3.2	2.65	400	95	62.0	5,000	3,100	30/–
Triotron ..	ZD 2	2.0	0.14	6,200	6.2	1.0	150	15	10.0	140	14,500	7/6
	YD 2	2.0	0.22	3,400	8.5	2.5	200	15	10.5	300	12,500	8/–
	UD 2	2.0	0.22	3,000	5.4	1.8	180	22	15.0	270	7,000	8/–
	SP 2	2.0	0.33	2,000	4.0	2.0	180	33	17.5	500	3,500	8/6
	YD 4	4.0	0.14	4,750	9.5	2.0	200	13½	10.5	270	13,500	8/–
	UD 4	4.0	0.1	3,300	4.8	1.45	150	19	11.0	200	7,500	8/–
	XD 4	4.0	0.15	2,400	6.0	2.5	180	18	17.0	350	6,000	8/6
	YG 5	5.0	0.07	5,800	7.0	1.2	180	12	7.5	180	12,500	8/6
	YG 6	6.0	0.1	4,500	9.0	2.0	200	13	10.0	270	13,000	8/6
Tungsram ..	P 215	2.0	0.2	3,300	5.0	1.5	150	18	12.0	280	7,000	7/3
	SP 230	2.0	0.3	2,500	5.0	2.0	180	23	18.0	460	6,000	8/–
	L 414	4.0	0.14	3,300	10.0	3.0	150	10	8.0	300	7,000	7/3
	P 414	4.0	0.14	1,700	5.0	3.0	200	25	20.0	400	4,500	8/–

Six-Sixty
Tungsram
Cossor
Fotos ..
Lissen
Marconi an
Osram.
Mazda..
Mullard
Six-Sixty
Cossor
Dario
Lissen
Marconi an
Osram.
Mazda

	PM 4	4.0	0.1	4,450	8.0	1.8	150	12	7.0	170	9,500	10/6
	PM 254 ..	4.0	0.18	2,000	4.2	2.1	150	22½	12.0	400	4,500	13/6
	PM 6	6.0	0.1	3,550	8.0	2.25	150	9	9.5	160	8,000	10/6
	PM 256 ..	6.0	0.25	1,850	6.0	3.25	250	26	20.0	800	5,000	13/6
	PM 256 A ..	6.0	0.25	1,400	3.6	2.6	200	33	30.0	900	3,600	13/6
	DO/20	7.5	1.3	2,000	5.0	2.5	425	66	40.0	3,000	6,000	30/-
	DO/25	6.0	1.8	1,150	3.0	2.6	400	95	63.0	5,000	3,100	30/-
	DO/60	6.0	4.0	1,000	3.5	3.5	500	95	120	12,000	2,900	150/-
Six-Sixty ..	SS 220 P ..	2.0	0.2	4,800	7.2	1.5	150	12	6.5	150	9,000	10/6
	SS 230 SP ..	2.0	0.3	2,750	5.5	2.0	150	15	18.0	320	6,000	13/6
	SS 410 P ..	4.0	0.1	4,200	7.7	1.9	150	12	6.0	170	9,500	10/6
	SS 420 SP ..	4.0	0.2	2,000	4.0	2.0	150	22	12.5	400	4,500	13/6
	SS 610 P ..	6.0	0.1	3,400	7.8	2.3	150	9	8.0	160	8,000	10/6
	SS 625 SPA ..	6.0	0.25	1,500	3.9	2.6	200	33	25.0	900	3,600	13/6
	SS 625 SP ..	6.0	0.25	1,780	5.8	3.25	250	24	27.0	800	5,000	13/6
	SS HV 6/5 ..	6.0	1.8	1,200	3.2	2.65	400	95	62.0	5,000	3,100	30/-
Triotron ..	ZD 2	2.0	0.14	6,200	6.2	1.0	150	15	10.0	140	14,500	7/6
	YD 2	2.0	0.22	3,400	8.5	2.5	200	15	10.5	300	12,500	8/-
	UD 2	2.0	0.22	3,000	5.4	1.8	180	22	15.0	270	7,000	8/-
	SP 2	2.0	0.33	2,000	4.0	2.0	180	33	17.5	500	3,500	8/6
	YD 4	4.0	0.14	4,750	9.5	2.0	200	13½	10.5	270	13,500	8/-
	UD 4	4.0	0.1	3,300	4.8	1.45	150	19	11.0	200	7,500	8/-
	XD 4	4.0	0.15	2,400	6.0	2.5	180	18	17.0	350	6,000	8/6
	YG 5	5.0	0.07	5,800	7.0	1.2	180	12	7.5	180	12,500	8/6
	YG 6	6.0	0.1	4,500	9.0	2.0	200	13	10.0	270	13,000	8/6
Tungsram ..	P 215	2.0	0.2	3,300	5.0	1.5	150	18	12.0	280	7,000	7/3
	SP 230	2.0	0.3	2,500	5.0	2.0	180	23	18.0	460	6,000	8/-
	L 414	4.0	0.14	3,300	10.0	3.0	150	10	8.0	300	7,000	7/3
	P 414	4.0	0.14	1,700	5.0	3.0	200	25	20.0	400	4,500	8/-
	P 430	4.0	0.3	2,000	5.0	2.5	250	32	35.0	900	5,000	11/-
	P 460	4.0	0.6	1,100	4.0	3.5	220	37½	62.0	1,800	3,300	16/-
	P 615	6.0	0.14	3,300	10.0	3.0	200	12½	12.0	400	7,500	7/3
	SP 614	6.0	0.14	2,300	6.0	2.6	200	22	20.0	—	—	8/-

INDIRECTLY HEATED A.C. VALVES.

Cossor ..	41 MP	4.0	1.0	5,000	13.0	2.6	200	9	10.5	260	10,000	17/6
	41 MXP ..	4.0	1.0	2,000	6.0	3.0	200	21	23.0	900	4,500	22/6
Marconi and Osram.	ML 4	4.0	1.0	3,000	9.0	3.0	200	13	20.0	800	7,000	17/6
Mazda.. ..	AC/P	4.0	1.0	2,650	10.0	3.75	200	15	13.0	650	5,000	17/6
	AC/P 1	4.0	1.0	2,000	5.0	2.5	200	30	16.0	1,000	5,000	17/6
Mullard ..	164 V	4.0	1.0	6,650	16.0	2.4	200	8½	8.0	270	13,000	17/6
	104 V	4.0	1.0	2,850	10.0	3.5	200	12	17.0	600	6,000	17/6
Six-Sixty ..	SS 4 PAC ..	4.0	1.0	3,000	10.0	3.3	200	12	18.0	600	6,000	17/6
Triotron ..	YN 4			4,800	12.0	2.5	180	9	15.0	300	11,000	10/6

DIRECTLY HEATED A.C. VALVES.

Dario	R 3880	4.0	0.3	2,200	8.5	3.8	200	19	20.0	—	—	10/-
Marconi and Osram.	P 8..	0.8	0.8	6,000	6.0	1.0	150	12	10.0	160	12,000	17/6
Mullard ..	AC 104	4.0	1.0	2,850	10.0	3.5	200	14	11.0	400	6,000	16/-
	AC 064	4.0	1.0	2,000	6.0	3.0	200	21	20.0	750	4,300	16/-
	AC 044	4.0	0.7	1,150	4.0	3.5	200	32	30.0	1,020	2,500	22/6

OUTPUT VALVES—(*Continued*).

Type.		Filament. Volts.	Filament. Amps.	At Zero Grid Volts and 100 Volts H.T. A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance (mA./Volt).	*A* Max. Anode Volts.	*B* Grid Bias (*for A*).	*C* Average Anode Current (*for A and B*) (mA.).	*D* Max. Undistorted Output (*for A, B and C*) (Milliwatts).	*G* Optimum Load (*for D*) (Ohms).	Price.
Six-Sixty ..	SSHV 4/1 ..	4.0	1.0	2,100	6.3	3.0	200	21	18.0	750	4,300	16/–
	SSHV 4/2 ..	4.0	0.7	1,200	4.1	3.4	200	32	28.0	1,020	2,500	22/6
Tungsram ..	L 190	1.0	0.9	4,200	10.0	2.4	150	9	7.0	200	—	7/9
	P 190	1.0	0.9	2,500	6.0	2.4	150	13½	12.0	350	—	9/6

PENTODE VALVES.

Type.		Filament. Volts.	Filament. Amps.	Mutual Conductance. (mA./Volt.)	*A* Max. Anode Voltage.	*E* Max. Screen Voltage.	*B* Grid Bias (*for A and E*).	*C* Average Anode Current (*for A, B and E*). (mA.)	*F* Average Screen Current (*for A, B and E*). (mA.)	*D* Max. Undistorted Output (*for A, B and E*). (Milliwatts.)	*G* Optimum Load (*for D*). (Ohms.)	Price.
Cossor ..	230 PT	2.0	0.3	2.0	180	120	9	14	1.6	400	11,000	22/6
	415 PT	4.0	0.15	2.0	180	120	9	14	1.6	400	11,000	22/6
	615 PT	6.0	0.15	2.0	150	120	7½	15	1.6	380	10,000	22/6
Fotos	BD 100 ..	2.0	0.4	1.8	150	150	15	10	3.5	500	10,000	18/6
	D 100	4.0	0.2	1.8	150	150	15	10	3.5	500	10,000	18/6
	BF 100	2.0	0.6	2.5	300	150	20	18	6	1,100	8,000	22/–
	F 100	4.0	0.3	2.5	300	150	20	18	6	1,100	8,000	22/–
Lissen ..	PT 225	2.0	0.25	1.4	150	150	6	6	1½	250	20,000	12/6
	PT 240	2.0	0.4	2.0	150	120	9	13	2	450	9,000	16/–
	PT 425	4.0	0.25	2.0	150	150	10½	16	2	650	8,000	16/–
	PT 625	6.0	0.25	2.5	200	150	10½	20	3	1,000	9,000	20/–
Marconi and Osram.	PT 240	2.0	0.4	1.65	150	150	9	16	6	500	10,000	22/6
	PT 425	4.0	0.25	2.0	200	150	7½	15	6	700	9,000	22/6
	PT 625	6.0	0.25	1.85	250	200	15	26.5	7	1,500	7,000	27/6
Mazda.. ..	230 Pen. ..	2.0	0.3	1.5	150	125	7½	9.5	2	350	10,000	22/6
	425 Pen. ..	4.0	0.25	2.0	150	150	12	18	4	800	7,000	22/6
	AC/Pen†† ..	4.0	1.0	2.5	250	200	10	30	5	1,900	8,000	27/6
Mullard ..	PM 22	2.0	0.3	1.3	150	150	12	13	4	400	11,000	22/6
	PM 24	4.0	0.15	1.75	150	150	12	20	5	500	10,000	22/6
	PM 26	6.0	0.17	2.0	150	150	15	19	5	750	9,000	22/6
	PM 24 A ..	4.0	0.275	2.0	300	200	21	21	6	1,500	8,000	27/6
	PM 24 B††† ..	4.0	1.0	2.1	400	300	40	20	6	3,000	—	30/–
Six-Sixty ..	SS 230 PP ..	2.0	0.3	1.25	150	150	12	12	4	400	11,000	22/6
	SS 415 PP ..	4.0	0.15	2.2	150	150	12	20	5	500	10,000	22/6
	SS 617 PP ..	6.0	0.17	1.9	150	150	15	18	5	750	9,000	22/6
	SS 4 Pent. SP	4.0	0.275	2.0	300	200	21	22	6	1,500	8,000	27/6

†† With indirectly heated cathodes. ††† Directly heated A.C. valve.

RECTIFYING VALVES.

Type.		Filament. Volts.	Filament. Amps.	Type of Rectification.	Max. Anode Volts. R.M.S.	Max. D.C Output** (Unsmoothed) Volts.	Max. D.C Output** (Unsmoothed) mA.	Price.
Cossor ..	44 SU	4.0	0.4	Half-wave	200	230	20	15/–
	412 SU	4.0	1.0	Half-wave	250	190	70	15/–
	408 BU	4.0	1.0	Full-wave	250—0—250	270	30	12/6
	506 BU	4.0	1.0	Full-wave	250—0—250	230	60	17/6
	412 BU	4.0	1.0	Full-wave	250—0—250	250	70	20/–
	612 BU	6.0	0.4	Full-wave	250—0—250	280	50	20/–
	624 BU	6.0	2.0	Full-wave	500—0—500	380	60	20/–
	825 BU	7.5	3.0	Full-wave	550—0—550	340	120	22/6
	660 SU	6.0	4.0	Half-wave	1,000	1,000	150	63/–
Dario	V 3880	4.0	1.3	Full-wave	350—0—350	300	75	10/6
	V 4001†	4.0	1.0	Full-wave	300—0—300	250	40	14/6
Lissen ..	U 650	6.0	0.5	Half-wave	300	300	40	12/6
	UU 41	4.0	1.0	Full-wave	300—0—300	300	75	17/6
Marconi and Osram.	U 5	5.0	1.6	Full-wave	400—0—400	520	45	20/–
	U 8	7.5	2.4	Full-wave	500—0—500	500	120	22/6
	U 9	4.0	1.0	Full-wave	250—0—250	245	75	20/–
	U 10	4.0	1.0	Full-wave	250—0—250	260	60	17/6
	GU I (gas-filled)	4.0	3.0	Half-wave	1,000	1,000	250	40/–
Mazda.. ..	UU 30/250† ..	4.0	1.0	Full-wave	250—0—250	250	30	12/6
	UU 2†	4.0	1.0	Full-wave	250—0—250	230	60	17/6
	UU 60/250† ..	4.0	2.0	Full-wave	250—0—250	250	60	17/6
	UU 120/250† ..	4.0	2.0	Full-wave	250—0—250	200	120	22/6
	U 60/500† ..	4.0	2.0	Half-wave	500	500	60	17/6

Type.		Filament. Volts.	Filament. Amps.	Type of Rectification.	Max. Anode Volts. R.M.S.	Max. D.C. Output** (Unsmoothed) Volts.	Max. D.C. Output** (Unsmoothed) mA.	Price.
Cossor ..	44 SU	4.0	0.4	Half-wave	200	230	20	15/–
	412 SU	4.0	1.0	Half-wave	250	190	70	15/–
	408 BU	4.0	1.0	Full-wave	250—0—250	270	30	12/6
	506 BU	4.0	1.0	Full-wave	250—0—250	230	60	17/6
	412 BU	4.0	1.0	Full-wave	250—0—250	250	70	20/–
	612 BU	6.0	0.4	Full-wave	250—0—250	280	50	20/–
	624 BU	6.0	2.0	Full-wave	500—0—500	380	60	20/–
	825 BU	7.5	3.0	Full-wave	550—0—550	340	120	22/6
	660 SU	6.0	4.0	Half-wave	1,000	1,000	150	63/–
Dario	V 3880	4.0	1.3	Full-wave	350—0—350	300	75	10/6
	V 4001†	4.0	1.0	Full-wave	300—0—300	250	40	14/6
Lissen ..	U 650	6.0	0.5	Half-wave	300	300	40	12/6
	UU 41	4.0	1.0	Full-wave	300—0—300	300	75	17/6
Marconi and Osram.	U 5	5.0	1.6	Full-wave	400—0—400	520	45	20/–
	U 8	7.5	2.4	Full-wave	500—0—500	500	120	22/6
	U 9	4.0	1.0	Full-wave	250—0—250	245	75	20/–
	U 10	4.0	1.0	Full-wave	250—0—250	260	60	17/6
	GU I (gas-filled)	4.0	3.0	Half-wave	1,000	1,000	250	40/–
Mazda.. ..	UU 30/250† ..	4.0	1.0	Full-wave	250—0—250	250	30	12/6
	UU 2†	4.0	1.0	Full-wave	250—0—250	230	60	17/6
	UU 60/250† ..	4.0	2.0	Full-wave	250—0—250	250	60	17/6
	UU 120/250† ..	4.0	2.0	Full-wave	250—0—250	200	120	22/6
	U 60/500† ..	4.0	2.0	Half-wave	500	500	60	17/6
	U 120/500† ..	4.0	2.0	Half-wave	500	500	120	22/6
	U 65/550	7.5	1.25	Half-wave	550	550	65	17/6
Mullard ..	DU 1	4.0	0.6	Half-wave	250	250	30	15/–
	DU 10	4.0	1.0	Half-wave	250	250	75	15/–
	DU 4	4.0	1.0	Half-wave	500	500	60	17/6
	DW 1	4.0	0.6	Full-wave	250—0—250	260	30	12/6
	DW 2	4.0	1.0	Full-wave	250—0—250	250	60	17/6
	DU 2	4.0	1.0	Full-wave	250—0—250	250	75	20/–
	DW 8	5.0	1.0	Full-wave	425—0—425	450	60	20/–
	DU 15	7.5	0.6	Half-wave	500	520	60	15/–
	DW 15	7.5	0.6	Full-wave	500—0—500	560	60	20/–
	DW 30	7.5	2.4	Full-wave	500—0—500	500	120	22/6
Philips ..	1801	4.0	0.6	Full-wave	250—0—250	260	30	12/6
	1821	4.0	1.0	Full-wave	250—0—250	250	60	17/6
	506 K	4.0	1.0	Full-wave	300—0—300	300	75	20/–
	1561	4.0	2.0	Full-wave	500—0—500	500	120	22/6
	1562	7.5	1.25	Half-wave	750	730	110	30/–
Six-Sixty ..	SSW 432	4.0	0.6	Full-wave	250—0—250	250	30	12/6
	SSW 462	4.0	1.0	Full-wave	250—0—250	250	60	17/6
	SSU 465	4.0	1.0	Half-wave	500	500	60	17/6
	SSU 765	7.5	0.6	Half-wave	500	500	60	17/6
Triotron ..	GN 14	4.0	0.25	Half-wave	250	230	30	10/6
	GN 24	4.0	0.25	Full-wave	250—0—250	250	30	10/6
	GA 24	4.0	0.9	Full-wave	250—0—250	250	60	12/6
Tungsram ..	V 430..	4.0	0.3	Half-wave	250	240	25	10/–
	V 495..	4.0	1.0	Half-wave	400	375	70	10/–
	PV 475	4.0	0.8	Full-wave	250—0—250	220	50	10/–
	PV 495	4.0	1.0	Full-wave	300—0—300	280	50	10/–

** Across a 4 mfd. condenser. † Indirectly heated.

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