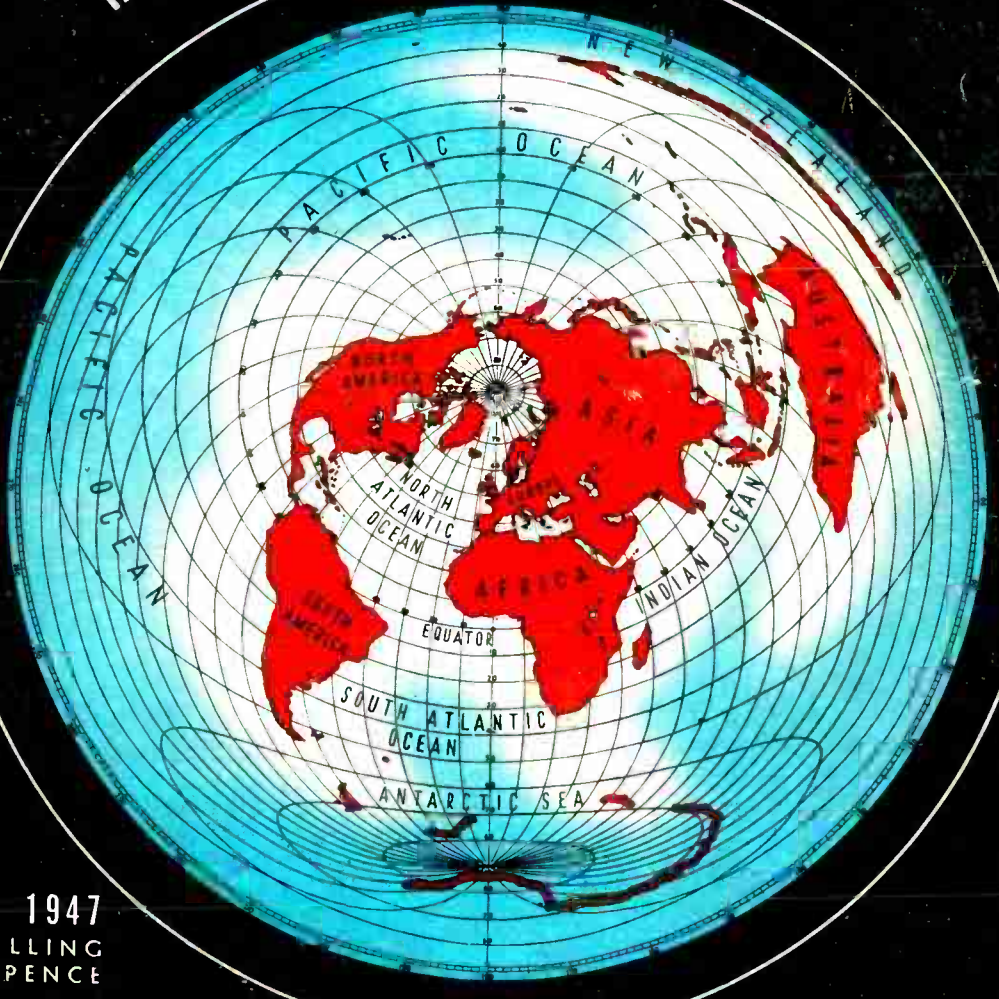
Wireless World

RADIO AND ELECTRONICS



OCTOBER 1947
ONE SHILLING
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Radiolympia Report

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STAND 135
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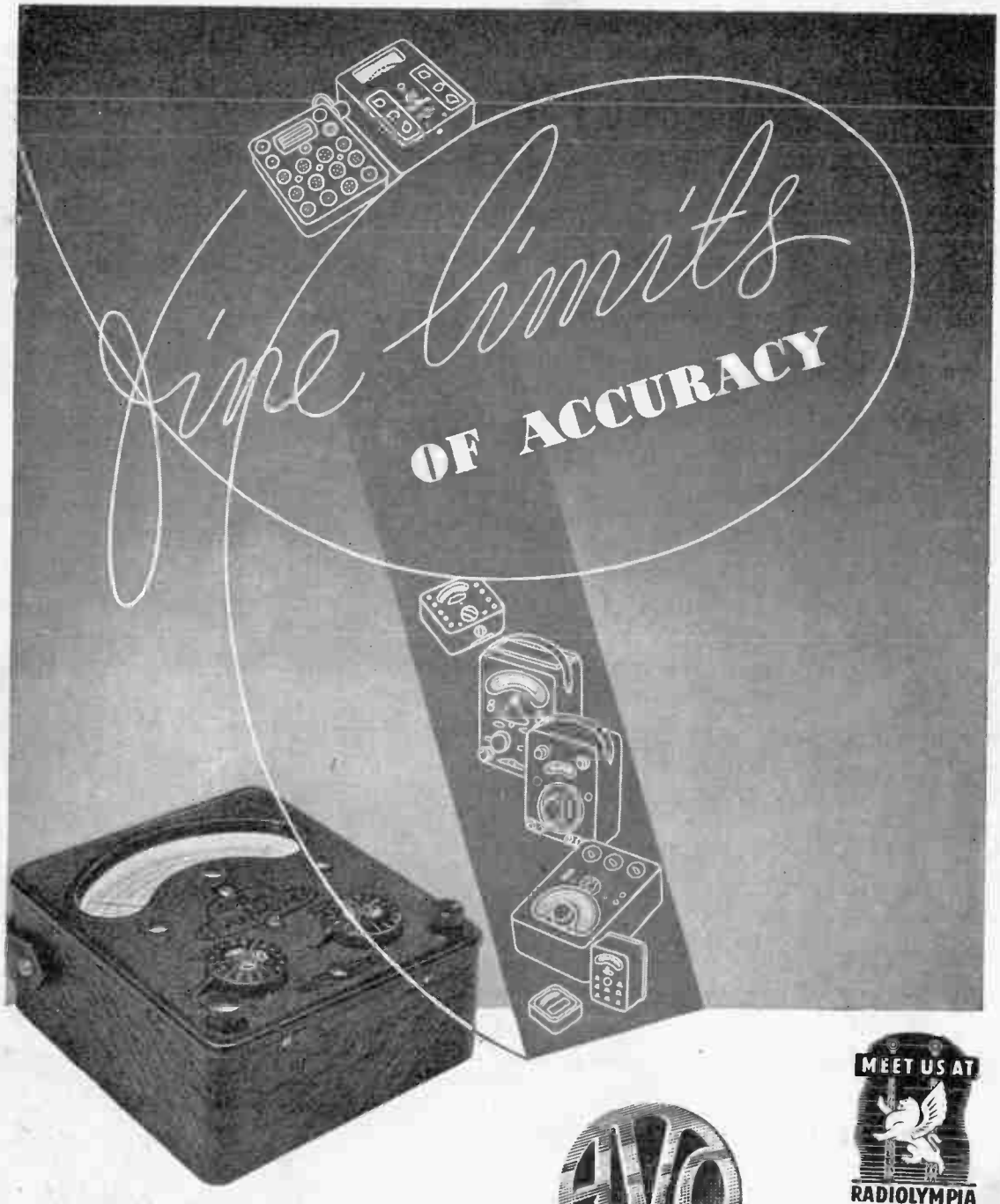

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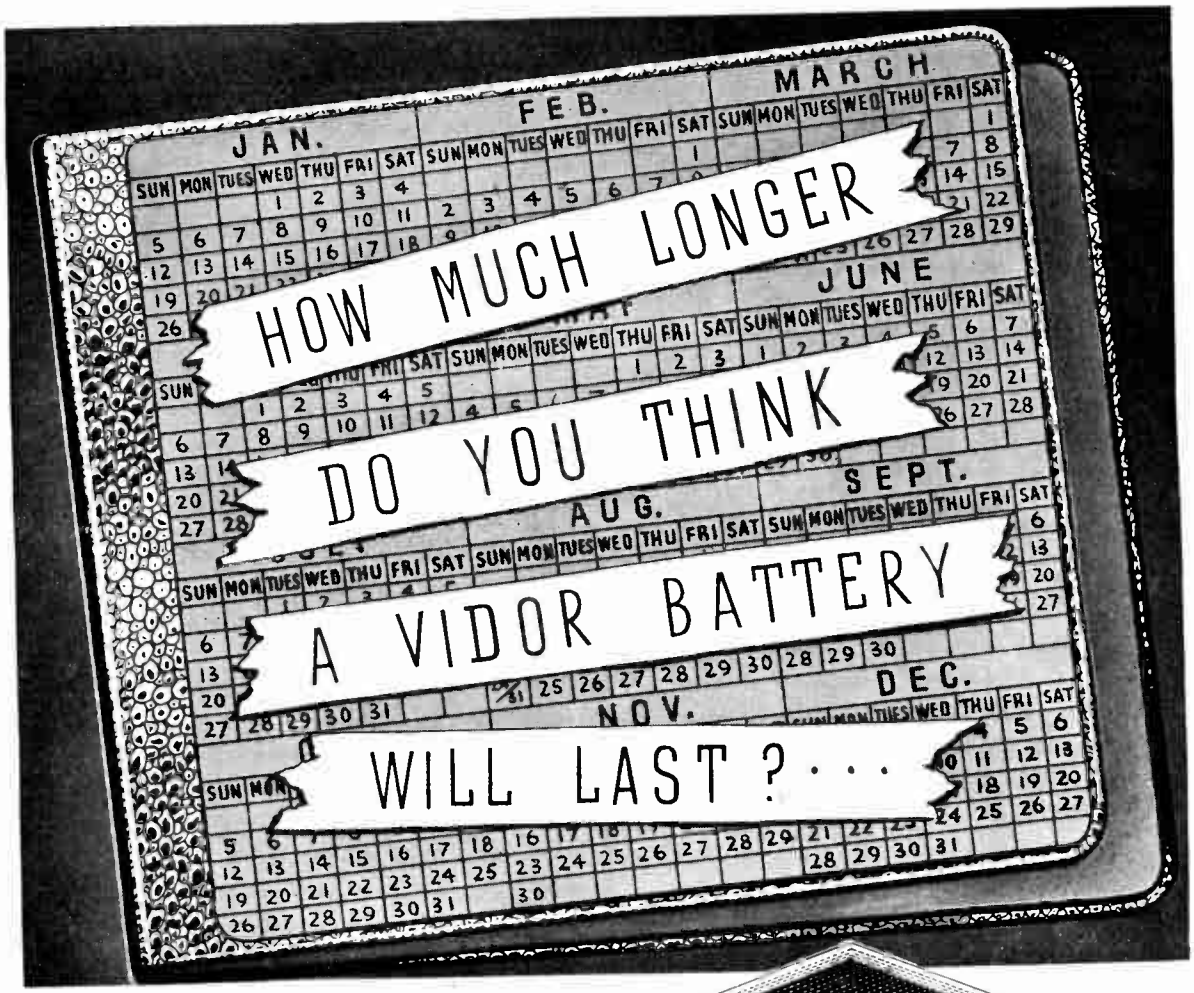

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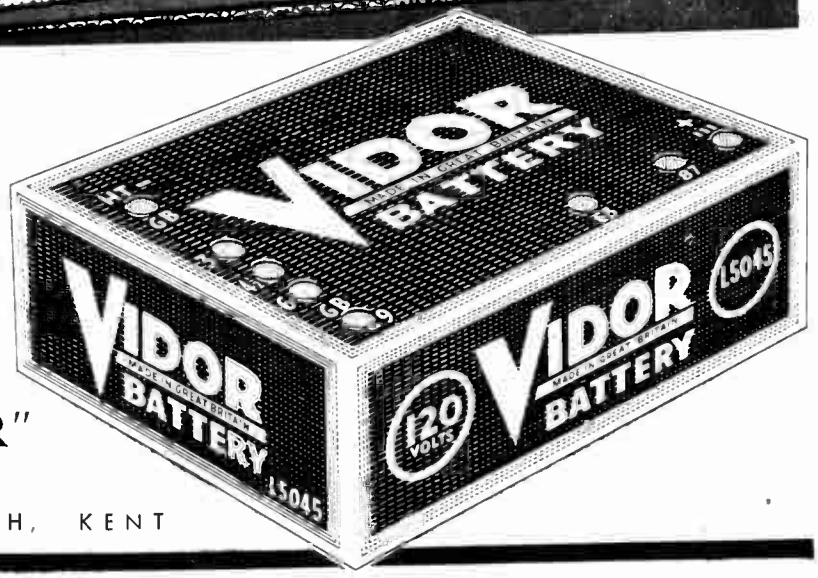

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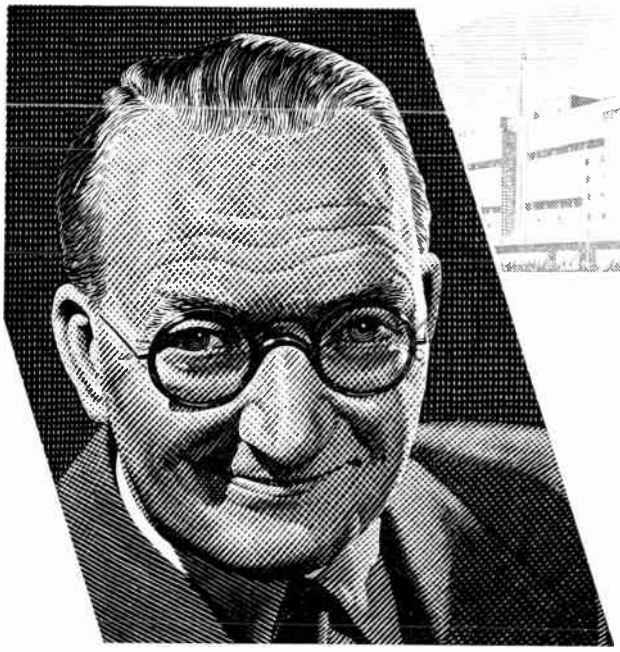
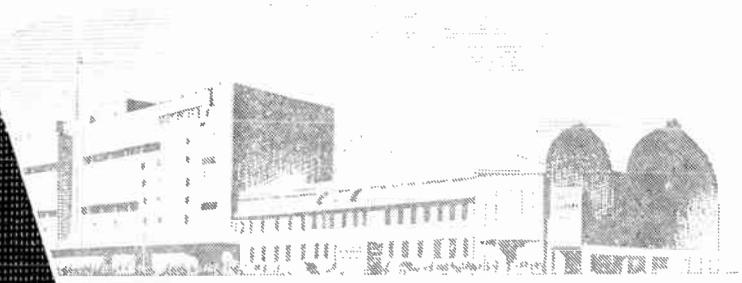




RADIOLYMPIC GAMES

by Christopher Stone

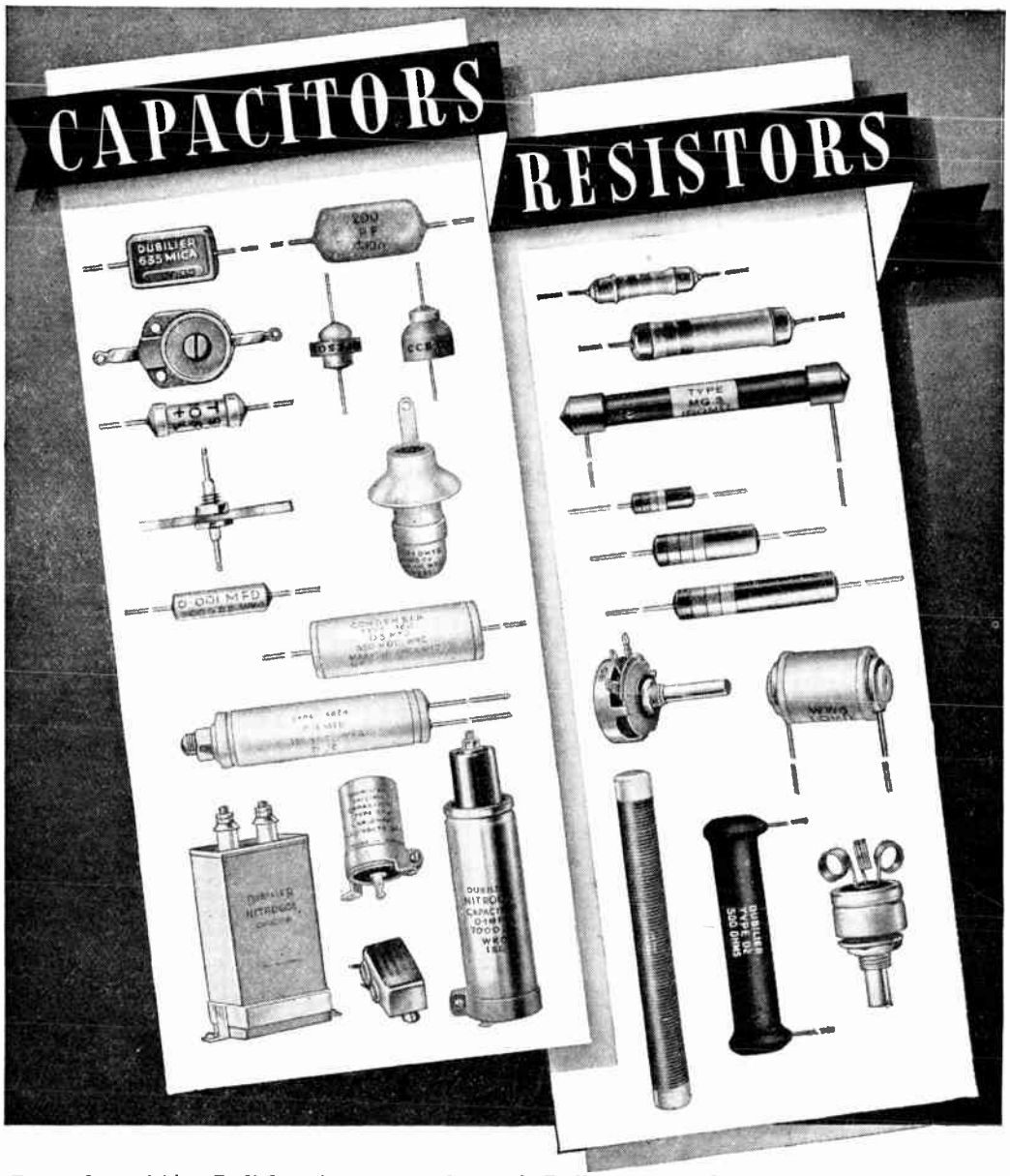
WHILE we all welcome the opportunity to see what's new, Radio exhibitions can be quite as exhausting as an Olympic quarter-mile. So save your energy and put Stand No. 38 high on your visiting list. You can be sure of a genuine welcome from my friends at Bush and from them you will learn something of a new Bush development which I am sure is going to cause quite a stir in wireless circles. Mark my words — and the Stand Number!

How right you'll be to visit

BUSH RADIO

at **STAND No. 38** *Radiolympia*

royds 47/6



To readers visiting Radiolympia we extend an invitation to meet us at Stand No. 80 Grand Hall, where the famous Dubilier range of Capacitors and Resistors will be exhibited. Our chief technical people will be there to discuss your problems with you, and to outline developments and extensions.

Capacitors and resistors are vital components in Radio, Radar and Television equipment, and the Dubilier range of these important essentials has been continuously developed and extended for the past 36 years. To everyone interested in how maximum efficiency has become an integral part of every item in this Dubilier range, a visit to Stand 80 Grand Hall is recommended.

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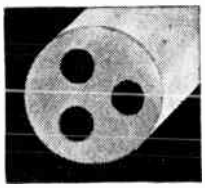

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ALLOY Tin/Lead	Equivalent B.S. Grade	MULTICORE Colour Code	Solidus °C	Liquidus °C	Recommended bit temperature	USES
60/40	K	Red	183	190	230°C	High quality work requiring low melting point alloy
45/55	M	Crimson/Buff	183	227	267°C	Hand soldering, Radio, Telephone and Electrical Equipment - Batteries
40/60	C	Green	183	238	278°C	

STANDARD GAUGES

Ersin Multicore Solder can also be supplied in any intermediate size

Standard Wire Gauge	Diam. in Inches	Diam. in M/ms.	Approx. Number of feet per lb. ALLOY 60/40	45/55	40/60
10	0.128	3.251	25.2	23.5	23.0
12	0.104	2.642	38.1	35.2	34.9
13	0.092	2.337	48.7	45.3	44.5
14	0.080	2.032	64.4	59.2	58.6
16	0.064	1.626	100.5	94.3	92.1
18	0.048	1.219	178.5	167.8	163.5
19	0.040	1.016	257.5	240.4	235.5
20	0.036	0.914	318.0	302.5	291.0
22	0.028	0.711	526.0	492.0	481.0

SIZE 1 CARTONS

High Tin 60/40 Tin/Lead Alloy

Catalogue Ref. No.	S.W.G.	Approx. length	List Price (Subject) s. d.
C 16014	14	44 ft.	6 0
C 16018	18	114 ft.	6 9

Standard 40/60 Tin/Lead Alloy

Catalogue Ref. No.	S.W.G.	Approx. length	List Price (Subject) s. d.
C 14013	13	27 ft.	4 10
C 14016	16	60 ft.	5 3

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IF YOU ARE UNABLE TO VISIT RADIOLYMPIA, HERE IS OUR ADVERTISEMENT FROM THE RADIOLYMPIA CATALOGUE. IF YOU ARE GOING TO RADIOLYMPIA, BE SURE AND VISIT OUR STAND No. 23, GRAND HALL, WHERE YOU WILL SEE HOW ERSIN MULTICORE SOLDER IS USED IN THE PRODUCTION OF RADIO COMPONENTS AND RECEIVERS.

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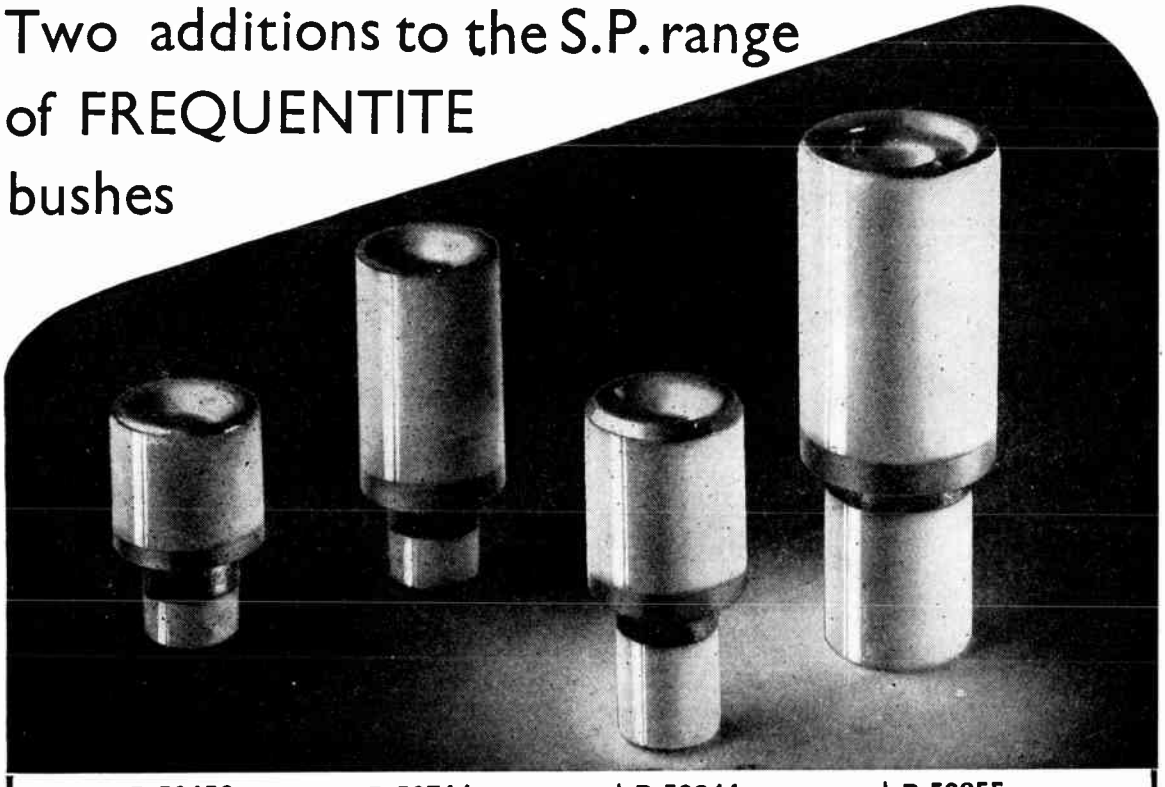
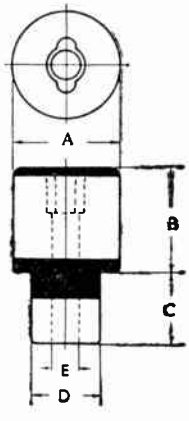
Two additions to the S.P. range of FREQUENTITE bushes



R.50650 R.50764 ★R.50844 ★R.50855

TYPE	A mms.	B mms.	C mms.	D mms.	E mms.
R.50650	9·5	9·5	6·4	6·25	2·75
R.50764	9·5	16·7	6·4	6·25	2·75
★R.50844	9·5	12·7	9·5	6·25	2·75
★R.50855	12·7	22·2	12·7	9·5	3·9

★ Recent additions to the range



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S.P.43

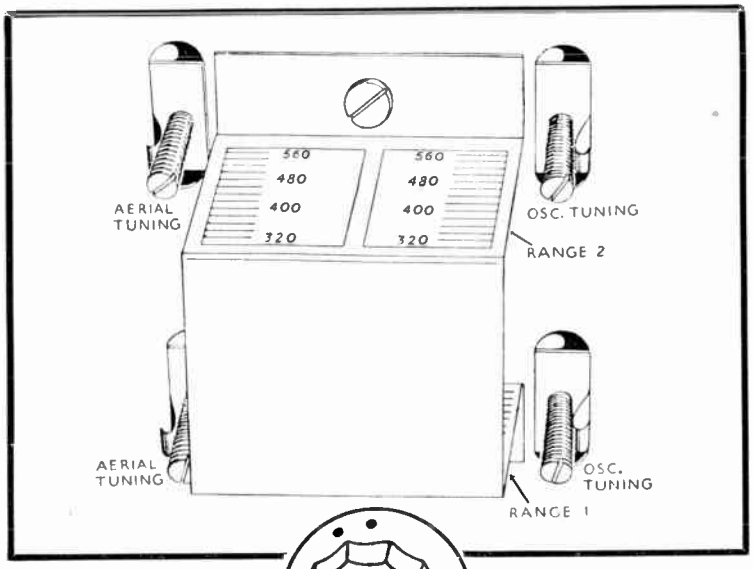
We want you to know.....

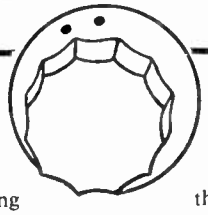
PRE-SET SWITCH SELECTED TUNING

THIS IS a feature of the 1947 Ferranti Models. It enables the listener to *switch* on any two stations of his choice on the medium waveband, without having to tune them in himself. The stations are *pre-set* and come in automatically correctly tuned.

Pre-set tuning is done by means of adjustable dust-iron cored coils, which ensure high stability of tuning. A negative temperature-coefficient condenser to eliminate the effect of temperature on tuning is a further contribution to stability.

The pre-set adjustment is carried out by means of screws which are accessible at the rear of the chassis without the necessity for removing the cabinet back. The screws are used in conjunction with calibrated wavelength scales in order to make timing adjustment easy.

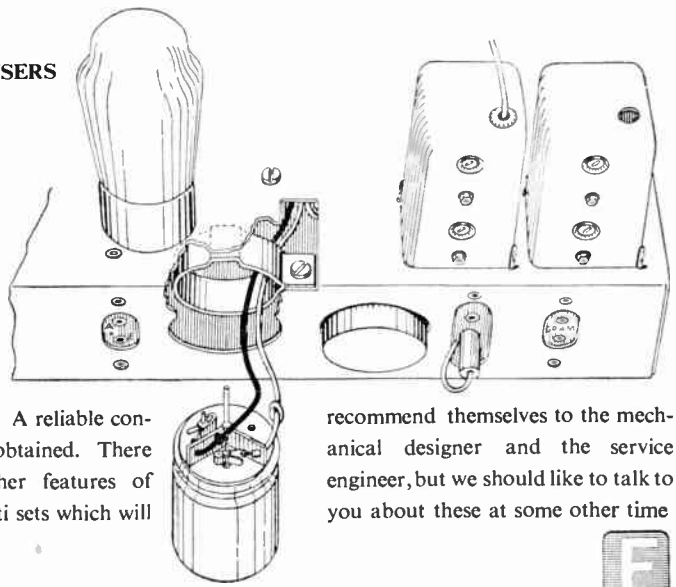




The wave-change switch is a 5-position switch with the three normal positions for Short, Medium and Long waveband selection, and two additional positions, (which are marked by two dots) to indicate the two pre-set stations. By turning the ordinary manual tuning control to a third station in the medium or long wave-band, three stations are available instantly by mere rotation of the wavechange switch, without the complexity and unreliability often associated with push-buttons.

DETACHABLE ELECTROLYTIC CONDENSERS

A FEATURE which will interest all service men is the ease of replacement of electrolytic condensers made possible in Ferranti design. This enables condensers to be held in position by a screw-secured clip. When the screw is released either or both of the condensers may be removed and the connector unit exposed. The actual connections to the condensers are made by a spring clip on the lead, and this can be detached by hand and secured to a new condenser. A reliable contact is obtained. There are other features of Ferranti sets which will recommend themselves to the mechanical designer and the service engineer, but we should like to talk to you about these at some other time

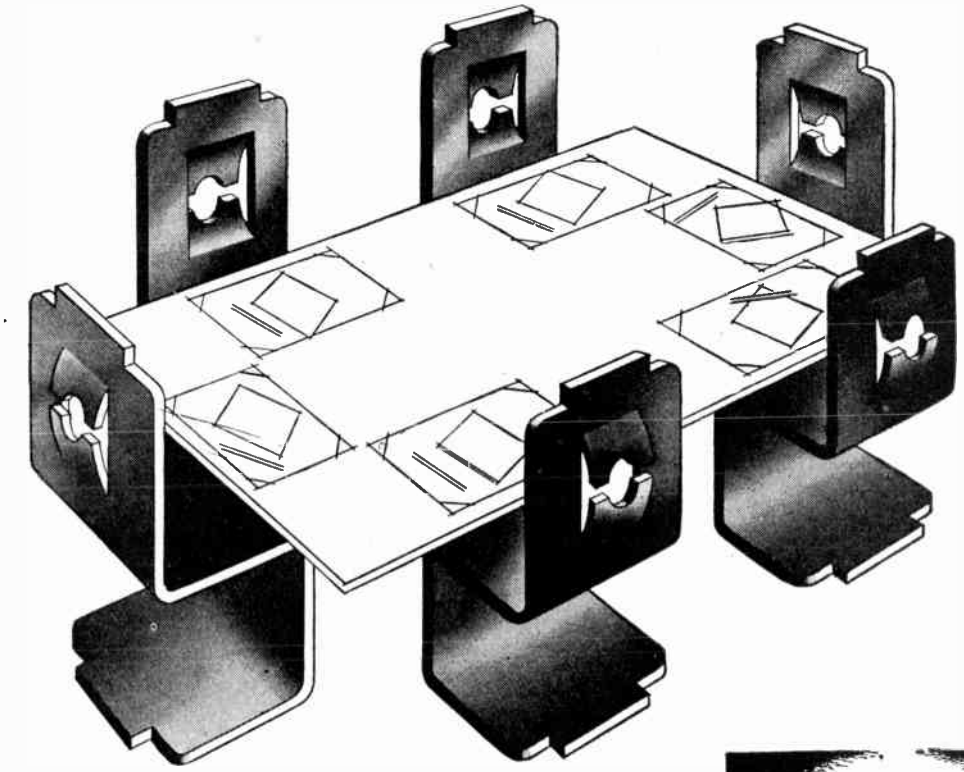


Ferranti Ltd MOSTON MANCHESTER 10: & 36 KINGSWAY LONDON WC2

FERRANTI RADIO

next for discussion please...

The beauty of Spire Fixing (yes, we said 'beauty' and meant it) is that it isn't fixed. It is a principle that can be adapted to almost any light assembly problem. There are already over 350 various Spire Fixings and fresh ones coming along almost daily. What can Spire do for you? Isn't there some fumbling, fiddling, fastening problem it could tackle? A blind or awkward assembly perhaps? An assembly that won't 'stay put'? There may be an existing Spire solution — if not, we'll design one. Can we discuss it?



THAT'S fixed THAT! The NU Types of Spire Fixings make blind assembly quick and certain. The NU is slipped over the edge of the sheet and the extrusion snaps into the bolt hole. If the bolt hole is some distance from the edge of the component a slot may be punched near the hole to enable the Spire Fix to be slipped into position. The NU fix gives a self-aligning assembly, the amount of float being varied as desired by altering the size of the bolt hole.

Spire Regd. ★ A BETTER way of fixing

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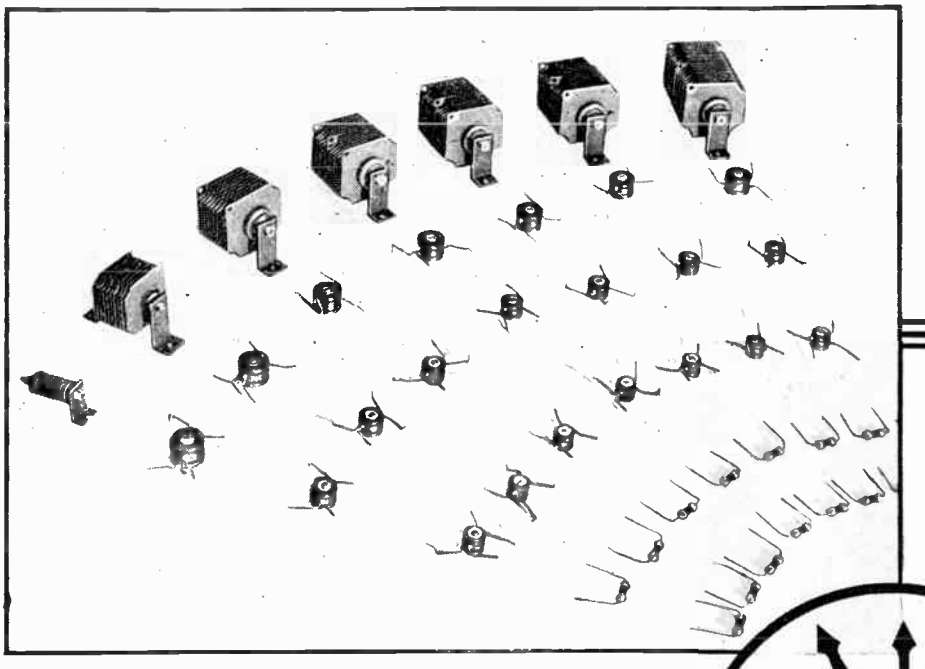

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for H.T. supply to A.C. and A.C./D.C. receivers.
Battery eliminators and trickle chargers.
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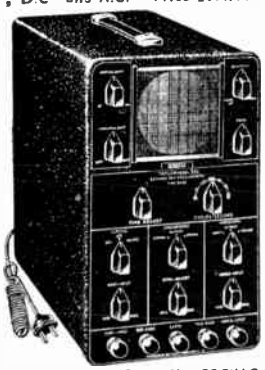
UNIVERSAL TAYLORMETER. Model 85A. 90 Ranges. Sensitivity 20,000 ohms per volt, D.C and A.C. Price £19.19.0



TAYLOR CATHODE RAY OSCILLOGRAPH. Model 30A. 3½" Cathode Ray Oscillograph. Linear Time Base from 10 to 10,000 cycles. A.C. Mains-operated. Price £27.10.0.

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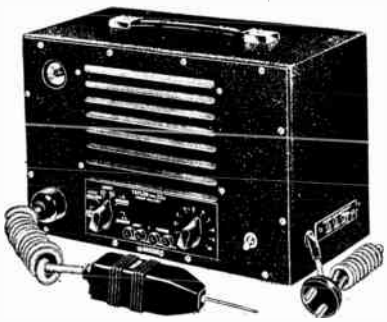

TAYLOR CIRCUIT ANALYSER. Model 20A. Audio and Magic-eye Indication. Pentode Detector in Prove. Ideal for fault finding. Price £15.15.0.

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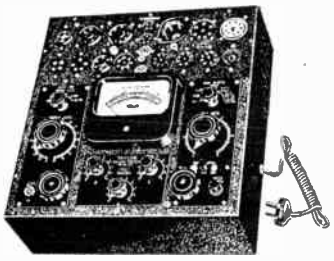

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- ★ 5-Band 10-Valve Superhet for A.C. Mains.
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- ★ Plug for External Battery Operation.
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Available also with general coverage coil unit.

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B4/40 TRANSMITTER

A Complete 40 watt Four Band Transmitter for Phone or C.W.

- ★ Four Bands 80-40-20-10 metres—single switch.
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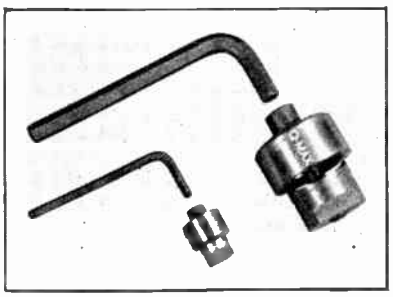
- ★ The whole completely housed in attractive black crackle finished steel cabinet 19"×10"×9½".

Nothing external except Microphone and Key.

PRICE: £75



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Sizes available :

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If there is no "Q-MAX" dealer in your locality,

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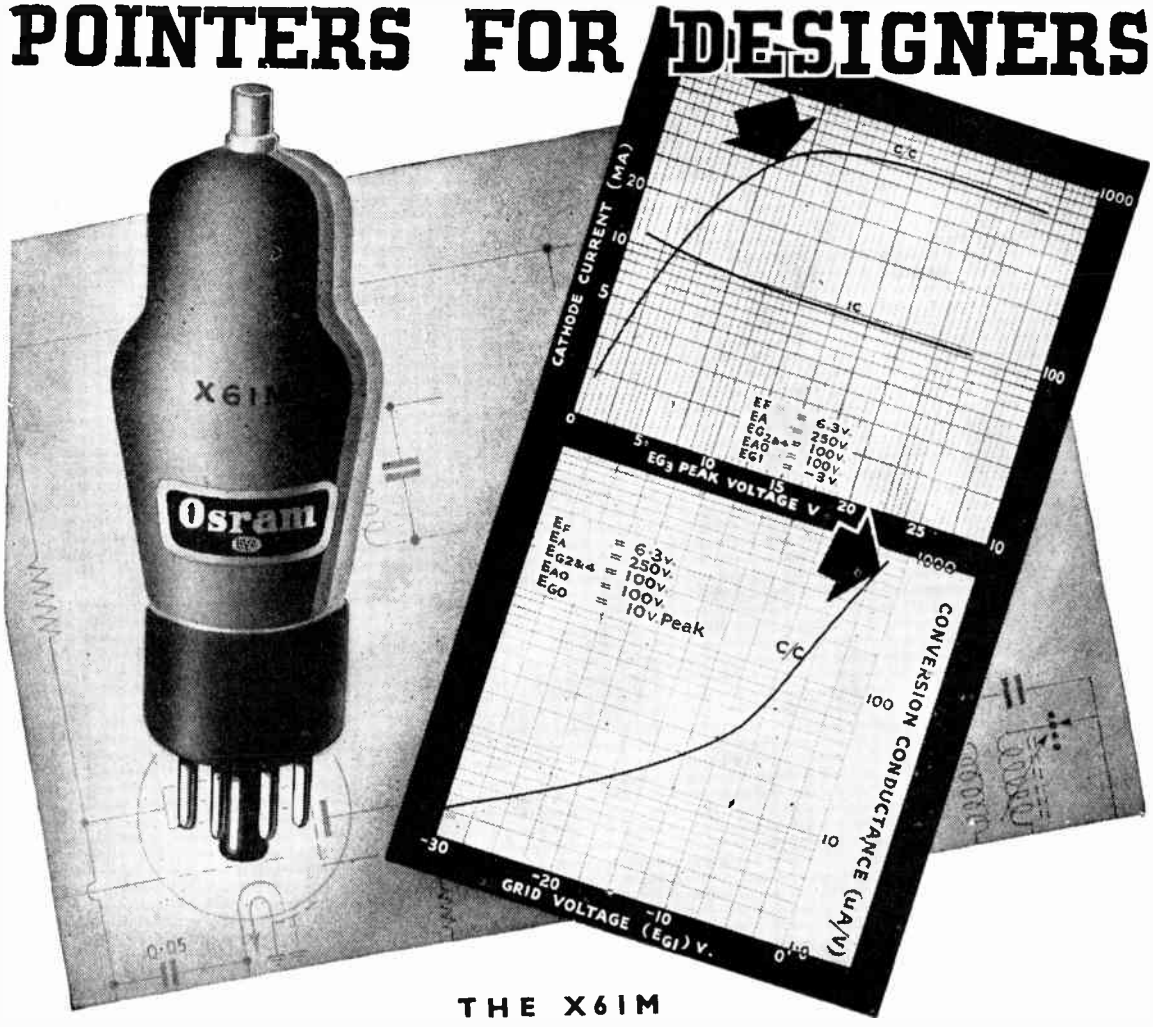

THE X61M

An indirectly heated 6.3v. frequency changer of the Triode-Hexode type, the OSRAM X61M is suitable for operation up to 60 megacycles per sec. (5 metres). Outstanding features include:—

- High conversion conductance for comparatively low cathode current, improving signal to noise ratio.
- Signal handling capacity is such that negligible distortion is apparent up to 5 volts R.M.S. on the signal grid.
- Negligible "pulling" when tuned anode oscillator is used, making ganging of tuned circuits easy.
- Control characteristic is designed to work in combination with KTW61 as IF amplifier, giving maximum control on both valves with negligible distortion.

A detailed technical data sheet is available on request.

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Osram VALVES

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Wireless World

Radio and Electronics

37th YEAR OF PUBLICATION

OCTOBER 1947

Proprietors:
ILIFFE & SONS LTD.

Managing Editor:
HUGH S. POCOCK,
M.I.E.E.

Editor:
H. F. SMITH

Editorial, Advertising and Publishing Offices:
DORSET HOUSE,
STAMFORD STREET,
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VALVES AND THEIR APPLICATIONS

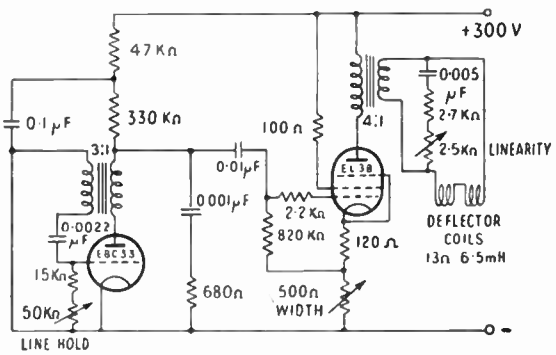
By M. G. SCROGGIE, B.Sc., M.I.E.E.

No. 10: Mullard OUTPUT PENTODE EL38

THE supreme merit of the cathode-ray tube, as so often explained, is the absence of appreciable inertia in its moving part—the beam. Just so; but if the beam is deflected electromagnetically, as in television, there comes into play the electrical equivalent of inertia—the inductance of the deflector coils. To make the beam fly back between lines it is necessary for the peak current through the coils to be reversed in less than 15 microseconds. This results in a back e.m.f., proportional to the current and to the inductance. The current must in any case come within the handling capacity of a reasonable valve; but in order to reduce it one must increase the number of turns on the coils (or the transformer step-down ratio); and the inductance goes up as the square of the number of turns (or ratio). So back e.m.f. is inversely proportional to current.

Peak-to-peak current x peak back—e.m.f., for normal television equipment, is of the order of 250 volt-amperes; so it is clear that the output valve must cope with fairly high signal values, such as 125 mA and at least 2,000 V. The EL 38 is a substantial pentode with a top-cap anode, rated to stand peaks up to 4,000 V., and cathode current 200 mA. Sufficient deflection for a television tube can be obtained for a power supply of about 85 mA (to anode and screen) at 300 V.

The design of such a stage, and particularly of the output transformer, is far too complicated to discuss in this space; but see Cocking's *Television Receiving Equipment*, Chapter VI, or his *Wireless World* articles, "Electromagnetic Deflection" (July, 1946, p. 217) and "Line Time-Base and E.H.T. Supply" (July, 1947, p. 251). An example of a circuit was shown in *Wireless World*, December, 1946, p. 405—The Pye B 16 T television receiver. Another appears below. In the former the EL 38 is driven by a blocking oscillator (see No. 8 in this series) using an EF 50, but a triode will do. The amplitude of the EL 38 output, which determines the width of the picture, can conveniently be controlled by negative feedback, using a variable resistor in the cathode circuit. Linearity is adjusted by varying the damping of the output circuit.



Some EL38 Data

Heater voltage	6.3 V.
Heater current	1.4 A.
Max. anode voltage	800 V.
Max. screen voltage	400 V.
Max. anode dissipation	25 W.
Max. screen dissipation	8 W.
At V_a 250, V_{g2} 250, V_{g1}-7:—	
Mutual conductance	14.3 mA/V.
Anode a.c. resistance	21,000 Ω
Capacitances:—	
Input	17.5 pF.
Output	6.5 pF.
Anode-to-grid	1.2 pF.

Mullard

This is the tenth of a series written by M. G. Scroggie, B.Sc., M.I.E.E., the well-known Consulting Radio Engineer. Reprints for schools and technical colleges may be obtained free of charge from the address below. Technical Data Sheets on the EL38 and other valves are also available.

THE MULLARD WIRELESS SERVICE CO. LTD., TECHNICAL PUBLICATIONS DEPARTMENT, CENTURY HOUSE, SHAFTESBURY AVE., W.C.2

Wireless World

Radio and Electronics

Vol. LIII. No. 10 **OCTOBER, 1947** **Price 1s. 6d.**

MONTHLY COMMENTARY

The National Radio Exhibition

EVERYONE concerned with the National Radio Exhibition is to be congratulated. The Radio Industry Council, as organizers, are now embarking on their first venture in this direction, as the Council was formed since the last pre-war show was held. They have introduced many changes of principle, all of which we consider to be for the better. The industry, collectively and individually, also deserves the highest praise for its courage and resourcefulness in carrying through, in the face of present-day obstacles, the idea of a show that is actually larger and of wider scope than its immediate predecessor of 1939. The show has now grown up; though it is actually the seventeenth of the series, it would have attained its majority some years ago had it not been for the war.

Ideally, an annual exhibition should aim at encouraging the widest possible section of the general public to take an intelligent and serious interest in radio matters of every kind. A secondary but highly important function is that the show should be regarded by those in all radio circles—including professional, industrial and trade—as the focal point of the wireless year. Pre-war shows did little to satisfy these requirements; at the worst, they tended more and more to publicize the less solid aspects of broadcasting, and at the best they did little more than mark a period in the calendar of production of broadcast receivers.

Rome was not built in a day, and it would be unreasonable to expect the perfect exhibition to emerge fully developed out of the chaos of war. But so many steps in the right direction have been taken that we can look forward to the future of radio shows with some confidence.

The critical visitor to Olympia will no doubt look for signs of the influence of the war years on current practice. In our view, the most important effects of that period will not be in matters that are evident superficially. True, radar technique has contributed several details of circuit design to television, but in general wartime developments were restricted to the higher frequencies, for which the peacetime applications are still limited. The real advance of the industry has been in individually trivial matters of "know-how;" under the stress of war it has learned many lessons that affect the details of design and production. Wireless components and equipment generally are better designed and better made than ever before. More efficient methods of production have in turn resulted in economies, with the result that prices compare favourably with those in other fields.

"Miniaturization" and "tropicalization" are two clumsy words that nevertheless represent important wartime advances. By learning how to make small components economically the industry has found means of greatly expanding the applications of radio and radio-like equipment; the hearing aid is one of the first examples that comes to mind. By mastering the problems of making apparatus that will resist extremes of temperature and humidity, the whole world has been made a potential market for the exporter. The contribution of the radio industry towards the restoration of our national export/import balance is already considerable; there is no technical reason why it should not be larger. We have the knowledge, the production capacity and the still more important asset of fertility in technical ideas.

Educational exhibits are not lacking, but this is a side of the exhibition that could be expanded in future years. The possibilities of the cinema are already being exploited with advantage in explaining some of the more subtle points of recent developments. This technique, used with skill and imagination, might be extended in many directions.

Two or three "conventions," to be held at Olympia, have already been arranged; here, again, is an idea that should be developed. Every encouragement should be given to those who wish to plan meetings to coincide with the annual exhibition.

Ignition Interference

1.—Its Nature, Magnitude and Measurement

By W. NETHERCOT, M.A., B.Sc., F.Inst.P.
(British Electrical and Allied Industries Research Association)

ALTHOUGH extensive investigations on interference from the ignition systems of motor vehicles have been made over many years by organizations such as the Post Office, the B.B.C. and the Electrical Research Association, little quantitative information has been published. The Electrical Research Association has issued many reports on this subject to its members but the information contained therein has not been published; at least since Gill and Whitehead's paper in *J.I.E.E.*, 1938.[1] It is the purpose of these articles to summarize the information contained in these reports and to give an up-to-date picture of the situation at present obtaining.

Origin of Interference. — The ignition circuit is essentially a spark generator. It can be represented approximately by the circuit shown in Fig. 1. L is the inductance of the H.T. winding of the coil or magneto and C_1 is its self-capacitance. l_1 and l_2 are the cables joining the coil to the distributor and the distributor to the sparking plug. For magnetos with integral distributor l_1 can be

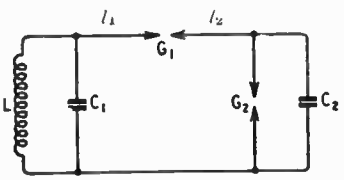


Fig. 1. Essential circuit of ignition system.

omitted. G_1 is the distributor gap and G_2 the sparking plug gap. C_2 is the self-capacitance of the sparking plug. The capacitance associated with the distributor gap is not shown.

[1] References are to a bibliography to be published with Part 2.

The circuit is shock excited by the breakdown of the gaps G_1 and G_2. The distributor gap breaks down at about 3 kV and the sparking plug gap anywhere between approximately 3 and 12 kV, depending on engine conditions. When the sparking plug breaks down the energy stored in the capacitance C_1 and the H.T. cables, both of which are charged to the breakdown voltage of the plug gap, is rapidly dissipated, giving rise to the so-called "capacity" component of the ignition spark. The current is oscillatory and has a complex wave shape with a high peak value, but decays rapidly, due to energy dissipation in the dielectric of C_1, the gaps G_1 and G_2 and the R.F. resistance of the circuit. For normal motor vehicles the current oscillates at a frequency between 30 and 50 Mc/s. The discharge lasts only for a microsecond or less but the peak current may be several hundred amperes. A succession of such discharges may occur due to current chopping before the final inductive discharge in which the amplitude of the low-frequency current is only a fraction of an ampere. The inductive discharge contributes a negligible amount to the radio interference except possibly at the lowest frequencies.

Spark Discharge.—The capacity spark discharge, and the effect of suppressor resistors on it, has been studied oscillographically by the author. Fig. 2 shows tracings of some of the oscillograms obtained on a typical ignition system with the plug gap breaking down at 5 kV. Increasing resistance reduces the amplitude of the current and at about 1,000 ohms changes the discharge from oscillatory to unidirectional. With 25,000 ohms in circuit it is indistinguishable, except for the steep front, from the subsequent inductive discharge.

These records were obtained with the resistor inserted at the sparking plug. A resistor inserted in the coil-distributor cable or at the distributor end of the plug cable reduces the rate at which the self-capacitance C_1 discharges to the same degree as does a similar resistor inserted at the plug end of the H.T. cable but, whereas the latter prevents the rapid discharge of the charged H.T. cable the former does not, and this is the reason why a single resistor in the coil-distributor cable is ineffective as a suppressor at frequencies above 80 - 100 Mc/s.

With the spread of television, the question of interference from motor-vehicle ignition systems will become increasingly important. These articles contain a summary of present-day knowledge on the nature of ignition interference, its measurement and suppression

The upper limit of the frequency band of the radiation depends on the rate at which the gaps G_1 and G_2 become conducting at breakdown. Theoretical considerations indicate that the voltage should fall to a negligible value in an extremely short time and this is borne out by experiment. The fall is too rapid for accurate measurement; some tests made by the author with a high-speed oscillograph on the breakdown under impulse of a 1 millimetre gap (which is of the order of the sparking plug gap) have shown it to take place in less than 4×10^{-9} sec., and it is probably considerably shorter than this. One of the oscillograms is reproduced in Fig. 3.

Frequency Distribution.—Measurement has shown that ignition interference has a continuous frequency spectrum from normal broadcast frequencies up to at

least 650-Mc/s. It is not serious at the lower frequencies, except to radio equipment situated within the vehicle, but rises rapidly in intensity above 10 Mc/s and is very strong at television frequencies. At one time it was thought that the intensity decreased progressively with increase of frequency above 100 Mc/s but more recent measurements, both here and in America, have shown that, although the strength of the interference varies with the frequency, there is no general decrease in intensity up to 650 Mc/s.[2] The engine of a motor vehicle is surrounded to a great degree by a bonnet consisting of metal plates and this has a marked effect on the magnitude of the interference radiated from the ignition system. As this effect is not amenable to calculation it is unwise to expect more than qualitative agreement between theoretical field strengths of the interference based on a simplified circuit such as shown in Fig. 1 and those obtained with field-strength measuring equipment.[3]

Methods of Measurement. — A detailed discussion on the principles of interference measurement is outside the scope of this article but quantitative estimates of its magnitude are meaningless unless the characteristics of the measuring equipment are specified.

Apparatus for the measurement of radio interference consists essentially of a high frequency voltmeter having a specified acceptance band with a linear detector as output meter arranged to measure, subject to certain time constants, the crest value of the interference. This is the well-known method of assessing the "annoyance" effect of interference to radio reception, and it has been standardized by the British Standards Institution and accepted by the C.I.S.P.R.[1]

It is necessary that the equipment should be adequately sensitive to both interference and carrier. For interference measurements gain and bandwidth are of equal importance and have to be considered jointly. The bandwidth has also to be chosen in relation to the type of transmission affected by interference. Reception of the television programme necessitates the use of receivers with 5- to 6-Mc/s bandwidths for the vision and approximately 25 kc/s bandwidth for the sound channel.

Measuring Equipment. — In practice, however, the bandwidth of the sound channel in a television receiver is considerably wider, i.e., of the order of 60 kc/s. Of the two measuring sets constructed by the E.R.A. the earlier one (6-50 Mc/s) has a designed bandwidth of 50 kc/s, but tests showed that its effective bandwidth to a wide-band signal such as interference was appreciably greater than this. The later set (20-120 Mc/s) had a bandwidth of 100 kc/s and both had output meters of the type mentioned above except that the discharge time was increased from the specified value of 150 milliseconds to 500 milliseconds.

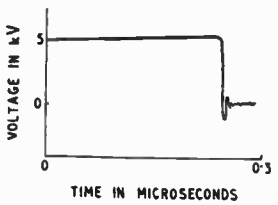


Fig. 3. Breakdown of 1-mm gap under impulse voltage.

The response of a meter of this type to a succession of pulses is a function of the pulse width, the time interval between pulses and the charge and discharge times of the meter. The ignition pulse is of very narrow width and at low repetition rates the meter reads only a small fraction of the peak value of the pulses.

Under these conditions, if the gain of the receiver is adjusted to give a measurable reading, there is a risk of overloading the amplifier, with the result that the measurements have no significance quantitatively. The response is improved by increasing the discharge time of the meter and this is the reason for increasing it to 500 milliseconds.

Comparison tests on ignition interference showed that the response of the two sets differed by less than 3 db and unless otherwise stated, all values of the interference field given in this paper were obtained with them.

Interference to Vision.—This does not become serious and the instantaneous value of the interfering field is such as to give an appearance comparable with "peak white" on the screen, that is, until a limit, which is of the order of the crest value of the signal, is exceeded. Accordingly the subjective effect of the interference requires a meter responding to the frequency with which such a limit is exceeded.

It is not possible to simulate such a characteristic with that of the crest type instrument found suitable for sound transmissions. However, tests on pre-war television receivers showed them to be more sensitive to most types of interference as regards sound than as regards vision. Accordingly, it was held that practical needs of suppression in such cases would be met by an instrument

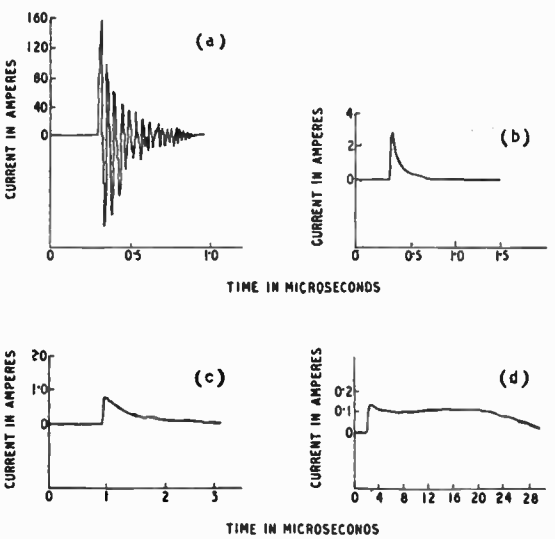


Fig. 2. Current in the "capacity" component of the ignition spark. (*a*) no resistance; (*b*) 1,000-ohm series resistance; (*c*) 5,000 ohms; (*d*) 25,000 ohms

Ignition Interference—

suitable for the sound transmission. Although a bandwidth of 100 kc/s is greater than the audio bandwidth of television receivers,

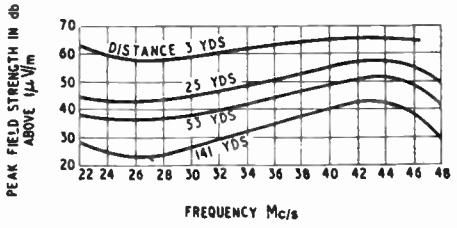


Fig. 4. Frequency variation of average peak-field strength of interference from motor vehicles.

the pre-war subjective tests carried out by the E.R.A. showed that the limiting signal-to-interference ratio for tolerable sound reception as measured in the way described above was independent of the type of interference and approached 40 db, the well-known limit for lower frequencies. The corresponding limits for the vision transmission were found in most cases to vary from 20-35 db.

Some recent tests by the B.B.C. and the E.R.A. on the subjective aspect of ignition interference to television receivers of the post-war type have indicated that when the receivers are fitted with audio and video noise limiters they are more sensitive on the vision than the sound channels, probably due to a reduction of the signal-noise ratio in the latter. More comprehensive tests are needed on this point and arrangements to this effect are in hand.

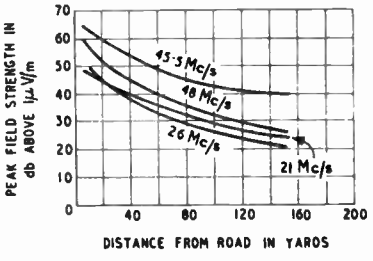


Fig. 5. Variation of average peak-field strength from motor vehicles with distance from road.

Tolerable Interference Level.—

Before the war BS833 specified that the interference level in the frequency band 1.5 to 150 Mc/s, measured at ground level 30ft from the interfering source, should not exceed 50μV/m[1]. In the tests mentioned above the peak field of the television service was 300μV/m and the interference from the vehicles, suppressed to a level of about 30μV/m, as measured at the television aerial, was just tolerable.

Many television aerials are situated considerably more than 30ft from motor vehicles and are often screened to some extent from the direct radiation by the presence of buildings; furthermore the residual field from many vehicles after suppression is less than 50μV/m.

In view of these facts the figure of 50μV/m is not an unreasonable one and although the specifications on radio interference are in course of revision, it is unlikely that the revised ones will call for a higher degree of suppression.[5] Practical tests have shown that ignition interference to television is reduced to a tolerable level by the simple methods well known before the war.[6]

Magnitude of Interference.—

The frequency range below 120 Mc/s has hitherto excited most interest for in it lie not only the television service but also other important services; e.g., police radio cars.

The E.R.A. has made an extensive statistical survey of ignition interference by measuring the radiation from motor vehicles at selected points near roads such as the Great West Road and Western Avenue which have fairly high traffic densities and on which the average speed is between 30 and 40 m.p.h. In addition upwards of 100 separate vehicles, both private and commercial, have been studied under controlled conditions.

Fig. 4 shows a series of measurements made on Western Avenue at frequencies between 22 and 48 Mc/s and at distances between 3 and 141 yards from the side of the road (ground level). The corresponding attenuation with distance curves are shown in Fig. 5. The order of levels observed and their relatively slow attenuation with distance indicate that motor vehicles can cause interference over a wide area.

Fig. 6 shows the results of tests on a number of vehicles at a standard distance of 30ft and a standard speed of 30 m.p.h. At 15 Mc/s the strength of the interference field is about 15 db below

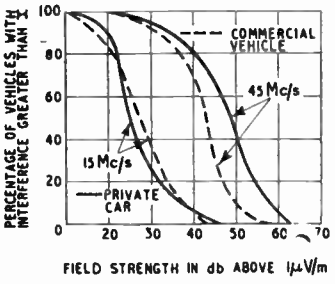


Fig. 6. Interference due to motor vehicles.

that at 45 Mc/s and it will be observed in the latter case that 1 mV/m is rarely exceeded (the maximum field recorded was 2 mV/m) and that only 40 per cent of the private cars tested exceeded 30 μV/m.

A series of measurements between 43 and 118 Mc/s at 30ft from the line of traffic on Western Avenue is shown in Fig. 7, which also shows the results of controlled tests on a number of vehicles at frequencies of 50, 82 and 103 Mc/s.

In the latter the vehicles were stationary at 30ft from the aerial and the engines run at a speed

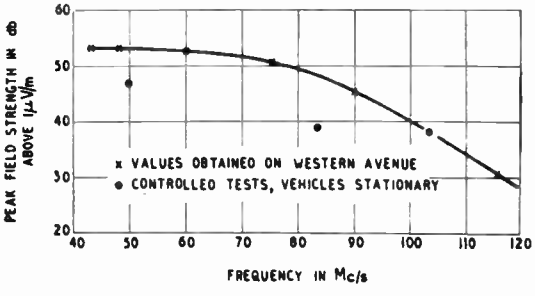


Fig. 7. Comparison of interference measurements on stationary and moving vehicles.

which produced the maximum reading of the output meter.

Results of Tests.—The agreement between the two sets of measurements is satisfactory, having regard to the different conditions of test. The results show that the interference level falls progressively with frequency increase over the range 43 to 118 Mc/s; at 118 Mc/s the level is about 20 db lower than that at 43 Mc/s. Fig. 4 shows that the level increases with frequency in the range 26 to about 43 Mc/s and so it appears that the band most susceptible to interference is that in which the television service operates.

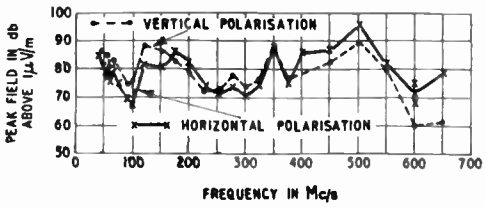


Fig. 8. Variation of interference with frequency for unsuppressed Vauxhall "12" car.

It should be mentioned that all the figures given above refer to the vertically polarized component of the ignition field. (Television aerials receive vertically polarized radiation.)

For reasons which have already been stated it is unnecessary, when considering interference in relation to television, to measure at distances less than 30ft from the source of interference, but for police radio cars, which must operate in close proximity to other vehicles, shorter distances are of more interest.

Table I shows how the level of interference from two 1940-model Vauxhall cars varies over the range 30 to 100 Mc/s with distances between 6 and 30ft.

The results are anomalous in that sometimes the interference level is unchanged or even increases with increase of distance. Factors which may account for this are the phase difference between the direct and earth reflected waves, the relation between the inductance and radiation fields and the fact that at short distances from a vehicle its dimensions become comparable with such distances. Interference radiated from the vehicle body arrives at the aerial from different directions and the magnitude of the sum of these is a function of the phase differences which depend on the distance of the aerial from the vehicle.

However, in general, the nearer the aerial is to the vehicle the more severe is the interference; on the average the mutual interference between two vehicles passing one another under normal road conditions is about twice as much as when they are separated by 30ft.

TABLE I

Vehicle	Distance in feet of aerial from centre of vehicle	Interference expressed as db above 1 μV/m						
		30	35	40	45	50	80	100 Mc/s
Vauxhall "12"	6	52	49	51	57	65	40	37
"	15	48	43	46	50	58	42	44
"	30	45	43	47	51	51	39	34
Vauxhall "14"	6	38	45	45	46	65	45	42
"	15	35	39	36	41	56	43	37
"	30	33	31	38	37	55	36	32

Interference above 120 Mc/s.—Very little information about ignition interference above 120 Mc/s is available; the only comprehensive results known to the author, apart from those given in George's paper, are those obtained jointly by the E.R.A. and the Radio Division of the National Physical Laboratory.*

* Reports by the National Physical Laboratory and E.R.A. in course of preparation. B. G. Pressey and G. E. Ashwell: "A Pulse Field Strength Measuring Set for Very High Frequencies." To be be published in *J.I.E.E.*, Vol. 93, Part 3A.

These tests were made on 1940 model Vauxhall "12" and "14" cars with a pulse field strength measuring set designed by the N.P.L. It consists essentially of a tuned half-wave dipole aerial, a frequency changer, an I.F. amplifier tuned to 35 Mc/s with a bandwidth of 2.5 Mc/s and a cathode ray indicator unit. The frequency ranges are 20 to 30 and 40 to 650 Mc/s.

Figs. 8 and 9 show respectively the variation of the interference with frequency for the "12" and "14" cars. It is seen that the curves are series of crests and troughs with variations in level of up to 30 db but that the average level does not fall off with increase of frequency which is in accord with George's results.

Some difficulty was experienced in determining the peak amplitude of the interference as the individual peaks, as seen on the C.R. screen, varied over the engine cycle by as much as 10 db, with occasional peaks, recurring about once a second, about 5 db above the general maximum peak level. A change of frequency of a few Mc/s was often enough to change completely the character of the peak-to-peak distribution.

The ratio of the horizontally to the vertically polarized components of the field is a function of the frequency, but appears to obey no simple law. With one or two exceptions it is well below 10 db.

Table II shows the distribution of radiation around the "14" car. The aerial positions A, B, C, D are shown in Fig. 10; the normal measurements were made at A.

It is seen that the distribution of radiation around the car is not uniform but there is no definite position for maximum interference. This seems to be a func-

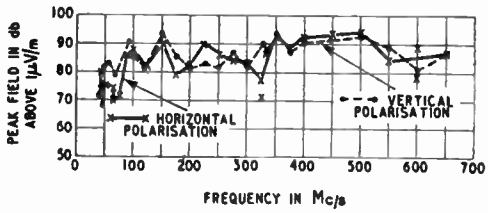


Fig. 9. Variation of interference with frequency for unsurpressed Vauxhall "14" car.

Ignition Interference—

tion of the frequency. It is probable that the distribution is affected very largely by the car body.

Fig. 11 (*a*) and (*b*) shows the variation of the field strength of the interference with distance at 175 Mc/s and 500 Mc/s respectively. They show that slightly higher levels are obtained with the greater aerial height but the tests were not comprehensive enough to permit definite conclusions to be drawn about the effect of polarization, aerial height and frequency on the attenuation with distance. They indicate no special relationship between these factors; on the average the level is reduced by about 30 db as the aerial is moved from 10 to 100 yards from the cars. This is about 10 db greater than that found for the frequency band up to 50 Mc/s which suggests that

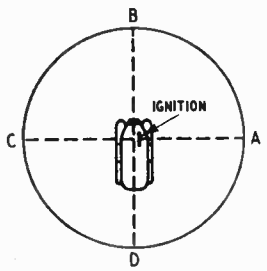


Fig. 10. Positions of measurement for results shown in Table II.

ignition interference at ultra-high frequencies will be much more restricted in area than at the lower frequencies.

Factors affecting Magnitude.—Referring to Fig. 6 it will be observed that there is a great variation in the strength of the interference from one vehicle to another; for instance at 30ft distance the field strength from some vehicles is less than 25 db above 1μV/m, with others it is as high as 66 db; i.e., a ratio of about 100 to 1.

There are a number of factors which account for this variation. The layout of the ignition system and its relation to the vehicle body have a large effect on the magnitude of the interference. In general the longer the H.T. ignition leads the greater is the interference, at least for frequencies up to that of television. Reduction of the length of these leads; e.g., by location of the distributor midway along the cylinder block, may reduce the interference considerably. A further reduction may be obtained if advantage is taken of the screening effect of proximity to the metal mass of the engine. The farther the leads can be kept from the bonnet, so is the interference likely to be smaller because of the reduced coupling between them.

The type of body affects the magnitude of the interference considerably; fortunately the modern trend in pressed steel body design leads to reduced interference. On many new vehicles the hinged part of the bonnet is in one piece as compared with the four-sectional type in which the bonding between individual members was very indifferent from an R.F. aspect. More efficient screening is the result, with consequent reduction of the interference. It is still common practice to mount ignition coils on bulkheads instead of on the engine and this gives a long distributor lead and circulating path for R.F. currents. E.R.A. tests have shown that if the coil is suitably mounted on the engine so as to reduce the dimensions of the radiating circuit and to confine it to the engine, the interference level may be reduced by 8-21 db. Redesign of the layout of the ignition system on the lines discussed above may in some cases avoid the necessity for the use of suppressors.

TABLE II

Frequency in Mc/s	Polarization	Interference level in db above 1 μV/m			
		A	B	C	D
55	Horizontal	74	66	75	69
55	Vertical	79	79	78	75
175	Horizontal	79	79	81	81
175	Vertical	85	82	88	88
300	Horizontal	84	79	78	86
300	Vertical	82	88	85	86
500	Horizontal	93	83	89	82
500	Vertical	95	86	94	90

Engine conditions, the type of sparking plug and its gap width affect the interference mainly in so far as they affect the breakdown voltage of the sparking plug gap, and the magnitude of the discharge current.

Spark Gap Length.—Increasing the gap width of the sparking plug increases the breakdown voltage but often this increase is less than linear. With some engines it is possible to increase the gap widths considerably without noticeably increasing the interference, since the breakdown vol-

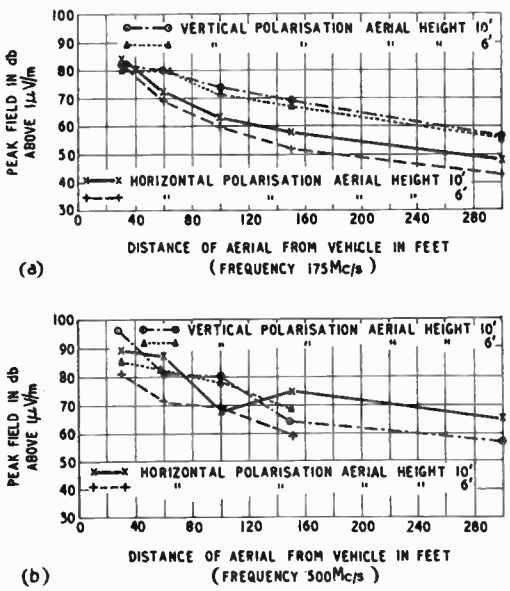


Fig. 11. Variation of interference with distance of aerial from vehicle and aerial height above ground.

tage, once the engines have attained normal working temperature, changes very little with appreciable variation of gap width.

On the other hand, additional spark gaps in the circuit should be avoided since each gap breakdown on the ignition circuit produces a R.F. voltage and current impulse. Also any additional gap in series with the sparking plug may be partially or wholly additive with it and so increase the peak voltage of the system and the magnitude of the discharge current. For this reason, apart from deleterious effect on the ignition performance, loose connections in the high tension circuit and large distributor gap due to worn rotors are to be avoided. Relatively little can be done to affect the magnitude of the interference by sparking plug design which anyway is controlled by other considerations.

Engine conditions influence the interference appreciably; the effects are rather complicated but in general maximum interference occurs at rapid acceleration from low speed and at wide throttle under heavy load such as occurs when ascending gradients at high speed.

Mobile Radio-Telephone

Marconi 100-Mc/s Equipment

A NEW V.H.F. radio-telephone designed by Marconi's Wireless Telegraph Company for use by police and fire services was demonstrated recently in London. This equipment operates in the 78 to 100-Mc/s band and consists of mobile units for installation in patrol cars, vehicles and launches and a fixed installation of considerably higher power for headquarters' use.

Perfectly reliable two-way communication was maintained between a car and a temporary fixed station in the centre of London, while signals were actually received in the car in the heart of London from the Company's works in Chelmsford. Reliable communication was also maintained between Chelmsford and the temporary headquarters' station.

No interference of any kind was caused by adjacent and passing motor cars, this freedom from the effects of the ignition systems being entirely due to the effectiveness of the noise limiters in the receiver. The radio car was not fitted with suppressors of any kind, yet there was no interference when operating on the move.

The mobile equipment is powered from the 12-volt car battery and consists of a double superheterodyne with crystal-controlled oscillator and a crystal-stabilized transmitter, both working on spot frequencies. There are no external tuning controls of any kind. The few controls that are needed are all located on a small remote control unit which can be mounted on the instrument panel, or anywhere else convenient.

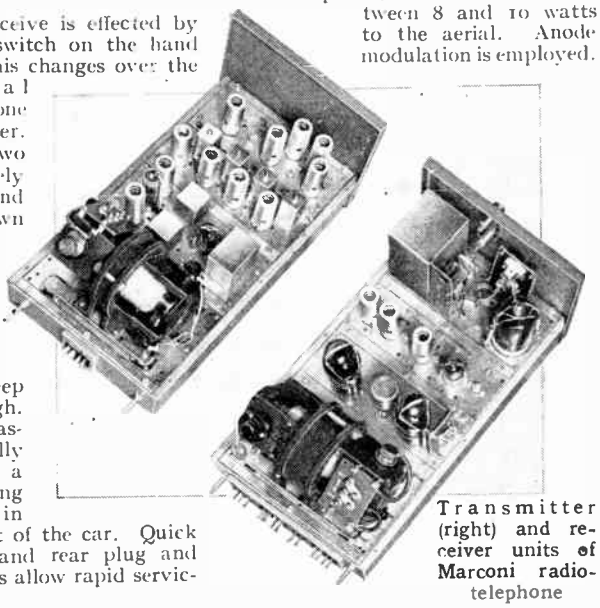
This control unit carries the switches for starting up the transmitter and receiver, but changeover from send to receive is effected by a press-button switch on the hand microphone. This changes over the short vertical aerial from one set to the other. Each of the two sets is entirely self-contained and includes its own rotary transformer.

Transmitter and receiver units are very compact: each measures 8in wide, 15½in deep and 7¼in high. They are assembled normally side-by-side on a shock-absorbing carrier located in the luggage boot of the car. Quick release fittings and rear plug and socket connectors allow rapid servicing of the units.

An additional facility provided is that the audio output from the modulating amplifier, which amounts to about 11 watts, can be switched at the remote control unit to a loudspeaker mounted outside the car and the microphone is then used for traffic control purposes.

The receiver is unusual in that, though it is a double superheterodyne, it has only one oscillator. As previously mentioned this is crystal controlled and the third harmonic is taken out in the anode circuit and injected into the first frequency changer. The first I.F. is about 45 Mc/s. After passing through one transformer the signal, with the original injected oscillations, is passed to a second frequency changer where a further conversion to 5 Mc/s is made. The main amplification then takes place at this frequency. The overall bandwidth of the receiver is 50 kc/s at −3 db, which allows for crystal tolerances in transmitter and receiver and also permits the system to operate, when required, with several headquarters' transmitters in different locations and on slightly different frequencies, but all modulated from a common source. This system was described in our issue of February, 1946.

The main interest in the mobile transmitter is perhaps its extreme compactness. Miniature components are used throughout as well as miniature valves. The working frequency is extracted from the crystal oscillator in one operation and then amplified by two successive stages, the last of which drives the final amplifier, which delivers between 8 and 10 watts to the aerial. Anode modulation is employed.



Transmitter (right) and receiver units of Marconi radio-telephone

Whilst the same receiver, but with a different power unit, is used in the headquarters' installation this transmitter is a comparatively high-power one and delivers about 50 watts of R.F. to the aerial. This has separate drive and power amplifier units, the former being crystal controlled and by means of doublers and triplers, all of which are small V.H.F. pentodes, the output is raised to the operating frequency after which two stages of high-power amplification are employed.

Various other applications are visualized for this new Marconi equipment such as ship-to-shore and ship-to-ship communication in harbour work, such as tug boat services.

Short Waves for Pleasure

Radio Engineer Takes a Busman's Holiday

By THOMAS RODDAM

SOMEONE lent us a flat in Stockholm for a month. This isn't going to be a description of non-austerity life in Sweden, although that would be a subject to gloat over. The flat had a radio set in it, one of those all-wave jobs which form an essential item of furniture nowadays. The aerial system was simply five floors height of central heating, and it seemed to do some good. On this equipment we tried to get some entertainment.

Of course, there was the local station, which came roaring in as all local stations do. The only trouble was that the programmes seemed to consist of short gramophone recitals and long talks in what was presumably Swedish. Entertainment value—to us—practically zero. The rest of the medium-wave band was pretty dead at all normal hours: the hour of darkness which forms the Swedish utility night in summer was needed for sleeping. The long-wave band is, of course, stiff with the caterwaulings of radio beacons, which form an interesting commentary on the popularity of the newer navigational aids. The receiver, by the way, was calibrated with the names of 100 medium-wave stations and 25 long-wave stations: it seemed a lot of marking for just one usable programme.

Shortcomings of Short Waves

This left us the short-wave band. Twelve megacycles in 8 inches, or $7\frac{1}{2}$ turns of a small knob. Actually, as the scale was not very linear, the useful range ran to about 2 Mc/s per turn, which means than to tune to within 1 kc/s of the carrier, the knob had to be adjusted to within 10 minutes of arc. It is possible to do this, but it is not easy, and I don't think a non-technical listener could, or would, manage it. Certainly my wife couldn't and just wouldn't try. Of course, it really didn't matter, because after a few minutes the receiver had drifted completely away. At a rough estimate it drifted at least five band-widths, and it certainly went on drifting for an hour. That meant that for the first half-hour it needed retuning every five minutes, and then at increasing intervals. Of course, we should never have switched off, but austere habits die hard, and in practice we tried to remember to switch on half-an-hour before we tried to listen.

This question of drift is well-known, and there are quite a lot of cunning ways of compensating for it, according to the literature. In receiver production, however, it seems as though the cost of fitting a short-wave range has exhausted the manufacturer. One solution which I haven't seen described is to fit a heater inside the box with a suitable cut-out switch, to bring the whole thing up to its steady temperature quickly. If the drift was all over in five minutes, that would be tolerable, but the slow creep after an hour is an abominable nuisance. The other really trying thing is this ticklish tuning; finding a station by searching a band is tolerable, but having to hold ones breath while doing it is not.

The receiver market in Europe is open to British receivers. Quite a lot of countries have long-wave local stations, so that American competition is not so serious; the Germans are, for the moment, out of the market. It is essential, however, that the receivers should be good. Europeans do listen to the B.B.C., because they want to improve their English. If they suffer as I did, they will get bored.

Then, of course, there are the programmes. Three times within 30 minutes we were given the same cricket scores on the same programme. In case we missed that, an hour later there was a sports bulletin. But I could never find Tommy Handley: I was told I should remember so-and-so, who was first violinist at the Argyle Theatre in Birkenhead before the war! I never was in Birkenhead and I don't know any first violinists, and nor do 99 per cent of the listeners to the overseas service. Can't a quick programme summary, free of the Boys at the Bolivar atmosphere, be slipped in after the news bulletins?

Reverting to a more technical point: can't Mr. Bennington help, too. I don't want to sit down with Tremellen charts or the month's ionospheric predictions to find which band to tune to. It is nice to know that in East Africa I should tune to the 19-metre band, but an indication that listeners 1,000 kilometres east of London should tune to such and such band, based on the current propagation conditions, would be most useful. As it is, I had to check the 19-metre band, to make sure that the poor signals on 25 metres weren't absorption rather than penetration, and then hunt around 31 metres to find the programme. Again, most listeners don't know that when the signals go bad they must change wavebands, and they certainly don't know which way to go.

My short period of complete dependence on broadcasting on short waves has been most instructive to me. It has brought out the seriousness of the defects, both in receivers and in B.B.C. information, of which I was already vaguely aware. It would be well if receiver designers could be made to depend completely on their own receivers for a time, so that they would make more serious attempts to cure their defects.

Electro-plating

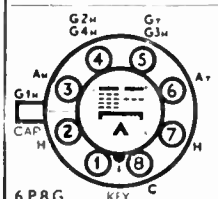
A COMPREHENSIVE collection of data for those concerned with the design, erection, maintenance or operation of electro-deposition plants is to be found in the "Handbook of Industrial Deposition." This book, just issued by our publishers on behalf of our associated journal, *Metal Industry*, confines itself to the practical aspects of the subject, and does not deal with theory. The Handbook costs 15/- (postage 7d).

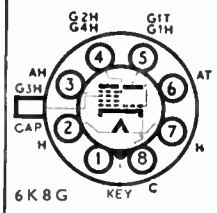
6P8G now implies that Service men must ★BRIMARIZE!

PUNCH HOLES HERE

TYPE	CHANGE SOCKET FROM	CHANGE SOCKET TO	CHANGE CONNECTIONS FROM OLD SOCKET	CHANGE CONNECTIONS TO NEW SOCKET	OTHER WORK NECESSARY	PERFORMANCE CHANGE
6K8G	INT/OCTAL NO CHANGE		NO CHANGE		REALIGNMENT WILL BE NECESSARY	SLIGHTLY REDUCED GAIN

RATED CHARACTERISTICS





	6P8G	6K8G	
Heater Voltage	6.3	6.3	Volts
,, Current	0.8	0.3	Amps
Anode Voltage	250	250	Volts
,, Current	2.2	2.5	mA.
Screen Voltage	80	100	Volts
Osc. Anode Resistor	50,000	40,000	Ohms.
Conversion	0.65	0.35	mA/V.
Hexode Input Capacity	7.5	5.5	m.m.f.d.
Hexode Output Capacity	21.5	5.5	,,
Osc. Input Capacity	17	7.0	,,

BOTH 6P8G and 6K8G are triode-hexode types with International Octal bases, and no change of connections will be necessary. The inter-electrode capacitances of the two types are different however, and it will be necessary to realign the oscillator and I.F. circuits after Brimarizing.

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6P8G

INSTRUCTIONS : Punch holes where indicated and cut away this portion. Cut out and file them in the order in which they appear. This column will then give you a quick reference index.

7

Virtually Distortionless TYPE A.D./47 AMPLIFIER

This is a 10-valve amplifier for recording and play-back purposes for which we claim an overall distortion of only 0.01 per cent., as measured on a distortion factor meter at middle frequencies for a 10-watt output.

The internal noise and amplitude distortion are thus negligible and the response is flat plus or minus nothing from 50 to 20,000 c/s and a maximum of .5 db down at 20 c/s.

A triple-screened input transformer for 7½ to 15 ohms is provided and the amplifier is push-pull throughout, terminating in cathode-follower triodes with additional feed-back. The input needed for 15 watts output is only 0.7 millivolt on microphone and 7 millivolts on gramophone. The output transformer can be switched from 15 ohms to 2,000 ohms, for recording purposes, the measured damping factor being 40 times in each case.

Built-in switched record compensation networks are provided for each listening level on the front panel, together with overload indicator switch, scratch compensation control and fuse. All inputs and outputs are at the rear of the chassis.

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for 12 volt battery and A.C. Mains operation. This improved version has switch change-over from A.C. to D.C. and "stand by" positions and only consumes 5½ amperes from 12 volt battery. Fitted mu-metal shielded microphone transformer for 15 ohm microphone, and provision for crystal or moving iron pick-up with tone control for bass and top and outputs for 7.5 and 15 ohms. Complete in steel case with valves.

As illustrated. Price £28 0 0

This 15-watt amplifier, has a response 35-25,000 cps. mixing arranged for pick-up and microphone, large output transformer for 4-7.5 and 15 ohms. Complete in 3-part leatherette case as illustrated, with 2-10in. P.M. Speakers, moving coil microphone and collapsible floor stand, retails at 40 gns.

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Heterodyning and Modulation

Do Additive and Multiplicative Mixing Amount to the Same Thing?

By C. J. MITCHELL, A.M.I.E.E.

FREQUENCY changing in a superhet can be accomplished in two ways, (a) by adding the signal to the oscillator and then rectifying the resultant voltage, or (b), by employing one voltage to modulate the other; in this case the modulation produces two sidebands, the lower of which is the required intermediate frequency. Method (a) is usually referred to as additive mixing, while the second method is called multiplicative mixing. If this process is studied carefully it will be seen that there is a very close connection between the two methods, and additive and multiplicative-mixing amount to almost the same thing. Frequency changing is really a multiplicative process, irrespective of the way in which the oscillator and signal voltages are combined. Simple addition of these voltages does not produce a difference frequency, and it is only after rectification that the intermediate frequency appears as a voltage.

The reader will probably agree that amplitude modulation is a purely multiplicative process, for the R.M.S. value of a modulated carrier voltage is being multiplied by a factor which is varying in magnitude at the modulation frequency. The equation to a modulated carrier voltage can be written down in the form :—

$$V_{inst} = V_{max} \sin 2\pi f_c t \,(1 + M \cos 2\pi f_m t) \quad .. \quad .. \quad .. \quad .. \quad (1)$$

where V_{inst} = the instantaneous value of the carrier voltage, f_c = the carrier frequency, f_m = the modulation frequency, M = the depth of modulation. M = 1 when the depth of modulation is 100 per cent.

The constant 1 at the beginning of the second term is present because the modulation factor varies between zero and 2 (when M = 1), and if this constant were omitted, the modulation factor would alternate between plus and minus. This would result in frequency doubling, for each trough due to the negative half-cycles of the cosine term would become a peak. The envelope would not be truly sinusoidal in form but would be similar to the shape of the output voltage of a full-wave rectifier.

If equation (1) is multiplied out it becomes :—

$$V_{inst} = V_{max} \sin 2\pi f_c t + MV_{max} \sin 2\pi f_c t \cos 2\pi f_m t \quad .. \quad .. \quad (1a)$$

In this form the equation shows that there is the unmodulated carrier voltage, plus what is apparently another voltage whose frequency is not obvious because it is the product of two sinusoidal quantities. It only requires the application of a little elementary trigonometry to change the form of the second term into something which shows the frequencies present.

From the identity: sin A. cos B $= \frac{1}{2} \sin (A + B) + \frac{1}{2} \sin (A - B)$, we can re-write the second half of equation (1a) as follows :

$$\tfrac{1}{2}MV_{max} \sin (2\pi f_c t + 2\pi f_m t) + \tfrac{1}{2}MV_{max} \sin (2\pi f_c t - 2\pi f_m t) = \tfrac{1}{2}MV_{max} [\sin 2\pi (f_c + f_m)t + \sin 2\pi (f_c - f_m t)] \quad .. \quad (2)$$

This shows the existence of two equal voltages whose frequencies are equal to the sum and difference of the carrier and modulation frequencies respectively. The amplitude of these voltages is equal to half the carrier voltage when M = 1. These are the well-known sidebands.

The modulation frequency is usually low compared with the carrier frequency, but in the case of the superhet frequency changer employing multiplicative mixing, the modulation frequency is very close to the so-called carrier frequency; the lower sideband due to this modulation is the required intermediate frequency.

It is rather interesting at this point to study a graph of a modulated voltage; when an R.F. voltage is modulated at an audio frequency, the sidebands are not apparent in a graph, but when a voltage is modulated at a frequency near to its own, a graph of the resultant voltage reveals the two sidebands quite clearly. The envelope of an amplitude-modulated wave is shown in Fig. 1(*a*); the ratio of the carrier frequency to the modulation frequency is 6 : 1 in this case. Fig. 1(*b*) shows the result of modulating the carrier at a frequency close to its own, the ratio between the two voltages being 11 : 12. It is seen that the whole curve moves up and down about the datum line at a frequency equal to the difference

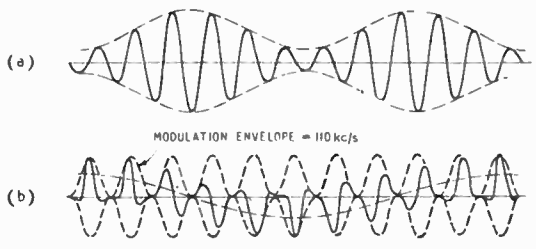


Fig. 1 (a). 60-kc/s voltage modulated at 10 kc/s. (b) 120-kc/s voltage modulated at 110 kc/s. In this case the sidebands can be seen in the graph. The average level varies at the difference-frequency (lower sideband) and the kink in each alternate half cycle of the carrier wave is the sum-frequency voltage (upper sideband).

Heterodyning and Modulation—

frequency. The average level line is the lower sideband, usually employed as the I.F. in a superhet. The upper sideband is not so obvious, but it will be noticed that a little kink appears in each alternate half-cycle of the resultant voltage, and if this kink appeared on the same portion of the wave in each cycle it would appear to be a second harmonic. Its position is constantly shifting, however, so it is not harmonically related to the carrier voltage; its frequency is not exactly equal to twice the carrier frequency, but very nearly so. It is the sum frequency, so this kink is the upper sideband. (100 per cent modulation is shown in order to accentuate the sidebands).

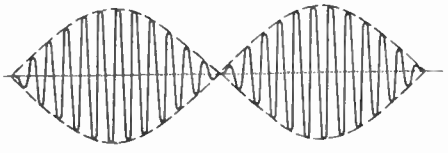


Fig. 2. When two sinusoidal voltages of equal amplitude and slightly different frequency are added together, the resultant voltage is modulated at the different frequency. Notice that this modulation is not sinusoidal.

Now let us consider the so-called additive process. Fig. 2 shows the result of adding together two equal voltages of slightly different frequency. The resultant voltage rises and falls between zero and 2V at the difference frequency. If we write down the equation to the resultant voltage it is seen that there are no voltages present with frequencies equal to the sum and difference frequencies, and although the contour of the envelope is varying at the difference frequency, this does not indicate the presence of a voltage of that frequency. The envelope of an amplitude-modulated carrier wave varies at an audio frequency, but there is no A.F. voltage present in the carrier wave.

If we express the two voltages in the form:

$V_a = V_{max} \sin 2\pi f_a t$

and $V_b = V_{max} \sin 2\pi f_b t$, then adding them together produces the result:

$$V_{a+b} = V_{max} (\sin 2\pi f_a t + \sin 2\pi f_b t) \quad .. \quad .. \quad .. \quad .. \quad (3)$$

since

$$\sin A + \sin B = 2 \sin \frac{(A + B)}{2} \cos \frac{(A - B)}{2},$$ we may re-write equation (3) as follows:

$$V_{a+b} = 2V_{max} \sin 2\pi \frac{(f_a + f_b)}{2} \cos 2\pi \frac{(f_a - f_b)}{2} \quad .. \quad .. \quad .. \quad (3a)$$

Equation (3*a*) shows the existence of a voltage whose frequency is equal to the average of the two frequencies concerned, *multiplied* by a sinusoidal term whose frequency is equal to *half* the difference frequency. How, then, does the resultant envelope vary in amplitude at the difference frequency? The answer is simple; the second term in (3*a*) passes through two peak values per cycle; one positive peak and one negative peak. The positive peak results in a maximum value of the resultant voltage, and the negative half-cycle produces another maximum, the only effect of the minus sign being to reverse the phase of the resultant voltage. Notice that although rectification has not yet been performed, the combined voltage is the result of a voltage with a frequency equal to the average of the two individual frequencies, which is being multiplied by a sinusoidally varying factor whose frequency is equal to half the difference frequency. Thus simple *addition* of two sinusoidal quantities results in multiplication. Where, then lies the difference between additive and multiplicative mixing?

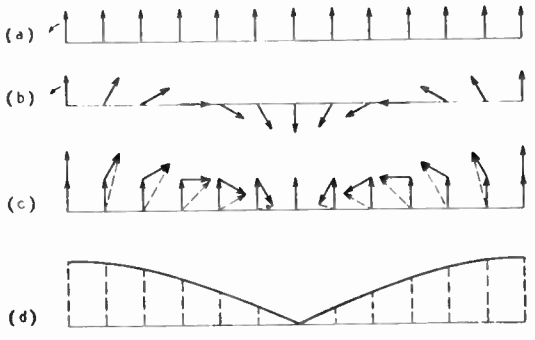


Fig. 3. Heterodyning and modulation.

The process of plotting many cycles of two voltages and then adding the ordinates together is extremely laborious and not always very instructive. More information can often be obtained by representing the voltages vectorially and adding the vectors together. It is generally understood that vectors of different frequencies should not be added together, but provided we are considering instantaneous conditions only, then it is quite permissible to add vectors together.

The series of vectors shown in Fig. 3 represents the conditions instant by instant, when two alternating voltages of different frequency are added together. Consider each vector to be rotating in a counter-clockwise direction; all the vectors shown in Fig. 3 (*a*) are rotating through $2\pi f_a$ radians per second, and those in Fig. 3 (*b*) are rotating through $2\pi f_b$ radians per second. The instantaneous voltage is proportional to the vertical component of the vector, so the voltages pass through their peak values as the vectors reach a vertical position. Each vector is virtually a snapshot of the conditions at regular time intervals, the snapshots being taken each time vector "a" has made one complete revolution; vector "b" is rotating at a lower speed than vector "a" so it appears in a different position each time and is rotating clockwise with respect to the reference vector "a."

The resultant voltage, instant by instant, is shown in Fig. 3 (*c*) and it is seen that the resultant voltage is modulated at the difference frequency. It is interesting to note that the modulation is not sinusoidal, and that the phase of the resultant voltage does not remain constant. The voltage

Heterodyning and Modulation—

is both amplitude and phase-modulated. The contour of the envelope is shown in Fig. 3 (*d*) by re-drawing the resultant vectors all in a vertical position.

If the two voltages are not equal, then the contour of the envelope tends to become sinusoidal; this can be shown quite easily by the vector method, but it is extremely laborious to show this by plotting sine waves. Further, the phase modulation cannot be seen when the sine waves are plotted. If a normal amplitude-modulated wave is dealt with by the vector method—that is, the vectors of the carrier and the two sidebands are plotted, then since the upper-sideband vector is rotating in a counter-clockwise direction with respect to the carrier vector, and the lower-sideband vector is rotating in a clockwise direction at the same speed, the resultant vector is not phase modulated, but remains vertical.

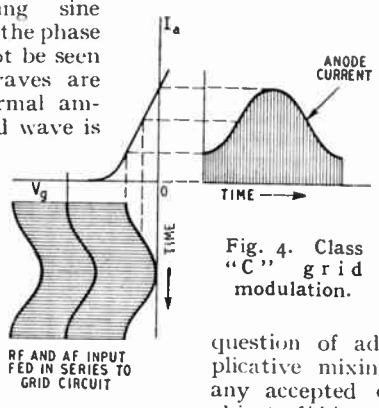


Fig. 4. Class "C" grid modulation.

The result of adding together two alternating voltages of different frequency is to produce a voltage which is amplitude-modulated at the difference frequency, and an actual alternating voltage of this frequency does not appear until after rectification.

Most people who cling to the convention that there is a distinct difference between additive and multiplicative mixing, will agree that modulation is a multiplicative process. If suppressor-grid modulation is employed, the gain of the valve is being varied, and since the output of an amplifier is equal to the product (input × gain), the multiplication in this case is obvious.

When Class "C" grid modulation is employed, the effective gain is varied by varying the bias on the grid of the modulator valve. An increase in bias results in a smaller fraction of the input wave running into the conducting region of the valve, as can be seen from Fig. 4. Is this not almost the same as suppressor-grid modulation? The modulation is accomplished by varying the gain of the valve, the only difference being in the method by which the effective gain is varied. On the other hand, it can be argued that the modulation in the case of a Class "C" modulator is an additive process followed by rectification; the carrier and modulator voltages being added together before being applied to the grid of the valve; rectification then takes place within the valve.

The author does not venture to lay down any hard and fast rules concerning this question of additive and multiplicative mixing, nor to dispute any accepted conventions. The object of this article is to point out the similarity of the two methods, and in conclusion, to suggest that frequency changing and modulation are both multiplicative processes, irrespective of the method employed.

Wharfedale Corner Cabinet L.S.

Twin Loudspeaker with Frequency Separation

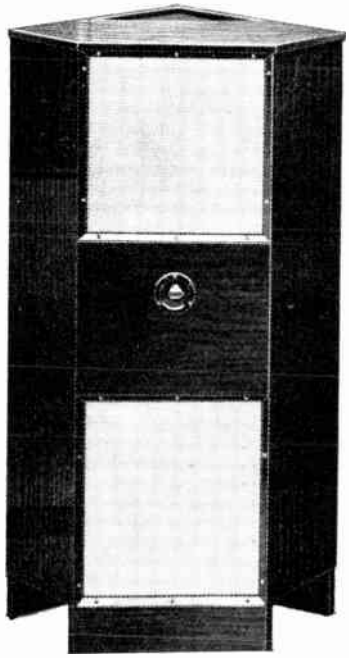
DESIGNED to fit in the corner of a room the new Wharfedale corner cabinet loudspeaker is available in mahogany, or oak of any shade to order. Solid wood of the order of 1in thickness is employed for the exterior walls of the cabinet to achieve the requisite rigidity at low frequencies, and internal divisions are of thick material.

A type W12 unit with cloth surround is used for low frequencies and a W10/CS unit for frequencies above 1,000 c/s. Frequency division is by means of a choke-capacity potential divider and a volume control employing a tapped choke is also provided. The high-frequency unit is at the top, and is fitted with a diffuser for the forward radiation and a reflector which directs part of the back radiation through a triangular aperture in the top of the cabinet.

The back radiation from the lower unit is passed through a bass chamber to apertures at floor level.

We have heard one of these loudspeakers in operation; the multiple sound sources give an attractive spatial effect not found in single cone units mounted in a plane baffle. The bass response is smooth and unobtrusive, indicating the absence of any marked resonance. Without tone control the output in the upper middle register was prominent on some gramophone recordings but should be well suited to compensate for sideband cutting when the loudspeaker is used in conjunction with the average radio receiver. No trace of cabinet vibration could be detected with inputs of the order of 4 to 6 watts, representing the maximum acoustic output which could be tolerated in the average living room, having regard to the high flux density and efficiency of the units employed.

The price of the Wharfedale corner cabinet loudspeaker, impedance 6 or 15 ohms, without transformer, is £17 10s. Transformers of any ratio can be supplied to order. The separator unit, with cross-over at 1,000 c/s is available as a component for use with pairs of similar existing loudspeakers of 3 to 15 ohms impedance. The price is £3 15s.



Wharfedale corner cabinet loudspeaker. The dimensions of the front are 44 in × 25½ in and the depth is 18½ in.

Exhibitors at the Show

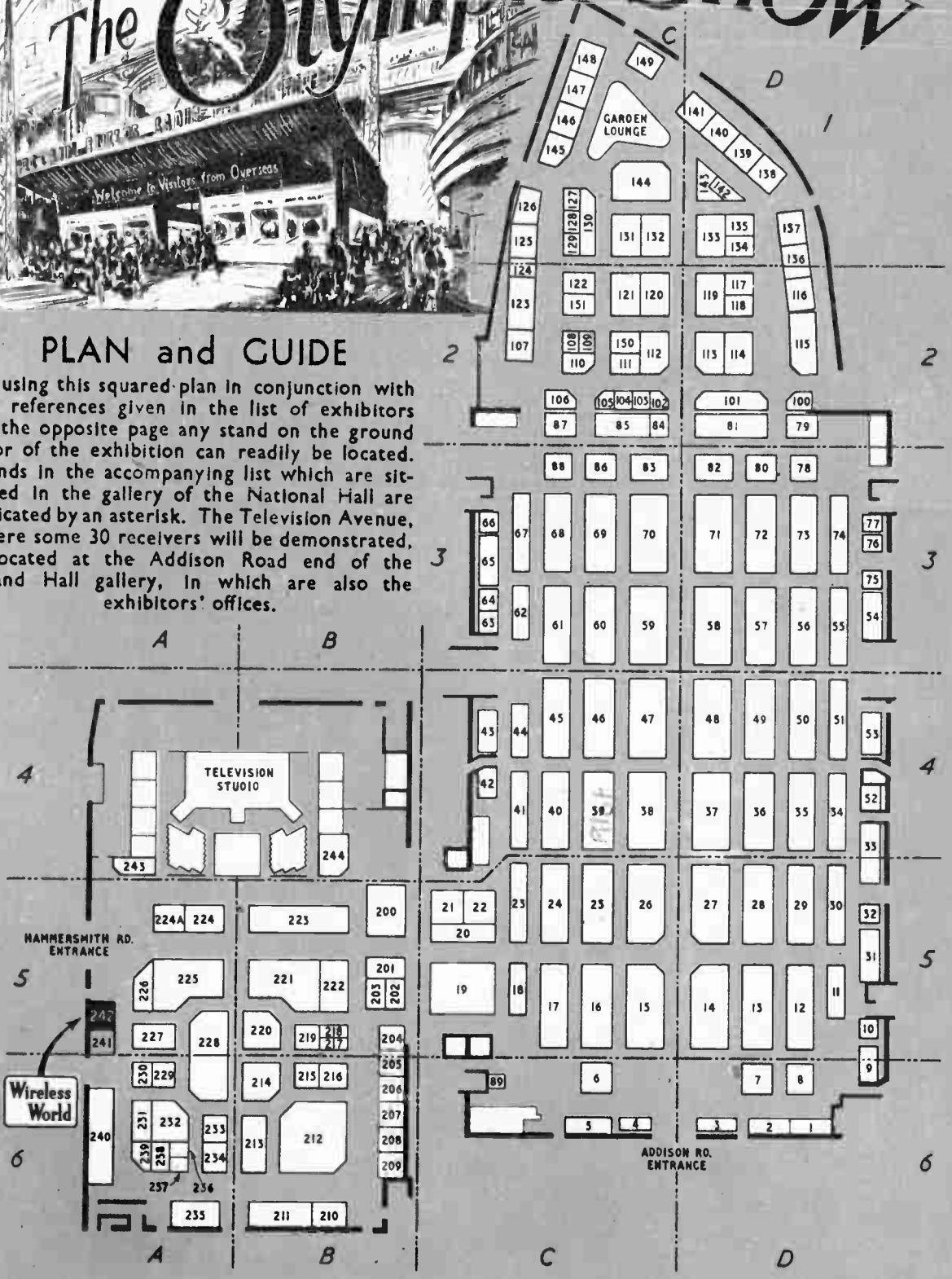
List of Stand-holders with References to the Plan Opposite

Name	Stand	Ref.
Ace Radio	55	D3
Acoustic Products	111	C2
Acoustical Mfg.	147	C1
Aerialite	78	D3
Aerodyne	7	D6
Albion Elec. Stores	107	C2
Allander	131	C1
Amplion	85	C2
Antiference	2	D6
Armstrong	205	B6
Automatic Coil Winder	113	D2
B.B.C.	243 & 244	A1 & B1
B. I. Callender's	200	B5
B.S.R.	222	B5
B.T.H.	213	B6
Baird	50	D4
Balcombe	28	D5
Barclay Stuart	204	B5
Beethoven	61	C3
Bell & Croyden	117	D2
Belling & Lee	33	D4
Bennett Power Prod.	122	C2
Bernards (Publishers)	321*	—
Bird, Sydney S.	31	D5
Board of Trade	84	C2
British Centralab	74	D3
British Mech. Prod.	127	C1
British Moulded Plastics	30	D5
British Rola	135	D1
British Tungsram	132	C1
British Vacuum Cleaner	121	C2
Brown Brothers	101	D2
Bulgin	3	D6
Burgoyne	208	B6
Bush Radio	38	C4
Cable & Wireless	223	B5
Celestion	86	C3
Champion Electric	68	C3
Cole, E. K.	46 & 110	C4 & C2
Collaro	35	D4
Concordia Elect. Wire	236	A6
Cossor, A.C.	15 & 224A	C5 & A5
Cossor Radar	224	A5
Coventry Factors	145	C1
Crypton	237	A6
Dagole	66	C3
Dallas	137	D1
Dawe	201	B5
Decca	14	D5
De La Rue	44	C4
Dibben	105	C2
Dubilier	80	D3
Duratube & Wire	11	D5
Dynaport Radio	12	D5
Dynatron	6	C6
E.I.B.A.	324*	—
E.M.A.	318*	—
E.M.I.	29 & 212	D5 & B6
Eastick	115	D2
Econasign	316*	—
Ediswan	29 & 212	D4 & B5
Electrical Inst.	218	B5
Electrical & Radio Trading	106	C2
Electrical & Radiological Inst.	231	A6
Electro Dynamic	311*	—
Electronic Engineering	216	B6
Electrothermal	32	D5
Emor	314*	—
Erie	41	C4
Everett, Edgcumbe	76	D3
Farnell	203	B5
Felgate	120	C2
Ferguson	26	C5
Ferranti	57, 77 & 215	D3, D3 & B6
Fidelity	309*	—
Fitton	114	D2
Franklin Electric	143	D1
Fulham Electrical	10	D5
G.E.C.	70 & 221	C3 & B5
G.P.O.	302, 303 & 304*	—
Gamma Electronics	238	A6
Garrard	24	C5
General Elec. Radio	217	B5
Goodmans	87	C2
Gramophone Co.	59	C3
Grampian	79	D2
Hale Electric	67	C3
Haynes Radio	53	D4
Hobday Bros.	116	D2
Hunt, A. H.	88	C3
Imhof	62	C3
Invicta	69	C3
Keith Prowse	89	C6
Kerry's	140	D1
Kleergaze	317*	—
Kolster-Brandes	48	D4
L.E.S. Distributors	148	C1
Lee Products	207	B6
London Elect. Mfg.	9	D6
London & Prov. Factors	123	C2
Long & Hambly	146	C1
Lowther Mfg.	323*	—
Lugton	141	D1
McMichael	60	C3
McMurdo	42	C4
Marconi Instruments	226	A5
Marconiphone	37	D4
Marconi's W.T.	225	A5
Masteradio	130	C1
Metropolitan Police	211	B6
Metropolitan Vickers	233	A6
Micramatic Elect. Inst.	21	C5
Midland Bank	313*	—
Min. Civil Aviation	235	A6
Min. of Supply	240	A6
Mullard	71, 112 & 214	D3, C2 & B6
Multicore	23	C5
Murphy	72 & 220	D3 & B5
Music Trades Review	108	C2
National Prov. Bank	312*	—
New London Electron Works	22	C5
Ossicaide	232	A6
Overseas Reception	82 & 83	D3 & C3
Page Engineering	63	C3
Parker Radio	315*	—
Partridge, Wilson	206	B6
Peerless Radio	307*	—
Peto Scott	8	D6
Petter Radio	102	C2
Philco	25	C5
Philips	16 & 227	C5 & A5
Pianomaker, Music Seller & Radio Retailer	124	C2
Pilot	39	C4
Plessey	65	C3
Portogram	56	D3
Practical Wireless	239	A6
Puckridge, F.	308*	—
Pye	58 & 229	D3 & A6
"Q-Max"	234	A6
Qualrad	241	A5
R.G.D.	36	D4
R.M. Electric	51	D4
R.S.C. Radio	45	C4
R.T.R.A.	100	D2
R.W.F.	103	C2
Radio Instruments	52	D4
Radiomobile	144	C1
Radiospares	73	D3
Raimo Raidio	305*	—
Regentone	40	C4
Relay Services	320*	—
Ripaults	1	D6
Roberts	43	C4
Romac	129	C1
S.T.C.	47, 61 & 228	C4, C3 & A5
Salford	75	D3
Scharf, Erwin	306*	—
Scott, Geo. L.	109*	C2
Shannons & Bishop	104	C2
Simon Sound Service	209	B6
Siess (Tools)	322*	—
Sobell	19	C5
Static Condenser	210	B6
Steatite	18	C5
Sterling Cable	128	C1
Stratton	230	A6
T.C.C.	5	C6
T.C.M. Co.	118	D2
Tannoy	17	C5
Taylor Elect. Inst.	119	D2
Tenaplas	133	D1
Trix	20	C5
Truvox	81	D2
Tucker Eyelet	134	D1
Ultra	13	D5
United Insulator	126	C1
V.S.E. Construction	4	C6
Varley	202	B5
Vidor	27	D5
Vitavox	54	D3
Webber, J. M.	149	C1
Westinghouse	34	D4
Weymouth	142	D1
Wharfedale	150	C2
Wingrove & Rogers	139	D1
Winter Trading	138	D1
Wireless & Electrical Trader	136	D1
Wireless World and *Wireless Engineer*	242	A5
Wright & Weaire	125	C1

The Olympia Show

PLAN and GUIDE

By using this squared plan in conjunction with the references given in the list of exhibitors on the opposite page any stand on the ground floor of the exhibition can readily be located. Stands in the accompanying list which are situated in the gallery of the National Hall are indicated by an asterisk. The Television Avenue, where some 30 receivers will be demonstrated, is located at the Addison Road end of the Grand Hall gallery, in which are also the exhibitors' offices.



National Radio

Stand-to-Stand Report

IN the following pages we give a report of individual exhibits printed in order of trade nomes. Overseas readers should note that, where prices are given, purchase tax (abbreviation P.T.) is shown separately : this tax is applicable only on the home market. This review is intended to serve not only as a guide for visitors but also as a permanent record of the industry's programme for 1947-48.

ACE (55)

Domestic receivers shown by this firm include an eight-valve superhet (Model A600) covering medium and long waves with bandspread tuning on seven short-wave ranges, and a three-waveband, five-valve superhet (Model B30) for export only, operating from a 6-volt battery.

Most of the receivers in this year's range will be fitted with the "fidelity bandwidth expansion system" in which one position of the tone control switch widens the I.F. band-width to 20 kc/s.

Ace Radio, Ltd., Tower Road, Pound Road, London, N.W.10.

"Lectrona" loudspeaker with die-cast frame.

ACOUSTIC PRODUCTS (111)

In the range of "Lectrona" loudspeaker units shown, the speech-coil former and high-frequency cone are moulded in one piece. A non-magnetic chassis reduces leakage field—an important point where the unit is to be installed near a C.R. tube. There are 8in and 10in permanent magnet types which are available in four colour-coded flux densities ranging from 6,500 to 9,500 lines per sq cm.

Acoustic Products, Ltd., 50-58, Britannia Walk, City Road, London, N.1.

ACOUSTICAL MANUFACTURING (147)

From the wide range of electro-acoustical equipment shown by this firm the MB32 amplifier and the labyrinth loudspeaker may be selected for special mention.

Overloading by unskilled operators or announcers is mitigated in the MB32 amplifier by a compressor circuit which comes into operation before the overload point and limits distortion to less than 4 per cent. A phase-shift bass-cut filter with a much sharper cut-off than usual is available when the load is taken by conventional projector speakers.

In the labyrinth loudspeaker a smooth response down to 30 c/s has been obtained by fitting the characteristics of the unit with those of a folded acoustic tube of less than the usual length. The type SL15 is ruggedly designed for P.A. work and a twin labyrinth (Type CL2) is available for domestic reception.

Acoustical Manufacturing Co., Ltd., Ermine Street, Huntingdon.

Ambassador auto radio-gramophone with 5-valve all-wave receiver chassis.

AERIALITE (78)

This firm specializes in aerials and associated equipment and an interesting feature of their display is the "miniatures" showing the various types of television and rod aerials mounted on chimney stacks.

The latest form of the Mastatic anti-interference aerial with screened down-lead is included, together with a range of car aerials for mounting on the roof, on the side of the scuttle, on the rear bumpers or below the running board.

A selection of "Ashton" cables, co-axial and balanced-twin aerial feeders is also included.

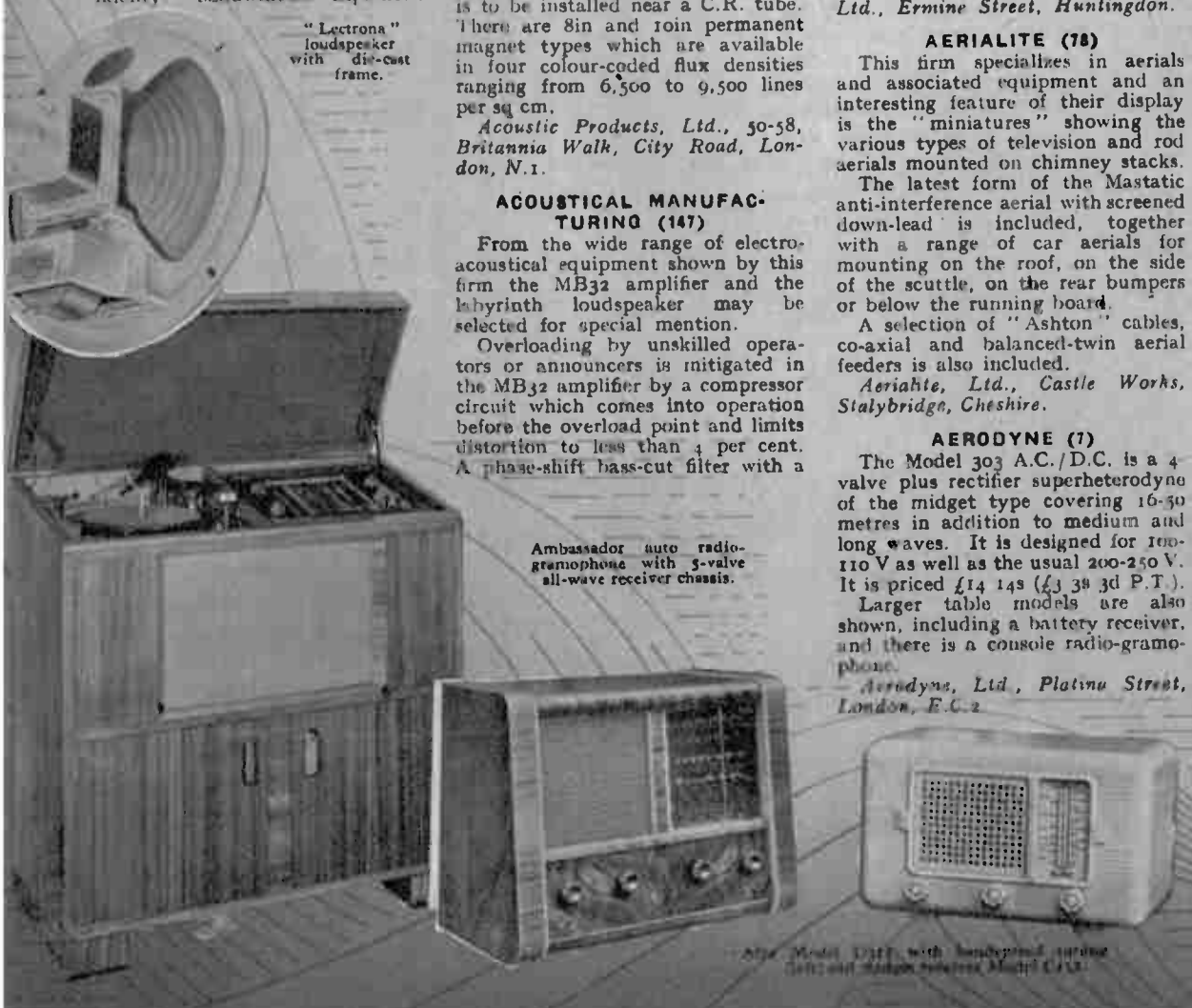
Aerialite, Ltd., Castle Works, Stalybridge, Cheshire.

AERODYNE (7)

The Model 303 A.C./D.C. is a 4 valve plus rectifier superheterodyne of the midget type covering 16-50 metres in addition to medium and long waves. It is designed for 100-110 V as well as the usual 200-250 V. It is priced £14 14s (£3 3s 3d P.T.).

Larger table models are also shown, including a battery receiver, and there is a console radio-gramophone.

Aerodyne, Ltd., Platina Street, London, E.C.2.



Exhibition 1947

THIS Exhibition, which is the 15th of the series, is the first to be held since the débâcle of 1939, when the show was closed prematurely on the imminence of war. It is being held at Olympia, West London, from 1st to 11th October, and is open daily from 11.0 a.m. to 10.0 p.m. (except Sunday). Admission costs 2/6. The show is larger than in pre-war days, and covers a wider field, embracing communication and electronic equipment as well as broadcast receivers.

Demonstrations of the performance of broadcast receivers in the hall is impracticable, but the loudspeakers of the sets on show are fed with B.B.C. programmes by a high-impedance line. Performance of the television receivers shown can, however, be studied, as the television programme is distributed at R.F. after being received by a central station working with a long tilted-wire aerial erected on the roof of Olympia. Elaborate measures have been taken against interference. A 3-mV signal is "piped" to each exhibitor through a separate cable.

ALBA (28)

A new table model superhet type D311 with bandspread tuning on six wavebands below 31 metres and with continuous tuning between 32-100 metres, 200-550 metres and 800-2000 metres, is among the wide range of broadcast receivers and radio-gramophones shown by this firm. In the new Alba midget receiver, Model C112, single-ended all-glass valves are employed and the superhet circuit consists of triode-hexode frequency changer, combined I.F. and A.F. amplifier, diode-pentode output stage and half-wave rectifier. There are three wavebands and the plastic cabinet measures 8in × 4⅞in × 4½in. The price is £13 13s (£2 18s 9d P.T.).

A. J. Balcombe, Ltd., 52-58, Tabernacle Street, London, E.C.2.

ALBION ELECTRIC STORES (107)

As wholesalers this company is not exhibiting products of their own manufacture but shows a selection of receivers and components by well-known manufacturers.

Albion Electric Stores, 125, Albion Street, Leeds.

ALLANDER (131)

With the exception of the A402 midget for A.C./D.C. operation all Allander receivers have a 5-valve superhet chassis covering long, medium and short waves for home use and with medium- and two short-wave bands for export.

Model A400 is a radio-gramophone with an automatic record changer, models A430 and A435 are consoles, the latter being an A.C./D.C. set. There are two table models, one for home and one for export.

Allander Industries, Ltd., 48, Avenue Street, Bridgeton, Glasgow.

AMBASSADOR (114)

For the home market Ambassador is showing a range of receivers embodying a 5-valve superhet circuit. This covers 9.7 to 1,900 metres in six ranges with bandspread on the short waves. An extra short-wave range replaces the long in the export version.

This chassis is available in table, console, radio-gramophone and bookcase styles.

The radio-gramophone is an attractive set having an automatic record-changer and storage space for 300 records.

A new 14-valve A.M.-F.M. receiver is shown covering 2.75 metres to 2,000 metres. It is a double superhet on the short waves, has a noise limiter, a six-gang tuning condenser and 12-watt push-pull output stage feeding twin loudspeakers.

R. N. Fitton, Ltd., Radio Works, Hutchinson Lane, Brighouse, Yorks.

AMPLION (85)

A magnetic pick-up at £1 9s 6d (+ 6s 8d P.T.) in which steel, fibre, or sapphire needles can be used, is a product of this firm. It has an output of about 1 V. A crystal pick-up is also made and has an output of some 7.5V at 500 c/s.

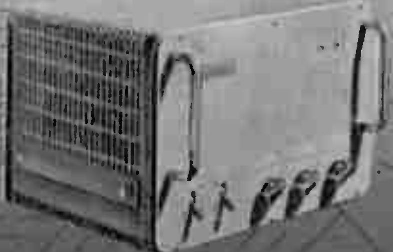
A portable receiver covering medium and long waves is designed for dry-battery operation. There is also a mains unit which is claimed to be suitable for any "All-dry" portable set; it is for A.C. only.

Amplion (1932), Ltd., 230, Tottenham Court Road, London, W.1.

Amplidyne 302 A.C./D.C. midget receiver.

Ambassador bookcase model of the [illegible] receivers.

Acoustical Manufacturing [illegible] Type [illegible] amplifier with automatic volume compression and [illegible] twin labyrinth "Corner" loudspeaker Type [illegible].



Beethoven Model U2038 A.C./D.C. receiver.

(Above) Armstrong RF103 chassis and (left) Antiference folded dipole with feeder made of 300-ohm flat-twin line.

Avo Electronic Testmeter and (right) High-sensitivity multi-range test set.

Belling-Lee valveholder for B8A-based valves.

ANTIFERENCE (2)

A television aerial of the compressed dipole type is shown by Antiference for use indoors and where space is limited. The Unipoint aerial is an anti-interference aerial system without the customary matching transformers. The design necessitates the use of a fixed length of screened downlead; one receiver only can be fed.

The Arnine short-wave folded dipole is made throughout of 300-ohm polythene insulated flat twin feeder. It is available for all the amateur and most of the short-wave broadcast bands.

Other Antiference specialities include a range of motor car aerials and all kinds of aerial accessories.

Antiference, Ltd., 67, Bryanston Street, London, W.1.

ARMSTRONG (205)

Receivers in chassis form are produced by this firm. The RF103 has an R.F. stage, triode-hexode frequency-changer, one I.F. stage and duo-diode-triode detector, A.V.C., and A.F. stage. This is followed by a phase-splitter, a push-pull triode A.F. stage and a push-pull tetrode output stage delivering 10 W. The set covers 17.9-50m, 195-530m and 800-2,000m in three bands. On gramophone 6-db bass lift is provided. The tone control gives treble lift. The chassis is priced at £18 18s (+ P.T.). An A.C./D.C. model at the same price has a 6-W output.

Similar chassis, the EXP83 and UNI83, but with a simpler A.F. system, are available.

Armstrong Wireless and Television Co., Ltd., Warlters Road, London, N.7.

AVO (113)

The Electronic Testmeter is a new valve-voltmeter type of instrument for voltage and current measurements up to 10 kV D.C. and 2.5 kV A.C. On D.C. the input resistance is over 100 MΩ total and on A.C. the upper frequency limit is 200 Mc/s. Other facilities provided are A.C. power output, decibels, capacitance 100 pF to 50 μF and resistance 0.2 Ω to 1,000 MΩ. There are 49 ranges all told.

Among the more recently introduced test apparatus is the AVO Valve Characteristic Meter fitted with a multiple selector switch for "wiring" the valveholders to suit any valve and an overload cut-out which protects the whole instrument. There is also a wide-range signal generator covering 50 kc/s to 50 Mc/s and having a switched coil turret and a multi-range high-sensitivity test set of the well-known Avometer style having a resistance of 20 kΩ per volt. The Douglas series of fully automatic coil winding machines are shown.

Automatic Coil Winder and Electrical Equipment Co., Ltd., Winder House, Douglas Street, London, S.W.1.

B.B.C. (243 & 244)

One of the two B.B.C. stands is devoted to engineering. Here is displayed the various processes in the production of sapphire recording and reproducing needles. The exhibit includes a projection microscope with a magnification of 250 for inspecting the finished cutter. Another section of the stand is devoted to a display depicting the technical processes through which the signal passes between the microphone and the aerial.

The two stands of the B.B.C. are linked by a photographic display of some of the outstanding events during the first twenty-five years of broadcasting in this country. The Corporation's 25th anniversary will be celebrated in November.

British Broadcasting Corporation, Broadcasting House, London, W.1.

B.S.R. (222)

In addition to beat-frequency A.F. oscillators and their standard range of P.A. amplifying equipment, this firm is showing a new ribbon microphone (Type RBM1) with floating suspension and built-in 500-ohm line transformer, a gramophone motor and pickup, in which the die-cast turntable is rim-driven and the pickup standard needle resonance around 4,500 c/s has been eliminated, and a direct disc recorder, Type DR13. The recorder is housed in a transportable wood instrument case and cuts discs up to 13in, 96 grooves per inch. The 15-ohm cutter requires 1 watt for average modulation. A lightweight play-back pickup is provided and the equipment includes swarf-removal brush, spiralling handle and automatic cutter lowering lever.

Birmingham Sound Reproducers, Ltd., Claremont Works, Old Hill, Staffs.

B.T-H. (213)

The aerial scanner and console of radar equipment developed for merchant shipping are shown on this stand. There is also a standard test-bench for use with X-band waveguides.

Crystal valves are shown and some miniature crystal receivers, as well as examples of silicon and germanium crystals.

Radio-frequency heating equipment, a resistance-welding control unit, a photo-electric relay and an electronic timer are on view as well as industrial valves, including thyratrons. There are also working models of a compensated thyratron motor-speed control and a remote-position control servo system.

British Thomson-Houston Co., Ltd., Rugby, Warwick.

BAIRD (50)

Four television receivers are

shown by this firm. The smallest is the Garrick with a 12-in C.R. tube. In addition to vision and sound it includes a broadcast receiver covering 15-50 m and 200-550 m with push-button control and 3-W output. The set costs £162 15s (plus £37 0s 6d P.T.).

The Adelphi and Lyric models are of similar general design but have more elaborate cabinets and cost £183 15s (plus £41 16s 4d P.T.).

The Grosvenor has a picture 22in by 19in with a flat viewing screen. The receiver has 11 wavebands and 30-W output. An automatic record changer is fitted and a recording unit can be provided if required. The price is not fixed but stated to be about £1,500.

John Logie Baird, Ltd., 4, Upper Grosvenor Street, London, W.1.

BARCLAY STUART (204)

Specialists in the production of injection, compression and transfer moulding for the radio industry, this firm is showing a variety of coil formers, tuning knobs and escutcheons as examples of the type of work they are prepared to produce to customers' requirements.

Barclay Stuart (Plastics), Ltd., Spencer House, South Place, London, E.C.2.

BEETHOVEN (81)

This exhibit comprises all-wave table model receivers, radio-gramophones and television sets.

Very impressive is the ARG1188 radio-gram with its 9-valve superhet chassis, 12in loudspeaker and automatic record changer. The 11-49-metre band is divided into nine band-spread ranges with an additional one covering 50 to 100 metres for export. For the home market this is replaced by a long-wave band; both cover the medium waves.

A T.R.F. circuit, with five R.F. stages, is used in the television set, the first two being common to the sound channel. It has a 9in tube which in the Model T918 disappears into the cabinet when not in use.

Beethoven Electric Equipment, Ltd., Chase Road, London, N.W.10.

BELLING-LEE (33)

An unusual aerial possessing directional properties and described as the inverted "V" is now included in the range of television aerials made by Belling and Lee. It is designed to fit in the roof space of a house in localities where a reasonably good signal is available. It can also be erected externally on a pole.

There is a new Skyrod "whip" aerial, now 18ft long, one for window-frame mounting, known as the Winrod, and a telescopic car aerial for mounting on the side of the scuttle.

Instead of one set of transformers for the Skyrod and another for the Eliminodyne anti-interference aerials one new design now serves for both.

Other items of interest include a new B8A valveholder, a variety of co-axial plugs and sockets for television and car radio feeders, many different kinds of terminals, fuseholders and a delay switch.

Belling & Lee, Ltd., Cambridge Arterial Road, Enfield, Middlesex.

BELL & CROYDEN (117)

Hearing-aids are shown on this stand. There are two lightweight battery models, one with internal batteries and the other with a separate battery unit. A mains unit is available so that batteries can be saved when mains are accessible.

There is a mains model also for office and home use and an audiometer is being shown.

J. Bell and Croyden (Savory and Moore, Ltd.), 117, High Street, Oxford.

BENNETT POWER PRODUCTS (122)

Among the range of broadcast receivers shown on this stand is a set including a time-switch which can be set to switch on at any predetermined time. The set is unconventional in appearance in that it is built to look like a clock.

Bennett Power Products, Gerrards Cross, Bucks.

B.I. CALLENDER'S (200)

In addition to a selection of wires, special cables and wave guides, a range of R.F. heaters designed for pre-heating moulding powder, soldering and welding thermoplastics is shown. Powers range from 0.2 to 5 kW, and in all but the last size the pre-heaters are fitted with electrode assemblies on top of the cabinet. Process timers are included.

An all-wave anti-interference aerial has been developed for use on the usual long, medium and short waves. A 60ft dipole is coupled to a receiver transformer through an 80-ft coaxial cable, polyethylene insulation being used throughout.

B.I. Callender's Cables, Ltd., Norfolk House, Norfolk Street, London, W.C.2.

B.I. Callender's all-wave anti-interference aerial system.

BOARD OF TRADE (84)

The Export Promotion Department of the Board of Trade is responsible for this stand, which consists entirely of an export enquiry bureau where visitors from overseas are especially welcome.

Board of Trade (Export Promotion Department), 35, Old Queen Street, London, S.W.1.

BRIMAR (47)

Prominence is given on this stand to the new loctal all-glass valve, which, by virtue of the improved characteristics with the pinchless form of construction, especially at the television frequencies, is likely to replace many of the current types even for general-purpose use. This valve has a grooved centre spigot

Bevelling tool used by the B.B.C. for grinding the facet round the cutting edge of the sapphire tips of recording cutters.

Baird "Garrick" television receiver.

which locks into the valveholder and prevents the valves in a receiver from falling out in transit.

Shown also is a range of new miniature valves intended mainly for use in small portables and hearing aids.

The Brimar replacements scheme, which is being demonstrated, shows how obsolete multiple valves may be replaced by modern types combined with metal rectifiers.

Standard Telephones and Cables, Ltd., Connaught House, Aldwych, London, W.C.2.

BRITISH MOULDED PLASTICS (30)

This company make a wide variety of plastic mouldings for the radio industry and the great advances made in the technique of plastic moulding are well exemplified by the inclusion of some early examples for comparison with the present-day article.

British Moulded Plastics, Ltd., Avenue Works, Walthamstow Avenue, London, E.4.

BRITISH VACUUM (121)

The Goblin Time-Spot receiver includes a time-switch and a calibrated volume control so that it can be pre-set for a particular programme.

The Magneta Time Co. are showing on this stand a range of P.A. equipment with outputs of 10–100 W.

British Vacuum Cleaner and Engineering Co., Ltd., Goblin Works, Leatherhead, Surrey.

BROWN BROTHERS (101)

These well-known traders are showing a representative display of receivers and equipment by some of the leading manufacturers.

Brown Brothers, Ltd., Brown's Buildings, Great Eastern Street, London, E.C.2.

BULGIN (3)

This company has always been noted for the extent and versatility of the vast range of components and parts they manufacture. Of special interest is the series of really miniature intervalve transformers.

There were well over 200 different types of switches, but nevertheless some new models have been added, including a series of press switches operating against a return spring and key-actuated toggles.

Other new items comprise a series of moulded signal lampholders giving easy access to the bulb for replacement, 8- and 12-pin plugs and sockets and a safety mains connector for television sets; removal of the back of the set automatically breaks the mains supply.

Fuses, plugs and jacks, connectors of many kinds, knobs, coils and I.F. transformers are also shown.

A. F. Bulgin and Co., Ltd., Bypass Road, Barking, Essex.

BURGOYNE (208)

Products as diverse as coaxial-cable connectors, electric soldering irons and a personal portable come within the scope of this firm.

The "Seven Second" solder gun, as its name implies, reduces the warming-up period and effects economies in current consumption as well as in time.

Measuring 7in × 4¾in × 2¾in, the "Playboy" personal portable weighs only 3¼lb and covers medium and long waves. Separate tuning scales calibrated in station names are provided and an automatic on-off switch is incorporated in the lid.

Burgoyne Engineering Co., Ltd., 1-3, Robert Street, London, N.W.1.

BUSH (38)

A feature of many of the sets shown by this firm is "Bi-Focal Tone." This is an arrangement whereby the audio-frequency response is broadened when the volume control is turned down for the reception of strong signals. The broadening is obtained by negative feedback and is arranged to improve the quality of local reception without complicating the operation of the set.

It is used in the AC2 table and SUG3 console models, which are priced at £20 14s 5d (plus £4 9s 7d P.T.) and £25 0s 10d (plus £5 8s 2d P.T.) respectively. They are both three-band sets of the four-valve type for A.C. operation, but A.C./D.C. models are being produced.

Portable sets, both battery and mains, are shown. The BP90 is an example of the former and the DAC90 one of the latter. It is for A.C./D.C. operation with a frame aerial.

Export models are the EAC91 and EAC95. D.C. models are available and vibrator power-packs for 6 V battery operation can be supplied. They cover two short wavebands and the medium. The EAC95 has an R.F. stage and a scale indicator permitting accurate resetting.

Television sets include the model T91, reviewed in our last issue, and a similar set with a larger (12in) tube.

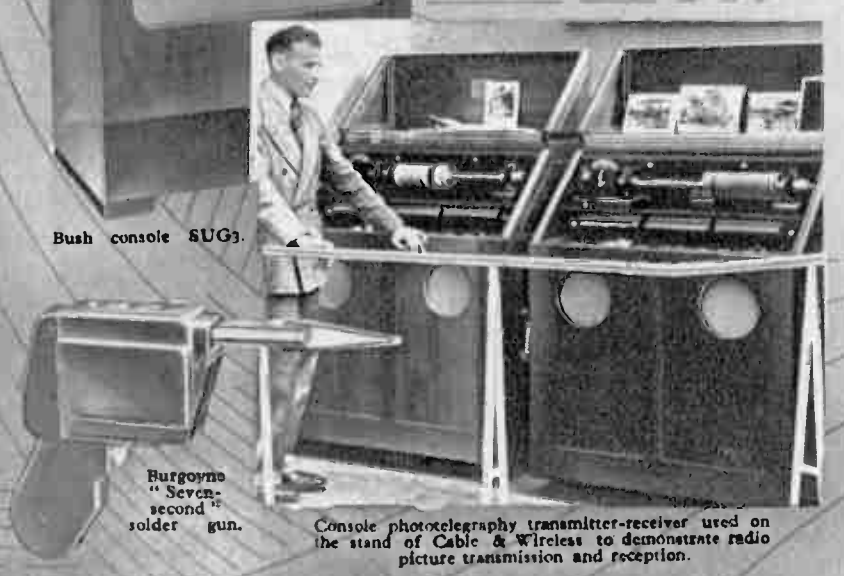
Bush Radio, Ltd., Power Road, London, W.4.

C. & W. (223)

A two-way wireless telegraph circuit is operating between the Cable & Wireless stand and the company's station at Barbados.

Among the latest equipment on show are a high-speed photo-electric

Bush console SUG3.



Burgoyne "Seven-second" solder gun.

Console phototelegraphy transmitter-receiver used on the stand of Cable & Wireless to demonstrate radio picture transmission and reception.

Cossor Model 477 A.C. band-spread receiver.

telegraphy transmitter, capable of handling up to 800 words a minute, and a photo-telegraphy transmitter-receiver. The latter, which was designed by C. & W. and manufactured by the G.E.C., transmits photographs, maps, etc., measuring 10in × 7in in about ten minutes. A device, normally used for monitoring, has been fitted to the console models on show whereby the picture being transmitted on a closed circuit from one set to the other is seen as it is being built up on "Teledeltos" aluminium-foil paper.

Cable and Wireless, Ltd., Electra House, Victoria Embankment, London, W.C.2.

CELESTION (86)

All loudspeakers in the Celestion range are of dustproof design and are treated to withstand tropical climates. They range from a 2½-in unit weighing 3½oz to a 18-in reproducer capable of handling 40 watts. Universal output transformers and cabinet extension loudspeakers are also shown.

Celestion, Ltd., 145, London Road, Kingston-on-Thames, Surrey.

CENTRALAB (74)

Piezo-electric pickups, microphones, headphones and loudspeakers are being exhibited here. The De Luxe Crystal Pickup has an output of 1.3 V R.M.S. and costs £4 4s (+P.T.). The Torpedo microphone has an output of −54db and costs £18 18s. A hearing-aid type with an output of −51 db at 100 c/s has a rising characteristic to about 3,500 c/s. It is priced at 25s. The loudspeaker shown is of the "pillow" type for use in hospitals.

Volume controls, sapphire gramophone needles, and vibration pick-up units are among the other exhibits.

British Centralab, Ltd., Canterbury Road, London, N.W.6.

CHAMPION (68)

A range of five receivers—including a car radio—is shown. The "Comet" (three wavebands) and "Planet" (two wavebands) sets are compact A.C./D.C. superhets in plastic cabinets, with built-in aerials. The Model X49 is designed for export, has three waveranges (medium and two short) and is housed in a walnut cabinet.

Champion Electric Corp., Champion Works, Seaford, Sussex.

CLIX (127)

Some new valveholders have been added to the Clix range of specialities; there is one for the miniature all-glass lock-in type valve, with or without centre spigot, and the B8B and B9C which are eight- and nine-pin models respectively, the latter being for the EF50 style of valve.

One other new item in the Clix range is a moulded M.E.S. lampholder for scale illumination. It is so designed that the lamp always makes a good contact and cannot become loose.

In addition there is a vast range of plugs and sockets, terminal strip connectors and many different types of valveholders on laminated and ceramic plates.

British Mechanical Productions, Ltd., 21, Bruton Street, London, W.1.

COLLARO (35)

Equipment for gramophone and radio-gramophone manufacturers, pickups, record players, motor and automatic record changers are shown on this stand and also the "Microgram" portable electric gramophone for A.C. mains with 2½-watt output.

Collaro, Ltd., Ripple Works, Bypass Road, Barking, Essex.

CONCORDIA (236)

Cables, flexes and wires of all kinds are made by this firm and the exhibit gives some idea of the range and variety of their products. The wide use of nylon, glass and asbestos in the manufacture of insulated wires to-day is well exemplified.

Concordia Electric Wire and Cable Co., Ltd., Long Eaton, Nr. Nottingham.

COSSOR (15 & 224A)

The television receivers shown by this firm include a C.R. tube incorporating an ion-trap to avoid ion burns on the screen. The time-bases include automatic linearity controls, there is a cathode-follower V.F. stage and a strip-built 3-Mc/s stagger-tuned I.F. amplifier.

In the Model 902, there is a 10-in tube with 6 kV for E.H.T. and the set costs £78 15s. (plus £17 13s 9d. P.T.). The Model 901 has a 15-in tube giving a picture 12½in by 9½in. The E.H.T. supply of 9 kV comes from a high-voltage coil pulsed at line frequency. The set includes an all-wave sound receiver.

Among the many broadcast sets shown the Model 477AC is of particular interest in having five S.W. bands as well as medium and long. Push-button waveband selection is used and there is flywheel tuning.

There are several battery sets, including the Model 481B, which is specially designed for rural areas.

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

COVENTRY FACTORS (145)

A wide range of equipment is shown by this firm of wholesalers. Receivers, components and accessories by manufacturers not exhibiting at Olympia are to be found on this stand.

Coventry Factors, Ltd., Radel House, Leicester Row, Coventry.

Goblin Time-Spot Receiver.

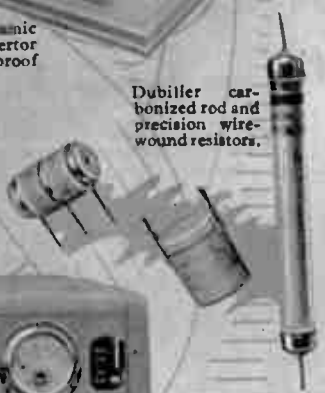
(Left) Bush export Models BAC95 and BU95 are externally the same. (Right) Safety mains connector made by Bulgin for television sets.

Cossor Model 902 television receiver (top) and Burgoyne "Playboy" personal portable Model R473.

Cyldon dual capacitor on ceramic base for miniature I.F. transformers.

Electro-Dynamic rotary convertor and sound-proof cabinet.

Dubilier carbonized rod and precision wire-wound resistors.



Davenset Model H battery charger for A.C. mains; output 15 volts 2.25 A.

(Top) "Double Decca" three-waveband portable for mains or battery operation and "Deccalian" portable electric record reproducer.

COSSOR RADAR (224)

Marine radar equipment similar to that installed in R.M.S. "Queen Elizabeth" is shown in a facsimile of a ship's chart room. Examples of "Gee" navigational equipment for aircraft are also shown.

Cossor Radar, Ltd., Highbury Grove, London, N.5.

CRYPTON (237)

This exhibit comprises battery chargers. The A1 will charge up to 6 cells at 1 A and the A63 will deal with 36 cells at 8 A. Other models cover all intermediate requirements. Most patterns have selenium metal rectifiers but some use valves.

Crypton Equipment, Ltd., 1, Victoria Street, London, S.W.1.

CYLDON (31)

All kinds of variable condensers, from the high-voltage transmitting types to miniature air- and mica-dielectric trimmers, are made by this firm. One of their latest productions is a miniature twin-mica-dielectric trimmer for inclusion in ⅜in square I.F. transformer cans.

In addition there is shown a small model-making press described as the Prestacon which can be used for the production of small brackets, punching shaped holes and for bending.

Sydney S. Bird and Sons, Ltd., Cambridge Arterial Road, Enfield, Middlesex.

DAGOLE (68)

The redesigned type "S" volume controls have centreless-ground shafts and a new type three-finger spherical contact spring.

Wire-wound resistances of all types are shown including standard 0.2 and 0.3-amp voltage droppers, coated in cement or heat-resisting paint. Other types are available in ratings of 1, 5, 10 and 20 watts.

Dagole and Co., Ltd., 5, Torrens Street, London, E.C.1.

DALLAS (137)

This firm of wholesalers is showing a large variety of receivers and amplifiers of various makes, as well as test gear, transformers, aerial equipment, and recording apparatus.

J. E. Dallas & Sons, Ltd., Dallas Buildings, Clifton Street, London, E.C.2.

DAVENSET (206)

Here are shown the latest models of Davenset battery chargers for both A.C. and D.C. supplies. Some of the units are very versatile and will accommodate several banks of accumulators while charging them at different voltage and current rates. Individual control of each circuit is provided. The latest selenium rectifiers are widely used.

This firm also continues to make their well-known range of Davenset mains transformers and chokes, one of the chief features in their design being the fully insulated and protected input and output connectors.

Partridge, Wilson and Co., Ltd., Davenset Works, Evington Valley Road, Leicester.

DAWE (201)

An enormous range of measuring and test apparatus is exhibited on this stand. The Modulated R.F. Oscillator Type 802A is unusual in having an aperiodic buffer amplifier between the master oscillator and the output. It covers 10 kc/s-50 Mc/s and is direct reading up to 30 Mc/s; the accuracy is ± 1½ per cent up to 10 Mc/s and ± 3 per cent to 30 Mc/s.

A new R.C. oscillator, type 400C, covers 0.1-1,000 c/s with an accuracy of ± 0.1 c/s or ± 3 per cent. Its output is 100 mW into 5 kΩ for a distortion of under 3%.

A Decade Inductometer, Type 230A, provides inductances up to 111.1 mH in 10-μH steps with an accuracy of ± 2 per cent. The inductors used are dust-cored and readjustment for higher accuracy at a particular frequency is possible.

Among the other apparatus on view are output power meters, valve voltmeters, impedance bridges, distortion meters, stroboscopes, and vibration meters.

Dawe Instruments, Ltd., Harlequin Avenue, Great West Road, Brentford, Middlesex.

DECCA (14)

Full frequency range recording and reproduction is the keynote of the exhibit, which culminates in the "Decola" standard model electric reproducer with a frequency range of 30 to 14,000 c/s. A portable self-contained electric reproducer, known as the "Deccalian," while not on the ambitious scale of the "Decola," nevertheless has many refinements, including the latest Decca lightweight pick-up with sapphire stylus.

The "Double Decca" portable, in its latest guise, provides reception in short as well as medium and long waves, and operates from A.C. or D.C. mains, or from internal batteries. The L.T. battery receives a trickle charge when the set is being used on mains.

Decca Record Co., Ltd., 1-3, Brixton Road, London, S.W.9.

DE LA RUE (44)

The many ways in which plastic materials is one form or another are now used in radio apparatus is well exemplified by this exhibit. A special display is made of Delaron resin-bonded laminated board, Delaflex insulating sleeving and other De La Rue plastic specialities.

De La Rue Insulation, Ltd., Imperial House, 84, Regent Street, London, W.1.

DIBBEN (105)

Servicing equipment, P.A. gear, receivers, loudspeakers, batteries

and valves by many of the well-known manufacturers are to be seen on this wholesaler's stand.

Horace Dibben, Ltd., Upper Banister Street, Southampton, Hants.

DUBILIER (80)

Here can be seen a most comprehensive selection of capacitors and resistors for use in communication, television and transmitting equipment. Many of these are designed to satisfy the most stringent tropical conditions.

The new series of Drilitic electrolytic capacitors now includes some double types in cylindrical metal cases with the case negative in some but insulated in others. The Nitrogol series of impregnated paper capacitors in sealed metal cases has been enlarged and improved, and there are a number of special television models for 3.5 kV to 10 kV working voltages.

Paper, metallized paper, mica and ceramic capacitors in a wide range of styles and values are also included in this section of Dubiliers' exhibit.

A fine display is also made of resistors. There are high-stability carbonized ceramic rod types for general purpose use, wire-wound precision models for instrument construction, ultra-high resistances, power resistors and volume control potentiometers in a profusion of sizes, types and characteristics.

Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, London, W.3.

DURATUBE (11)

A comprehensive display of wires and cables insulated with Duratuf "S" P.V.C. includes screened types suitable for communication equipment. Other applications of extruded P.V.C. shown are decorative strips, plaited covered tinsel wires for carrying handles on portable receivers, and thread for binding wiring assemblies.

Duratube and Wire, Ltd., Faggs Road, Feltham, Middlesex.

DYNATRON (6)

The Ether Conqueror models shown on this stand include a 12-valve receiver covering 10-32 m and 30-85 m as well as the medium and long wavebands. The harmonic distortion at 5 W output is claimed to be less than 0.1 per cent. Spin tuning is fitted and there is variable selectivity with bandwidths of 5, 10, 15 and 20 kc/s. Independent bass and treble tone controls are fitted. The model K129M is priced at £168 (plus P.T.) and includes an automatic record-changer.

Another model including a television receiver costs £325 10s (plus P.T.). The tuner and amplifier with loudspeaker are available separately in chassis form at £84 (plus P.T.).

This firm is also showing a range of A.F. amplifiers, and special equipment for Geiger counter measurements.

Dynatron Radio, Ltd., Perfecta Works, Ray Lea Road, Maidenhead, Berks.

E.D.C.C. (311)

This firm has long specialized in the production of small machines for converting a D.C. voltage to A.C., or stepping up a D.C. supply to a higher voltage. Such machines are essential for operating radio, television and P.A. equipment when the right kind of supply is not laid on.

Their range of equipment also includes soundproof cabinets and anti-interference filters which are effective from 10 to 2,000 metres. A special type of machine with exceptionally good voltage regulation is supplied for television sets.

The exhibit includes petrol-electric generating sets, constant-current charging dynamos and small rotary transformers for operating mobile equipment from car batteries.

Electro Dynamic Construction Co., Ltd., St. Mary Cray, Kent.

E.I.B.A. (324)

The Electrical Industries Benevolent Association, the object of which is to help the non-manual members of the industry who "fall on bad times," is using this stand as an information bureau.

Electrical Industries Benevolent Association, 32, Old Burlington Street, London, W.1.

E.I.C. (218)

Among the several test sets shown on this stand is one with range selection by push-buttons. Described as the Test Set 5PB it is a universal meter for measuring current, voltage, resistance and capacitance. The ranges are: current up to 500 mA; A.C. and D.C. volts up to 1,000; resistance up to 2 MΩ with internal battery and capacitanc from 100 pF to 0.1 μF. The meter resistance is 1,000 ohms/volt.

This firm make a portable electrostatic voltmeter with a single range and full-scale deflection of 6 kV for E.H.T. measurements in television.

Electrical Instrument Co. (Hillington), Ltd., Boswell Square, Hillington, Glasgow, S.W.2.

E.M.A. (315)

The Electronic Manufacturers' Association, which aims at promoting the welfare of the British electronics industry, defines electronic apparatus as including all equipment "depending for its function in whole or in part on the emission of a stream of electrons, including apparatus incorporating thermionic valves." The stand of E.M.A. is for the use of its members as a club room for the purpose of meeting business associates.

Electronic Manufacturers' Association, Vernon House, Sicilian Avenue, London, W.C.1.

Dawe Instruments Type 802A modulated R.F. oscillator.

Push-buttons replace the usual range switch in this E.I.C. test set.

Crypton Model A62 battery charger.

Dynatron T69A tuner and 1.559 amplifier chassis.

E.M.I. (212)

Electronic devices shown on this stand include examples of recent Emitron television camera developments and a new film scanner. There is also a scale model of one of the E.M.I. mobile television vans.

A range of R.F. dielectric heaters for pre-heating plastic moulding powders is represented and applications in other industries are indicated. Radio aids to navigation include marine radio transmitters as well as marine and light radar equipment, and there is a working model demonstrating the principles of the "Rebecca" system of beam approach for aircraft.

Tape and portable disc recording apparatus is shown and there is also a section explaining the scope of the training courses in electronics provided by E.M.I. Institutes.

Electric and Musical Industries, Ltd., Hayes, Middlesex.

Erie Ceramicon "Feed-thru" capacitor.

B.T.H. R.K. permanent magnet loudspeaker shown by Ediswan.

Mazda Octal- and B8A-base type valves showing the reduction of size with the latter.

[illegible] radiogram Model A[illegible] and (right) "Radio-time" receiver Model A33.

E.M.I. SALES & SERVICE (29)

Community aerial systems for blocks of flats are represented among the various systems of R.F. and A.F. programme distribution shown. There is a series of P.A. amplifiers from 12 to 200 watts, and a wide variety of aids to service ranging from tools to test gear.

E.M.I. Sales & Service, Ltd., Sheraton Works, Hayes, Middlesex.

E.R.I.C. (231)

This firm is showing a variety of apparatus which includes R.F. tuning coils, I.F. transformers, tuning units, power transformers, vibrator units and loudspeakers.

In addition there are complete receivers and radio-gramophones. They have three wavebands, four in the export models. There is also a television set with a 12-in tube.

A multi-range high-impedance valve voltmeter covers 5-1,000 V, A.C. and D.C.

Electrical and Radiological Instrument Co., Ltd., 54-56, Church Road, London, W.3.

EASTICK (115)

The Eelex range of standardized plugs and sockets and spring-loaded testing prods manufactured by this company are exhibited on this stand. As wholesalers they are also showing a comprehensive range of proprietary components and accessories.

J. J. Eastick and Sons, Ltd., 12, Errol Street, London, E.C.1.

EDDYSTONE (230)

Three new sets occupy prominent places on the Eddystone stand. The Model S680 communications receiver is an improved version of the "504." It is a nine-valve super having two R.F. and two I.F. stages, the latter incorporating a crystal filter giving a 45-db attenuation 1 kc/s off resonance. Use of this filter is optional. This receiver provides continuous tuning from 30 Mc/s to 600 kc/s.

The Model 640 is also new and is essentially an amateur's receiver as its coverage is 31 to 1.7 Mc/s. An eight-valve superhet circuit is employed with one R.F. and two I.F. stages with crystal filter. The price is £42 (£9 0s 7d P.T.).

The other set is intended for export and is described as Model S659. It has two tuning bands, each with two ranges, covering 10 to 50 metres and 110 to 575 metres respectively.

In addition there is a full range of the short and ultra-short wave components for which Eddystone are so well known.

Stratton and Co., Ltd., Eddystone Works, Birmingham, 31.

EDISWAN (49 & 219)

Magnetically-deflected television tubes with screen diameters of 7in, 9in and 12in are shown, as well as a range of Mazda valves. These include miniature A.C./D.C. types with the B8A base taking 0.1 A heater current. The miniature A.C. types include an R.F. pentode with g_m = 7.5 mA/V and fitted with the B7G base. This is the 6F12 and there is a double-diode, the 6D2 on the same base.

Both magnetic and piezo-electric pickups are shown. The former has an output of 0.7 V R.M.S. at 1,000 c/s and is priced at 27s 6d (+ 6s 3d P.T.), while the latter has an output of 1.7 V R.M.S. and costs 50s (+ 11s 5d P.T.).

The B.T.H. Senior R.K. loudspeaker is of the permanent-magnet type with a curved cone. It is rated to handle 10 W peak; it has a fundamental resonance at 45 c/s and covers 30-12,000 c/s. It costs £6 15s without transformer.

This exhibit also includes the loudspeakerphone, an electro-encephalograph with an automatic wave analyser, industrial valves and metal-to-glass seals.

Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2.

ELECTRON (22)

Insulated aerial wire is being shown on this stand as well as D.C.C. one- to four-way telephone wire. There is also a rod aerial costing 21s with 25ft lead-in.

New London Electron Works, Ltd., Boleyn Road, London, E.6.

ELECTROTHERMAL (32)

Retaining devices made of moulded rubber and fibre glass material to prevent valves from falling out of their holders in mobile and transportable sets are shown, together with various other applications of asbestos and glass-fabric insulating materials to radio equipments.

Electrothermal Engineering, Ltd., 270, Neville Road, London, E.7.

EKCO (46 & 110)

In accordance with the policy of this firm to extend the trading cycle in new models from one to two years, none of the sets to be produced in 1947/48 will supersede any of the receivers so far produced in the 1946/47 period.

Table models are represented by a standard all-wave set with no frills (A.C. and battery versions), by a receiver of superior specification and performance falling between the A23 and A28 models and by the "Radiotime" combined programme setting alarm clock receiver for those who need a "second set."

Those requiring a "luxury" radio-gramophone will find their needs fulfilled by the Model ARG37 with Garrard automatic record changer mechanism, push-pull output stage and 30 to 10,000-c/s 12-inch loudspeaker.

Television receivers, car radios and export models complete the firm's exhibit.

E. K. Cole, Ltd., Ekco Works, Southend-on-Sea, Essex.

EMOR (314)

A three-waveband superhet built in the form of a globe, with circumferential tuning scale and loudspeaker grille at the top, is the principal exhibit. Tuning is effected by rotating the globe, and subsidiary controls are in the form of sleeves concentric with the supporting rod, which stands 4½ft high and is adjustable to 6ft.

Emor Radio, Ltd., 45, Kilburn High Road, London, N.W.6.

ERIE (41)

Some new ceramic double-cup condensers rated at 5 kVA are shown for use in transmitting and radio-heating equipments. These will carry comparatively heavy R.F. currents with working voltages ranging from 5 to 10 kV. Three capacitances in each of two temperature coefficients are so far available, viz., 20 to 39 pF and 51 to 100 pF respectively.

Included also is a new ceramic trimmer of the circular rotor type designed to exclude all dust from the rubbing surfaces, thereby greatly improving both stability and noise factor. Other new "Ceramicons" comprise lead-through and stand-off condensers in which the fixing bush serves as one connection, the other being the insulated bush or pillar.

The exhibit contains many varieties of carbon rod and wire-wound vitreous enamel resistors as well as carbon track potentiometers.

Erie Resistor, Ltd., Carlisle Road, The Hyde, London, N.W.9.

ETRONIC (67)

The Model RA640 receiver is being shown here. It is a three-band set costing £18 18s (+£4 1s 3d P.T.), and the valves are arranged as frequency-changer, I.F. stage, detector, A.V.C., and 1st A.F. amplifier, and tetrode output.

Hale Electric Co., Ltd., Radio Works, Talbot Road, London, W.13.

EVERETT, EDGCUMBE (78)

Among the exhibits on this stand is an All-purpose Tester. This is a multi-range A.C. and D.C. meter, with voltage, current and ohmmeter ranges. The Model A has a meter with a 3½-in scale length; the Model E one with a 6-in scale.

The Vampire is a new rectifier-type A.C. test set having one voltage and four current and power ranges.

A 500 V insulation and earth circuit conductivity tester called the "Hum Metrohm," derives its power from a battery through a buzzer, transformer and rectifier.

Valve testers are shown, including an elaborate model for educational establishments. It is designed to facilitate taking characteristic curves and to permit the operation of the valve in certain circuits.

Everett, Edgcumbe and Co., Ltd., Colindale Works, London, N.W.9.

FARNELL (203)

This firm is showing close tolerance silvered-mica capacitors and a range of chokes, transformers and resistances. There are also loudspeakers, electric soldering irons and radio tools, including a ratchet screwdriver and B.A. socket set.

A. C. Farnell, Ltd., 15, Park Place, Leeds, 1, Yorks.

FERGUSON (26)

The Model 201RG is a 6-valve plus rectifier receiver with push-pull output of 6 W and three wavebands. An R.F. stage is included and there is an automatic record changer. There is a smaller radio-gramophone—the 461RG, with 3½ W output.

Among the table models there is an A.C./D.C. set, the 203U, which covers medium and long waves. It has a plastic cabinet and is normally designed for 200-250 V mains. A model for 100-110 V is available. The price is £15 (£3 4s 6d P.T.).

The Model 204 is designed for export and there are three versions of it—one for A.C. supplies, one for A.C./D.C., and one for 6-V battery operation. A television set, Model 841C, is being shown.

Thorn Electrical Industries, Ltd., 105-109, Judd Street, London, W.C.1.

FERRANTI (57, 77 & 215)

Ranges of battery, 4-V A.C., 6.3-V and 0.15-A valves are shown by this firm as well as high-voltage rectifiers and both 9-in and 12-in television C.R. tubes. There are also cold-cathode tubes, crater lamps, stroboscopic lamps and electrometer valves for industrial application.

A cloth-guiding device and a yarn-breakage detector are shown, and there is a hyperbolic computator. This

Everett Edgcumbe Model E All-purpose Tester.

Ferguson Mains Minor, Model 203U.

Elstone output transformer and replacement winding shown by Farnell.

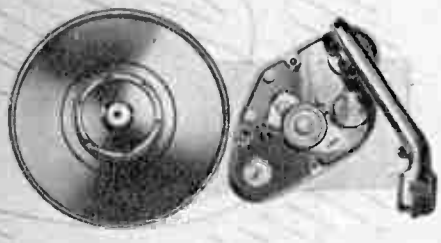
Everett Edgcumbe Hum Metrohm.

Eddystone Model S680 communication receiver (left) incorporating a crystal filter.

Ferranti Tesvac H.F. Unit Model P1.A.

(Right) G.E.C. television and broadcast receiver Model BT7092 with (below) communication receiver, Model BRT400.

Gamma all-wave universal receiver. (Below) Garrard Model RC70 automatic record changer.



last corrects automatically the positional information obtained from navigational aids such as Gee, Decca, Loran, into range and bearing. It shows also the track and distance to a chosen destination.

The Tesvac is a portable H.F. unit with an output at 4 Mc/s for testing the degree of vacuum in any glass or partly glass system. The exploring electrodes are held near the glass and the degree of vacuum can be judged by the nature and colour of the discharge.

Ferranti, Ltd., Hollinwood, Lancs.

FIDELITY RADIO (309)

Laminated plastic cabinets in a wide range of colours are available for the small table model receivers made by this firm. Radio-gramophones in wood cabinets are also shown.

Fidelity Radio, 11, Blechynden Street, London, W.11.

FRANKLIN ELECTRIC (143)

The components shown include capacitors of the dry electrolytic, silvered-mica, paper, and ceramic types, as well as carbon and wire-wound resistors, both fixed and variable. Rotary and toggle switches are on view and a feature is made of windings for transformers, chokes and field coils.

Franklin Electric Co., Ltd., 27a, Howland Street, London, W.1.

FULHAM ELECTRICAL (10)

Silvered ceramic fixed condensers ranging in capacitance from 1 to 400 pF are shown on this stand. They include models with positive and negative temperature co-efficients and combination of these two types will provide a capacitance of exceptional stability or, if required, one having a predetermined temperature co-efficient.

Fulham Electrical Components, Ltd., 459, Fulham Road, London, S.W.10.

G.E.C. (70 & 221)

Communication equipment on the main stand includes a 1-kW F.M. broadcast transmitter and portable V.H.F. transmitter-receiver, also with frequency modulation. The BRT400 communication receiver is a 13-valve superhet with two signal-frequency stages covering 150 kc/s to 31 Mc/s in six bands. It is equipped with every circuit refinement and is fully "tropicalized." A magnetic tape recorder having a playing time of 35 minutes and using oxide-impregnated plastic tape is shown, and there is a typical sound reproduction system, suitable for large factories, with a power output of 500 watts. The G.E.C. 5-kW industrial R.F. heater is also shown.

Flat-ended 9-inch C.R. tubes are employed in the G.E.C. television sets (BT7092 and BT7094) which include three-waveband broadcast receivers. Louvred cabinets are a characteristic of G.E.C. sets this year and in the Model BC4850 and its A.C./D.C. version BC4855 "piano-key" station selection requiring vertical instead of horizontal pressure are provided. These are also a feature of the BC4750 luxury table model and its radiogram and auto-radiogram versions BC4758 and BC4758R.

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

G.P.O. (302, 303 & 304)

Designed to illustrate the work of the Post Office in many fields of communication this stand provides visitors with an opportunity of seeing some of the apparatus produced by the research engineers at Dollis Hill. One such piece of equipment is the frequency-range limiter. This demonstrates the effect of suppressing the upper and/or lower sidebands.

A cable fault-locator is shown for which is claimed an accuracy in the location of faults in a radio-frequency cable to within 1 per cent in distance up to 10 miles.

The process of inverting the transmitted frequencies symmetrically about a central frequency and correcting them at the receiving end is demonstrated visually and aurally. This method of frequency inversion was introduced during the war to help safeguard confidential telephone conversations.

Another aural and visual demonstration shows how various types of signal are affected by fading and noise peculiar to long-distance S.W. communication. The use of this equipment to simulate fading, etc., permits the examination of radio-telephone systems in the laboratory under controlled conditions.

Enquiries from listeners and viewers regarding electrical interference are invited.

General Post Office, London, E.C.1.

GAMMA (238)

A 5-valve A.C./D.C. receiver with a long-wave band for home use and an extra short-wave range in lieu for export is shown with a choice of cabinet styles. There is also an inter-office communication equipment having a control unit, separate amplifier and station units. The design permits a "pageing call" to be sent out.

Gamma Electronics, Ltd., 12, Greenford Road, Greenford, Middlesex.

GARRARD (24)

Gramophone motors, record-changers and pick-ups for every application are shown. The new Model S radiogram unit makes use of a constant speed drum drive motor mounted on a unit plate with automatic stop and Type E magnetic pickup. The friction driving

wheel is interchangeable and the unit can be supplied to give 78 r.p.m. on 60 c/s mains. It is claimed that the drum drive gives increased torque for heavy recordings, and the same motor is used in the new Model RC70 record changer. This plays ten 10in or 12in records (not mixed) and the operation time between records is four seconds.

Garrard Engineering and Manufacturing Co., Ltd., Newcastle Street, Swindon, Wilts.

GENERAL ELECTRICAL RADIO (217)

Those seeking receivers and radiogramophones with specifications above the average will find much to interest them on this stand. The seven-valve three-waveband receiver Model GER/E7 has two I.F. stages and the sensitivity is stated to be 8 μV on the two short-wave ranges, which cover 12-23 metres and 30-120 metres. The third waveband is 200-550 metres. Other models incorporating record players are available. A radio-gramophone Model GER/G24 is also shown, in which a simple turntable for playing special records is provided in addition to a record changer. Separate amplifier chaunels are provided for 16-2,000 c/s and 2,000-16,000 c/s, and there are three loudspeakers with separate controls for bass, middle and top frequencies.

General Electrical Radio Co., 92, Charlotte Street, London, W.1.

GOODMANS (87)

Among the high-quality loudspeaker units shown on this stand the twin-diaphragm model with a frequency range of 45-15,000 c/s may be selected for special mention. A range of bass reflex cabinet speakers for high quality reproduction has been developed, the largest of which incorporates the twin-diaphragm unit. Among P.A. equipment may be mentioned the new cabinet units and a diffuser loudspeaker with a high-efficiency drive unit designed to handle 5 watts.

Goodmans Industries, Ltd., Lancelot Road, Wembley, Middlesex.

GRAMPIAN (79)

A high-grade 12-inch loudspeaker with curved-sided cone is among the new products shown by this firm of P.A. equipment manufacturers. It has a power handling capacity of 15 watts and the Alcomax magnet develops 14,000 lines/cm^2 in the 1$\frac{1}{4}$-in diameter gap. Two circular diffuser loudspeakers are also shown. They are of the reflector plate type and designs are available for suspension from or direct-mounting on the ceiling.

The Type DP1 moving coil microphone employs a pressed duralumin diaphragm and aluminium speech coil weighing only 560 milligrams. Response correction is provided by coupled acoustic chambers and a die-cast streamlined housing is provided.

Grampian Reproducers, Ltd., Hampton Road, Hanworth, Feltham, Middlesex.

H.M.V. (59)

The Model 1604 table model radiogramophone is of special interest. It includes an automatic record changer of compact design and takes up no more space than a conventional table model receiver. Other table models are the Model 1119 push-button A.C. mains transportable and the Model 1115 for A.C./D.C. mains with built-in aerial. The console Model 1605 radio-gramophone with pull out front gives easy control and access to the record changer from armchair level.

A 10-in tube is used in the Model 1804 television which costs £61 19s (+ £14 1s 11d P.T.) while the Model 1803 at £94 10s (+ £21 10s P.T.) employs a 15-in tube giving a picture size 12$\frac{1}{2}$in × 10in.

Future developments are foreshadowed by the display of an electrical gramophone reproducer with a frequency range of 30 to 15,000 c/s and a 43-valve 12-waveband combined radio-gramophone and television receiver designed for both A.M. and F.M. reception.

The Gramophone Co., Ltd., Hayes, Middlesex.

HAYNES (53)

The Model HR77 televison receiver shown by this firm has a 14-in cathode-ray tube. There are six R.F. stages and one V.F. stage and the detector is of the full-wave type. Hard-valve time-bases are used and the sound side is unusual in having a push-pull triode output stage. The price is £120 (+ £26 13s 4d P.T.).

A wide range of chokes and transformers is shown including some with Crystalloy cores. Scanning and focus coils for television are on view, and there are E.H.T. transformers of the hermetically sealed type for outputs up to 7 kV.

Haynes Radio, Ltd., Queensway, Enfield, Middlesex.

HOBDAY (116)

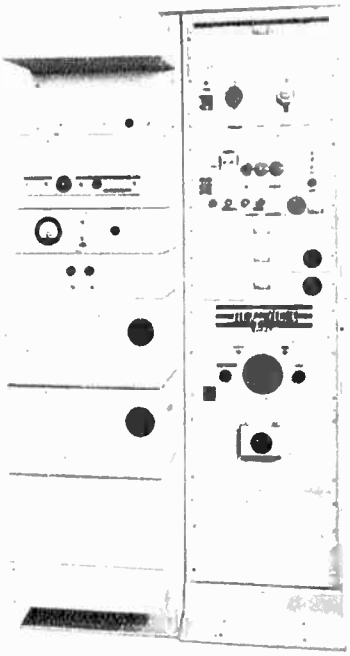
A representative display of radio and television receivers and accessories made by the leading manufacturers is shown by this firm of wholesalers. A certain quantity of test equipment is also exhibited.

Hobday Bros., Ltd., 21-27, Great Eastern Street, London, E.C.2.

HUNT (88)

The activities of this company are devoted to the manufacture of capacitors and their exhibit comprises specimens of the many varieties of fixed capacitors, semi-variable trimmers and associated apparatus now in production.

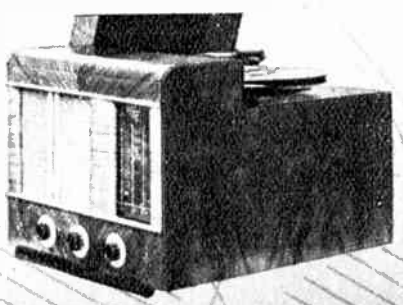
Among the many types of fixed condensers are tubular paper-dielectric types, some of which are miniature pattern employing the



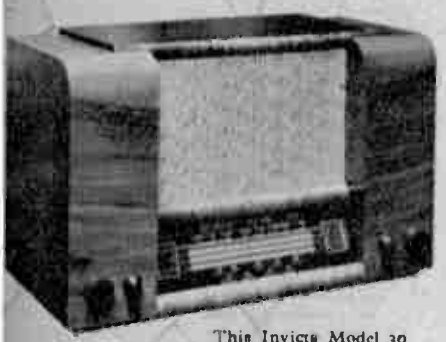
(Top right) Equipment for simulating fading shown by G.P.O. It enables radio-telephone systems to be examined in the laboratory under "working" conditions.

(Right) H.M.V. table radiogram Model 1604.

(Below) General Electrical Radio Model GER/G9 radiogramophone.



Marconiphone "personal" portable Model P17B.



This Invicta Model 30 superhet covers the trawler band.

(Below) Imhof radio-gramophone cabinet.

metallised paper form of construction developed by Hunts, moulded mica and silvered mica condensers, large capacitance paper condensers in rectangular metal cases and an extensive range of dry electrolytics.

Included also is an imposing display of small preset trimmers some on ceramic bases.

The exhibit includes the capacitance and resistance bridge manufactured by this company.

*A. H. Hunt, Ltd., Garratt Lane, London, S.W.*18.

IMHOF (82)

This firm specializes in instrument cases and handles. The cases are of welded sheet steel and are finished in a wide range of colours. The Type 1022B, for instance, measures 21¼in by 15in by 10¼in, costs 69s, and can be supplied finished in light grey, brown, yellow, red or black. Receivers and radio-gramophone cabinets are also made.

Alfred Imhof, Ltd., 112-116, *New Oxford Street, London, W.C.*1.

INVICTA (89)

Receivers for the home market as well as for export are shown on this stand. Among the former is a television receiver in a console cabinet fitted with a 9-in tube and having a T.R.F. circuit. It costs £55 (+P.T.).

Housed in an attractive walnut cabinet is a four-waveband A.C. superhet with one range covering the trawler band. This set is the Model 30 and costs £17 (£3 13s 2d P.T.).

There is a three-waveband A.C./D.C. superhet and a self-contained all-dry battery receiver, the price of which is £13 5s (£2 16s 11d P.T.).

Shown for export are two A.C./D.C. five-valve superhets, one for 110/250 volts A.C. supplies and a six-valve model incorporating bandspread tuning.

*Invicta Radio, Ltd., Parkhurst Road, London, N.*7.

K.B. (48)

The television set exhibited is the CV 40 with a 12-in tube giving a picture 10in by 8in. It is a superheterodyne employing 19 miniature valves and a temperature-compensated oscillator.

There is a radio-gramophone with automatic record-changer and storage space for records. The pick-up is of light weight and has a sapphire needle; the loudspeaker is provided with an acoustic labyrinth and a high-note diffuser. The receiver has four bands with bandspread for 14.5-15.4 Mc/s and 9.4-10 Mc/s. Flywheel tuning is used and there is an internal frame aerial for local reception. There is a similar receiver without the gramophone equipment.

The BR40 is a 7-valve 7-band set with bandspread on five S.W. bands. It has one R.F. and one I.F. valve, and fly-wheel tuning. A similar set, the BR40T, is an export model designed for tropical use.

There is a wide range of small sets, including some reflex types, and many are available as export models with tropical components.

Kolster-Brandes, Ltd., Footscray, Sidcup, Kent.

KERRY'S (140)

Among the items featured on this stand are a number for which this company—formerly East London Rubber Co.—are the sole wholesale distributors. They include the "Roberts" portable combined valve and circuit analyzer and the Hutchings mains unit, Type A14, for converting all-dry portables to mains operation.

*Kerry's (Gt. Britain), Ltd., Warton Road, London, E.*15.

KLEERGAZE (317)

A preparation for applying to the glass screen of a television set, or the dial of a radio set, to prevent condensation and misting is shown on this stand. It has the additional quality of imparting a high polish.

Kleergaze, 30a, *Sackville Street, London, W.*1.

L.E.M. (9)

This firm specializes in the manufacture of silvered mica fixed capacitors and these are made in capacitances ranging from 1 to 10,000 pF. The working voltage of the standard pattern is 350 D.C., but there is a range available for 750 volts D.C. and a limited selection for operation at 5,000 volts. The silvered mica construction enables close tolerances to be achieved even in quantity production.

London Electrical Manufacturing Co., Ltd., 450, *Fulham Road, London, S.W.*10.

L.E.S. (148)

The exhibit of this firm of wholesale distributors consists entirely of proprietary articles, and is intended for the trade visitor only.

L.E.S. Distributors, Ltd., 15, *Alfred Place, London, W.C.*1.

LEE PRODUCTS (207)

Kits of parts and circuit diagrams for the construction of radio receivers are shown. They are available for export as well as for the home market and include amplifiers, T.R.F. and superhet receivers.

Lee Products (Great Britain), Ltd., Radio House, East Street, Brighton, Sussex.

LONDON & PROVINCIAL FACTORS (123)

Proprietary equipment, including receivers, test gear, inter-communication units, battery chargers, loudspeakers, rotary convertors, aerials and components in great variety are shown by this firm.

London and Provincial Factors, Ltd., 230, *Tottenham Court Road, London, W.*1.

LONG & HAMBLY (145)

Specialists in moulded rubber parts, the company are showing, among other items, masks for television and C.R. tubes, valve retainers, a wide range of grommets and rubber-metal bonded parts.

Long and Hambly, Ltd., Empire Works, Slater Street, High Wycombe, Bucks.

LOWTHER (323)

Receiver and amplifier units for high-quality reproduction are shown by this firm. The Type DT/4 functions as a straight receiver for local station reception, and as a superhet with variable selectivity for more distant programmes. Types LEI/2 and LES are straight and superhet units respectively for those who do not require the dual tuner.

Three A.F. amplifiers are available, Type B5F with single PX25 output valve, Type A10F with PX4s in push-pull, and Type A15F with two PX25s in the output stage. The latter amplifier employs separate rectifiers for the H.T. supply to the output valves and the preceding stages.

Lowther Manufacturing Co., Lowther House, St. Mark's Road, Bromley, Kent.

LUGTON (141)

The display on this stand, which is mainly of interest to dealers, is divided into four main categories: receivers, public address gear, test gear and servicing replacements. Among the P.A. equipment is a high-quality record reproducer and the test gear includes a 6,000-volt electrostatic meter for television servicing. Lugtons are sole distributors of Leland instruments for England, Wales and Northern Ireland.

Lugton and Co., Ltd., 209-212, Tottenham Court Road, London, W.C.1.

MARCONI (225)

The exhibits on this stand are concerned with the "heavier" side of the radio industry. Here are shown some typical examples of the equipment used in broadcasting stations, for navigation on the sea and in the air, for high speed point-to-point communication and for mobile use.

There is a complete 5-kW medium wave broadcast transmitter with some typical microphones for use in studios, a horn-type aerial for a V.H.F. television link and, among the air navigation equipment, is a lightweight communication and automatic direction finder for aircraft. The Marconi Radiolocator for use in merchant ships gives a P.P.I. picture of everything "seen" by the radar transmitter.

The versatility of Marconi equipment is further emphasized by the new V.H.F. mobile transmitters and receivers designed for the use of police forces, fire services, dock and harbour authorities.

Marconi's Wireless Telegraph Co., Ltd., Marconi House, Chelmsford, Essex.

MARCONI INSTRUMENTS (228)

Two items of test equipment that will attract the interest of most radio service technicians are the TF888 Receiver Tester and TF868 Universal Bridge. The former is a versatile test set comprising a crystal-checked signal generator, an A.F. tone source and an output meter. The frequency range is 75 kc/s to 50 Mc/s and the A.F. generator produces 1,000 c/s for modulating the R.F. output, or as a separate signal for A.F. testing. Battery or mains operation is optional.

The TF868 provides facilities for the measurement of inductance from 1 μH to 100 H; capacitance from 1 pF to 100 μF and resistance from 0.1 Ω to 10 MΩ. The single dial gives direct readings without the complication of multiplication factors.

In addition, test sets of various kinds for use in receiver and component production are shown and demonstrated.

Marconi Instruments, Ltd., St. Albans, Herts.

MARCONIPHONE (37)

A "personal" portable (Model P17B) with a four-valve superhet circuit is among the range of Marconiphone receivers which this year are for the most part of compact design with built-in aerials. Model T14A, on the other hand, is intended for long-distance reception as well as quality of reproduction and covers 13.5 to 52 metres in three waveranges with band-spread tuning in addition to the normal medium- and long-wave ranges. The corresponding ARG14A radiogramophone includes a record-changing mechanism of new design.

The Model VT50A television receiver incorporates a 10-in tube and gives a picture size of 8¾in × 6½in.

A display of export models, transmitting and receiving valves, cathode-ray tubes, H.T. batteries and accessories, such as pickups and record players, completes the exhibit.

Marconiphone Co., Ltd., Hayes, Middlesex.

MASTERADIO (130)

This exhibit comprises a wide range of equipment including car sets, radio-gramophones and television receivers. There are special export models and aerials for car sets.

Masteradio, Ltd., 10-20, Fitzroy Place, London, N.W.1.

McCARTHY (120)

T.R.F. amplifiers are used for both sound and vision in the tele-

Marconi Instruments universal bridge Type TF868.

Invicta Model TL21 television receiver.

Marconi V.H.F. mobile radio-telephone transmitter and receiver units.

Marconi Instruments Receiver Test Set, Model TF888.

vision receiver shown by this firm. There are four R.F. stages in the vision channel with the first common to the sound channel. It includes a 9-in magnetic-type tube and derives its E.H.T. in a rather unusual manner by rectifying the output of an R.F. oscillator. Extensive use is made of miniature valves.

Shown also is a range of superheterodyne broadcast receivers, all of which have negative feedback.

Felgate Radio, Ltd., 6, Studland Street, London, W.6.

McMICHAEL (60)

In addition to a wide range of mains receivers and radio-gramophones, McMichael has a special display of battery sets. The outstanding model is a battery radio-gramophone providing a radio coverage of 16.5 to 171 metres as well as the medium and long waves. It has a 10-in speaker and a spring motor capable of playing a 12-in record on one winding. Q.P.P. output is used and the consumption is 12 mA H.T. and 0.5 A L.T. There is a table model receiver and a consolette with the same chassis.

In addition to a twin-speaker de luxe radio-gramophone embodying every up-to-date feature there is a television set which is also an all-wave receiver covering 13.3 to 2,000 metres. It is a console type and is fitted with a 12-in tube.

Shown also is a range of export models with similar circuit specifications to those mentioned but giving continuous tuning from 9 to 550 metres.

McMichael Radio, Ltd., 190, Strand, London, W.C.2.

McMURDO (42)

This firm is showing a range of Amphenol valveholders in both bakelite and ceramic materials, including the B8A and B7G types.

There is also a range of A.F. amplifiers, among which a 15-W model is interesting in view of the use of an R.F. oscillator to generate heater current for the early valves in order to reduce hum.

McMurdo Instrument Co., Ltd., Victoria Works, Ashtead, Surrey.

MEICO (21)

The Meico moving-coil microphone is shown and also two audio amplifiers, the Model U10 for A.C./D.C. mains giving 10 watts, and the Model 5A for A.C. mains rated at 5 watts. Examples of power transformers, coil winding and sheet metal work undertaken by this firm complete the exhibit.

Micramatic Electrical Instrument Co., Ltd., Meico Works, Congleton, Cheshire.

METROVICK (233)

Radio test gear and the "Seascan" marine radar equipment, developed to meet the Ministry of Transport specification, are shown. The test gear includes examples of signal generators, valve voltmeters, miniature oscilloscopes, etc. There are also an electronic industrial process timer, and examples of the application of "Metrosil" non-ohmic resistances in spark and surge suppression. Accurate polythene mouldings are a speciality of this firm and samples are on display.

Metropolitan-Vickers Electrical Co., Ltd., Trafford Pk., Manchester.

MINISTRY OF CIVIL AVIATION (235)

The slogan of the Ministry's exhibit is "safety in the air." There is a replica of a civil aviation area control room which provides a live demonstration of the movement of aircraft in what is known in aeronautical circles as the South East Flight Information Region. The controller and radio operators are actually handling traffic and the movements of all aircraft in and out of London which are being handled by Control Headquarters (of which this stand is a sub-section) are depicted on a wall map.

Ministry of Civil Aviation, Ariel House, Strand, London, W.C.2.

MINISTRY OF SUPPLY (240)

The purpose of the exhibits on this stand is to show the research and development work done by the Ministry for the War Office, Air Ministry and industry.

On the air side is shown the latest V.H.F. aircraft communications equipment in contrast with that used during the Battle of Britain. The latest equipment, the TR1920, which operates in the 100-124-Mc/s band, is a combined transmitter-receiver of exceptionally small dimensions. The main unit, excluding cables, weighs approximately 22 lb. With a load of 45 ohms the transmitter has an output of 4-5 watts. Receiver sensitivity is of the order of 15 μV for A.G.C. threshold. Another item of interest is a daylight viewing skiatron which has been designed to meet the need for the daylight operation of A.C.R. (Approach Control Radar) in aerodrome control towers. The H2S simulator described in February *Wireless World* is shown.

Among the ground equipment is shown the No. 10 set, described in our June and September issues last year, and the proximity, or V.T., fuse.

Ministry of Supply, Shell Mex House, Strand, London, W.C.2.

MULLARD (71, 112 & 214)

Receivers, valves and C.R. tubes are displayed on this stand. The receivers are of all types from the MUS221, with a plastic cabinet, and

Measuring the bit temperature of a soldering iron while in use by means of a pyrometer, demonstrated by Multicore.

Murphy A102R radio-gramophone and (right) V116 console television receiver.

Interior of Ossicalde Model RP7 hearing aid.

for A.C./D.C. operation, to the MTS315 television console model giving a picture 10in by 8in which includes also an "all-wave" receiver. The MAS281 five-valve A.C. set includes an R.F. stage specially designed for a good short-wave performance.

In addition to the home models, there is a range of special export types covering the medium- and short-wave bands and designed to withstand extreme heat, cold and humidity.

Among the wide range of valves shown are 1.4-V miniature types on the B7G base and the sub-miniature types for hearing aids are of special interest. There are also special television types and low-power transmitting valves.

Measuring instruments, including C.R. oscilloscopes, and transmitters are being shown as well as Ticonal magnets, air-dielectric trimmers and high-stability resistors.

Mullard Wireless Service Co., Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

MULTICORE (23)

The Ersin Multicore three-core solder is being shown, but a major part of the stand is occupied by demonstrations of the use of the solder in radio production. One of these is a conveyor at which girls from the Bush Radio factory are assembling and soldering coil units. Another consists of an illustration of the way in which the solder is used by A. H. Hunt for soldering the ends of tubular paper capacitors at the rate of 500 joints per hour.

Apparatus for the measurement of the bit temperature of a soldering iron while a joint is being made is shown.

Multicore Solders, Ltd., Mellier House, Albemarle Street, London, W.1.

MURPHY (72 & 220)

This firm is showing broadcast and television receivers. Of the latter, there are the V114 and V116 table and console models with 9-in and 12-in tubes respectively. Interference limiters are included.

The A100 is a small set so designed that the controls are accessible from either side. It is for A.C. operation and embodies miniature technique.

A full-scale set is the A122, but is unusual in being of the baffle type; that is, the "cabinet" is little more than a baffle plate carrying the controls and tuning scale on the front and the enclosed receiver on the back. The set itself is of the four-valve type and negative feedback is used in the A.F. circuits.

There is a radio-gramophone, the A102R. The receiver has three wavebands and fly-wheel tuning. A larger model, the A104 has an automatic record changer and the receiver has an optically projected tuning scale effectively 50in long.

Murphy Radio, Ltd., Welwyn Garden City, Herts.

OSSICAIDE (232)

A 3-valve R.C. coupled circuit is used in the latest Osray hearing aids. They are housed in neat moulded cases of small size with self-contained batteries. Consumption is very low, being 70 mA L.T. and 1.5 mA H.T. Models are shown also with separate battery cases.

Ossicaide, 1, Upper Richmond Road, London, S.W.15.

OVERSEAS RECEPTION (82 & 83)

With the slogan for the exhibition "Britain Builds Radio for the World," it is very fitting that the central feature of the west end of the Grand Hall should be the reception rooms set aside for overseas visitors.

Overseas Reception and Information Office.

PAGE (63)

A bedside lamp incorporating a loudspeaker is among the range of extension loudspeakers made by this firm. The "Switchmatic" control unit will operate any number of extension units and enables the set or any individual speaker to be switched on or off from the extension point. A range of 5-, 6½- and 8-in loudspeakers for set manufacturers is also shown.

Page Engineering Co., Ltd., Franklin Road, Portslade-by-Sea.

PARKER RADIO (318)

A table model and a radio-gramophone are the principal products of this firm. The Model S/AD/3 A.C./D.C. superheterodyne, covering short, medium and long waves, is housed in a mahogany cabinet 12in × 9in × 6½in and costs £14 3s 6d (plus £3 3s P.T.). In the Model RG/AC/Q radio-gramophone a Class A push-pull output stage is employed and the pick-up is a Lexington moving coil.

Parker Radio Manufacturing Co., 756, Harrow Road, London, N.W.10.

PEERLESS (307)

Communication type receiver chassis with alternative A.F. output stages, designed to meet the requirements of discriminating technical users, form the principal exhibit. The 16-valve Model 1546 receives medium and long waves in addition to four short-wave ranges covering 3 to 60 Mc/s. An R.F. stage with bandpass aerial filter precedes the frequency changer, which is followed by two I.F. stages with variable selectivity, including a crystal "gate." The A.V.C. circuit in-

(Above) McMichael battery radio-gramophone and [illegible] portable receiver.

V.H.F. aircraft transmitter-receiver exhibited by the Ministry of Supply is shown on the right. A rear view of the main unit withdrawn from the cabinet is given above. The transmitter and receiver occupy the top deck with the power supply unit beneath.

Mullard A.C./D.C. receiver Type MUS221

cludes an inter-station noise limiter. The standard A.F. unit employs 6L6 valves in push-pull; negative feedback is variable. The whole of the receiver is "tropicalized" to meet the severest conditions.

Peerless Radio, Ltd., 374, Kensington High Street, London, W.14.

PETO SCOTT (8)

A range of A.C. and A.C./D.C. sets is exhibited on this stand. They include the H52 at £22 1s (plus £4 14s 10d P.T.), an A.C. three-band set and the HU52 at £22 15s (plus £4 17s 10d P.T.) for A.C./D.C. use. They are four-valve superheterodynes with triode-hexode frequency-changer, one I.F. stage, duo-diode-triode detector, A.V.C. and A.F. stage, and tetrode output valve.

In the H52 and HU52, the wavebands are 15-51.7m, 170-550m and 750-2050m. There are also SU51, S51 and H51 models otherwise similar but covering 12.5-47.5m 47.5-170m and 170-550m.

An all-dry battery portable weighing 14½lb costs £14 14s 9d (plus £3 2s 10d P.T.) including batteries. There is also a radio-gramophone.

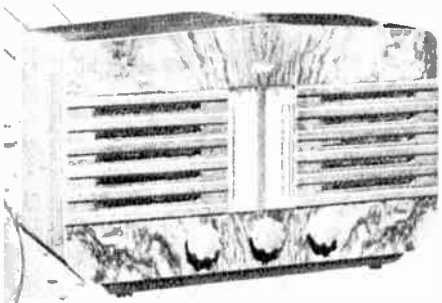
Peto Scott Electrical Instruments, Ltd., Addlestone Road, Weybridge, Surrey.

Portogram Transcontinental table-model radio-gramophone.

PETTER (102)

A comprehensive range of proprietary components and accessories is shown by this wholesale firm, which specializes in meeting the needs of the service-man. The company has the sole agency for London and Eastern Counties for the Advance signal generator.

Petter Radio and Electrical Supplies, 201-7, Forest Road, London, E.17.



Pilot Little Maestro de Luxe A.C./D.C. receiver.

PHILCO (25)

The Model A1708CG television receiver shown on this stand is of the T.R.F. type with three R.F. stages in the vision channel. A 9-in tube is used and the cabinet has folding doors covering the tube when not in use. In a larger model, the A1707, the tube is mounted on a hinged panel and disappears when out of action.

The Model D-537RG is a table model radio-gramophone of the "letter-box" type. The receiver is of the four-valve + rectifier type with three wavebands.

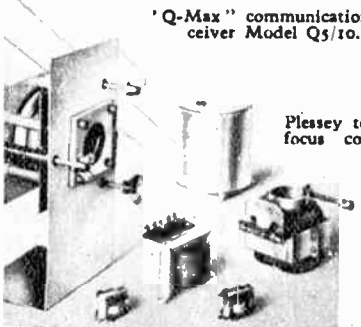
A four-band set, the A747W has an R.F. stage and covers 4.5-30 Mc/s on short waves. A tetrode output valve is used and there is a C.R. tuning indicator.

A new four-valve portable using miniature valves is on view. It covers medium and long waves with built-in frame aerials.

There are also some large radio-gramophones.

Philco Radio and Television Corp. of Gt. Britain, Ltd., 204, Great Portland Street, London, W.1.

"Q-Max" communication receiver Model Q5/10.



Plessey television components, focus coils, scanning transformers and deflector coils.

Philco car radio set and control unit.

PHILIPS (16 & 227)

Except for the cheapest table model, the television receivers shown on this stand all include a seven-valve three-band broadcast receiver. Two picture sizes are available, 7½in by 6in and 10in by 8in, and the sets include interference limiters in both sound and vision channels.

The receivers are mostly table models and include a small A.C./D.C. set—the 209U. Most, however, are four- or five-valve types for A.C. mains. A high-fidelity radio-gramophone has a push-pull output stage and twin loudspeakers. The receiver is of the seven-valve type. The automatic record-changer will handle a mixed batch of up to eight 10in and 12in records.

R.F. induction heaters are shown on Stand 227. The F12/1 has an input of 5 kW and the FV100 an input of 100 kW. A Mass Chest X-Ray Unit and a Therapy unit with an output of 300 W at 6 m are on view as well as a welding control unit.

Philips Electrical, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

PILOT (39)

Among the new receivers shown for the first time is the Little Maestro De Luxe, an A.C./D.C. 4-valve (plus rectifier) superhet with separate scales for the medium and long waves. Housed in a walnut cabinet it costs £13 13s (£2 18s 9d P.T.).

There is the Little Maestro, also an A.C./D.C. superhet with a 4-valve chassis. A choice of cabinets is provided with prices varying slightly, the average is £12 5s (£2 12s 9d P.T.). Both are miniature sets with concealed aerials.

A table radiogram with the modest dimensions of 15in × 11½in × 15½in is also new and, like the other Maestros, has a 4-valve (plus rectifier) superhet chassis, but for A.C. mains only. It provides for short-, medium- and long-wave listening and costs £32 (£6 17s 8d P.T.).

Pilot Radio, Ltd., 31-37, Park Royal Road, London, N.W.10.

PLESSEY (65)

Components for the receiver manufacturer include trimmers, chokes, electrolytic condensers, drive mechanisms, variable condensers, switches, vibrators and transformers. Scanning coil assemblies, line and frame transformers, focus coils, etc., are also available for the television set maker.

Loudspeakers include types with centre-pole magnets and reduced external field, suitable for use in television sets.

The Plessey record-changer has an overall height above the table of 4½in and depth below of only 2½in. It offers the standard performance

of eight mixed 10-in or 12-in records with a much-simplified mechanism, and the special clutch device safeguarding the pickup arm mechanism is a useful feature.

Vibrators of both synchronous and non-synchronous types are shown.

Plessey Co., Ltd., Vicarage Lane, Ilford, Essex.

POLAR (139)

This company specialize in the production of variable condensers and condenser drives for set manufacturers. Their well-known bar construction is retained for the frame of the standard and miniature types. A three-gang assembly of the latter kind measures 2¼in × 1⅛in × 1⅛in only.

The capacitance of Polar condensers is largely decided by users' requirements, but there is an upper limit normally imposed by space considerations in both the standard and miniature patterns. In the former it is 532 pF and in the latter 362 pF.

Several different types of reduction mechanism with remote and integral drive are shown, together with a series of air- and mica-dielectric trimmers.

Wingrove and Rogers, Ltd., Mill Lane, Old Swan, Liverpool, 13, Lancs.

PORTADYNE (12)

The model U57 receiver is of the three-band type for A.C./D.C. operation, with self-contained aerial for local reception. It costs £19 17s 6d (+ £4 5s 6d. P.T.). There is an export model, the U57E, which has two short-wave bands and medium waves.

An A.C. 5-valve set (including rectifier) is the A548. This has also three bands and costs £22 1s (+ £4 14s 10d P.T.).

Another 5-valve set, an A.C./D.C. model, has one medium and one short-wave band only. It can be supplied with medium and long wavebands as an alternative. It is priced at £13 2s 6d (+ P.T.).

Dynaport Radio and Television, Ltd., Portadyne Works, 18-19, Gorst Road, London, N.W.10.

PORTOGRAM (56)

This firm is showing a wide range of receivers and radio-gramophones. The Transcontinental Table-Model radio-gramophone has an output of 8 W from a push-pull stage and is a three-band superheterodyne. The Corner Console has an output of 3 W (A.C./D.C. Model) and 4 W (A.C.) and is designed to fit into the corner of a room.

Portogram Radio Electrical Industries, Ltd., Preil Works, St. Rule Street, London, S.W.8.

PUCKRIDGE (308)

Here is shown the Radio Listening Reminder, a device with three clock dials with hands which can be set as a reminder when to switch on the set.

F. Puckridge and Nephew, Ltd., Mount Works, 96, Upper Clapton Road, London, E.5.

PYE (58 & 229)

A new range of receivers with built-in frame aerials but mains operated is shown for the first time. Two are 3-valve (plus rectifier) superhets, one for A.C., the other for A.C./D.C. operation and the third is a 4-valve (plus rectifier) transportable for A.C./D.C. mains. All cover short, medium and long waves and have provision for external aerials when needed.

The exhibit includes the new Baby "Q" all-dry portable and a 4-valve super. A car radio set for 6- or 12-volt supplies with manual tuning and loudspeaker measures 5⅞in × 5⅞in × 6⅛in only. It is a 4-valve superhet with vibrator and rectifier H.T. supply and the price is £12 12s. (£2 14s 2d P.T.).

Two television receivers are shown, one is a table model and the other a console. Both have the same T.R.F. circuit for sound and vision, 9-in magnetic tube and noise limiters. The table set costs £42 (£9 8s 8d P.T.) and the console £52 10s (£11 15s 10d P.T.).

Pye, Ltd., Radio Works, Cambridge.

"Q-MAX" (234)

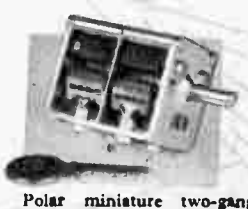
Components for the construction of short-wave transmitters and receivers and complete instruments such as the B4/40 transmitter with 10-, 20-, 40- and 80-metre tank coil turret are shown. The Q5/10 communication receiver is a five-band ten-valve superhet for A.C. mains with plug for external battery operation. A four-valve all-dry short-wave receiver is available at £12 12s (+ £2 17s 5d P.T.) and covers 11 to 350 m.

"Q-Max" (Electronics), Ltd., 10, Little Turnstile, London, W.C.1.

QUALRAD (241)

This firm is showing a range of receivers including an A.C./D.C. model—the Midgetuned—with pretuned circuits. There is a 6-valve A.C./D.C. set with a push-pull output stage; also a range of components.

Qualrad Products, Ltd., 29, Red Lion Street, Richmond, Surrey.



Polar miniature two-gang condenser compared in size with an ordinary Yale key.

R.Q.D. (36)

An attractive ten-valve radio-gramophone fitted with an automatic record-changer occupies a prominent place on this stand. It is a five-band superhet having three short-wave ranges, 13.8 to 52 metres inclusive, and the usual medium- and long-wave facilities. Other features include variable I.F. bandwidth, 8-watt push-pull output stage and tone control. An export

Pye transportable A.C./D.C. receiver, Model K47C, and car-radio set compared in size with a matchbox.

Portadyne Model A548 receiver.

Philips Model 563A television receiver.

Peto-Scott HE71 receiver.

(Top left) Radiomobile push-button car-radio equipment, Model 100. (Above right) Rola "Regal" extension loudspeaker.

(Above) R.G.D. 10-valve radio-gramophone.

"Cameogram" A.C./D.C. portable radio-gramophone (R.S.C. Radio).

version of this equipment is shown in which the long waves are replaced by a 50- to 145-metre band and all parts are fully tropicalized.

There is a seven-valve three-waveband auto radio-gramophone and a television receiver fitted with a 12-in tube giving a 10-in × 8-in picture. A superheterodyne circuit is used with six valves in the vision chain and three in the sound, the frequency changer being common to both. Magnetic scanning is used.

Radio Gramophone Development Co., Ltd., Pule Meadow Print Works, Bridgnorth, Shropshire.

R.I. (52)

Two important additions have been made to the range of "Airflo" receivers. The Model RG488 is a radio-gramophone with two PEN45 valves in push-pull feeding up to 12 watts to a 12-in loudspeaker. An R.I. miniature pickup with sapphire needle is used.

The "Airflo" television receiver Model T484 employs 21 valves plus three rectifiers and the vision receiver fully modulates the 12-in tube for a signal of 200 μV. The picture size is 10in × 8in and the price £110 (+ £26 9s 5d P.T.).

Components shown include pick-ups, valveholders with beryllium copper contacts, transformers and chokes.

Radio Instruments, Ltd., Purley Way, Croydon, Surrey.

R.M. ELECTRIC (51)

Among the receivers made by this firm are two of more than usual interest. One is a quality local-station receiver made for rack mounting and having an 8-valve T.R.F. circuit with push-pull output giving 4 watts, with bass and treble tone controls. The other is an R.F. feeder unit for use with any existing amplifier. It is a superhet covering 16 to 50 metres with medium and long wavebands and consists of a frequency changer, I.F. and combined detector, A.G.C. and A.F. stage. It is in chassis form.

R.M. Electric, Ltd., Team Valley, Gateshead, 11, Durham.

R.T.R.A. (100)

The advice bureau provided by the Radio & Television Retailers' Association at this stand is open both to traders and the public. Full particulars regarding membership of the organization representing the country's radio retailers are available for traders, whilst the public can obtain information about R.T.R.A. members in any locality.

Radio and Television Retailers' Association, 18, Woburn Square, London, W.C.1.

R.W.F. (103)

A lounge and enquiry bureau for the benefit of members of the Radio Wholesalers' Federation are provided at this stand.

Radio Wholesalers' Federation, 58, Gordon Square, London, W.C.1.

RADIOMOBILE (144)

The car radio receivers shown on this stand embody a six-valve superheterodyne receiver covering the medium and long wavebands. In the Model 100 station selection is effected by four push-buttons. The preselected combination can be changed without dismantling any part of the set and four more selected in a matter of minutes.

Change from medium to long waves and tone adjustment for speech or music are likewise push-button operated, but a rotary volume control, combined with an on/off switch, is used. Noise filters are included in the circuit and ignition suppressors are not normally required. The Model 100 costs £27 6s (£6 10s 6d P.T.). There is a companion set with manual tuning priced at £23 18s (£5 15s 6d P.T.) and a range of car aerials.

Radiomobile, Ltd., Cricklewood Works, London, N.W.2.

RADIOSPARES (73)

This company specializes in the distribution of replacement parts designed in many cases especially for use in the repair of radio equipment.

Radiospares, Ltd., 19-23, Fitzroy Street, London, W.1.

RAIMO RAIDIO (305)

Among the products of this firm are extension loudspeakers and remote control units. They have also the De-Phone radio hearing aid which enables phones to be connected to the external L.S. sockets of an ordinary receiver; volume control is included.

A range of cabinets is shown.

Raimo Raidio Products, 1b, Old Torquay Road, Paignton, Devon.

REES MACE (45)

Modern versions of the Rees Mace "Cameo" and "Gnome" receivers are shown and also a Model SC70 battery portable for which unusually high sensitivity is claimed. The "Cameogram" universal mains portable radio gramophone measures only 17½in × 14in × 10in, yet includes two internal loudspeakers; the four-valve + rectifier receiver operates on three wavebands.

R.S.C. Radio, Ltd., 40, Welbeck Street, London, W.1.

REGENTONE (40)

Table model, console and radio-gram versions of a number of superheterodyne chassis with five, seven and eight valves are shown. Models with tropicalized components are available for export.

Regentone Products, Ltd., Eastern Avenue, Romford, Essex.

RELAY SERVICES ASSOCIATION (320)

Designed to represent a living room, the stand of the Relay Services Association of Great Britain is

fitted with the various types of loudspeaker installed by the relay companies.

Relay Services Association of Gt. Britain, 25, High Street, Tunbridge Wells, Kent.

RIPAULTS (1)

The principal activities of this company are devoted to the manufacture of cables, wires, insulated and screened sleeving, resistance line-cords and the assembly of cable forms for the radio industry. They also produce tag connectors and small presswork to manufacturers' requirements.

Ripaults, Ltd., Southbury Road, Enfield, Middlesex.

ROBERTS (43)

This firm is showing portable receivers. The P4D is a four-valve battery model, comprising frequency-changer, I.F. stage, diode-triode detector and A.F. stage and tetrode output valve. It is housed in a rexine-covered case and weighs 19½ lb.

The P5A has a circuit of similar general form but is designed for A.C. mains operation. This one weighs only 17½ lb.

Both sets have internal frame aerials for medium and long wavebands, and provision is made for the connection of an external aerial for the S.W. band.

Roberts' Radio Co., Ltd., Creek Road, East Molesey, Surrey.

ROLA (135)

A complete range of energized and permanent magnet loudspeakers, the latter including units with Alcomax II magnets, forms the backbone of the exhibit. These speakers are suitable for incorporating in receiving sets or as extension units, though for the latter purpose the ready-made Rola "Regal" in plastic cabinet will meet most requirements.

British Rola, Ltd., 8, Upper Grosvenor Street, London, W.1.

ROMAC (129)

A personal portable and a car radio receiver are the principal exhibits. The Model 126 portable is a superhet covering 193-888 metres. A layer-built H.T. battery gives 30-40 hours' service and L.T. is supplied by a type U2 dry cell which lasts 6-8 hours. Wires embedded in the shoulder carrying-strap are used as an aerial. The weight is 4½lb and the dimensions 9½in×5½in×2in.

In the Model 107 car receiver two units are employed, the "control" unit on the dash containing the R.F. amplifier and frequency changer, while the "loudspeaker" unit contains I.F., detector and output stages, as well as the non-synchronous vibrator and power rectifier.

Romac Radio Corporation, Ltd The Hyde, London, N.W.9.

SALFORD (75)

A quartz-controlled oscillator for the calibration of radio receivers is one of the most interesting exhibits. The fundamental is 100 kc/s and the useful range of harmonics extends to about 30 Mc/s; there is provision for A.F. modulation.

Quartz crystals in evacuated containers are shown with frequencies ranging from 4 kc/s to 15 Mc/s. The Type JCF/200 with a frequency of 100 kc/s is adjusted to 0.01 per cent as standard and higher accuracies can be supplied if required. Thermostatically - controlled units on international octal bases are available and some types have an overall stability of 5 parts per million over a wide ambient temperature range.

Selenium-rectifier type photocells of high sensitivity for use in the control of industrial processes are also shown, and the exhibit will include toroidal dust-cored coils, decade switches, slow-motion drives, small measuring instruments, the "Selectest" A.C./D.C. testing instrument, "Miniscope" C.R. oscilloscope and G.E.C. resistance and capacity bridge.

Salford Electrical Instruments, Ltd., Peel Works, Silk Street, Salford, 3, Lancs.

SCHARF (306)

Sapphire - pointed gramophone needles of straight, trailer and miniature type are shown, also a new lightweight pick-up (No. 121) retailing at 35s plus P.T.

Erwin Scharf, 49, De Beauvoir Road, London, N.1.

SCOTLAND YARD (211)

The part played by radio in providing speed in the communication system of the Metropolitan Police is shown on this stand. The V.H.F. equipment, employing frequency modulation, which is fitted in patrol cars, is seen *in situ*.

Metropolitan Police, New Scotland Yard, London, S.W.1.

SCOTT (109)

This firm is showing silicon-steel laminations for transformers, chokes and relays as well as types for meters and motors.

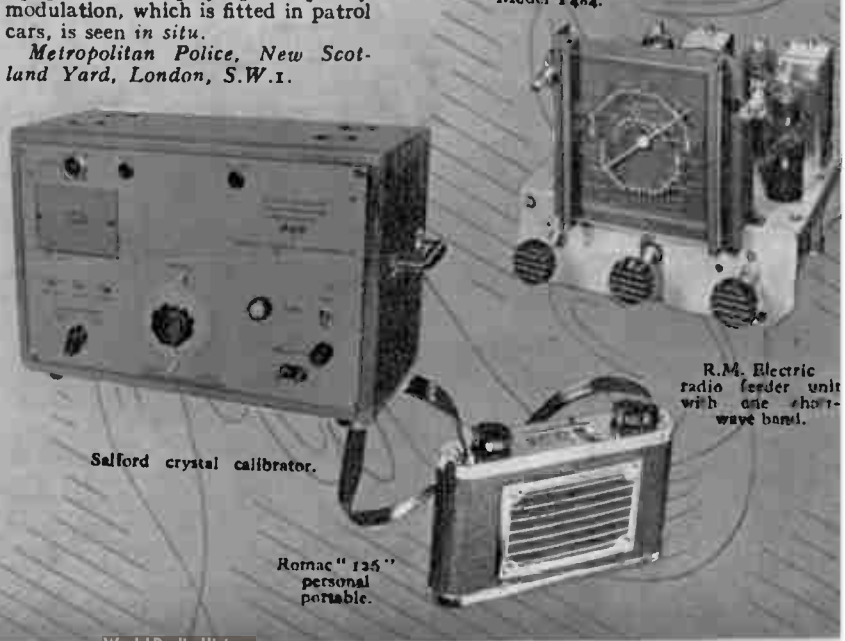
Geo. L. Scott and Co., Ltd., Cromwell Road, Ellesmere Port, Cheshire.

SHANNONS & BISHOP (104)

The activities of this firm are devoted to the distribution to the trade of certain proprietary receivers, test apparatus and accessories. There is shown also the Leak amplifier having a push-pull output stage with negative feedback giving 15 watts with 0.1 per cent distortion and a linear response.

Shannons and Bishop, Ltd., 182, Wardour Street, London, W.1.

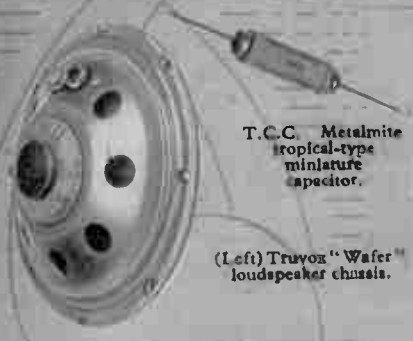
R.I. television receiver Model T484.



Salford crystal calibrator.

R.M. Electric radio feeder unit with one short-wave band.

Romac "126" personal portable.



T.C.C. Metalmite tropical-type miniature capacitor.

(Left) Truvox "Wafer" loudspeaker chassis.

Ceramic lead-through and by-pass capacitors made by United Insulators.

Four S.T.C. Uniplates assembled as a bridge rectifier for measuring instruments.

Trix 6-channel electronic mixer.

Simon 14-watt record-replaying unit, taking up to 12-in discs.

S.T.C. (64 & 228)

Several new types of rectifier have been developed by Standard Telephones for use in radio, television and electronic equipment. These include L.T. rectifiers for battery chargers, several different models for H.T. supply and a series of rod-type units for the E.H.T. supply in oscilloscopes and television sets.

This company also has a display of quartz crystal oscillators and resonators, equipment for industrial applications of radio heating, part of a 130-kW broadcast transmitter and compact radio-telephone sets for installation in aircraft and in vehicles.

Audio equipment, such as moving-coil microphones, P.A. amplifiers and test-room instruments, including a new double-beam oscilloscope, are also included.

Standard Telephones and Cables, Ltd., Connaught House, Aldwych, London, W.C.2.

SIMON SOUND SERVICE (209)

A comprehensive service to sound record studios — professional and amateur—is represented by accessories and complete instruments of all types.

Simon Sound Service, 48, George Street, Portman Square, London, W.1.

SOBELL (18)

Model 717 (six valves + rectifier) has two I.F. stages and push-pull output valves; there are four wavebands. A rotary drum scale exposes only one wave-range at a time. In addition to the table model there is the Model 717G in dwarf console cabinet and Model 717AG with separate compartments for radio receiver, record changer and record storage. Both models have automatic record changers.

A combined television and broadcast receiver (Model T107) has an interesting tuning device in which the broadcast tuning scales are contained in a sliding panel which hides the picture tube and television controls when they are not in use. The television set gives a 10-in x 8-in picture and includes impulsive noise suppression on both sound and vision.

Sobell Industries, Ltd., Langley Park, Nr. Slough, Bucks.

STATIC CONDENSERS (210)

The firm is showing paper dielectric capacitors in rectangular metal cans and also of the tubular type. They are available with voltage ratings up to 20 kV.

Static Condenser Co., Ltd., Wokingham, Berks.

STEATITE (18)

Specimens of the many different forms of ceramic insulating materials made by this firm for the radio industry are displayed on this stand. Of special interest are such products as variable condenser spindles and threaded coil formers, ground to very close dimensional limits after manufacture.

Included also is an extensive range of standard type metallized insulators for use as hermetic seals and a profusion of ceramic bases in various shapes and sizes for the multifarious uses to which ceramic insulating materials are put in modern radio equipment.

Steatite and Porcelain Products, Ltd., Stourport-on-Severn, Worcs.

STERLING CABLES (128)

A comprehensive range of the insulated wires and cables using rubber, synthetic rubber and plastics made by this firm is shown. Their products also include co-axial cables for high frequency applications and wires and cables with special tropical insulation.

Sterling Cable Co., Ltd., 25, Queensway, Enfield, Middlesex.

T.C.C. (5)

Every variety of fixed capacitor in paper, mica and electrolytic types for radio and television equipments is to be found on this stand. Miniature and tropical styles are included.

For conditions of extremely high humidity T.C.C. have a range of super-tropical models described as Metalboss, Metalpack and Metalmite in sealed aluminium cases, the last being a miniature type.

Designed especially for television equipment and C.R. oscilloscope purposes is a range of high-voltage (750 V to 15 kV) capacitors in moulded bakelite cases.

An interesting type is the extremely small Picopack series of electrolytics which measure only 0.34in in diameter and include a 1μF size for 350 volts D.C.

Telegraph Condenser Co., Ltd., Wales Farm Road, London, W.3.

TANNOY (17)

A number of new products for sound amplification and distribution are shown.

The "Commercial" radio-gramophone, which is intended for school and similar installations comprises a playing desk, a newly designed radio chassis and a 25- or 60-watt amplifier assembled in a wooden cabinet. Designed for low record wear, the "Commercial" moving-iron pick-up uses standard needles with a rubber-sprung quick release mounting. The frequency response is claimed to be substantially level from 50 to 8,000 c/s.

Tannoy Products (Guy R. Fountain, Ltd.), Canterbury Grove, London, S.E.27.

TAYLOR (119)

This exhibit consists of a very comprehensive display of multi-range measuring instruments and specialized test equipment such as circuit analysers, cathode-ray oscilloscopes and bridges.

The Model 20A circuit analyser provides facilities for checking re-

ceiver performance; it contains an amplifier and loudspeaker and is mains operated.

The Model 30A cathode-ray oscilloscope has a 3½-in tube, an input amplifier, linear time base covering 10 c/s to 10 kc/s and provision for synchronising. The price is £27 10s.

Taylor Electrical Instruments, Ltd., 419-424, Montrose Avenue, Slough, Bucks.

TELCON (118)

R.F. cables with Telcothene dielectric are shown and include types suitable for use at 10,000 Mc/s. The range includes coaxial and twin-wire types. Transmission lines intended for the amateur transmitter are shown and have impedances of 150 Ω and 300 Ω. There are also other cables, including high-voltage types for C.R. tube H.T. leads.

Various high-permeability alloys and glass-sealing alloys are also shown.

Telegraph Construction and Maintenance Co., Ltd., 22, Old Broad Street, London, E.C.2.

TENAPLAS (133)

A selection from the wide range of thermoplastic extrusions in polythene and polyvinyl-chloride is shown.

Tenaplas, Ltd., Upper Basildon, Nr. Pangbourne, Berks.

TRIX (20)

A.F. amplifiers with outputs ranging from 15 W to over 500 W are among the P.A. equipment produced by this firm; the model V885 is unusual in giving a 20-W output with AC/DC operation. Gramophone units and receivers are shown as well as horn-type loudspeakers, and there are 4- and 6-channel electronic mixers.

Trix Electrical Co., Ltd., 1-5, Maple Place, Tottenham Court Road, London, W.1.

TRUVOX (81)

A reduction of weight of 40 per cent and a depth roughly one-quarter of the diameter are advantages of the novel method of construction adopted in the "Wafer" series of loudspeakers. The magnet is enclosed within the depth of the cone and the magnetic circuit is completed by the chassis itself.

High-quality pickups shown include a ribbon type with a frequency range claimed to be linear between 25 and 20,000 c/s, a moving coil covering 40 to 16,000 c/s, and a "Ferrocoil" also with detachable sapphire needle, suitable for use without pre-amplification in normal radio-gramophones.

Truvox Engineering Co., Ltd., Truvox House, Exhibition Grounds, Wembley, Middlesex.

TUCKER EYELET (134)

This firm manufactures all types of eyelets for the radio industry. An extensive range of soldering and connecting tags is included in the exhibit.

Geo. Tucker Eyelet Co., Ltd., Walsall Road, Birmingham, 22, Warwick.

TUNGSRAM (132)

Valves made by this firm cover a very wide range of types and replacements for most makes are available. So far as possible lists have been consolidated, and the valves included are adequate for most purposes.

The American and international octal range covers the requirements of most industrial control devices, amplifiers, domestic and car radio receivers. Octal-based "E" series valves are being continued, and there is a range of miniature button-based valves with standard B7G pin arrangements for personal portables and hearing aids.

British Tungsram Radio Works, Ltd., West Road, London, N.17.

ULTRA (13)

Among a wide range of broadcast receivers this exhibit includes the Model A511 auto-radio-gramophone. It covers 18.8–6 Mc/s, 1,500–545 kc/s, and 300–150 kc/s and has an output from push-pull tetrodes of 6 watts. A metal rectifier is used for H.T.

The T49 table model has flywheel tuning and the set is in three sub-units, two of which are hinged to allow ready access to the interior for servicing. The cabinet is of moulded plastic material in two shades of brown.

Ultra Electric, Ltd., 62, Buckingham Gate, London, S.W.1.

UNITED INSULATORS (128)

Among the latest products of this firm is a silvered-mica twin capacitor available up to 200 pF designed for use as the base of an I.F. transformer. Two sizes are made, one for midget I.F.s measuring ¾in square and one for standard types of 1¼in square.

A departure from the traditional tubular, disc and cup shapes for small ceramic capacitors is made by the introduction of a wafer pattern for capacitances of from 10 pF to 100 pF.

United Insulator Co., Ltd., Oakcroft Road, Tolworth, Surbiton, Surrey.

V.S.E. (4)

Radio receivers and portable amplifiers are the main interest of this firm.

The V.S.E. lightweight portable amplifiers are designed to operate on A.C. or D.C. mains, 190-250 volts and the "Junior" model at £24 is rated at 10 watts with two CL33 valves in push-pull. The V.S.E. 16-watt amplifier uses four CL33's in parallel push-pull.

V.S.E. Construction Co., Ltd., 5-7, Denman Street, London, W.1.

Sobell Model T107 receiver with (right) control panel down for broadcast reception and (below) up for television.

Taylor Model 20A circuit analyser.

Ultra T49 three-band receiver.

VARLEY (202)

Dry accumulators with capacities of 10 a.h. to 32 a.h. for radio purposes are shown and there is a hearing-aid model of 4 a.h. and 4 V which measures 3¼in by 3¼in by 1¾in and weighs 1 lb 8 oz.

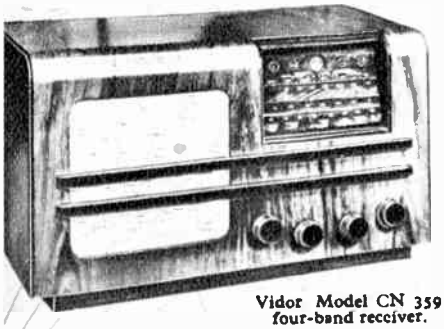
Varley Dry Accumulators, Ltd., Bypass Road, Barking, Essex.

VIDOR (27)

A "pocket" receiver measuring only 8¾in by 3¼in and costing £17 (+£3 13s P.T.) is shown. It is a four-valve superheterodyne covering medium and long waves and including batteries and loudspeaker weighs 4¼ lb.

There are two television sets, Models 369 and 370, with 9-in and 12-in tubes. They are superheterodynes and 19 valves are used in all.

Vidor, Ltd., West Street, Erith, Kent.



Vidor Model CN 359 four-band receiver.

VITAVOX (54)

A wide range of microphones, loudspeakers and P.A. equipment is shown. It includes the "Bitone" reproducer with multi-cellular H.F. horn and 12-in L.F. cone speaker combined with cross-over filter network.

The "550" series of multicellular horn loudspeakers are designed as "tweeters" for high-quality domestic reproducers, and are available in 3- and 6-cell sizes.

Vitavox, Ltd., Westmoreland Road, London, N.W.9.

WEARITE (125)

I.F. transformers with dust-core trimmers are shown in several types. In the 550-type the size is 3¼in by 1¾in square and the coils have a Q of 115 at 465 kc/s; two different degrees of coupling are available in different models. The M400B type is 1⅛in by 1⅛in square and is for frequencies of 460 kc/s, 1.6, 2.1, and 4.86 Mc/s, the Q ranges from 90 to 120.

Miniature A.F. transformers measuring only 1⅜in diameter by 1⅞in high are shown, and include microphone, intervalve and push-pull types. There are ceramic rotary-type switches, a range of mains transformers and chokes.

Coil packs, containing aerial and oscillator coils for three wavebands, together with switching are on view, as well as the well-known range of P coils.

Synchronous and non-synchronous vibrators are shown, and there are Vibro power units, containing transformer, buffers and R.F. filters.

Wright and Weaire, Ltd., 2, Lord North Street, London, S.W.1.

WEBBER (149)

The exhibit of this firm consists of various proprietary makes of broadcast receiver, battery chargers, H.T. and L.T. batteries.

J. M. Webber and Co., Ltd., 244, Tottenham Court Road, London, W.1.

WESTINGHOUSE (34)

The latest pattern Westalite rectifier is now made in a variety of types covering most requirements of H.T. and E.H.T. supply in radio equipments. These models are smaller, lighter and more efficient than earlier types.

Westinghouse are showing seven units, HT43 to HT49 inclusive, for use in A.C. receivers and a special range of 16H tubular rectifiers for E.H.T. supply in C.R. equipment and television sets. Two 16H units in a voltage doubling circuit will give over 8,000 volts D.C. at 8 mA.

A 16K miniature rectifier is available giving 150 volts D.C. at a few milliamps for use in test apparatus, also some improved copper-oxide Westectors in miniature and hermetically sealed types.

Westinghouse Brake and Signal Co., Ltd., 82, York Way, London, N.1.

WEYMOUTH (142)

A new range of dust-core coils in cans measuring 2in by 1in by 1in is shown on this stand. These K-type coils cover 33-2,000 m and there are air-core models for 12-35 m.

Several coil packs for three wavebands are made and include switching and trimmers. There are permeability tuners of both the straight and superheterodyne types. They can be supplied to cover any two bands between 150 kc/s and 15 Mc/s.

Weymouth Radio Manufacturing Co., Ltd., Crescent Street, Weymouth, Dorset.

WHARFEDALE (150)

A new cabinet-type loudspeaker designed for schools is shown. Known as the "Varitone" it employs an 8-in moving coil unit with a bass resonance at 45 c/s and the phase inversion opening at the bottom of the cabinet is fitted with a door which is closed when reproducing speech.

The twin speaker corner cabinet, for which a frequency range of 40-18,000 c/s is claimed, employs a 10-in unit for high and a 12-in unit for low frequencies, with an electrical separator unit giving a cross-over at about 1,000 c/s. This separator, which is suitable for loudspeaker impedances of 2 to 15 ohms and will handle 30 watts, is available as a unit, price £3 15s.

Wharfedale Wireless Works, Bradford Road, Idle, Bradford, Yorks.

WINTER TRADING (138)

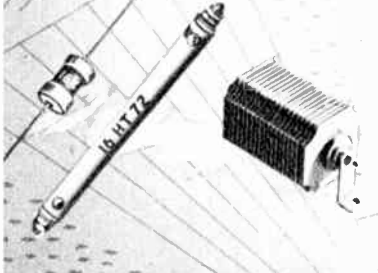
These wholesale distributors and factors are exhibiting equipment by many of the well-known manufacturers. Components form a large part of the exhibit.

Winter Trading Co., Ltd., 6, Harrow Road, London, W.2.

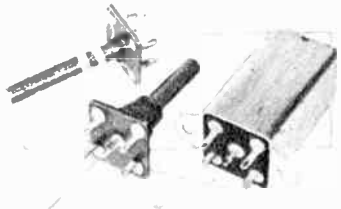
ight) Wharfedale Varitone" loud-speaker.

Vitavox Type "B" moving-coil microphone.

(Below) Westinghouse rectifiers; types shown are 16K, 16HT72 and HT43.



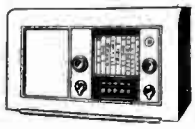
(Right) Weymouth K-type coils.



RADIOLYMPIA *highlights this wonderful* EKCO *Range!*

A52 *A.C. Superhet 26 gns. plus £5.17.5d. tax*

A44 *A.C. Superhet 17 gns. plus £3.16.9d. tax and* B53 *Battery Superhet 15 gns. plus £3.7.9d. tax*



A28 *Bandspread A.C. Superhet 32 gns. plus £7.4.6d. tax*

A23 *A.C. Superhet and* U49 *AC/DC Superhet 22 gns. plus £4.19.6d. tax (both models)*

C36 *A.C. Radio Console 32 gns. plus £7.4.6 tax*

A33 *"Radiotime" for A.C. mains 23 gns. plus £5.3.11d. tax*

U29 *"Second Set" for AC DC operation 14 gns. plus £3.3.3d. tax*

TS46 *Table Television. Price to be announced*

RG35 *A.C. Radiogram 55 gns. plus £12.8.4d. tax*

ARG37 *A.C. Auto-Radiogram 120 gns. plus £27.1.10d. tax*

TSC18 *Television plus Radio. Price to be announced*

TSC30A *Television Console 66 gns. plus £15 15.4d. tax*

CR32 *Car Radio 21 gns. plus £4.14.10d. tax*

ES31 *Extension Speaker £3.10.0d. free of tax*

CC65 *Switch Clock £5 plus £1.2.0d. tax*

Ekco Television Indoor Aerial £1.10.0d. free of tax

Ekco Car Radio Aerials CA57 27/- CA71 31/6

Quality plus reliability and outstanding performance . . . these are the characteristics of Ekco Radio and Television. Those who know Ekco's background will affirm that this is the result of a combination of brilliant scientific conception, painstaking development and the maintenance of a standard of electrical and mechanical efficiency unsurpassed in the industry. ***See them on Stand 46.***

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Unbiased

By FREE GRID

Juan Fernandez, 1947

SOMETIMES amid the turmoil of modern life with its incessant jangling of telephones and clatter of typewriters, I find myself longing for the solitude of Alexander Selkirk as he sat on the beach at Juan Fernandez wondering with some satisfaction what particular crisis he was missing at home. There must be many like me in this respect and I am happy to be able to tell everybody that I have found at least one place where one is as much cut off from the outside world as the unfortunate Mr. Selkirk, and that is in a British railway train.

When travelling in one of these archaic monsters the other day I suddenly remembered that I had not told Mrs. Free Grid I should be away for a few days. Reaching automatically for the 'phone I was brought up sharply by the realization that for no apparent reason, despite all our much vaunted carrier-current system, not a single train in this country is fitted with a telephone call box nor even a telegraph station. I was, I reflected, far more cut off than was Mr. Selkirk who could at least have put messages in bottles and thrown them into the sea—that is if he had possessed any bottles.

Thinking of bottles reminded me that I could obtain one of these from the dining car, stick a message and a ten shilling note inside it and hurl it out as we rushed through a wayside station. The dining car attendant pointed out, however, that this

Red tape run riot.

was a breach of the company's regulations regarding the hurling of bottles from windows whereby platelayers might be injured.

I determined, therefore, to avail myself of the privilege whereby on payment of £5 a train may be stopped by pulling the communication cord, and I took from my wallet the necessary pound notes to hand to the guard. To me this seemed, and still does seem, a simple enough business transaction whereby one pays, although rather stiffly, for a service rendered. But not a bit of it! Those who talk of the red tape that is likely to be rampant when the railways are nationalized seem to imagine that it is non-existent now. The contrary is true, for not only did the guard refuse to accept my £5 but the whole time-wasting and money-wasting machinery of the law, for which you and I pay, had to be set in motion solely to fulfil the requirements of red tape. In the end, of course, I had to pay over exactly the same £5 (plus needless costs) which could have been paid in the first place without any fuss or bother.

As a result of my experience, I cannot help reflecting that if marooned railway travellers cannot have a telephone service, they might at least be provided with a broadcast listening service (headphones only, of course). This is especially necessary now that the newsprint cuts mean that it is no longer possible to buy a newspaper with sufficient reading matter to while away the tedium of a long journey.

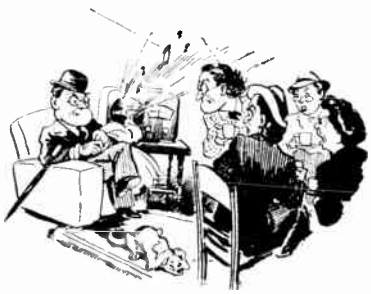
Conversational Counterblast

THE factory-made wireless set that enhances the furnishing scheme of almost every British home, be it cottage or castle, contains very little that has not originated in the fertile brain of an amateur. Even where the originator of an idea has been a member of the research staff of some radio manufacturer, he has generally first thought of it when in his bath or at some similar moment of his time not purchased by his firm.

Recently I had further proof of the above when there was demonstrated to me a receiver specially designed to fill a very pressing need of an unorganized section of the listening public for whom no manufacturer cares a sailor's farewell, which is, I understand, a rather less refined version of the expression recently made famous in government circles.

I chanced to be on a visit to a friend living near London Airport where, of course, domestic wireless reception during the passing overhead of a plane is made virtually impossible. I was listening to a talk in the B.B.C.'s "Quiet Hour" series when the roar of an approaching plane was heard and I stretched out my hand to turn the volume up, but before I could do so it increased automatically. By the time the plane was overhead the whole place was filled with the stentorian roar of the broadcaster reading the late Poet Laureate's "Into the silence."

With the passing of the plane the reader's voice gradually died down in happy synchrony with the sentiments expressed in the poem. Long



Peace, perfect peace.

before the poem had come to its appointed end I was up and doing, carrying out an investigation into the innards of the set to see what produced this phenomenon. In addition to the aerial lead-in I found a pair of leads running up to the roof where I discovered a carefully positioned microphone. This picked up the noise of the approaching plane and triggered off a special A.V.C. arrangement, rather in the manner of Vogad—faithfully dealt with by "Cathode Ray" in the issue of *Wireless World* for July 20th, 1939, which brought a super amplifier temporarily into circuit.

Needless to say I at once saw the immense possibilities of the invention for something far more pressing than overcoming the noise of planes. I hurried home and set about the necessary alterations to my receiver and I am glad to say that I was able to test it out the very next afternoon at one of Mrs. Free Grid's interminable "at homes." The receiver rose nobly to the occasion. For the first time in my life I succeeded in listening to the B.B.C. programmes throughout the whole of the afternoon's interminable proceedings.

Transformers—Obvious and

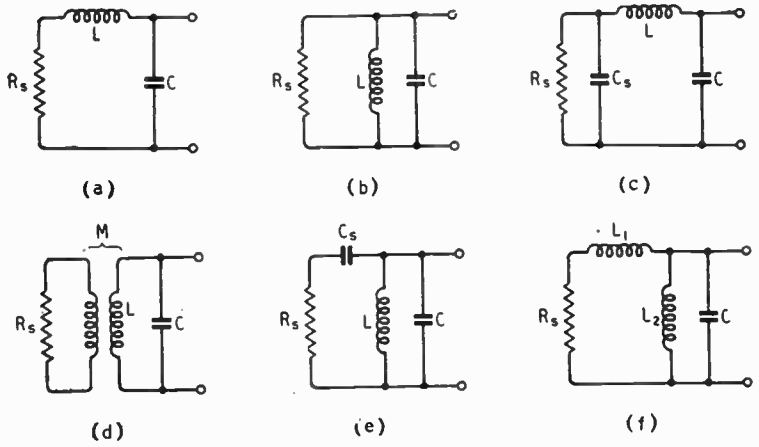


Fig. 1. These are some of the "transformer" couplings explained. The resistance R_S is converted by them to

(*a*) ω^2L^2/R, (*d*) L^2R_S/M^2
(*b*) R_S (*e*) $1/\omega^2C_S^2R_S$
(*c*) $\frac{C_S^2}{C^2}[R + 1/(\omega^2C_S^2R_S)]$ (*f*) $\omega^2L_1^2/R_S$

measured between the terminals in each case. ($\omega = 2\pi f$).

A FEW months ago, while reading one of the more learned articles in this journal*, I came across the following statement:

"The aerial or other source of signal is usually coupled to the first valve *via* some network consisting of at least one circuit tuned to resonance; this acts as a transformer, and the aerial therefore appears to the valve as a resistance having some value RA which depends on the transformer ratio."

As it was not an article for beginners, the author quite rightly proceeded on his argument without further explanation of this fact; but it struck me in passing that it might not be obvious to all how a single tuned circuit can act as a transformer, nor did I remember having seen the point explained in any elementary book. (I am now looking forward to receiving numerous autographed copies of elementary books with the passages on this subject prominently marked.)

The author of the article showed several examples of the sort of circuit he had in mind, reproduced here as Fig. 1. There will be no difficulty in identifying *d* as a transformer, but how about *a*?

One of the things that the books do explain is how resistance (or any other impedance) is, in effect, transferred from one winding of a transformer to another. If the coupling is 100 per cent, and the ratio is 1 : 1, then from the primary's point of view it is all the same whether a resistance is connected across the secondary or the primary. The ratio being 1 : 1, voltage and current are the same on both sides, so $\frac{\text{voltage}}{\text{current}}$ (i.e., the impedance) is obviously the same too. But if the resistance is connected across a secondary winding having twice the number of turns, as in Fig. 2, the primary voltage is one half and the primary current is twice that through the secondary resistance, so the resistance of R looked at from the primary side is one quarter of R. More generally, the voltage across the primary of a perfect $1 : n$ transformer is $1/n$ of that across the secondary; the load current is n times as much; so the impedance is $1/n^2$ times the impedance across the secondary. Splitting impedance up into its components, resistance and inductance are effectively multiplied by $1/n^2$, and capacitance by n^2.

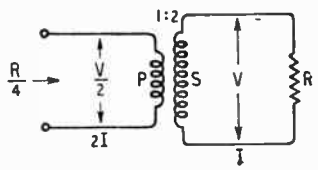


Fig. 2. Interposing a perfect 1:2 transformer has the effect of dividing the resistance R by 2^2, so far as the terminals on the left are concerned

If the coupling is less than 100 per cent, the problem is not so simple but still quite manageable. One considers the transformer as a combination of a perfect one (representing the proportion that is coupled) with inductances in series (representing the uncoupled parts of the windings), as in Fig. 3.

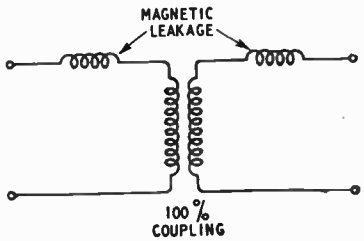


Fig. 3. An incompletely coupled transformer can be represented as a combination of a completely coupled transformer and two completely uncoupled coils (either of which can be "transferred" to the other winding, to make only one).

Going back to our very simple case in Fig. 2, there is no change in principle if the winding with the smaller number of turns is made common to both, giving an auto-transformer (Fig. 4*a*). Simpler still, if the ratio is 1 : 1, as in Fig. 4*b*, then it is quite obvious that the resistance, referred to the primary (which in this case happens to be the secondary, too) is R.

What about the inductance in parallel, you say? Well, if the

* "Noise Factor" L. A. Moxon May 1947 p. 171.

Otherwise

"BY CATHODE RAY"

Things Not Appearing on the Diagram

transformers we have been thinking about are low-frequency ones, with substantial iron cores and many turns, their primary inductances are generally so large that the current taken by them (the "magnetizing current") can be neglected in comparison with the current resulting from connecting load. But the doubtful-looking "transformers" in Fig. 1 were definitely intended for high frequencies, in which case the complicating effect of the parallel inductance can be disposed of even more perfectly, by tuning it; i.e., connecting in parallel with it an equal impedance of the opposite kind—capacitance (Figs. 4*c* and 1*b*).

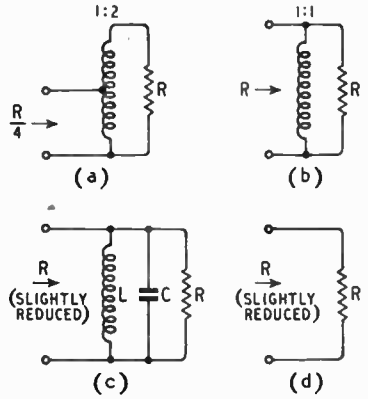


Fig. 4. Working back, via an auto-transformer, to the direct connection of a load resistance R.

From the point of view of the supply terminals, the currents through L and C, being in nearly opposite phase, nearly cancel out, leaving the equivalent of a high resistance, known as the dynamic resistance, though "Diallist" (very sensibly, it seemed to me) suggested that it might be called the "rejectance," seeing that it is the net impedance of a rejector circuit. Whatever it is called, this resistance can be merged with the parallel load resistance R, which is thereby reduced. The effect of the tuned circuit on the supply being represented now by an adjustment of the value of R, there is no longer any need to show the mutually cancelling L and C, and we finally arrive at Fig. 4*d*.

A 1 : 1 transformer can hardly be considered a transformer at all, because it has no power to change the effective load resistance. And none of the arrangements shown in Fig. 1 looks like a step-up or step-down auto-transformer, because no tapped coil is visible. But they all depend on well-known principles, all of which we have already used in connection with Fig. 4. They are:

(1) The impedances of inductances and capacitances. These depend on frequency, and as they tend to cancel one another out they are given opposite signs:

X_L (inductive reactance) $= \omega L$ ohms

X_C (capacitive reactance) $= -\dfrac{1}{\omega C}$ $\quad (\omega = 2\pi f)$

(2) The usual rules for combining impedances is series and in parallel. Any number of impedances of the same kind (R, X_L or X_C) in series can be reduced to one, by simple addition. Reactances of the opposite kind can be reduced in the same way if the signs are observed; but R and X have to be "added at right-angles" ($Z = \sqrt{R^2 + X^2}$) or by the magic j if you prefer it. In Fig. 5*a*, if the length of Rs represents the resistance, and X_{LS} an inductive reactance in series with it, Z represents by its length the magnitude of the total impedance, and by its angle the phase. If R and L are in parallel, the procedure is the same, except that the lengths have to represent the reciprocals (Fig. 5*b*).

(3) Putting Figs. 5*a* and 5*b* together, it is easy to see that it is possible for the impedance to be the same in both. In other words, given R and X in series, it is possible to substitute another R and X in parallel which are equivalent. And *vice versa*. But as X depends on frequency, they are equivalent at only one particular frequency. Making Z the same in both circuits, the equivalents work out as:

$$R_S = \frac{R_P X_P^2}{R_P^2 + X_P^2} \qquad X_S = \frac{R_P^2 X_P}{R_P^2 + X_P^2}$$

$$R_P = \frac{R_S^2 + X_S^2}{R_S} \qquad X_P = \frac{R_S^2 + X_S^2}{X_S}$$

These are extraordinarily useful formulae. And very often, especially in high-frequency circuits, they can be simplified. If the series reactance is considerably greater than the resistance—say at least five times greater—or the parallel reactance is much less than the resistance, then $R_S^2 + X_S^2$ is nearly the same as X_S^2, and it is accurate enough to say:

$$R_S = \frac{X_P^2}{R_P} \qquad X_S = X_P$$

$$R_P = \frac{X_S^2}{R_S} \qquad X_P = X_S$$

In a tuned circuit the reactance is cancelled out by one of the opposite kind, leaving resistance only. R_P is what is called the dynamic resistance, or "rejectance"; while "Diallist's" name for Rs is "acceptance."

Armed with the three principles summarized above, one can easily

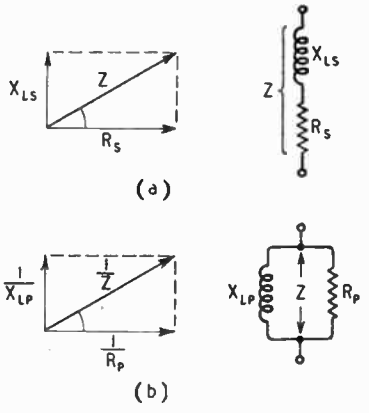


Fig. 5. The well-known vector diagram ("completing the parallelogram") method of adding resistance and reactance (*a*) in series and (*b*) in parallel. If the resultant Z is the same in both cases, then X_{LS} and R_S in series are equivalent to X_{LP} and R_P in parallel—a very useful dodge in circuit calculation.

Transformers—Obvious and Otherwise—

reduce the examples in Fig. 1 (except the recognizable transformer, *d*) to their equivalents. Take *a*, for a start. Assuming Rs is relatively small, Rp follows at once as Xs^2/R_s (which of course is ω^2L^2/R_S), and XL and Xc cancel out at resonance. So this is a suitable circuit for matching the usually low resistance of an aerial to the high input impedance of a valve. It is the equivalent of a $R_s : X$ step-up transformer. ("X" in this can be either the L or the C kind, because when in tune they are equal).

Circuit *f* is just the same, except that there is already a parallel inductance, L_2. So it is necessary that the reactance of L_1 and L_2 in parallel tune with C. The conversion formula is as in *a*; but as L_1 can—in fact must—be greater than is needed to tune with C by itself, the object of this circuit would be to get a bigger step-up ratio than with *a*.

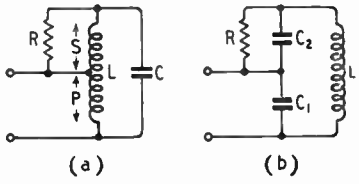


Fig. 6 (*a*) is obviously a transformer. (*b*) is an alternative form, tapped on the capacitance side.

Circuit *e* is the same as *f* except that the series reactance is capacitive, and the formula is modified accordingly.

Circuit *c* is a little trickier, because R_S and C_S in parallel must first be converted to series equivalents; the series reactance then partly cancels out with the reactance of L. The balance (which must be inductive) tunes C, and the series resistance is converted to its parallel equivalent. This double conversion means that with normal component values it is suitable for smaller ratio transformations than *a*, *e* and *f*. An advantage is that in very high-frequency apparatus, where the difficulty is to avoid excessively low reactances, L is tuned by two capacitances in series, so can be larger than otherwise. C_S and C might be the irreducible output and input capacitances of valves, for instance.

This suggests a new line of thought, which I shall try to develop next month; but in the meantime there is a way of looking at Fig. 1*c* that may be more helpful than this series-parallel-series business. Fig. 6*a* is obviously a tuned transformer, in which the terminals are connected to the primary winding and R is across the secondary. R can be converted to any other value, seen at the terminals, by varying the tapping on the coil; i.e., the ratio of the transformer. It is a type of transformer very commonly used to couple anode to grid circuit in a valve oscillator, and is then known as the Hartley circuit. But an alternative is the Colpitts circuit, which is similar except that the capacitance, instead of the inductance, is "tapped" (Fig. 6*b*). The ratio is then determined by the ratio of C_1 to C_2, remembering that the reactance of the two in series corresponds to that of C in Fig. 6*a*.

In case you haven't noticed it, Fig. 6*b* is Fig. 1*c*.

BOOK REVIEW

Elementary Radio Servicing. By William R. Wellman. Pp. 260 + xi. Macmillan & Co., Ltd., St. Martin's St., London, W.C.2. Price 21s.

THIS book is intended to meet the requirements of those who have had instruction in the theory and practice of wireless apparatus but who are inexperienced in fault-finding. The arrangement of the book is unusual; it is divided into chapters dealing with different parts of the equipment, but each chapter consists of a few pages only of general explanation together with a number of so-called "Job Sheets". These are followed by a number of questions for the student, but answers are not given.

The Job Sheets are really potted instructions for testing particular parts of a circuit or particular components. For instance, the chapter on A.F. amplifiers has four sheets; for a pentode output stage, for a 25L6 beam-power stage, for a triode push-pull stage, and for a self-balancing phase-inverter circuit. Under the heading "Procedure" the author almost invariably starts by advocating voltage measurements and he gives figures of the voltages to be expected at various points in normally designed equipment.

The examples quoted above show some confusion of thought on the part of the author, for there is no difference from the fault-finding point of view between pentode and beam tetrode stages. The only difference between the two stages quoted lies in the applied voltages. Furthermore, defects in the input coupling capacitor are treated in one only and the impression is thus given that they are peculiar to that one instead of being equally applicable to both

The testing of the phase-inverter circuit is particularly badly done. In the first place the circuit shown is not of the self-balancing type it is claimed to be, but is one in which the balance depends on the maintenance of the correct ratio of two resistances in relation to the gain of a stage. In the second place, after a lengthy discussion on voltage checking, there is a brief reference only to checking the balance with an A.F. input, but no indication at all of what is to be done if the circuit is then found to be unbalanced

In a section headed "The Volt-Ohm-Milliammeter" there is no reference whatever to the milliammeter and the use of this instrument in fault-finding receives no mention at all.

The book is of American origin and the references to circuit techniques are to American practice. Although the ground covered is wide, the treatment is superficial.

W. T. C.

BOOKS RECEIVED

Radio Test Instruments.—By Rufus P. Turner. Most of the material in this American book has appeared during the past five years in *Radio News*, and is concerned mainly with the building of test gear—from simple current and voltage meters to signal generators. 221+xv pages, with 182 diagrams and illustrations. Ziff, Davis, Ltd., The Grampians Building, Western Gate, London, W.6. Price 25s.

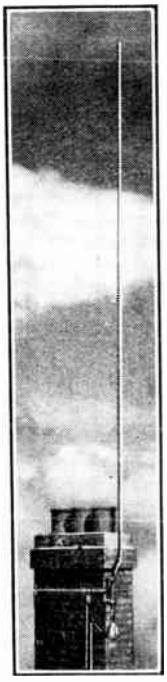
C. & W. Press Handbook.—The third edition of this booklet includes, in addition to cable tariff rates, details of the cable and radio facilities afforded by Cable & Wireless and its associated companies throughout the world. 36+xii pages. Cable & Wireless, Ltd., Electra House, Victoria Embankment, London, W.C.2.

BELLING-LEE QUIZ (No. 16)

Answers to questions we are often asked by letter and telephone

Q. 46. What are you showing at Radiolympia ?

A. 46. NEW SKYROD. NEW ELIMINOISE.



The illustration (left) shows the new "Skyrod" mounted on a chimney. Kit No. L618.

The new Belling-Lee "Skyrod" will be 18 feet long, in three sections, of high tensile alloy, for chimney mounting. Instead of one set of transformers for the "Skyrod" and another for the "Eliminoise," there will be one set only, which will normally be used with the "Skyrod," but may also be used with a horizontal aerial, or attached to the cross bar of a television dipole (Belling-Lee U.K. patent No. 520628) to enable the reflector to be used as an anti-interference aerial. As we have been unable to improve the electrical design, this has been left as in the original "Eliminoise," the performance of which has never been equalled. We have, however, considerably improved the mechanical design of both the aerial and receiver transformers. They have been "streamlined" inside and out. All parts necessarily so, are easily accessible and much time will be saved in installation. A very real facility has been added to the receiver "Eliminoise" which is intended to be fixed to the skirting board, and is provided with a coaxial output, the new Belling-Lee coaxial plug and socket being incorporated. The lead to the receiver consists of a 5ft. coaxial cable with its appropriate plug to the transformer, the set end terminating with two O.Z. 1/8in. dia. plugs soldered on, the junction being a polythene moulding. We would remind readers that the wave bands covered are 10–56; 200–560; 1,000–2,000 metres.

The above illustration is of our new "Eliminoise," Kit No. L308K, including Transformers, Cable, Aerial and Earth wire, Insulators and a Receiver connecting lead. U.K. Patents No. 477218, 479118.

We are also showing a full range of TELEVISION AERIALS including the comparatively new INDOOR TELEVISION AERIAL FOR ATTIC OR LOFT. This is intended for districts where field strength is strong. It has very distinct minima, which can be used against interference. Can be used indoors, or is supplied with metal mast and lashings for chimney mounting. If you do not already know them, see also the "WINROD" WINDOW AERIAL and the "CAROD" CAR AERIAL.

A.B.8A VALVEHOLDER has been added to the range of other well-known types which include HIGH VOLTAGE VALVEHOLDERS.

THERMAL CUTOUTS for the protection of fractional h.p. motors are being shown and demonstrated, a motor being run which may be stalled by a brake. The action of the cut-out being brightly illuminated is observed through a powerful lens. Cutouts are a rapidly increasing part of our production, and our engineers will be glad to discuss these with engineers of firms who are interested.

A range of FILTERS FOR THE SUPPRESSION OF H.F. INTERFERENCE is shown. Most of these have been re-designed since last Radiolympia, to take care of the higher frequencies now more commonly in use.

SPARKING PLUG SUPPRESSORS and DISTRIBUTOR SUPPRESSORS are available to prevent motor cars from interfering with television; incidentally, every employee of every exhibitor should have his car suppressed.

AMATEURS will find that they are interested in practically everything shown and will be made specially welcome. Our AMATEUR AERIAL KIT is already fairly well known.

COMPONENTS include a full range of TERMINALS; improved single, double and multi PLUGS AND SOCKETS; a comparatively new range of COAXIAL PLUGS AND SOCKETS, single, twin "T" section and couplings; FUSES AND FUSEHOLDERS, including a fairly new miniature panel fuseholder; also GLASS SEAL TERMINALS.

We are proud of our production, but, although in general our deliveries are as good as most, we are anything but proud of them, nor are we complacent. We do our best and crave your patience although we are ourselves impatient.

Radiolympia 1947
STAND No. 33

BELLING & LEE LTD
CAMBRIDGE ARTERIAL ROAD. ENFIELD. MIDDX

Television Receiver Construction

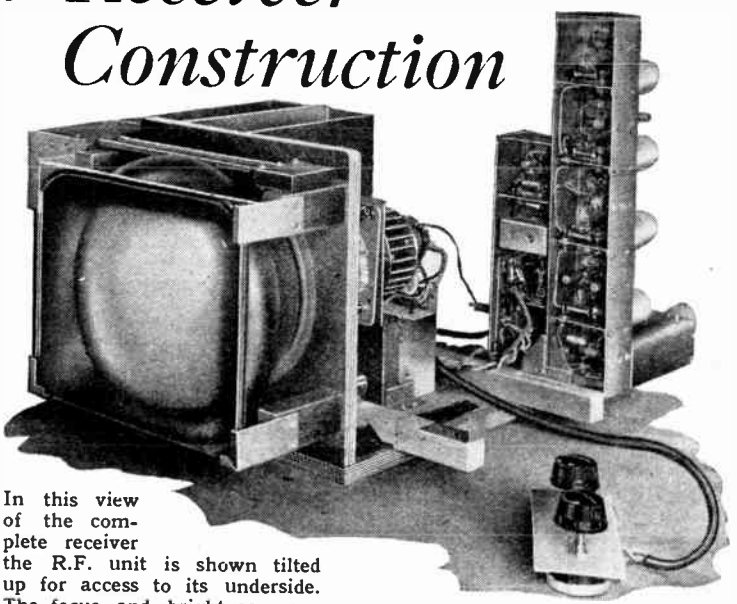
8—Receiver Unit

AT high frequencies the use of high-conductivity material for the chassis must be considered essential. As the R.F. currents do not penetrate deeply into the material, it would be economical to use steel with copper or silver plating. However, it is simpler to use sheet copper, and the thickness needed is governed by mechanical considerations.

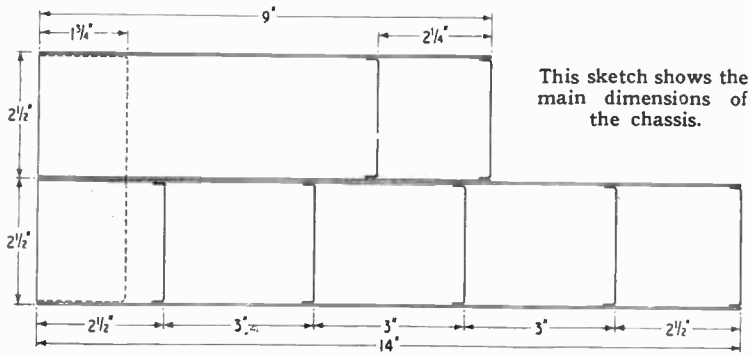
As shown in the photographs, the vision and sound chassis are of channel section and are bent from pieces of No. 20 gauge copper sheet. Cross screens, cut away to clear the valveholders, are fitted, and No. 26 gauge is adequate for these. The two chassis are bolted together after the cross screens have been fitted and it is, of course, necessary to use countersunk-head screws for those in the adjacent faces of the chassis.

The V.F. stage is carried in a compartment above the rear of the main chassis. This economizes in space and brings the V.F. output close to the base of the C.R. tube. For this, brass is adequate, but there is no objection to copper if it is preferred.

It is essential to pay particular attention to obtaining very short direct leads, and it is especially important to make sound soldered connections to the chassis for all earth points.



In this view of the complete receiver the R.F. unit is shown tilted up for access to its underside. The focus and brightness controls can be seen fitted to a small panel which can be mounted in any convenient place.



This sketch shows the main dimensions of the chassis.

The cross-screen divides the valveholder leads into two groups which fall into adjacent compartments. On the input side there are the earthy heater, internal screen, grid and cathode connections, while on the output side there are the non-earthy heater, screen, anode and suppressor connections. The second internal-screen connection falls immediately beneath the cross screen.

This last is earthed by a short lead soldered to the chassis on the input side of the cross screen and the suppressor is similarly earthed, but on the output side. The earthy-heater tag is earthed to the chassis as closely as possible to it and a short lead is run along adjacent to the chassis for the live heater lead.

The earthy heater, adjacent internal screen and centre spigot are all joined together on the valveholder. In addition, there are a short lead from "internal screen" to chassis, one very short lead from "internal screen" to chassis, and one very short one from the centre spigot to the cross-screen. This last connection is important.

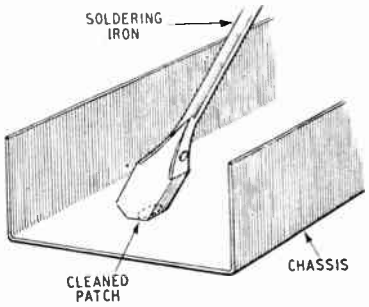
The screen and anode decoupling capacitor is mounted on the cross screen on the output side and the 0.001-μF main bias-resistor by-pass capacitor is held by the same screws on the input side. A small hole is drilled through the cross screen adjacent to the earthy ends of the capacitors and a wire passed through it is soldered to the two capacitors, to the screen and to the suppressor tag on the valveholder.

The H.T. side of the decoupling capacitor is joined directly to the screen tag on the valveholder and also supports one end of the decoupling resistor.

The 50-pF cathode capacitors are supported in the wiring over the valveholder and soldered directly with the shortest leads to the cathode tag and the internal-screen tag adjacent to the heater. The main 100-Ω bias resistor is soldered across the

Television Receiver Construction—0.001-μF cathode capacitor with the 33-Ω resistor from the un earthed end to cathode.

It is necessary to provide some support for the H.T. ends of the 220-Ω anode and screen de-



Illustrating the kind of soldering-iron most suitable for making sound joints to a copper chassis.

coupling resistors. There are many ways of doing this. The one adopted is particularly neat, but a little troublesome because the supports are specially made. A short length of $\frac{3}{16}$in insulating rod has a 2 B.A. thread run on it and a small hole drilled lengthwise down its centre. A tightly fitting piece of wire is pushed through the hole and the whole forms a lead-through insulator which is secured in a hole in the cross-screen by two 2 B.A. half-nuts.

Now it will be clear from the above that there are a good many soldered connections to the chassis. If this job is tackled in the right way and with the right tools there is nothing difficult about it, but it is impossible to make good joints if one adopts an ordinary soldering technique. This is because of the high heat conductivity of copper, which makes it difficult to raise the temperature of a small piece of the chassis sufficiently.

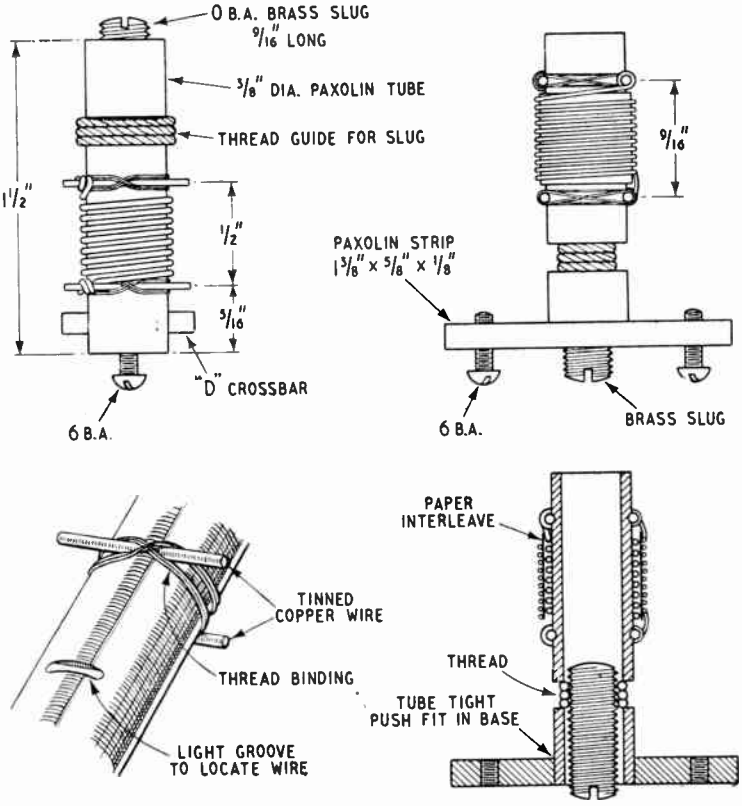
The average soldering iron is quite useless for the job. It is essential to have a big heavy bit so that it can store an adequate quantity of heat; the smallest satisfactory bit weighs about $\frac{1}{2}$lb. It is essential to have an adequate contact area between the bit and the chassis so that the heat can flow rapidly from the "iron" to the chassis. A long tapered bit is useless. The bit should not taper at all until it is close to the end, and it should then have a blunt, wedge-shaped nose. The whole flat end of one side of the wedge can then be placed in contact with the chassis.

The sort of bit that is satisfactory, and the simplest way of soldering the leads to the chassis are shown in the sketch. A small area is scraped quite clean, say, with the end of a screwdriver, and a piece of rosin-core solder about $\frac{1}{4}$in long is placed on the clean patch. The iron must be clean and really hot. It is placed on top of the solder, which it melts almost instantly, and pressed against the chassis. After some 5-10 seconds the copper chassis will locally be hot enough, and a slight rub of the iron will make the solder take. The previously tinned lead is then slipped under the nose of the iron and held perfectly still while the iron is removed and the solder cools.

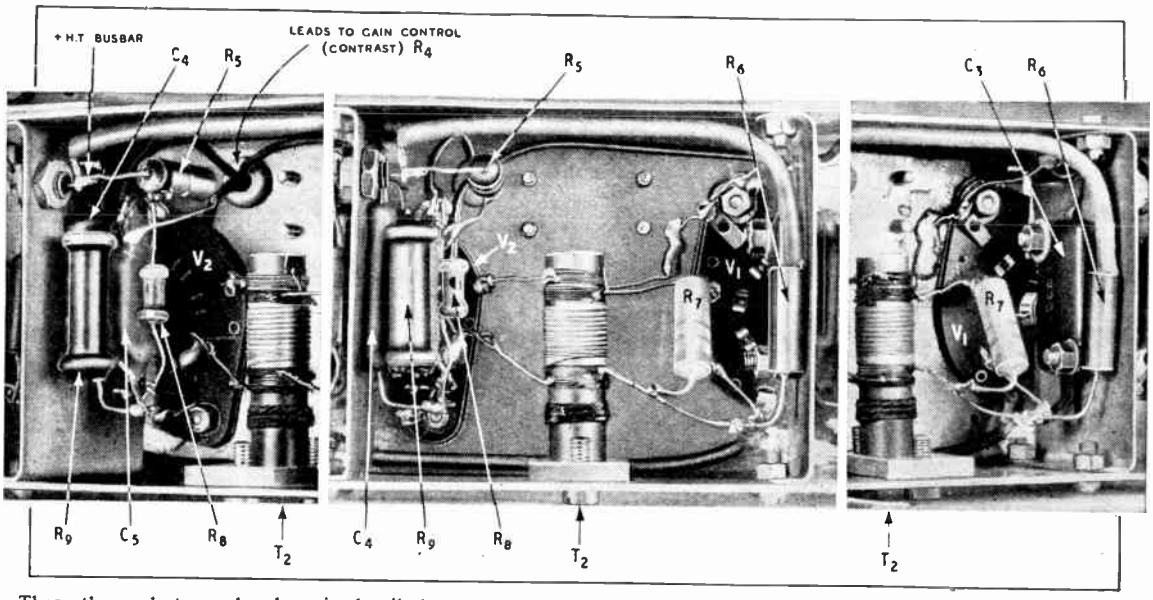
All this sounds rather difficult, but it is not, and a little practice will enable sound joints to be made with ease. It is worth taking a little trouble to acquire the knack, for bad joints will be a perpetual source of trouble. It will probably be hard to obtain an electric iron with the right shape of bit for the job, and it is best to use a plain one heated by a bunsen burner or a blow lamp.

The photographs which illustrate this article show the details of the wiring where they are important. They are substantially the same in all compartments, there being only minor differences brought about by the trap circuits.

The coils themselves are unscreened since in view of the low stage gains they are far enough apart for magnetic coupling to be small and the cross partitions provide screening for the electric fields. They are double wound, not to provide a band-pass effect, for this is obtained by stagger tuning, but to save coupling capacitors and to provide separate



These drawings show the details of the R.F. coil construction. Winding data is given elsewhere.



These three photographs show in detail the arrangement and wiring of the R.F. stages. The centre one shows T2 coupling V1 (right) to V2 (left), while the right- and left-hand pictures show the same compartment from different angles.

earth return circuits for the anode and grid circuits of adjacent valves. This helps considerably in obtaining stability at high frequencies.

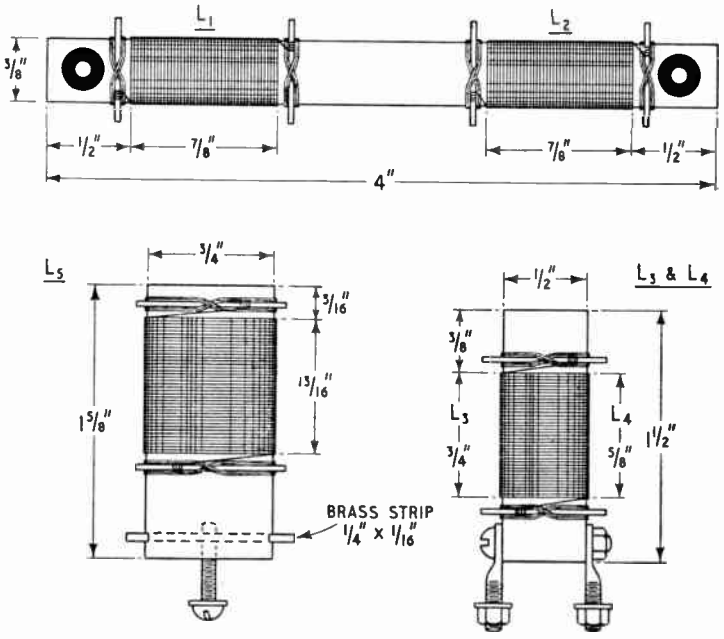
Drawings of the coil details are given. They are wound on a $\frac{3}{8}$-in outside diameter $\frac{1}{16}$in wall Paxolin tube and fitted with o B.A. brass slugs for tuning. An internal "thread" is provided by the simple expedient of cutting away two segments of the wall of the tube and winding this with thick thread; this should be done with the slug in place.

Thin wire is used for all the vision-channel coils, since losses are unimportant as the circuits must be heavily damped to obtain the bandwidth. The effect of coil losses is, therefore only to modify the damping resistors needed.

This does not apply to circuits operative on the sound channel, either in the sound amplifier or as rejectors. Heavier wire is used here, but in spite of the higher losses as compared with copper, brass slugs are retained in the interests of uniformity. Copper slugs are better in theory, but the difference is not enormous and o B.A. copper rod is not easy to obtain.

Two forms of coil mounting are used. As can be seen from the photographs the sound-channel coils, the rejector and one vision-channel coil are mounted in the usual way by a 6 B.A. screw through the chassis into a short metal rod passing through holes in the side of the former.

The other coils are mounted by a Paxolin plate which has two holes tapped 4 B.A. for fixing screws and a hole fitting tightly on the outside of the coil former. The former is pushed into this hole and flooded with shellac.

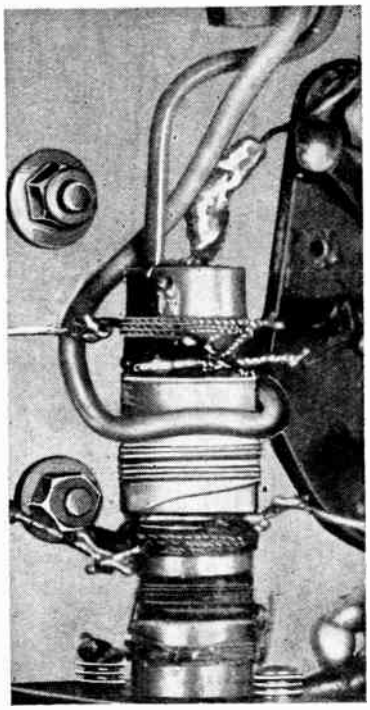


Details of the detector filter and the various correction coils are given here.

Television Receiver Construction—

Winding details of all coils, including the V.F correction coils, are given in the Table. They are not difficult to make, but are somewhat tedious because there are rather a lot of them.

The R.F. coil formers are nearly all alike, and the labour is reduced by carrying out similar operations on all coils in turn rather than completing each one individually. The best procedure is to cut all the formers to length, remove burrs from the ends, mark off the positions of the slots for



This close-up of T3 clearly shows the coupling loop to the sound channel. It is formed in the wiring.

the thread holding the slugs, and then cut the slots with a miniature hacksaw. If the former is then slipped on a piece of ¼in brass rod, the segments are easily removed with a sharp, narrow-bladed chisel.

A few formers have holes for fixing bars, and these can now be drilled. The solder tags should be attached next. A small V-groove should be put in the former where each tag is wanted with a small triangular file. The tags are short lengths of tinned copper wire, about No. 20 gauge. In most cases the tags are in pairs opposite one another. The two tags of a pair should be placed in their grooves and held in place by a tight binding of thin thread. The whole former should then be given a coating of shellac varnish.

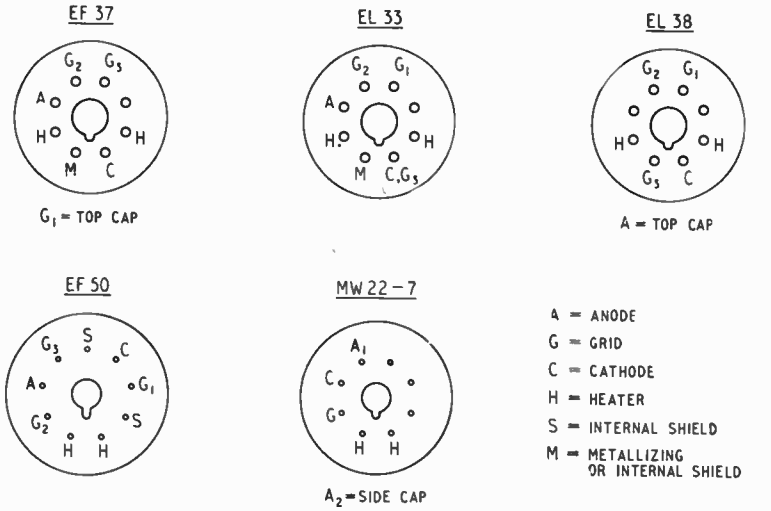
When dry, the slugs should be fitted. These are 1in lengths of 0 B.A. brass rod with a saw-cut across one end. The slug should be put into the former and then thick thread should be wound into its thread, through the slots cut in the walls of the former, and tied tightly. This will be found to provide quite a good screw thread and is sufficiently robust for the purpose. Unless the ends of the slugs are tapered slightly and smoothed, it is not recommended that a slug be removed completely after it is fitted. The

(*Continued on page* 395)

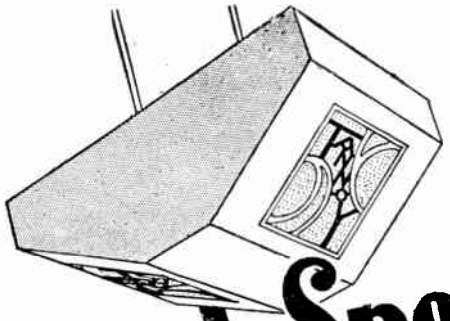
COIL WINDING DATA

Note.—In all multi-winding assemblies, all windings are in the same direction, and grid windings are overwound on anode windings with one turn of shellacked paper between for insulation; adjacent ends are grid and anode on the one hand and earth and +H.T. on the other.

Component	Wire (S.W.G.)	Winding 1—2 (turns)	Winding 3—4 (turns)	Resonant Freq'cy (Mc/s.)	Remarks
T_1	36 D.S.C.	2½	15	43	Winding 1—2 is interwound with 3—4 at earthy end without interwinding insulation.
T_2	36 D.S.C.	11	11	43	
T_3	36 D.S.C.	10	10	41.5	Sound coupling coil of 1 turn inserted in wiring; to be disconnected while adjusting T_3.
T_4	36 D.S.C.	9	9	47	Winding 3—4 is tapped for connection (5) at 1 turn from (4).
T_5	36 D.S.C.	13	13	46	
T_6	26 D.S.C.	12	—	41.5	
T_7 (a)	26 D.S.C.	13	—	41.5	
T_7 (b)	26 D.S.C.	12	—	41.5	
T_8	26 D.S.C.	10	—	41.5	
L_1, L_2	36 enam	84	—	—	
L_3	38 enam	108	—	—	
L_4	38 enam	90	—	—	
L_5	40 enam	112	—	—	

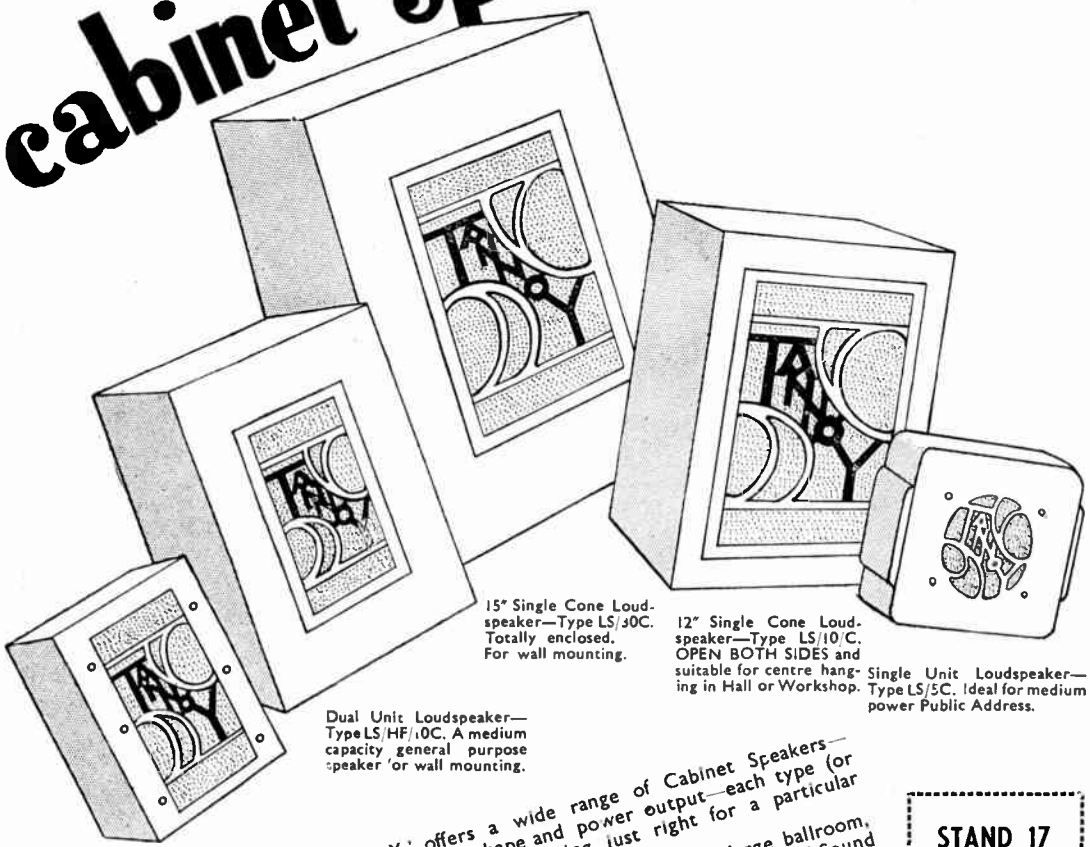


For convenience the base connections of the valves used are given here, in all cases looking at the underside of the valveholder.



Indoor Suspension Loudspeaker—Type LS/T/10C. Fitted with two 8" units and covers a wide area.

cabinet Speakers.. ..



15" Single Cone Loudspeaker—Type LS/30C. Totally enclosed. For wall mounting.

12" Single Cone Loudspeaker—Type LS/10/C. OPEN BOTH SIDES and suitable for centre hanging in Hall or Workshop.

Single Unit Loudspeaker—Type LS/5C. Ideal for medium power Public Address.

Dual Unit Loudspeaker—Type LS/HF/10C. A medium capacity general purpose speaker for wall mounting.

Dual Unit Loudspeaker—Type LS/HF/5C. Designed for mounting on wall or across a corner.

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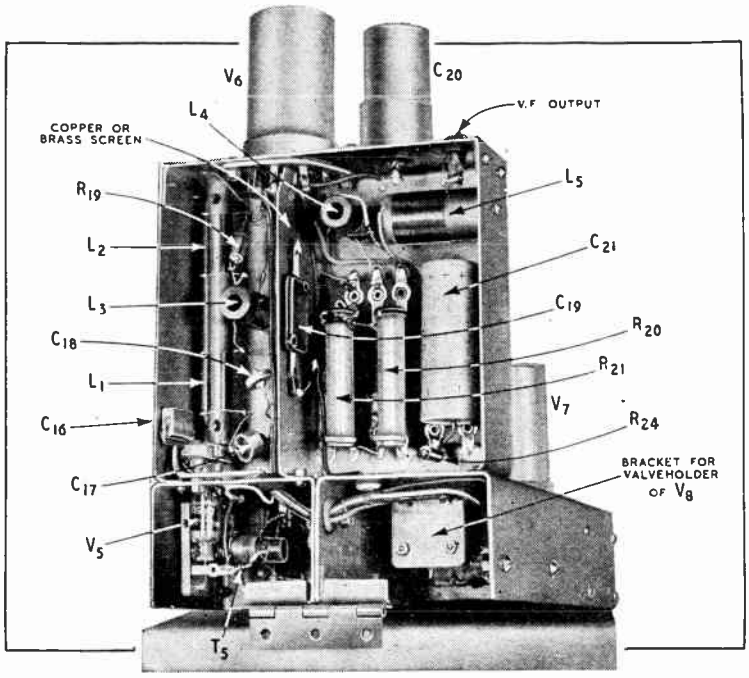
Television Receiver Construction—reinsertion of a slug with any roughness on the end is likely to cut the thread.

Winding is easy. The turns are given in the Table, and they are spaced by eye so that the full coil fills the winding space available, starting and finishing about one turn spacing from the tags. After putting on one winding, the coil is given a light coating of shellac, and when it is in the tacky stage one turn of thin, previously shellacked, paper is put over it. This forms the interwinding insulation and is held firmly in place by the outer winding which is the same as the inner in most cases. A second light coat of shellac completes the coil.

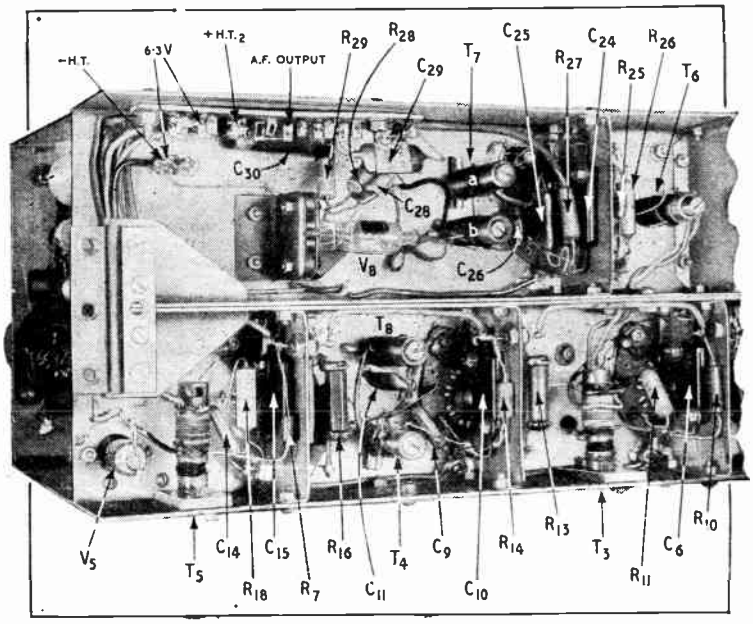
In T_1 the feeder-coupling coil needs no special insulation, and is interwound with the grid coil at its earthy end. The end of the $2\frac{1}{2}$-turn coil is held down by tying it with thread. On the outer winding of T_4 there is a tapping one turn from the earthy end of the outer winding. This is not terminated on the former but is run straight to T_8.

In all cases the inner winding is the anode one and the outer the grid one. It should be noted that the coupling coil in series with T_6 is a single turn over the middle of T_3 done in the wiring by looping the connection around the coil.

It must be emphasized that as the valve and other stray capacitances are relied upon entirely for tuning, the inductances needed in the coils depend on these capacitances. Anything but minor variations in wiring, or the use of valveholders of widely different pattern will alter the capacitances and so the inductances required. The slug adjustments are provided mainly to correct for unavoidable changes of this kind, but the range of adjustment obtainable in this way is not very large.



The V.F. side of the set is shown here. A vertical screen separates the detector chokes L1, L2, L3 from the output V.F. components.



A general view of the underside of the sound and vision channels.

It is possible, therefore, that in a few cases some adjustment to the turns may be needed. It is unlikely that lower capacitances will be obtained, so that such adjustment is unlikely to be more than the removal of one turn. It will be necessary only if it is found that a circuit will not tune to a high enough frequency with the slug fully in.

A signal generator or calibrated test oscillator is needed for alignment. The cathode-ray tube can be used as an output meter, even with an unmodulated oscillator, for with the D.C. couplings used the brightness depends on the D.C. output of the detector. The Brightness Control should be kept so adjusted that the brilliance is low and the signal-generator output kept at a suitable level.

The signal generator should

Television Receiver Construction—have its output cable terminated in the proper resistance to suit it and the signal from it applied between the grid of V_4 and chassis. T_5 is then tuned for maximum output with an input of 46 Mc/s.

Then connect the signal generator between the grid of V_3 and chassis, and tune T_4 for maximum output at 47 Mc/s. Then adjust T_8 for *minimum* output at 41.5 Mc/s; this trimmer should be critical. Readjust T_4 at 47 Mc/s and then T_8 at 41.5 Mc/s.

Transfer the signal generator to the grid of V_2 and chassis; disconnect the coupling coil on T_3 from T_6, and adjust T_3 for maximum output at 41.5 Mc/s. Reconnect the coupling coil and adjust T_6 for *minimum* output at 41.5 Mc/s.

Then go to the grid of V_1 and adjust T_2 for maximum output at 43 Mc/s, and finally connect to the aerial socket and adjust T_1 for maximum output at 43 Mc/s. Leaving the signal generator connected, adjust T_7 (a) and (b) for maximum output from the sound channel with an input at 41.5 Mc/s. A pair of phones can be connected from the sound output tag or an A.F. amplifier and loudspeaker can be used.

Quality of B.B.C. Transmissions

Chief Engineer Interviewed

By H. A. HARTLEY

READERS will recall my criticisms of the quality of B.B.C. transmissions and the reply of the Corporation's Chief Engineer in *Wireless World* of January-March last. Mr. Bishop has since been good enough to give me a detailed account of the Corporation's engineering approach to the problems. Readers will be glad to know that Mr. Bishop and his colleagues are far from satisfied with what they have already achieved and are continually striving to do better, although in fairness it should be pointed out that he does not think that conditions are as bad as I made out.

High-fidelity enthusiasts have strongest grounds for complaint in the transmission of orchestral programmes, and Mr. Bishop is fully aware of the shortcomings there. The principal difficulty is the present lack of suitable studios for large orchestras and with good acoustical properties. The main orchestral concerts in London originate in the Maida Vale studio, the People's Palace and the Albert Hall. The loss of the Queen's Hall was a grave blow to musical London. The acoustical performance of the Maida Vale studio could undoubtedly be improved by structural alterations, and both the People's Palace and the Albert Hall were technically "difficult." In certain cases correction is introduced into the A.F. chain, but this is seldom a cure for acoustic problems: if the auditorium itself kills the extreme top, then no amount of tone correction can put it back. Certain of the smaller studios at Broadcasting House, reconstructed since the war, give excellent results. Throughout the war period there was practically no acoustical research, and owing to the extreme difficulty of getting either building materials or labour for rebuilding it will take a long time to bring all the studios acoustically up to date. Nevertheless, Mr. Bishop puts improvement of studios near the top of his list of priorities.

On outside broadcasts and S.B.s a limiting factor is Post Office lines. The line from B.H. to Brookman's Park is flat to 15,000 c/s, and many of the important trunk routes are flat up to 8,000 c/s, but on other routes it is not always possible to achieve this figure.

Distortion has sometimes been allowed to creep in in control and monitoring, but the B.B.C. engineering operating staff, greatly expanded during the war, is fully alive to these dangers. In wartime it was impossible to give adequate training to new staff, but this is now being done in the Engineering Training Dept. under Dr. Sturley.

An interesting point mentioned by Mr. Bishop was the provision of perforated desk tops in talks studios to avoid sound reflections into the microphone when speakers drop their heads.

On the matter of recorded programmes Mr. Bishop said they sometimes had difficulties in bringing artistes to the microphone when they were wanted. Programmes were recorded only when it was impossible to achieve a live broadcast; improvements in the quality of recording and reproduction were constantly being made and they had gone to considerable expense to design and construct entirely new equipment, which was now in use.

Mr. Bishop gave his assurance that a feeling of healthy discontent could be said to animate his department. The economic situation of the country imposed severe restrictions on what they were trying to do. In reply to a specific question, Mr. Bishop denied that they restricted the band-width of their transmissions because of international repercussions on the problem of interference.

MANUFACTURERS' LITERATURE

ILLUSTRATED brochures (for manufacturers only) have been received from The Plessey Co., Ilford, Essex, and deal with the following: Electrolytics, Chokes and Transformers, Drives and Couplings, Miscellaneous Components.

Bulletin B528D from Muirhead and Co., Elmers End, Beckenham, Kent, describes the Muirhead-Wigan Decade Oscillator with a frequency range of 1 c/s to over 100 kc/s.

"Sobell Television Dealer's Manual"—including typical questions asked by the public and some model answers. A few copies are available to other dealers on application to Sobell Industries, Langley Park, nr. Slough, Bucks.

Catalogue of "Ashton Radio Cables," including all types of screened leads for pickups, microphones, car radio, etc., from Aerialite, Ltd., Castle Works, Stalybridge, Cheshire.

List of ex-Government electronic and radio equipment from Clydesdale Supply Co., 2, Bridge Street, Glasgow, C.5.

Brochure "From Wet to Dry" describing Varley dry accumulators. Instructions for care and charging of the batteries are given. From Varley Dry Accumulators, Ltd., By-pass Road, Barking, Essex.

WORLD OF WIRELESS

Exhibition Plans ♦ Radio Facilities Extended ♦ International Organizations

RADIOLYMPIA

FINAL arrangements for the first post-war National Radio Exhibition, which opens at Olympia on October 1st (preview September 30th), have now been made.

We give below a few of the details regarding special sections.

Conventions.—The convention hall situated in the National Hall gallery is being used during the afternoon session—3 to 5—on October 2nd, 6th and 7th for conventions organized by the Radio Wholesalers' Federation, Radio & Television Retailers' Association and Television Society, respectively. It is available for exhibitors' meetings at other times.

Television Avenue.—Some twenty manufacturers are exhibiting over thirty receivers in the specially constructed television avenue which is fed with the B.B.C. programme at R.F. from a central pre-amplifier. This 250-foot long avenue is situated at the Addison Road end of the Grand Hall gallery.

Films.—Throughout the exhibition there will be six sessions daily in the cinema located in the Grand Hall gallery. The hour-long exhibitions begin at 11.30, 2, 3.30, 5, 6.30 and 8. The main films being shown and the concerns exhibiting them are:—

"The Decca System of Navigation" (Decca). "Electronics" and "Electronics in Industry" (B.T-H.). "They're Called Electrons" (Ediswan). "North Sea—Work of Coast Stations" (G.P.O.). "Radar Record" and "Radar Goes to Sea" (Metrovick). "R.D.F. to Radar" (Ministry of Supply).

Admission to the shows is free but tickets must be obtained from the exhibitors.

Electrons at Work and Play.—This "novelties" section includes demonstrations of radar, infra-red, radio control of a model train and transmission of sound on light. The section is located at one end of the National Hall gallery. At the opposite end is a promenade from which visitors can see the production of programmes in the B.B.C. television studio.

EXTENDING RADIO FACILITIES

THE recent announcement that the Postmaster-General had allocated seven frequencies for the exclusive use of the Press for two-way radio communication prompted the question "Is the P.M.G. lending a more sympathetic ear to applications for new licences?" It is learned from the G.P.O. that frequencies over 67 Mc/s will be issued to certain specified classes of applicant where it is known that the ordinary line telephone cannot possibly give the required service.

As has already been mentioned in previous issues tugs and railways have been allocated frequencies. Other classes of undertaking to which permission may be granted are:— electricity undertakings, road vehicles of public utility, hired cars and taxi services, port authorities, professional cars and for communication between works and sites in constructional undertakings.

What is believed to be the first taxi service to employ a radio-communication system in this country was recently licenced in Cambridge.

The maximum power of the central station in the Press scheme will be 150 watts, the mobile stations 25 watts and the pack sets one watt. The maximum range of all stations licensed by the G.P.O. for such schemes is at present limited to 15 miles.

I.B.U. AND I.B.O.

THE merits and demerits of these two organizations caused a clash at an early meeting of the Atlantic City Conference when the International Broadcasting Union applied for admission to the meetings. The application met with strong opposition from delegates from the countries belonging to the International Broadcasting Organization formed just over a year ago.

The main reasons given for the exclusion of the Union were:

1. It is a deceased organization;
2. It includes Franco Spain (which is not represented at the conference) among its members;
3. It should give way to the I.B.O. whose aims are identical and which has a greater number of members;
4. It suffered Axis influence during the war and permitted the Control Office to pass to German Administrators.

Sir Stanley Angwin, head of the

World of Wireless—
British delegation supported the recommendation from the Executive Sub-Committee that the Union should be admitted as an observer. This was ultimately adopted by twenty-four votes to twenty with seventeen abstensions.

Britain is not a member of either organization and in giving support to the recommendation Sir Stanley stated that while he "deplored the existence of two separate broadcasting organizations in Europe he also deplored what is an obvious attempt to suppress one of them (the U.I.R.). . . . Until a single unified broadcasting organization can be set up in Europe, forming part of a larger world organization, and conforming to I.T.U. accepted rules of membership and voting, the U.I.R. should be allowed to continue to exist."

AIR RADIO

OUTSTANDING among the radio equipment displayed at the recent exhibition of the Society of British Aircraft Constructors at Radlett, Herts, were two radio compasses, one by Marconi's W.T. Company and the other a G.E.C.-Salford design. They work on the M.F and L.F. bands.

The present tendency is for ordinary aircraft routine communications—as opposed to direction finding—to be carried out on entirely separate equipment built largely in unit form. Separate receivers and transmitters, all fully miniaturized and fitting the standard S.B.A.C. aircraft racking, were shown by Marconi and by Standard Telephones while G.E.C. had a lightweight V.H.F. radio telephone designed especially for installing in privately owned civil aircraft. It is hoped to describe the outstanding exhibits in greater detail in our next issue.

WEATHER SHIPS

IN compliance with an international agreement signed in London last year eight nations are to establish and operate weather reporting ships at thirteen stations in the North Atlantic. Great Britain is manning two stations and has for the purpose converted four corvettes into floating meteorological observation stations. Each ship will be at sea 27 days and will be relieved by a sister ship before proceeding to her base at Greenock.

In addition to their primary task of undertaking meteorological observations the ships will also provide radio navigational aids for transatlantic aircraft and air-sea rescue facilities, for which purpose they are painted the well-known daffodil yellow.

The reports provided by the ships will supplement those of meteorological reconnaissance aircraft and merchant shipping. Their main advantages are that they will be reporting from set positions at regular intervals and giving observations on the upper atmosphere by the use of radiosondes every six hours.

The ships' radio equipment is operated by a Chief Radio Officer, six radio Petty Officers and two radar Petty Officers, who, like the remainder of the crew of fifty, have been selected from the R.A.F. and Merchant Navy.

The radio gear includes beacons, D.F. sets, radar apparatus for following the flight of radiosonde balloons to a height of 40,000 feet, and Loran. In addition to the five main transmitters there are four lifeboat transmitters and the equipment carried by the balloons. These transmit C.W. modulated at audio frequency (700-1,000 c/s). The inductance in each of the three sets (one each for pressure, temperature and relative humidity) is varied by a mumetal armature the position of which with respect to the coil is controlled by the meteorological element (pressure, aneroid capsule; temperature, bi-metal coil, humidity, gold-beater's skin).

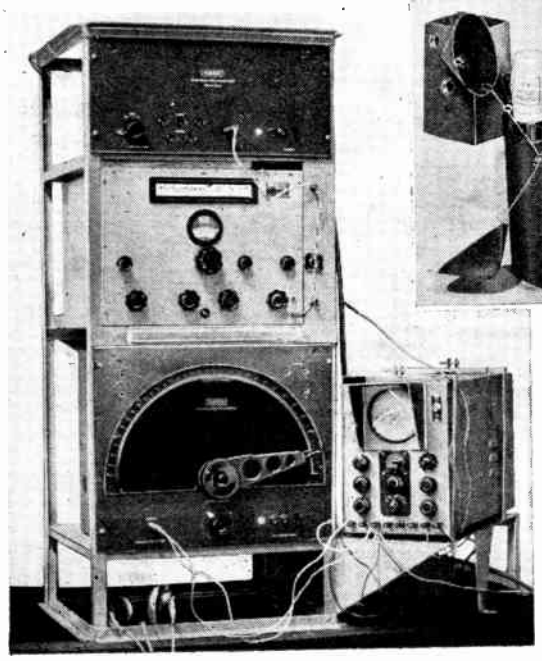
AIRCRAFT RADIO OPERATORS

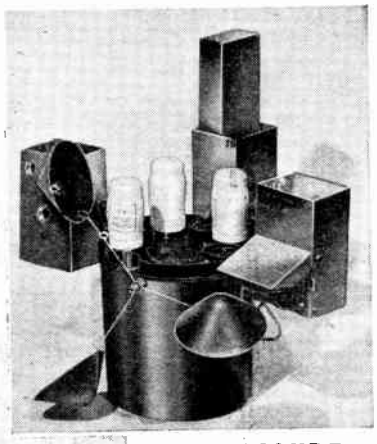
A MORE advanced knowledge of radio, higher operating speeds and a higher pass standard generally will, in future, be required of those sitting the examination for the Civil Aircraft Radio Operators' combined radiotelegraphy and radiotelephony licence.

The proposed changes, which will probably be introduced at the beginning of next year, raise the operating speeds as follows:—

(1) Plain Language; 25 words per minute (375 characters in 3 minutes).
(2) Code; 20 groups per minute (60 groups of five letters in 3 minutes).
(3) Cipher; 12½ groups per minute (25 groups of five figures in 2 minutes).

These changes have been made in accordance with the proposed revised Air Navigation (Radio) Regulations.





RADIOSONDE equipment (*above*), with Bakelite cover removed, as carried aloft by 6-foot diameter balloons. On the left is the apparatus for receiving the automatic transmissions from the balloon on 27.5—28 Mc/s. Both visual and aural means of checking the received A.F. signal are provided

PERSONALITIES

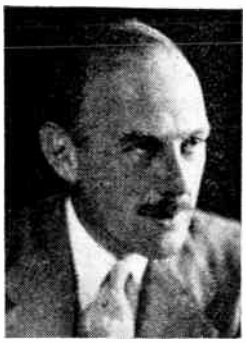
Sir Edward Appleton received the honorary degree of Doctor of Laws of St. Andrews University, Dundee, during the recent meeting of the British Association for the Advancement of Science at which he was a speaker.

W. E. Benham, B.Sc., F.Inst.P., who was until recently with P.R.T. Laboratories (now Airmec Laboratories), has been appointed to the board of Gamma Electronics, Ltd.

D. C. Birkinshaw, B.B.C. television superintendent engineer at Alexandra Palace, has, we regret to record, an attack of infantile paralysis. Although a comparatively mild attack, it will necessitate him being away for some months

Harold Bishop, C.B.E., B.Sc. (Eng.), B.B.C. chief engineer, was recently elected a Fellow of the City and Guilds of London Institute (F.C.G.I.).

R. C. Hiscock has resigned his position as general sales manager of Birmingham Sound Reproducers to take up an appointment with the Plessey Co. He has been succeeded by **Norman Miers**



RT. HON. OLIVER LYTTELTON the new president of the Radio Industry Council in succession to Alfred Clark. He was President of the Board of Trade and Minister of Production during the war.

A number of radio personalities were among those recently decorated by U.S.A. with the American Medal of Freedom. Among them were:—

Sir Frank Smith, who was during the war controller of telecommunications equipment, Ministry of Supply, and chairman of the Ministry's scientific advisory council. He received the Medal with Silver Palm.

Dr. R. L. Smith-Rose, superintendent, Radio Division, N.P.L., received the Medal with Silver Palm for his work on radio propagation.

Dr. H. G. Booker, who was head of the mathematics section of T.R.E., received the Medal with Bronze Palm for his work on micro-wave radar.

Dr. H. G. Hopkins, radio-physicist, received the Medal with Bronze Palm for his contributions in the field of radio direction finding.

Dr. E. T. Paris, principal director of scientific research (defence) in the Ministry of Supply, received the Medal with Bronze Palm for his work on the development of radar communications and other electronic equipment for the Army.

W. Ross, M.A., who is principal scientific officer on radio navigational aids (Ministry of Transport), received the Medal with Bronze Palm for his services in the field of radio and radar, especially when serving as liaison officer in the U.S.A.

J. M. C. Scott, secretary of the Ministry of Supply U.S.W. Propagation Panel, received the Medal with Bronze Palm for his work on radio propagation.

WHAT THEY SAY

Useful but Fallible.—"Electronic devices will be accepted by the British shipmaster merely as useful, though fallible, aids, and never in substitution for the traditional methods and principles of good seamanship."—From the Report of the Officers' (Merchant Navy) Federation.

International Short Waves.—"Of the total of 300,000,000 people throughout the world who daily listen to some form of broadcasting, less than three per cent hear any form of direct short-wave broadcasting."—Brigadier General Stoner, Chief Communications Engineer, United Nations, speaking at U.N.E.S.C.O. international radio network conference in Paris.

Radio-meteorology.—"The most striking manifestations of these effects (the bending of radio waves round the curvature of the earth) were noticed during the war, when it was found that, under certain fine-weather conditions, it was possible for a coastal radar station to receive echoes from a ship which had passed well beyond the horizon. . . . The need to correlate radio phenomena with meteorological conditions has prompted the radio-physicist and the meteorologist to join forces in attacking the problems of what is practically a new subject, radio-meteorology."—Sir Edward Appleton in his address as president of the Mathematics and Physics Section of the British Association meeting in Dundee.

IN BRIEF

Licence Figures.—Of the 10,883,500 broadcast receiving licences in force in Great Britain and Northern Ireland at the end of July, 21,200 were for television receivers.

Ferry Radar.—It is proposed by the Wallasey Corporation Ferries to install radar gear for the guidance of vessels when close to the landing stages.

No Outside Aerials.—Tenants of new council houses at Saffron Walden, Essex, will not be permitted to erect outside aerials. The housing committee reported that outside aerials are not needed for new sets. In view of protests by one councillor it has been decided to consider applications from householders with old sets and from short-wave enthusiasts.

Unlicensed Transmitter.—At the Wirral Justices Court on August 28th, Reginald C. J. Maude, of West Kirby, Cheshire, was fined £10 for operating an unlicensed transmitter. The postal authorities stated that transmissions were on 160 and 200 metres.

Consol Tables have been prepared by the Ministry of Civil Aviation so that bearings may be plotted from the stations at Bushmills and Stavanger when the specially prepared charts are not available.

Electron Jubilee.—The special exhibition arranged at the Science Museum, South Kensington, London, S.W.7, to mark the jubilee of the discovery of the electron by J. J. Thom-

World of Wireless—

son, will be opened on September 27th. Industrial organizations and the universities have helped in providing the exhibition, which is designed to show the principles underlying the applications of the many devices in which the electron plays an essential part. A handbook on the exhibition is obtainable at the Museum or by post from the Institute of Physics, 47, Belgrave Square, London, S.W.1, price 1s 2d.

Worked His Passage.—When the wireless operator on the Union Castle liner *Roslin Castle* had to be left at Freetown, Sierra Leone, because of illness, a Cable and Wireless operator from Ascension Island who was delayed in Freetown on his way home took on the operator's job and the vessel was able to proceed.

Out of Date.—A number of Maximum Price Orders have been revoked by the Board of Trade with the publication of the Miscellaneous Maximum Price Orders (Revocation) Order, 1947 (S.R. and O. 1947, No. 1749), as they no longer serve any useful purpose. The revoked Orders are:—

Radio Valves (Maximum Prices) Order, 1942 (S.R. and O. 1942, No. 1934), controlling prices of valves imported under lend-lease;

High Tension Dry Batteries (Maximum Prices) Order, 1942 (S.R. and O. 1942, No. 2512), controlling prices of 120-volt lend-lease batteries;

Imported Wireless Receiving Sets (Maximum Prices) Order, 1944 (S.R. and O. 1944, No. 200), controlling prices of American receivers.

I.E.E. Meetings.—As in the past few years, admission of non-members of the Institution to its meetings will again be permitted. Those "interested in the proceedings, but who may be unable to claim admission to any of the classes of membership" may therefore receive an admission card to meetings on completing the application form (obtainable from the secretary) and on payment of £1 for the session.

Broadcasting Stations.—The third revised edition of our booklet "Guide to Broadcasting Stations" is now available. In addition to the geographical and frequency lists of world short-wave stations and European medium- and long-wave transmitters this edition includes other useful information for the broadcast listener. The 1,400 entries have again been checked against the frequency measurements made at the B.B.C. Tatsfield Receiving Station. Copies are obtainable from booksellers or direct from our Publisher, price 1s (postage 1d).

Anti-Interference.—The Canadian Government has prohibited the use of unscreened diathermy apparatus after January 1st. All new equipment must be frequency stabilized and include harmonic suppression.

City and Guilds Exams.—Although last year there was an overall decrease of 92 in the total number of examinees (14,941) in the five subjects comprising the telecommunications group, there was an increase of 98 in telephony (total 2426) and 52 in transmission and lines (1227). The decreases were: telegraphy 43 (total 796), radio communication 139 (3,970), and technical electricity 60 (6,522). The number of candidates for the radio service work examination increased by 33 to 289.

INDUSTRIAL NEWS

T.C.C.—A new factory—Whiteside Works—at Bathgate, Linlithgow, Scotland, recently started production of T.C.C. condensers. When in full production it will employ 1,000 people.

Ultra.—The London County Council is purchasing £33,550 worth of school radio equipment from Ultra Electric.

Gamma Electronics, Ltd.—The offices and works of this company, which has been reorganized, have been transferred from Greenford, Middlesex, to Burwood Road, Hersham, Walton-on-Thames, Surrey. (Tel.: Walton-on-Thames 4483).

Page Engineering Co., Ltd., has moved from 119, Maple Road, Surbiton, Surrey, to Franklin Road, Portslade-by-Sea, Sussex. (Tel.: Portslade 7253).

Diamonds.—A monthly abstract of articles on the properties and industrial applications of diamonds is obtainable free from the Industrial Diamond Information Bureau, St. Andrew's House, 32-34, Holborn Viaduct, London, E.C.1.

A Montreal firm of radio representatives offer to act for European manufacturers wishing to export to Canada. Letters sent to this office will be forwarded.

CLUBS

Birkenhead.—Seventy-four members have been enrolled during the past year by the Wirral Amateur Radio Society which meets twice a month in the Y.M.C.A., Whetstone Lane, Birkenhead. The annual general meeting will be held on October 8th at 7.30. Sec.: B. O'Brien, G2AMV, 26, Coombe Road, Irby, Heswall, Cheshire.

Birmingham.—The last of this season's D.F. tests organized by Slade Radio will be held on September 28th. The Club's fortnightly meetings are held on alternate Fridays at 8.0 in the Parochial Hall, Broomfield Road, Erdington. The next meeting is on October 3rd. Sec.: C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23, Warwick.

Farnborough.—Details of the programme arranged by the R.A.E. and Farnborough District Amateur Radio Society, which meets on alternate Mondays in the R.A.E. Assembly Hall, Farnborough, at 7.30, are obtainable from the Sec.: P. R. Burkitt, Park View, Priory Street, Farnborough.

Grimsby.—The Grimsby Amateur Radio Society has now moved to new premises at 115, Garden Street, Grimsby, where meetings are held every Thursday at 7.45. The club's transmitter, a T1131, will soon be operating. Sec.: R. F. Borrill, G3TZ, 115, Garden Street, Grimsby, Lincs.

Liverpool.—Weekly meetings of the Liverpool and District Short-Wave Club are held on Tuesdays at 7.30 at St. Barnabas Hall, Penny Lane, Liverpool. On Monday evenings practice morse is transmitted on 3,562 kc/s from 7.0 to 7.30, call G3BHT. The club's own transmitter (G3AHD) will soon be operating on 3.5 Mc/s. Sec.: B. G. Meaden, G3BHT, 10, Alfriston Road, West Derby, Liverpool, 12, Lancs.

Slough.—The local group of the R.S.G.B. recently staged a show of amateur equipment during the town's Holidays-at-Home carnival and secured several prizes in the model engineering competition. A transmitter was operated on 7 Mc/s throughout the exhibition.

Stourbridge.—Meetings of the Stourbridge and District Amateur Radio Society are held on the first Tuesday of each month at King Edward School, Stourbridge, at 8.0. Sec.: W. A. Higgins, G8GF, 35, John Street, Brierley Hill, Staffs.

Worthing.—Although full membership of the Worthing and District Group of the R.S.G.B. is for members of the Society, visitors are welcomed to the monthly meetings. The next meeting will be held on October 2nd at Oliver's Café, Southfarm Road, Worthing. Sec.: G. W. Morton, 42, Southfarm Road, Worthing, Sussex.

MEETINGS

Institution of Electrical Engineers

Ordinary Meeting.—Presidential address by P. Good, C.B.E., on October 9th.

Radio Section.—Chairman's address by C. E. Strong, O.B.E., B.A.I., on October 15th.

Discussion on standardization in the electrical industry to be opened by the president on October 27th.

The above meetings will be held at 5.30 at the I.E.E., Savoy Place, London, W.C.2.

London Students' Section.—"The Influence of Propagation on the Uses of Radio Waves," by E. M. Hickin, chairman, on October 20th at 7.0 at the I.E.E.

Cambridge Radio Group.—"Further Education for the Engineer," by R. W. Wilson, B.Sc. (Eng.), chairman, on October 21st at 6.0 at the Cambridgeshire Technical College.

North-Eastern Radio and Measurements Group.—Address by V. Z. de Ferranti, M.C., on October 20th at 6.15 at King's College, Newcastle.

North-Western Radio Group.—"New Possibilities in Speech Transmission," by D. Gabor, D.Ing., on October 22nd at 6.30 at the Engineers' Club, Albert Square, Manchester.

South Midland Radio Group.—"Practical Waveguides," by L. G. H. Huxley, Ph.D., on October 27th at 7.0 at the James Watt Memorial Institute, Birmingham.

LETTERS TO THE EDITOR

More Views on Loudspeaker Damping

MR. LANGFORD-SMITH has raised a very interesting point in his letter on the damping of moving-coil speakers. It seems that a more comprehensive picture of the effect of source impedance on the frequency response as well as on the transient response is required.

The moving coil is a generator of mechanical energy, to which the mechanical "Ohm's Law" can be applied. It is presented with a complex mechanical load, which can be divided into two parts.

(1) A number of reactances, each with a resistive component to represent losses. The various suspension stiffnesses will appear as capacitive reactance, and the cone and coil masses as inductive reactance. This part will have large and rapid variations with frequency, and will become very small at the principal resonance points. For example, at the bass resonance, the total cone mass will resonate with the suspension stiffnesses in series.

(2) The radiation resistance of the cone. By definition, the power radiated will be Ru^2 where u is the velocity of the coil. R varies only slowly with frequency in a well-designed speaker. Thus to obtain a smooth frequency response u should be made independent of frequency.

The sum of (1) and (2) is the total loading on the coil, which varies greatly with frequency. Thus for u to be independent of frequency it should be independent of the load into which the coil works.

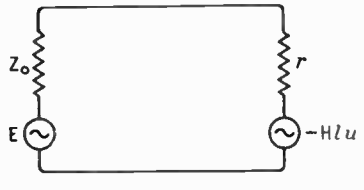
Turning now to the electrical side, an equation can be derived connecting the coil velocity with the driving E.M.F. (E).

Force on coil $= Hl I$ .. .. (1)

Mechanical load $(Z_M) = \frac{Hl}{u}$ .. .. .. (2)

Back E.M.F. in coil $= -Hlu$

Where H = field strength in gap, l = length of wire in field, I = current through coil, u = velocity of coil.



Let the coil resistance be r and the source have internal impedance Z_0, then applying Kirchhoff's law to the driving circuit, and substituting for I from (2),

$$E - Hlu - \frac{Z_M u}{Hl} r - \frac{Z_M l}{Hl} Z_0 = 0$$

Re-arranging,

$$u = \frac{E}{Hl} \cdot \frac{1}{1 + \frac{Z_M(Z_0 + r)}{H^2 l^2}}$$

It may now be seen that the term $\frac{Z_M(Z_0 + r)}{H^2 l^2}$ should be made as small as possible, as it is desirable that u should be independent of Z. It appears that the effect of the driving circuit impedance is to introduce into the driving circuit a voltage in series with the back E.M.F. of the coil dependent on the cone impedance, which prevents the back E.M.F., being equal to the driving voltage E. As only the sum of Z_0 and r appears in the equation, it would seem to be of little value to reduce Z_0 much below r. It may also be seen that the stronger the field the better the linearity of response.

The approach to the problem is to minimize *variations* in Z_M by increasing the radiation resistance and/or decreasing the cone reactances. The bass resonance is being dealt with in this way in several modern speakers by using acoustical resonance to increase the radiation resistance at low frequencies. This is also why the exponential horn type speaker is still supreme for quality reproduction.

J. H. D. WALTON.

Swindon.

THE correspondence on loudspeaker damping which has arisen as a result of Mr. F. Langford-Smith's comments on my remarks in the April issue is very interesting, in that it demonstrates the confusion which may be caused by an over-simplification of the equivalent circuits and electrical analogues of electro-mechanical apparatus, and by the use of a term—in this case "Damping Factor"—which is not a clear description of the effect to which it refers.

The equivalent circuit of the ideal loudspeaker postulated by Mr. Langford-Smith is a resistance whose dissipation is equal to the energy radiated. Such a system requires no damping as there is no possibility of energy storage. A practical loudspeaker, however, has an equivalent circuit which may consist of a network as shown in Fig. 1.

The symbols R and L represent the physical resistance and inductance of the speech coil winding. The speech coil performs the dual function of a motor (shown as M)

Loudspeaker Damping—

coupled to a generator (itself) shown in the diagram as G. The coupling of this motor-generator is loaded by a complex mechanical resonant system (the diaphragm and suspension) which has the properties of inertia (m), compliance (C_m) and mechanical resistance (r_m), with which is lumped the acoustical radiation resistance which is Mr. Langford-Smith's ideal loudspeaker.

Due to the complex nature of this mechanical system and the fact that it can store energy, the generated E.M.F., e, bears a complicated phase and amplitude relationship to the current, i, which causes the generating motion, and it is by virtue of this relationship that the mechanical properties of the vibratory system are reflected back into the electrical system as Z_m, the "motional impedance," determining along with R and L the apparently complex impedance at the terminals of the loudspeaker. The fact that this "motional impedance" is not really an impedance but a generated E.M.F., is the key to the question of loudspeaker damping. The current due to e

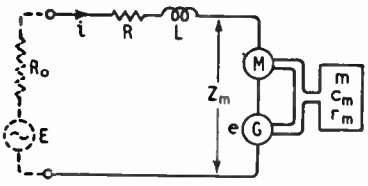


Fig. 1.

which provides the damping is limited only by the impedance of R, L and R_o (the output resistance of the amplifier), and the percentage electrical damping is therefore determined by the relative values of R_o and the impedance, $R + jX_L$.

Taking the term "damping factor" at its face value, it would be only reasonable to expect that an increase in the value of this factor would produce a corresponding proportional increase in the effectiveness of the damping. This is not so, however, and the relationship, simplified by neglecting the reactive components, is of the form shown in Fig. 2. The optimum value assigned to this curve is a matter of personal choice, but a figure of 10 which I put forward when the cathode follower output stage controversy was at its height (*W.W.*, August, 1944) seems reasonable as it produces 91 per cent electrical damping. "Damping factors" of this order appear as a by-product when negative feedback is applied to reduce non-linear distortion in an amplifier to negligible proportions.

The relationship between the relative amounts of electrical and mechanical damping in any particular loudspeaker must surely determine the effect of a given percentage change in the amount of electrical damping. This must vary considerably with loudspeaker constants and may account for the somewhat divergent views on the matter. I venture to suggest, however, that it is normal for the suspension resistance to be very low, and H. F. Olson states ("Elements of Acoustical Engineering," Van Nostrand, p. 112) that it may generally be neglected. If this is so, the electrical damping would have a marked effect on the behaviour of the system, and it is my experience that this is usually the case.

While the question of loudspeaker damping is being discussed, it may be of interest to *Wireless World* readers to know that a method has been evolved by the writer which makes use of the generated E.M.F. in an electro-mechanical vibratory system to control the motion of the system. The method, which is a development of suggestions put forward by Messrs. P. d'E. Stowell and M. K. Taylor, consists basically, as applied to a loudspeaker, of extracting the generated E.M.F. (which is proportional to speech coil velocity), and using it to control the velocity by means of a negative feedback system. The extraction of the generated E.M.F. is achieved by a simple bridge network as in Fig. 3, and requires no special attachments to the loudspeaker.

The system demands a high-grade amplifier with very low phase shift of the type described in the April and May issues. It has been made to operate satisfactorily over a frequency range of 10-1,000 c/s using a standard 12-in loudspeaker, the coil velocity of which was made proportional to input amplitude and

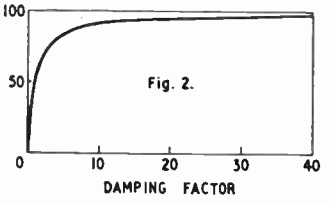


Fig. 2.

completely independent of frequency. By suppressing the radiation from the back of the diaphragm and adjusting the frequency characteristics of the amplifier circuits, the loudspeaker could be made to have any desired radiation characteristic. Since the behaviour of a 12in diaphragm loudspeaker departs from that of a rigid piston above 1,000 c/s, it was not thought desirable to attempt control above this frequency, and the upper range may be dealt with by a separate radiator.

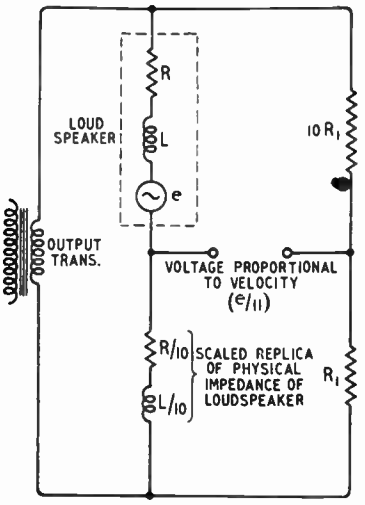


Fig. 3.

The system is still undergoing development and should ultimately provide a close approach to an ideal radiator.

D. T. N. WILLIAMSON.
Research Department,
Ferranti, Ltd.
Edinburgh.

The "-tron" Family

I WAS very much interested in the "Unbiased" column of your February, 1947, issue relative to the suffix "tron."

For a considerable number of years, I have had a hobby of collecting the uses of this suffix in newly coined words. Since writing an article on the subject for an American periodical, *Electronic Industries*, January, 1946, I have continued my collection and it now totals about 200. It ranges from "aeriotron" to "zyklotron" and covers words beginning with every letter of the alphabet except J, W, X and Y.

W. C. WHITE.
General Electric Company,
Schenectady, N.Y., U.S.A.

"Push-pull Phase-splitter"

FOR many years now I have made up for my own interest most of the L.F. amplifiers which have appeared in your pages, and a few days ago completed the new phase-splitter described in the August number.

This amplifier, after a period of most careful listening, is in my opinion just about as near perfection as anything of the sort I have

made up for myself or heard in commercially made amplifiers. The apparatus is very easy to make and requires no special instruments to balance the two output valves, also it is very inexpensive.

G. POTTER

Tenterden, Kent.

Short-wave Conditions

Expectations for October

By T. W. BENNINGTON *(Engineering Division, B.B.C.)*

DURING August the average daytime maximum usable frequencies for these latitudes were somewhat higher than during July, while the night-time M.U.F.s were considerably lower than during that month. This was in conformity with the normal seasonal trend, and the M.U.F.s should now continue to vary in that manner towards the winter. The night-time decrease was, however, greater than would have been expected, because on a large number of nights conditions were disturbed.

Daytime working frequencies were therefore fairly high, though not high enough to allow much use of such frequencies as the 28-Mc/s band. Night-time working frequencies were such that those as low as 11 Mc/s were required on some paths. Sporadic E was prevalent—though somewhat less so than during July—and medium-distance communication on very high frequencies was frequently possible by way of this region. It is not expected that this situation will last much longer.

The first 11 days of the month were relatively undisturbed, but later there were some ionosphere storms of very long duration and, on certain days, of marked severity. The most disturbed periods were 12th, 14th, 16th-23rd and 24th-27th.

Forecast.—During October the daytime M.U.F.s should continue to increase, and should, in fact, reach values which will be near the peak of those for the present sunspot cycle. Long-distance communication on very high frequencies will be quite often possible in all directions from this country. The 28-Mc/s amateur band, for example, should be regularly usable at the appropriate time of day, and the month will be propitious for the establishment of contacts over long distances on 50 or 56 Mc/s, though not, of course, as a regular feature. Night-time working frequencies are expected to decrease somewhat as compared with September. Frequencies as low as 9 Mc/s will become the optimum for a few night-time circuits, though frequencies lower than this are unlikely to be really necessary.

The E and F1 layers will not *control* transmission for any distance in these latitudes, and Sporadic E is not likely to be much in evidence, so that medium-distance communication on high frequencies will not often be possible.

Below are given, in terms of the broadcast bands, the working frequencies which should be regularly usable during October for four long-distance circuits running in different directions from this country. (All times in this article are in G.M.T.) In addition, a figure in brackets is given for the use of those whose primary interest is the exploitation of certain frequency bands, and this indicates the highest frequency likely to be usable for about 25 per cent of the time during the month for communication by way of the regular layers:—

Montreal:	0000	11 Mc/s		(18 Mc/s)
	0500	9 ,,		(15 ,,)
	0800	11 ,,		(19 ,,)
	1000	17 ,,	or 21 Mc/s	(30 ,,)
	1200	26 ,,		(39 ,,)
	2000	21 ,,	or 17 Mc/s	(29 ,,)
	2200	15 ,,		(22 ,,)
	2300	11 ,,		(19 ,,)
Buenos Aires:	0000	15 ,,		(22 ,,)
	0200	11 ,,		(19 ,,)
	0600	15 ,,	or 17 Mc/s	(24 ,,)
	0800	21 ,,		(31 ,,)
	0900	26 ,,		(43 ,,)
	2000	21 ,,		(32 ,,)
	2100	17 ,,		(26 ,,)
	2300	15 ,,		(23 ,,)
Cape Town:	0000	11 ,,		(20 ,,)
	0500	15 ,,		(22 ,,)
	0600	21 ,,		(30 ,,)
	0700	26 ,,		(41 ,,)
	1800	21 ,,		(32 ,,)
	1900	17 ,,		(26 ,,)
	2100	15 ,,		(22 ,,)
Chungking:	0000	11 ,,		(17 ,,)
	0100	9 ,,		(16 ,,)
	0300	11 ,,		(18 ,,)
	0500	17 ,,	or 21 Mc/s	(24 ,,)
	0700	26 ,,		(36 ,,)
	1300	21 ,,		(30 ,,)
	1500	17 ,,		(25 ,,)
	1700	15 ,,		(22 ,,)
	1900	11 ,,		(18 ,,)

Ionosphere storms are often prevalent during October and some periods of poor communication are therefore to be expected At the time of writing it would appear that such disturbances are more likely to occur within the periods 1st, 6th-7th, 9th-13th, 16th-18th and 25th-28th than on the other days of the month.

RANDOM RADIATIONS

By "DIALLIST"

Eventful Years

RADIOLYMPIA again, after eight exhibitionless years! I find it hard to believe that so much time has passed since we were there; but passed it has and the world has changed not a little in those years. When the last exhibition was held the word "radar" had not been coined and R.D.F. was known only to the little band devoted to its early developments. Very little was known about the centimetre waves, though investigation of their possibilities for short-distance communications was going forward. The magnetron and the Sutton tube were still to be invented. And who could have guessed that the crystal would stage a comeback as the most effective detector of microwave transmissions? Who would have dreamt that we should before long be pouring wavelets through such radio-plumbing as the wave-guide or launching them into the ether from aerials so queer as the "cheese" or the "horn"? The square pulse we knew from its use for the frame sync and line sync of television; but few can have foreseen the importance that pulse technique was to have, or that some form of pulse-modulation would make it possible to modulate a single carrier with several speech channels simultaneously. All those things and more have happened since the last Radiolympia and many of their applications will be there for all to see.

□ □ □

Broadcast Receivers

To the majority of those who flock to Olympia the new broadcast and television receivers will be the most interesting of the exhibits. That is as it should be. The bulk of the space is occupied by those who live by selling receivers and, though this year it is to be a radio rather than just a broadcasting exhibition, its main object must be to maintain, renew or arouse interest in apparatus designed for entertainment in the home. There will be plenty, I am sure, to interest everyone amongst the broadcast receivers and the television sets, though one sighs rather to think what there might have been, had there been no post-war restrictions, no purchase tax, no shortage of labour or of materials. Several points have struck me particularly in the designs of the receivers which have so far come my way. First, the small sets, those whose basic price (and by "basic" I mean the price before purchase tax is added) has been kept down to somewhere near the £15 mark. To produce such a set is not easy to-day, if it is to be efficient and easy to handle. The price limit reduces the possible number of valves (excluding the rectifier, which after all, need not be a valve), to four at the outside. Now, it is almost an axiom of wireless that the more highly efficient you make the circuit of a receiver, the more difficult it is likely to be for any but an expert to get the best out of it. Designers were thus faced by the double problem of getting the last ounce out of a small number of valves and of making the combination handleable by the wettest-nosed of wet-nose listeners! In both these essentials they have succeeded pretty well.

□ □ □

The Bigger Sets

For years I've been urging that it is of little use to try to popularize short-wave listening if the short-wave ranges of broadcast receivers have tuning arrangements so coarse that only by the exercise of considerable manual skill and the patience of Job can a desired station be brought in. I'm glad to see quite excellent bandspreading arrangements provided on the S-W range in several of the bigger sets. This should be a popular feature and I hope it will meet with the success it deserves. There is, though, just the chance that many potential buyers have come to the conclusion, after so many years of clumsy tuning arrangements, that the short waves are not their cup of tea. Really one could hardly wonder if it were so: have you ever tried "exploring" the 19-metre band with a small superhet of the "broadcast" type built in years gone by? I put the word exploring in inverted commas, since I've known dials on which the whole band occupied less than a quarter of an inch! Let's hope that such absurdities are things of the past and that the man in the street will be convinced that short-wave listening can be an enthralling hobby. Given the right kind of set, it certainly is.

□ □ □

The Missing Stage

It is, in a way, surprising to find how few of our receivers are provided with a R.F. amplifying stage. Without at least one such stage—or, at any rate, a bandpass input from the aerial to the first valve—it is hardly possible to eliminate second-channel interference entirely. Both the R.F. stage and the bandpass filter have one big drawback in these hard times: each means an extra section in the variable tuning capacitor and additional coils. Variable capacitors larger than the two-gang are expensive and not easy to obtain. Very possibly they are difficult to come by mainly because the demand for them is comparatively small. I have never believed that the cost of a wireless set of the larger type mattered very much, for the man who wants a really good receiver is quite prepared to pay for it.

□ □ □

Shocks and Switches

A FRIEND of mine was disconcerted the other day by receiving a pretty shattering electric shock when he thought that he had taken all the proper precautions to prevent such a thing. His A.C. mains set had died on him and, having removed the chassis from the cabinet, he was making a preliminary examination, with aerial and earth disconnected and the set switched off. A visual inspection disclosed nothing amiss, so he decided to connect up aerial and earth in the faint hope, which most of us cherish at such times, that there was nothing really wrong and that the set was just being pernicketty. With the bare end of the earth wire in his left hand, he put his right on to the chassis in order to turn it into a convenient position. It was at that moment that he bought a genuine fourpenny one. The set was switched off, wasn't it? Yes, but there happened to be an insulation defect in the mains transformer primary circuit and it chanced that the two-point plug at the end of the set-to-mains flex was so inserted in its socket that the switch in the receiver was in the neutral lead. The chassis was thus very much all alive-oh, even though the switch in the set was at "off." The shock, as you'll see, could just as easily have smitten one who was not engaged in looking for a fault at all, but was merely connecting his earth lead, holding the wire in one hand and feeling with the fingers of the other for the socket or spring-clip in the set.

□ □ □

Safety First

Personally, I've never much liked the single-pole mains switch used in conjunction with a two-pin plug,

for it is an even chance whether or not you connect up in such a way that the switch breaks the phase lead. Ideally, the receiver switch should always be of the double-pole variety, for "off" ought to mean that the set is completely disconnected from the supply. Some well-designed sets have this safeguard, but far too many don't. It is sound practice to use a three-point plug and socket for the mains connection, making sure, of course, that the phase pin of the plug is wired to the lead from the switch in the set. It's rather surprising, when you come to think of it, that the wiring regulations in force should allow the use of any flex-connected apparatus containing a single-pole switch in conjunction with a two-point plug. The three-pin plug is eventually to become the standard domestic fitting, but it may be years before its adoption is universal.

MERCHANT SHIP EQUIPMENT

MORE rigorous requirements for the radio equipment of British merchant vessels are foreshadowed by the issue by the Post Office of three specifications. In a foreword it is stated that the G.P.O., in consultation with the Ministry of Transport, shipping interests and radio equipment manufacturers has decided that technical improvements of the apparatus now in general use is needed to cope with present-day traffic congestion. A series of specifications, in keeping with modern standards, stating the minimum performance that will be required to secure the P.M.G.'s Certificate of Approval for each major item of ship radio equipment, has been issued. The titles are:—

Radio for Merchant Ships: Performance Specifications. Pp. 49; price 1s

Radio for Merchant Ships: Performance Specification for a Motor Lifeboat Radio Equipment. Pp 9; price 3d.

Radio and Radar for Merchant Ships: A Performance Specification for Climatic and Durability Testing. Pp 6; price 2d.

Of these specifications (which are issued by H.M. Stationery Office) first-mentioned is the most important; it deals with several different types of transmitters and receivers, as well as with D.F. gear.

Eventually all marine equipment will be required to conform to these specifications. Due notice will be given of the date after which new installations must conform; also of the date on which existing installations must be brought into conformity.

RECENT INVENTIONS

A Selection of the More Interesting Radio Developments

WIRING SYSTEMS

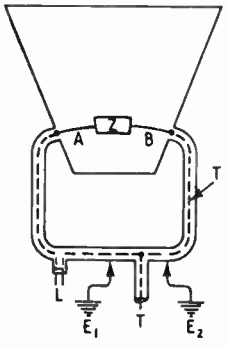
THE assembled parts of a wireless set are connected up in circuit through strips of a metallic paste, which is laid in grooves previously made in a chassis of insulating material. The paste is made by mixing finely powdered copper with amyl acetate, in which some celluloid has been dissolved. As the acetate evaporates, the celluloid binds the copper particles into a firm mass of good conductivity. The chassis is of synthetic resin.

At unavoidable cross-over points apertures are made to connect one of the upper grooves with another formed in the under-surface of the chassis. Recesses are shaped to take the bases of the principal components, and are fitted with rubber packing to force the terminals into firm contact with the conducting strips.

Murrayfield Nominees, Ltd., and P. Plowman. Application date, Oct. 13th, 1944. No. 583285.

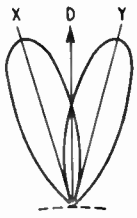
APPROACH BEAMS

THE inner ends of the radiators A, B are connected through a half-wave non-radiating reactance Z, so that the currents in both limbs are of the same sign, i.e., positive or negative. The outer ends are fed from the inner wire of a coaxial transmission line T, the outer conductor of which is connected to a horn-shaped reflector of rectangular cross-section. The line assembly is tuned to the operating frequency by an adjustable stub or loop L.



(a)

Beam switching device.



(b)

The direction of the radiated beam depends upon the distribution of the standing wave system along the limbs A, B, relative to the sides of the reflecting horn, and this will alter as the position of the voltage node at the earthing point is changed. The axis of the maximum lobe can accordingly be swung from X to Y, in order to define an approach path D, by rapidly switching the earth contact between the points E_1 and E_2.

Standard Telephones and Cables, Ltd., and E. O. Willoughby. Application date May 2nd, 1941. No. 581724.

VARIABLE TUNING CIRCUITS

THE stability of a valve oscillator is adversely affected by the varying shunt impedance value of the normal tuning circuit at different frequencies. One known method of compensation is the use of an inductance coil with a Q-factor that is inversely proportional to frequency, but this has certain disadvantages.

According to the invention, the problem is solved, in the case of a capacity-tuned circuit, by connecting across a part or the whole of the circuit an auxiliary resistance in series with an auxiliary capacity. The specification contains an analysis of the conditions required to keep the shunt impedance of the corrected circuit constant, as the tuning control is varied, without incurring undue losses at the lowest frequency, and gives specific formulæ for the values of both the auxiliary components in terms of the conductance of the main circuit at its upper and lower limits of frequency.

A. C. Lynch. Application date, July 10th, 1944. No. 585365.

AUTOMATIC STROBING

IN radar equipment, as used on fighter planes for intercepting enemy bombers, the echo signal from a selected target is isolated and distinguished from other signals by a strobing voltage, which first searches for the desired signal and is then automatically locked to it, so that only this signal can appear on the C.R. screen to show the instantaneous position of the quarry. An auxiliary voltage is then applied to "draw-out" the indicating spot along the time-base, and to add lateral extensions or "wings," which serve to indicate the instantaneous range of the bomber, as the fighter is "homing" on to it. Control voltages are used to cut out undesired ground reflections, and for other purposes.

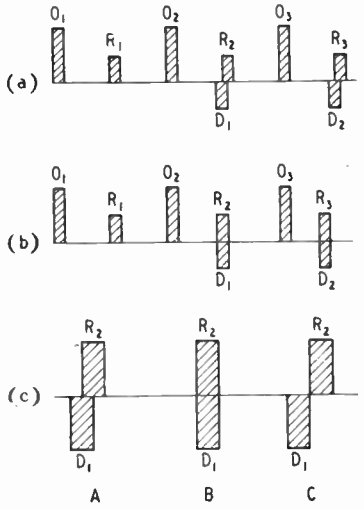
The master control voltage is initiated by each exploring pulse, and is fed to a delay network, from which the other operative voltages are tapped off. The duration of the "searching strobe" is gradually increased until, in the course of its "drift" along the time-base, it overlaps the desired echo signal. The coincidence of the two on the grid of a gate valve then allows that signal alone to appear on the indicator. Simultaneously the "drift" control is cut out, so that the strobe stays locked to the signal. A frequency-discriminating circuit holds the echo signal at the centre of the strobe interval.

F. C. Williams, E. L. C. White, and D. Blumlein (legal representative of A. D. Blumlein). Application date October 15th, 1943. No. 582503.

MEASURING RELATIVE VELOCITY

THE relative speed of a craft in pursuit of another is shown by reflected pulse signals on a calibrated meter of the centre-zero type.

Each of the twin grids of a tetrode detector, forming part of the radiolocation set carried by the pursuit plane, is separately coupled to the echo-



Pulse indications of relative velocity.

receiving aerial, one directly, and the other through a circuit which reverses the signal voltage and introduces a time lag equal to the pulse repetition frequency less half a pulse-width. Both parts of the split echo signal are also equalized in amplitude, before they reach their respective grids. One grid thus receives a part of each echo signal directly, whilst its twin grid receives a part of the delayed and reversed echo signal from the previous pulse, both combining to control the anode current that is fed to the indicator.

In the diagram the transmitted pulses are marked O, the direct echoes R, and the delayed echoes D. Diagram (a) shows the signal conditions for constant relative velocity, and (b) those that occur when the pursuer is gaining on his quarry. In diagram (c), A and B show the corresponding grid voltages, and C those when the pursuer is losing ground.

J. Forman and Pye, Ltd. Application date April 17th, 1941. No. 581166.

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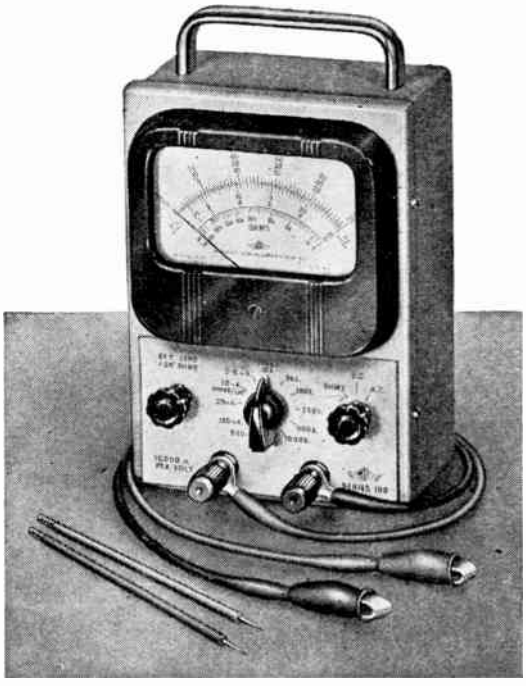

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A Service Engineers' Universal Testing Set with a sensitivity of 10,000 Ohms per Volt. The Instrument is housed in a strong metal case with carrying handle, and is complete with one pair of leads having detachable bull-dog clips and test prods.

Ranges :	AC/DC Volts : 10, 25, 100, 250, 500, 1000. D.C. Milliamps : 2·5, 10, 25, 100, 500. AC/DC Microamps : 100 Microamps on the 10V range. Resistance ranges : 0-1 Meg. (13,500 Ohms mid scale). 0/10,000 Ohms (135 Ohms mid scale).
Frequency Range :	15 to 20,000 Cycles per second.
Accuracy :	3% on D.C. Ranges. 4½% on A.C. Ranges (for sinusoidal waveforms). 5% on Resistance Ranges (Compensated for normal variation of cell voltage).
Size :	9" × 5¼" × 4".
Terminals :	Socket head type.

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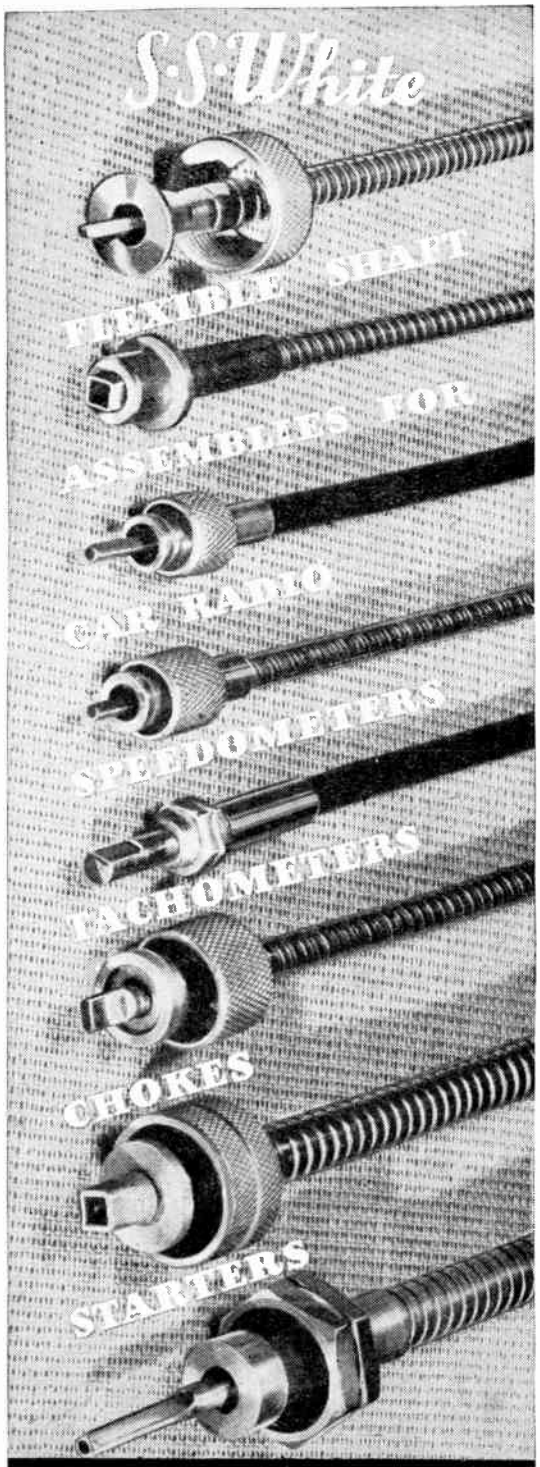

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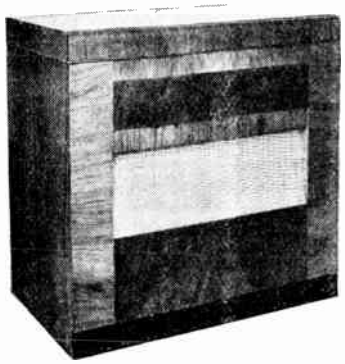

Dignified appearance and good workmanship. Size 31½in. high, 18½in. deep, 33 wide. French polished, veneered walnut. Price **£26.** Also available complete with electric motor with auto stop, **£30 3s. 9d.**, or with electric motor, auto stop and magnetic pick-up. **£32 13s. 4d.**
Ditto with Rothermel Crystal Pick-up, **£35 2s. 1d.** or with 8 record-mixer changer, **£45 7s. 6d.**

FERRANTI 1 MILLIAMP METERS. 3½in. external diameter, flush mounting, with self-contained Westinghouse bridge rectifier. Scale marked 0-10 volts with fifty divisions, fitted in well-made wooden box 6 × 5 × 5in. **35/-.**

D/C TO A/C CONVERTERS. Input, 18/24 v. D/C. Output, 230 v. 50 cycles 100 watts, **£5.**

POWER PACKS. Input, 210-240 v. 50 cycles. Output, 250 v. 80 m a, 6.3 v. 3-5 a. Fully smoothed. Contained in substantial screening box, with full wave valve. **£2 10s.**

MAINS TRANSFORMERS. All 230 v. 50 cycles input. **Type 2.**— 40 v. 2 amps. (Excellent for rewinding.) **15 -.**
Type 4.—865-0-865, tapped at 760 and 690 v., 500 milliamps with L.T. trans. 4 v. 3 a. twice. **£3 15s.**
Type 8.—6 v. 10 a. and 4 v. 10 a. **15 -.**
Type 3.—500-0-500 v. 150 m a 4 v. 2½ a, 4 v. 1 a, 4 v. 5 a. **35/-.**
Type 5.—450-0-450 v. tapped at 300 v. 150 m a, 4 v. 3-5 a, 4 v. 3-5 a. **30 -.**
Type 35.—300-0-300 v 250 m a, 4 v. 3-5 a, 6.3 v. 5-7 a, 6.3 v. 1-2 a., **35 -.**

OSCILLOGRAPH POWER UNITS.—Input, 220 volts. Consist of kit of parts incorporating mains transformers, metal rectifiers voltage doubling condensers.
Type 406.—Output, 1000 v. and 6.3 v., **20 -.**

R.A.F. 1155 RECEIVERS. Brand new, complete, **£17 10s.**

A/C POWER PACK (230 v. input) for above, **£2 10s.**

SHORT-WAVE CONDENSERS. High-grade ceramic insulation, super midget type, single gangs available in 10, 20, 50, 75 (75 pf. has double spindle for ganging). Price **2/6.**

2-GANG, in 4, 8, 9.6, 27.1, 50, 75 p.f. Price **5/-.**

2-GANG. Full size, 160 p.f. Price **5/-.**

WAVE CHANGE SWITCHES. Available with any of following wafers : 2-pole 3-way, 3-pole 3-way, 4-pole 2-way, 2-pole 4-way, 1-pole 4-way, with shorting bar; 2-pole 5-way : 1 gang, **4 -** ; 2-gang, **5/6** ; 3-gang, **7/-.**

TYPE 100.—A rotary transformer with completely smoothed output, contained in a soundproof metal screening box. Input 6 v. D/C; output 220 v. 50 m/a D/C, **30/-.**

TYPE 113.—A rotary transformer. Input 6 or 12 volts. With 12 v. input, output is 600 v. 250 m/a, with 6 v. input, output is 300 v. 200 m a, **30 -.**

500 MICROAMP METERS. Moving coil, 2in. diameter flush mounting. Available by the following manufacturers : Met.-Vick 500 ohms ; Ferranti 79 ohms ; Weston 116 ohms. Either type **21 -.** Special quotations for quantities. The following accessories are available to convert the above meter into a multimeter. Set five multipliers plus/minus 2½ per cent. to read 10 v., 50 v., 100 v., 250 v., 1,000 v., **7/6** the set. Bridge type meter rectifier, **10/-.** Separate 0-10,000 ohms scale chart, 1,000 ohms. Present resistance, and fixed resistor to convert meter into ohm-meter with 1½ v. battery, **3/6.**

BAKELITE CABINETS

MIDGET RADIO KIT. Build your own midget radio. A complete set of parts, including valves, loudspeaker and instructions. In fact, everythin except cabinet necessary to build 4-valve Medium and Long Wave T.R.F. radio operating on 200-250 v. mains, A.C or D/C. Valve line-up, 6K7, 6J7, 25A6, 25Y5. Wavelengths covered 200-557 and 700-2,000. Size 10 × 6 × 6in. Completely drilled chassis. Price, including tax, **£7 7s. 6d.**

SUPERHET MIDGET RADIO KIT. A complete kit of parts for a 5-valve superhet. Covers 16-50 and 200-557 metres, AC DC 200-250 v. 6K8, 6K7, 6Q7, 25A6, 25Y5. Size, 10 × 6 × 6in. Completely drilled chassis. Price including tax, **£8 5s.**
An attractive brown bakelite cabinet as illustrated above can be supplied for either kit at a cost of **25 -.**

METAL RECTIFIERS.

Output Volts	Current	Type	Price
600	40 m a.	H.W.	5 -
280	40 m a.	H.W. or V.D.	5 -
325	65 m a.	H.W. or V.D.	5 -
36	75 m.a.	Bridge	1/6
16	1 amp.	Bridge	12 6
48	1½ amp.	Bridge	25 -
16	5 amps.	Bridge	30 -
16	8 amps.	Bridge	37/6
4	¼ amp.	H.W.	5 -

ALUMINIUM CHASSIS. Substantially made of bright aluminium, with four sides.

7 × 3½ × 2in.	4 6	9½ × 4½ × 2in.	5 6
10 × 8 × 2½in.	7 -	12 × 9 × 2½in.	7/9
14 × 9 × 2½in.	8 3	16 × 8 × 2½in.	8 6
20 × 8 × 2½in.	10 6	22 × 10 × 2½in.	13/6

MANSBRIDGE TYPE CONDENSERS. Huge purchase of military surplus paper condensers. Super quality oil filled.

Capacity	Working Voltage	Size	Price Each	Per Doz.
2 mf.	1,000	4½ × 1½ × 1	2 6	20 -
2 mf.	600	3½ × 1½ × 1	1/9	14/-

TYPE 103 ROTARY TRANSFORMER. Normal rating is 19 v. D/C input. Output, 300 volts 30 m a and 6.5 volts 3 a. D/C. By applying between 200 and 250 volts D/C to the H.T. output side, the two low-tension windings may be used to charge accumulators. The 19-volt side will charge a 6-volt accumulator at 2-3 amps the 6.5 side a 2-volt accumulator at 1-2 a. With a 12-volt input to the 19-volt side, 180 v. at 30 m a and 4 v. at 3 a. may be obtained. With a 6-volt input to the 6.5 side, 160 v. at 30 m a may be obtained. By extending the spindle which is flush with the frame and applying 200 to 250 v. D/C mains to the 300 v. side, the unit becomes a powerful high-speed electric motor, suitable for small drilling machines, etc. Similarly, it may be used with 6 or 12 v. input to the 6.5 v. or 19 v. side. It employs a powerful ring magnet and is of substantial construction, costing originally over **£5.** A fortunate purchase enables us to offer these fine units at **10 -.**

Philips Amplifiers. Military surplus, soiled condition. Perfect working order, 12-volt battery operated, speech only, output 8 watts, push-pull output. Incorporate 220 v. 80 m a vibrator pack, **35 -.**
3 Valves for same (OZ4 and two EL35), **35/-.** High output carbon hand mike for same, **5 -.**

2-VALVE SHORT-WAVE BATTERY KIT. A complete kit of parts for a 2-valve receiver, covering 15-600 metres, including valves, coils, drilled chassis, H.T. and L.T. dry batteries to last approximately 6 to 12 months. A pair of double headphones and full instructions. Price **£3 10s.** An extra coil can be supplied covering 600-1,900 metres, at **4/-.**

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A well made mahogany finished pedestal cabinet, containing a quality electric gramophone motor and pick-up in upper compartment, and record space in lower. Height, 30in. Width, 16in. Depth, 15in. Price **£18 18s.**

RECORD PLAYERS. Consist of a High Quality electric gramophone motor 200 250 v. 50 cycles with speed regulator, 12in. turntable, automatic start and stop, Quality magnetic pickup, mounted on a strong metal frame, Price **£8 19s. 6d.** Identical Model but with Rothermel Crystal pickup, **£10 19s. 6d.**
AUTOMATIC RECORD PLAYERS. A reliable automatic 8 record mixer changer, 200/250 v. 50 cycles, with reject and repeat mechanism, mounted on a strong metal frame. Price **£20.**
METERS. A huge purchase of military surplus meters allows us to offer the following bargains. Best makes, Bakelite cases, prices are approx. ¼ original cost.

Range	Ext. Diam.	Basic Movement	Fitting	Type	Price
300 v.	3½"	8 M/A	Flush	M.I. A/C	7/6
500 M/A	3"	—	Proj.	M/C D/C	12/6
40 v.	2"	5 M/A	Flush	M/C D/C	7/6
2½A	2"	—	Flush	Thermo	7/6
4A	2½"	—	Port	H. Wire	7/6
3KV	3½"	2½ M/A	Flush	M/C D/C	20/-
20A	2"	25 M/A	Flush	M/C D/C	7/6
40A	2"	12½ M/A	Flush	M/C D/C	7/6
25A	3½"	5 M/A	Flush	N C D/C	7/6
25A	3½"	25 M/A	Proj.	M/C D/C	7/6

SUPER OUTPUT TRANSFORMERS. By means of a series parallel arrangement wherein the maximum winding is used for each ratio extremely high efficiency is obtained. Any valve single or pushpull may be matched to any voice Coil (2 to 30 ohms) type Mo.15, 15 watts, **30/-.**

PREMIER MAINS TRANSFORMERS.
All primaries are tapped for 200-230-250v. mains 40-100 cycles. All primaries are screened. All LTS are centre tapped.

List No.	Output.	Price
SP.175A.	175-0-175 v. 50 m/a, 6.3 v. 2-3 a., 5 v. 2a	25/-
SP.175B.	175-0-175 v. 50 m/a. 4 v. 1 a. 4 v. 2-3 a.	25 -
SP.250A.	250-0-250 v. 60 m/a, 6.3 v. 2-3 v. 5 v. 2a.	25/-
SP.250B.	250-0-250 v. 60 m/a. 4 v. 1-2 a., 4 v. 3-5a.	25/-
SP.300A.	300-0-300 v. 60 m/a. 6.3 v. 2-3 a., 5 v. 2 a.	25/-
SP.300B.	300-0-300 v. 60 m/a. 4 v. 2-3 a., 4 v. 3-5 a., 4 v. 1-2 a.	25/-
SP.301A.	300-0-300 v. 120 m a. 5 v. 2-3 a., 6.3 v. 3-4 a.	28 -
SP.301B.	300-0-300 v. 120 m a 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-5 a.	28/-
SP.350A.	250-0-350 v. 100 m a. 5 v. 2-3 a., 6.3 v. 2-3 a.	29/-
SP.350B.	350-0-350 v. 100 m a. 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-5 a.	29/-
SP.351	350-0-350 v. 150 m a. 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 3-6 a.	36/-
SP.351A.	350-0-350 v. 150 m a. 4 v. 2-3 a., 4 v. 3-6 a., 4 v. 1-2 a., 4 v. 1-A.	39/-
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SP.425A.	425-0-425 v. 200 m/a. 6.3 v., 2-3 a. 6.3 v. 3-5 a., 5v. 2-3 a.	47/-
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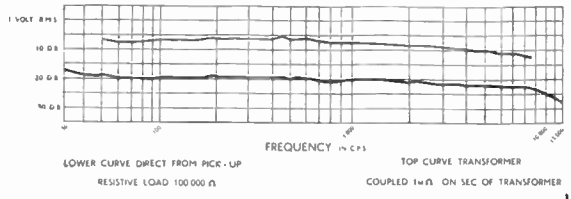
E

The "Connoisseur" is proved by trade tests

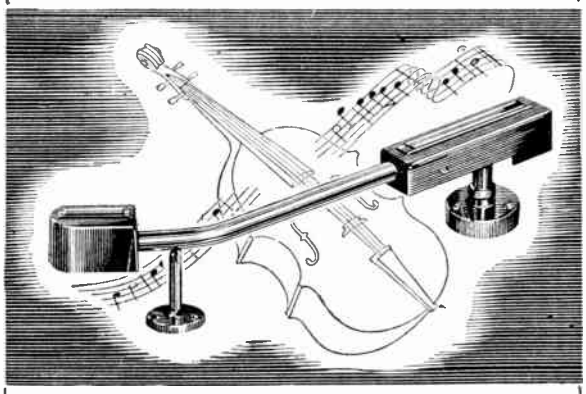
Exhaustive trade tests have substantiated our claims for the "CONNOISSEUR" pick-up. Below we give the response curve to which every "CONNOISSEUR" pick-up is individually tested.

Supplies are very limited but we invite trade enquiries to our distributors who will endeavour to meet your requirements.

RESPONSE CURVE *Connoisseur* PICK-UP

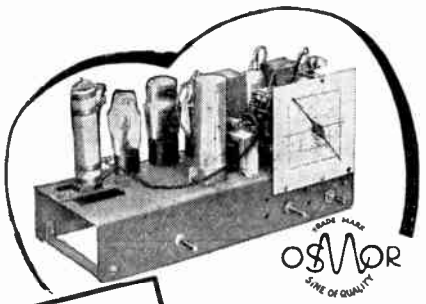


1. Every "Connoisseur" pick-up is hand tested and passed to ± 2DB of above response curve.
2. Our new type damping material working in gap direct on to armature does not affect bass resonance point.
3. The required downward pressure is 1.1/3 ozs. which has been achieved without counter-balancing or springs.
4. Being a constant velocity device Bass compensation is required in the amplifier and alternation of high frequencies to suit individual recordings.
5. Output direct from pickup .1 volt.
   With transformer coupled .5 volt.



Apply to :—
Albion Electric Stores, 125, Albion Street, Leeds 1, or to
Lawton Brothers (Sales) Ltd., Henry Square, Ashton-under-Lyne.

Made by : A. R. SUGDEN AND CO. (ENGINEERS) LTD., BRIGHOUSE, YORKS.



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All the principal components of a factory-made 3 wave superhet receiver, matched and assembled, ready for wiring. Tested and proved for reliability, sensitivity and many exceptional qualities. Easy to build ; saves time ; no snags.

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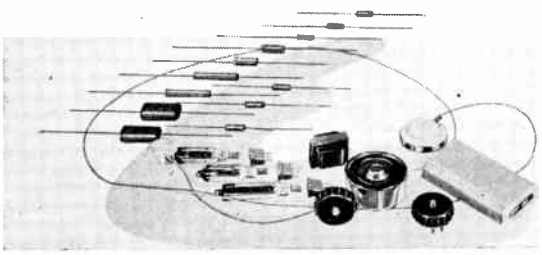

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1617

The Problem

The directional response characteristic of single unit loudspeakers is very pronounced at the higher audio frequencies which are audible only in a comparatively narrow channel directly in front of the reproducer with a corresponding lack of intelligibility and brilliance elsewhere.

This feature is particularly troublesome when high quality sound reproduction is required in public halls, theatres and small cinemas where the size and expense of a large dual channel loudspeaker system is often not justified.

The Solution

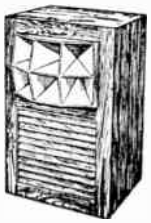
It is for such installations that the Vitavox Bitone Reproducer has been designed. High frequency reproduction in this instrument is handled by a small multicellular horn and moving coil pressure unit, this assembly providing adequate coverage and at the same time because of its high efficiency, a rising high note characteristic which is an advantage in auditorium reproduction. A 12" moving coil cone type loudspeaker operating in a vented enclosure reproduces low frequencies and a cross-over filter network is fitted to divide the frequency spectrum correctly between the two units. The whole assembly is mounted in a polished Walnut finished cabinet as standard, Oak and Mahogany veneered models being available to special order, and can be relied upon for applications where quality of performance rather than first cost is the main consideration.

MEET US AT RADIOLYMPIA OCT. 1-11 STAND No. 54 GRAND HALL

SPECIFICATION AND PRICES

Power Handling Capacity: Model 610—10 watts; Model 620—20 watts. *Size:* 32" x 21" x 20". *Terminating Impedance:* 7·5 ohms. *Filter Attenuation:* 12 d.b. per octave. *H. F. Distribution (appx):* 60° x 40°.

MODEL 610 — £42 0 0
MODEL 620 — £50 0 0



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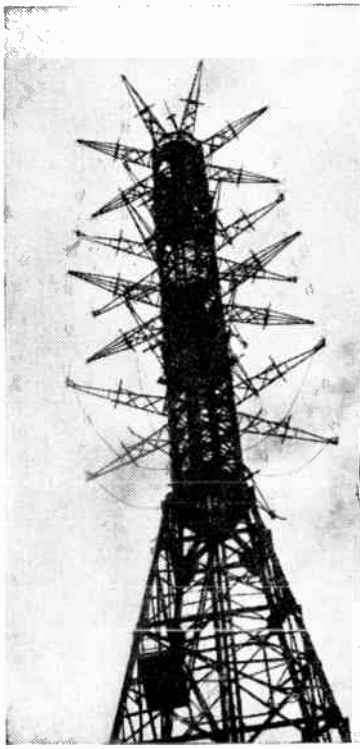

TELCON R.F. CABLES

for all Television and Radio requirements

CABLE CHARACTERISTICS

CODE	Zo	CAPACITY	ATTENUATION
K25	300 ohms	4·6 μμF per foot	At 1 Mc/s 0.15 db/100 Ft. " 10 " 0.4 " " " 50 " 1.0 " "

Dimensions 0·44" x 0·09"

TYPE: FLEXIBLE TELCOTHENE TRANSMISSION LINE

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Founded 1864

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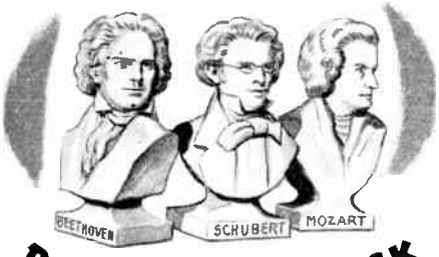
TELCON



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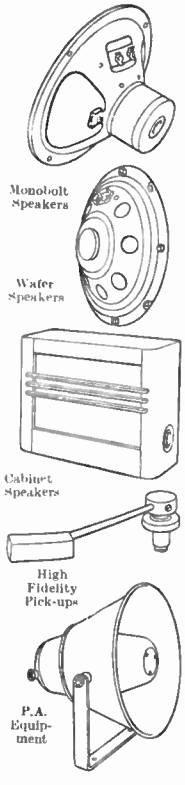

We can't, of course. Not just like that. But we do say that if you use Truvox Equipment with amplifiers of comparable quality you will get realism as dramatic as if the composer were indeed conducting again.

New Truvox loudspeakers, new gramophone pick-ups, results of years of specialist endeavour will be shown for the first time at Radiolympia on Stand 81. We hope that you will see them there, but if you cannot, a postcard will bring satisfying literature.

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ENGINEERING CO. LTD.
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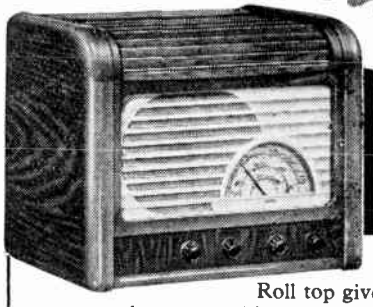
Technically outstanding

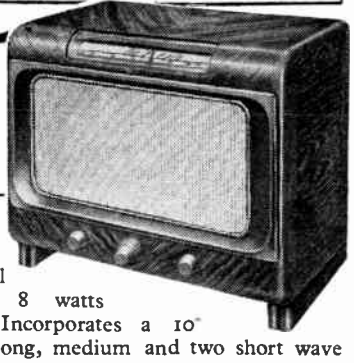
We believe that the only way to build a receiver is to begin at the beginning with a sound circuit design—a design that's been tested and re-tested—a design that will stand up to the most critical examination. From this design a prototype is constructed in which every component receives the some rigorous testing. We leave the experts to pass judgment on the resulting Sobell receivers. We are confident that for ease of control and absolute fidelity of reproduction these models will be found to have no equals—that, in fact, you will pronounce them to be 'technically outstanding'.



SOBELL MODEL 516 T.G. TABLE RADIOGRAM

Roll top gives easy access to gramophone turntable. The receiver is a 5-valve super-het. operating from 200/250 volts, 40/100 cycles per second A.C. supply. Wave range: 16-50 metres; 193-577 metres; 800-2,140 metres.

SOBELL MODEL 717 7-VALVE RECEIVER



Built with a push-pull output stage giving 8 watts undistorted output. Incorporates a 10" loudspeaker. Covers long, medium and two short wave ranges. Voltages as for 516 T.G.

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TWO YEARS' FREE ALL-IN SERVICE IN THE HOME

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AUTOMATIC CHANGER POLYPHONIC RADIOGRAM
£94 17s. 6d, plus Purchase Tax.
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Kenya: Campling Bros. & Vanderwal Ltd., Salisbury Road, Nairobi.

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57, St. Martin's Lane, W.C.2. (Temple Bar 4284)
Works: Farnham, Surrey. (Farnham 6461/2/3).

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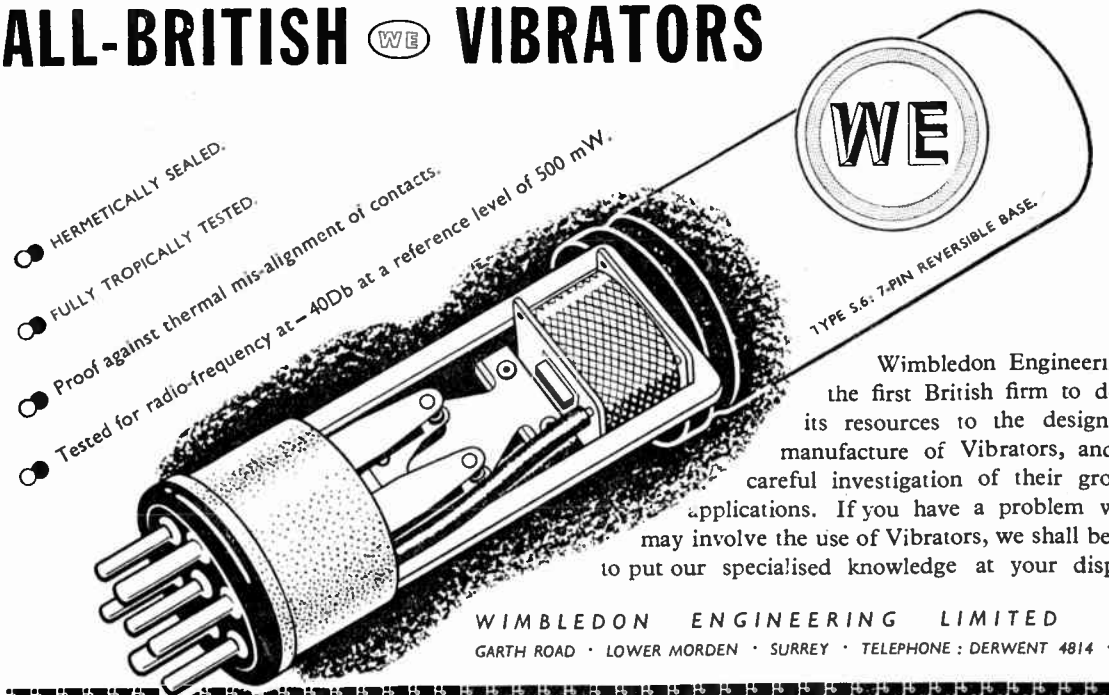

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FOR STABLE FREQUENCY GENERATION

FEATURES :

Low temperature coefficient—less than 2 in 10^6 per °C. Patented nodal suspension. Mounted in vacuum; performance independent of climatic conditions. Exceptionally high Q value. High stability. Small size, 3in. × $\frac{5}{8}$in. overall excluding pins. Fits standard miniature deaf aid valve socket.

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Proprietors, **THE GENERAL ELECTRIC CO. LTD.** England.

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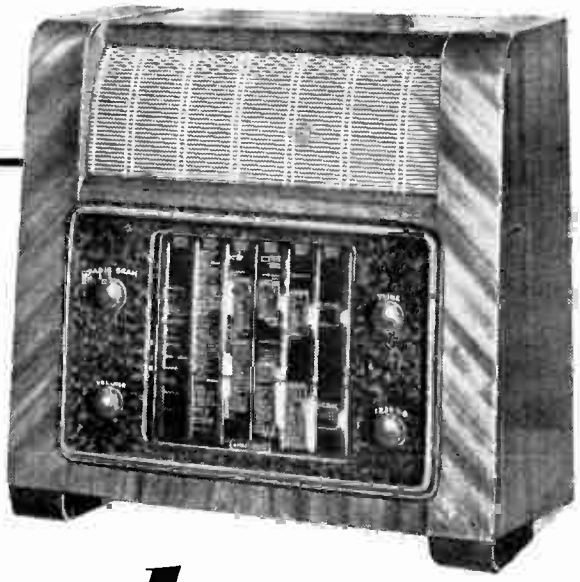

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BRIEF SPECIFICATION 5 valve 6 waveband A.C. Superhet. Electrical Bandspreading on principal S.W. Bands. New design output circuit giving exceptional wide frequency response. A really outstanding receiver for Short Wave listeners who also appreciate quality reproduction.

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Rate 6/- for 2 lines or less and 3 - for every additional line or part thereof, average lines 5-6 words. Box Numbers, 2 words plus 1/-. Press Day : November 1947 issue, first post Wednesday, October 8th. No responsibility accepted for errors.

WARNING

Readers are warned that Government surplus components which may be offered for sale thraugh our columns carry no manufacturer's guarantee. Many of these components will have been designed for special purposes making them unsuitable for civilian use, or may have deteriorated as a result of the conditions under which they have been stored. We cannot undertake to deal with any complaints regarding any such components purchased.

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TWO Defiant 6-valve superhet chassis, with 10in speakers, one Lowther dual H.Q. tuner.—Pioneer Films, 348, Gray's Inn Rd., W.C.1. Terminus 7311. [8305

DEGALLIER'S, Ltd., announcement.—When token imports American receivers is permitted we shall have these; information will be in this column when available, please watch future issues. [7541

AMPLIFIERS; new 1947 model Hi-Fi units, with triple tone controls, built to customer's specification. — Broadcast & Acoustic Equipment Co., Ltd., Broadcast House, Tombland, Norwich 26970. [6433

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HIFI, Ltd.—May we send you details of our latest "Hifi" quality amplifier, designed for use with moving coil pick-ups and to satisfy the most discriminating of music lovers.—150, High St., Lye, Worcestershire.

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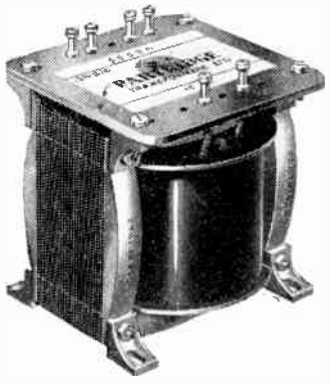
PARKER RADIO offer semi-midget 3-waveband superhets and table model receivers, housed in mahogany veneered cabinets; trade and export enquiries invited; receivers manufactured to specification; meet us at Stand 315 Radiolympia.—Parker Radio Manufacturing Co., 756, Harrow Rd., N.W.10. [8270

BAKER'S.—New 7-valve 'Wireless World' Quality amplifier with tone control stage, 8 watts push-pull triode output, price includes super Quality triple cone, 12in permanent magnet speaker, with large output transformer and all valves; also as above but with 15 watts tetrode output, ideal for realistic reproduction or public address; 2½d stamp for partics., prices, etc.—Baker's Selhurst Radio 75, Sussex Rd., S. Croydon. Croydon 4226.

SILVER DRAGON.—Although we have not been able to secure stand space at Radiolympia we certainly have the finest receiver which will be available, 10m-2,000m communications sensitivity, variable selectivity, band spread, top and bass compensated controls, expander, 10 watts P.P. output, exquisite cabinet work.—Details from The Moreton Cheyney Co., Ltd., Darkhouse Lane, Coseley, Bilston, Staffs.

Partridge News



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Firm clamping of the laminations by means of scientifically designed pressure die-castings.

Interlocked fixing feet providing alternative mounting.

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Telephone: *Abbey 2244*

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AC mains superhet receivers, 2 sw and 1 mw bands, brand new ex-factory; £15/10 ea; 6½in P.M. speakers, new, boxed, 21/- ea; Truvox microphones, 13/6 ea; volume controls, less switch, 1/6 ea.—Uncle Tom's Radio Cabin, 5, Seven Stars Court, Manchester, 4. [8427

"THE finest amplifier I have yet heard; better than many at twice the price."—This is what a satisfied customer states about our amplifier, built to "W.W." (May issue) design; quality parts only used, producing superb results; price £25/10; kits of parts can also be supplied; pre-amplifier, elec. motor and pick-up and 12in speaker extra.—Enquiries to Radio Trades Manufacturing Co., Laurel House, 141, Little Ealing Lane, W.5. Eal. 6962. [8331

UNIVERSAL ELECTRONIC PRODUCTS, 36, Marylebone High St., London, W.1. Tel. No. Wel 4058. Our U.E.7 amplifier is designed for the connoisseur who requires the best possible reproduction together with the highest standards of workmanship and materials; 10 watts undistorted output from 9 valves (triodes) in double push pull with independent controls for treble and bass; we invite you to hear this instrument demonstrated; 2½d stamp for details. [8264

RECEIVERS, AMPLIFIERS—SECOND-HAND

A.R. 88 L.F., perfect, 55gns; B28/CR100, offers.—Box 2223. [8246

R1155 R.A.F. receivers, excellent condition, 16 to 4,000 metres; £15.

IN nearly new condition, realigned and calibrated, guaranteed working order; £17/10. Circuit diagram and component value, 1/6 postfree

CAN be supplied with output stage/power pack and loudspeaker; £27/10.

FULLY modified, as follows, becomes an all round super set with high quality output. D.F. parts removed, new front panel, bass and treble boost with separate tone controls, R.C. coupled push-pull output (2-PX4s), gram input, other refinements, complete with loudspeaker; £35.—Write for details.

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AR88 receiver for sale, condition good; £65.—Paul's Radio, Nolton St., Bridgend, Glam

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CR.100 late model, 12 valves, inc. noise limiter; offers £30; (Manchester).—Box 2225. [8240

HRO receiver, 9 coils, spare valves, Xtal, S meter, etc.; good condition; £50.—Box 2531. [8289

EX-RADAR set, 5in c.s., c.r.t., 26 valves, 6116, 6SN7, 6SJ7, 100 kc/s, crystal; £10.—Box 2526. [8271

EDDYSTONE 358X, 90kc-30mc, Xtal gate, as new; £45.—19 Patten Rd., Wandsworth, London, S.W.18. [8224

14v 10-160m communications RX xtal, BFo a/eter, limiter, a.v.c., complete in cabinet; £45.—Box 2030. [8165

15-WATT amplifier, Callaro turntable and pickup, 12in Goodman's speaker in cabinet; £25 lot.—Box 212. [7747

HALLICRAFTERS S.27, 27.8 to 143 mcs AM/FM 110-230 volts, good condition; offers over £35.—Box 2209. [8227

1155 Comms. recvrs., 5 waveband, £13/10; modified, £14/10; tested.—Pippet Busketts Way, Ashurst, Southampton.

R1155 receiver, accurately lined up and complete with power pack and loudspeaker in separate cabinet; £16.—Box 2206. [8218

CR91 (similar AR88), new, complete with handbook; best offer over £50, or would exchange good radiogram.—Box 2033. [8174

PHILIPS communication receiver, one RF, two IF, L/W, M/W, short 5.6-18 m/cs, a.c. power pack, as new; offers.—Box 2028.

PAM A.C. ampifier, 25 watts, twin speakers, high-fidelity m/c mic. and stand maker's guarantee; offers.—Fin. 4066.

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EDDYSTONE 358X 90kc to 31mcs, with power pack, in beautiful condition.—Offers to 2, Logie Rd., Causeway Head, Stirling.

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HOWARD 450A, 12-valve, 65 mc/s, 550 kc/s, Xtal first-class condition, new condensers, alignment instructions; collect Glasgow; offers.—Box 2529. [8286

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TROPHY communication receiver (46mc 550kc) a.c. model, condition as new, complete with speaker; £22 or near offers.—Macdonald, Fodderty Cotts., Dingwall, Rossshire. [8162

4 Walkie-talkie sets No. 38, short range R/T communication, 3 complete and recently netted, in working order; 1 spare set, instruction supplied. £14/10.—P. Brooke, The Temple, Goring, Berks. [8187

R.C.A. AR88 comms. rec., 540 kc/s to 32 mc/s, 6 wavebands, BFO, 100 watts output, L.S. terminals and 'phone jack, as new, voltage 110 to 250v, in stages; highest offer to Simpson, 40, Mowson Lane, Worrall, Sheffield.

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A.C. 5-valve 8-watt push pull amplifiers, negative feedback, complete with large multi-ratio output transformer, £9; ditto 10-watt 6V6, £10; a range of feeder units T.R.F. and superhet from £5/5.—R.T., 64, St. Leonard's Rd., London, S.W.17. [8253

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JAMES W. GRAHAM, M.I.R.E. Radio Engineer 98, South St. Perth. 8177

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HARTLEY-TURNER 215, perf., £7; output transformer, 15/-.—Box 2207. [8220

HARTLEY-TURNER duode, 4 ohms, with rectifier, £5.—Osborne, 30, Forester Road, Bath. [8223

4 G.E.C. 10-watt p.m. 15-ohm units on 42in all-metal exponential horns; as new; offers.—Box 2226. [8242

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S.A.E. for list; extensive stocks of all types of radio equipment.—Radiographic, Ltd.

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CAPEHART auto. record changer, perf. order; £10.—1, Browning Way, Heston, Mx

ROTHERMEL Senior pick-up, new, with latest hi-fidelity cartridge, 50/-.—Hunt, Stagsden, Bedford. [8200

SINGLE and auto radiogram units, cabinets, chassis, amplifiers, speakers, pick-ups, midgets, etc.; s.a.e. catalogue; trade inquiries invited.—Radio Unlimited, 16, Carnarvon Rd., Leyton. [8184

TYPE 12 P.U. and transformer, 55/ ; A.C. gram. motor, 200-250v, £6/10; model 25 P.U., 30/-.—Box 2032. [8172

NEW Collaro microgram unused, in carton, cost £20/10/8, accept 16 gns.—Winwood, 12, Carnarvon Rd., Leyton. [8206

VOIGT moving coil pick-up with diamond stylus; almost new; £14/10.—Joseph Enock, Ltd., 273a, High St., Brentford.

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HAYNES quality radiogram, comprising R2 unit, 6 watt amplifier, Simpsons turntable, Haynes speaker in oak cabinet, £55; reason for selling moved to D.C.—Box 2046.

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V.G. tracking gear, Dralowid D.T.7 cutting head, V.G. synchronous motor and turntable, 78 230 A.C., in wooden case, as new; Aeco recording motor and turntable, 33/1/3-78 A.C./D.C. Rothermel spherical sound cell microphone and socket, offers; few reground sapphire Stylus, 12/6 each.—Box 2144. [8188

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RILEY Elect. Eng. Co. (Hull), Ltd., offer new components, kits, everything for the home constructor; lists; competitive prices.—69a, Church St., Sutton-on-Hull, Yorks. [8243

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H.R.O. coils, frequency bands between 50-960 kc/s; £1 each; offer for 50 entertained.—Box 2143. [8185

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AMPLIFIERS from 5- to 50-watt, mains or battery, radiogram components, motors, cabinets, changers, chassis, speakers pick-ups, players, micrograms, midgets kits, microphones, etc.; s.a.e. catalogue.—Radio Unlimited, 16, Carnarvon Rd., Leyton. [8204

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A LARGE quantity of radio components, including condensers, flexible couplings, 3 pole 3-way switches, line cord, multi range ohms meters, screened wire single and twin, 3-core flex., 2- and 4-way fuse boxes, etc.—'Phone or call L. Goodman (Radio), Ltd., 9, Percy St., Tottenham Ct Rd., W.1 Mus. 0216.

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KITS of radio receivers from £7/8; 4- and 5-valve, new materials, table models, semi-midget; our latest kit.—Wylwyn Star 1947 has connections for gramophone pick-up, extensions to loudspeaker A.V.C., 6 hours average time for constructing; full details, diagrams with each kit; c.w.o. or c.o.d.—Isherwoods, Reme House, 81, Plungington Rd., Preston. Tel. 3348. Estd. 1936. [6788

AMATEUR selling up!—Universal Avominor with 5a shunt, £5; D.104 crystal mike, £3; telescopic mike stand, £1; 3½in M.C. meter, 100-0-100μa, 50/-; "Avodaptor" valve tester, 10/-; all above, together with 21 valves (many new), 66 switches 43 vol controls, 25 electrolytics, 36 trimmers and tuning, and 100 other condensers, 200 resistors, chokes, transformers, coils, plugs, etc., etc., £35; s.a.e. for list.—Madge, 267, Porters Ave., Dagenham.

GEE ELECTRIC, 15, Little Newport St., London, W.C.2. Tel. Ger. 6794.—A few of the many lines held in stock: 32mfd 650vw tropical condensers, 12/6; 4mfd 800vw paper condensers, 5/-; 5mfd 2,500vw paper condensers, 7/6; 5in page speaker p.m., 16/6 each; 3½in p.r.t., as per last month's issue, £4/10; this month's special ex-Gov. modulator unit type 76, containing relays, i.f.s, fuse holders, also condensers, transformers, resistors, and valve holders, all new, bargain price to clear, 27/6 each; trade supplied. [7886

GOODSELL, Ltd., 40, Gardner St., Brighton, Sx.—Demonstrations of the new Armstrong R.F.103 4 band feeder units using Denco turrets, I.F.T.s as last month's advert, details upon request; Denco catalogues 7d, No. 1 Bulletin 3/21/2; 1d stamp for list of components for constructors; Williamson amplifier as per specification with all Partridge transformers to specification, £20/10, including valves; general test and frequency response check, usual guarantee; pre-amplifier with 4-position bass lift and 4-position treble lift using E.F.37s, at £2/10; a few Denco C.T.3 coil turrets, 6 bands, ex-stock. [8403

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BARGAINS in new and unused ex-Service equipment.—Indicator units type 6C, containing one 3in cathode ray tube, 2 VR91 (EF50), 2 VR54 (ECC31) valves, 20 various resistances, 4 potentiometers, 8 condensors, co-axial input and output sockets, etc., new and unused, in maker's sealed carton, 5gns each, carriage paid; 40 feet lengths flat twin R.F. feeder ribbon cable with connector, 300 ohm impedence, new and unused, in maker's original carton, 8/6 post paid; ex-R.A.F. type 256, oil filled 4kva, input 230 volts, 50 cycles, output 18kv, weight approx. 4½cwt, in maker's sealed crate, £15, carriage forward.—Wireless Instruments (Leeds), Ltd., 54 and 56, The Headrow, Leeds, 1. Tel. 22262. [7766

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WANTED, "Wireless World," Aug. 18th, 25th, 1938, June 8th, 1939.—Box 2974.

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REWINDS and conversions to mains and output transformers, fields, etc., from 4/6. pp equipment a speciality.—N.I.. Rewinds, 4, Brecknock Rd., N.7. Tel. Arnold 3390. [6283

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REPAIRS to moving coil speakers, cones, coils fitted field rewound or altered; speaker transformers, clock coils rewound, guaranteed satisfaction, prompt service; no mains trans. accepted.
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STURDY rewinds, mains transformers, chokes and fields; we give prompt delivery and guarantee satisfaction; 14 years' experience; prices on request.—Sturdy Electric Co., Ltd., Dipton, Newcastle-on-Tyne. [4316

LOUDSPEAKER and transformer repairs "almost by return of post"; we offer the quickest service in the trade, at competitive prices. Send 1d for our monthly service bulletin, Dept. W.—A.W.F. Radio Products, Ltd., Borough Mills, Bradford, Yorks. Tel. 22838.

LOUDSPEAKER repairs, any make, reasonable prices, prompt delivery, to the trade and quality fans; 25 years' combined experience with Rola, Magnavox, Goodmans, Celestion.—Sound Service Radio, 80, Richmond Rd., Kingston-on-Thames Kin. 8008. [4977

REWINDS, mains transformers, speaker field coil, chokes, high-grade workmanship, 7-day delivery; new transformers constructed to customers' specification, singly or in quantities.—Metropolitan Radio Service Co., 1021, Finchley Rd., N.W.11. Speedwell 3000. [3719

24-HOUR service, 6 months' guarantee, any transformer rewind, mains output- and i.f.s., etc., all types of new transf., etc., supplied to specification; business heading or service card for trade prices.—Majestic Winding Co., 180, Windham Rd., Bournemouth.

COIL specialists.—Tuning and oscillator coils, I.F., L.F. and mains transformers rewound and wound to specification; wavewinding, L.S. repairs.—Electronic Services (R.T.R.A.), 17, Arwenack St., Falmouth, Cornwall; and 49, Uxbridge Rd., Ealing, W.5.

REWINDS, mains transformers, layer wound wax impregnated, O/P transformers, chokes fields, clock coils, pick-ups, fractional hp motors, competitive prices, prompt delivery; guaranteed work.—W. Groves, Manufacturing Electrical Engineer, 154, Icknield Port Rd., Birmingham, 16. [4547

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LOUDSPEAKER repairs. L. Cottenham for your loudspeaker repairs, all types repaired at keen competitive prices; field coils rewound to any resistance; quick service and guaranteed satisfaction.—Send to L. Cottenham, Loudspeaker Repair Factory, Whetley Lane, Bradford, Yorks. Enquiries will receive immediate attention. [8350

NATIONAL RADIO SERVICE & TELEVISION CO.—Trade service engineers; immediate service any district; rewinds to all types transformers, armatures, motors, loudspeaker cones, speech coils fitted, British and American components and valves; enquiries invited for contract trade service; multiple transformer winding.—63, High St., St. John's Wood, N.W.8. Primrose 6725 [6752

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MISCELLANEOUS

SPEECH disability; Mr. H. V. Hemery consults at Wigmore Hall Studios, W.1.

ALUMINIUM chassis panels to your own specification from 3/9 each.—M.E.A.D. 13, Bence Lane, Darton, Barnsley. [8290

"W.W." bound volumes, 1929-38, "Harms-worth Wireless Encyclopedia" (3 bound volumes).—14, Southlands, Newcastle-on-Tyne.

SALE.—Copies of journals, inc. "W.W.," Q.S.T. Elec. Eng., also books; s.a.e. details.—R. Rowlands, The Laurels, Hawarden, Chester

BRAND new A.M surplus 2-volt radio accumulators at ess than half the usual price, 8/6 post paid; trade supplied.—Dept. S., Enfields, High St., Midsomer Norton, Som.

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EX-GOVT. elec. lamps, brand new, ring makes; one million in stock at approx. 75 per cent off list prices; 2 volt to 230 volt; 0.2 watt to 1,500 watts; various caps; Prefocus projectors, 12 volt to 230 volt; send for list; special prices for export, etc.—Auto Collections, Ltd., 126, St. Albans Ave., Bedford Park, W.4. Tel. Chiswick 1601. [8122

DURALUMIN tube, 1in 20 gauge 9d ft, 13ft 9/-, 7/16in 16 gauge aluminium tube 6d ft, max 12ft lengths; aluminium chassis 18 gauge 10×8in 5/6, 12×9in 6/-, 16×8in 6/6, 20×8in 8/-, 22×10in 10/6; all 2½in depth; aluminium sheet 22 gauge 1/4, 20 gauge 1/9, 18 gauge 2/-, 16 gauge 3/- sq ft; all postage extra; also in stock aluminium angle, ⅝, ¾, ⅞, 1in; flat strip, moulding; send s.a.e. for list of aluminium, etc.—Fanthorpe, 6, Hepworth's Arcade, Hull. [8285

RADIO and electrical accessories ex stock 6BA brass locknuts, 1/10 per gross (minimum 20 gross); a varied selection of BA screws, nuts, bolts, etc. (list on application). Paxolin strip and tubing, 2/- per lb; twin screened flex, 50/- per 100 yards; 50,000 ohm wire wound volume controls, 25/- per dozen; coil and valve screen tins, 1 9/16in×1⅝in×4¼in, 3/- per dozen; tinned copper wire (minimum 56lb), 2/- per lb; radio chassis, 8in×6½in×2½in, £5 per 100; transmitter racks, 21in×19in×17in, 15/- each JOHN DOWNTON & Co., 89, High St., Epping, Essex. Tel. Epping 2163. [8282

WORK WANTED

INSTRUMENT gear cutting capacity.—Lloyd & Ramsden, Huntingdon St., Nottingham.

LIGHT press capacity available up to 25 tons, and assembly, in London area.—Box 1437. [8074

WE make wireless and radiogram cabinets for home and export; immediate deliveries.—Radiac, Ltd., 26, Brondesbury Rd., London, N.W.6. Maida Vale 8792 [8025

CAPACITY available press tools, plastic moulds, jigs and fixtures; production, ⅝in capstan capacity.—Blair Tool Products, 112, Greyhound Lane, Streatham, S.W.16. [7959

FOXWINDERS, 74a, East Hill, Wandsworth, S.W.18, are now able to quote you for your light press work, blank form or piercings, milling, turning and guillotining. [8382

QUALITY enthusiasts! Have that new high fidelity set you are contemplating designed and/or built by a specialist; all types of apparatus built to requirements.—Write for quotation to BCM/HIFIDEL, London, W.C.1.

DRAWING and tracing work for radio and electrical engineering, jig and tool and light engineering, photoprinting; full sets of drawings undertaken to commercial or Ministry standards.—Drawing & Tracing, Ltd., 456a, Ewell Rd., Tolworth, Surbiton 'Phone Elmbridge 7406. [7703

TELEVISION aerial installations and aerial maintenance, full range of antennas supplied and/or installed by experts; removals and re-erections arranged; our pre-war Trade Service Dept. is now open.—Brochures from Wolsey Television, Ltd., 87, Brixton Hill, S.W.2. Tulse Hill 1240. [7320

BUSINESSES FOR SALE OR WANTED

ACTIVE manufacturing radio business in Midland industrial city, with retail side, holding exclusive pre-war American agencies, extensive export sales with wide-world demand, capable of expansion; £25,000.—Box 2592.

EASTBOURNE (the "sun-trap of the south"); electrical and radio business for sale as going concern; shop, charging-room and large well-fitted workshop; busy position; rent £90 p.a., 14 years lease; £1,500; "all at" s.a.v., old-established.—Sole Agent, George Howard, F.A.I., P.A.S.I., 56, Grove Rd., Eastbourne 3569. [8272

FINANCIAL PARTNERSHIPS

ELECTRICAL radio engineer seeks active partnership London business, £200-£1,000 available; also wiring, appliances, office administration and export experience; travelled, linguist.—Box 2203. [8214

WANTED a working partnership in small progressive radio electrical business in West Country, some capital available.—Write Box 2530. [8288

SITUATIONS VACANT

NORTHERN Polytechnic, Holloway, N.7.

THE Governing Body invite immediate applications for appointment as full-time lecturer in radio engineering; salary scale: £300×£15—£525, plus £36-£48 London allowance, together with other allowances in accordance with the Burnham Award; forms of application, together with full particulars, will be forwarded on receipt of a stamped addressed foolscap envelope.—R. H. Currell, Clerk.

CROWN Agents for the Colonies.—Applications from qualified candidates are invited for the following post:—BROADCAST Officer required by Gold Coast Government for 1½ to 2 years, with possible permanency; salary according to age and war service in scale £600 to £970, including overseas pay; outfit allowance £60; free passages; candidates should have had thorough training in theory and operation of wireless broadcast transmitters and in studio technique; should understand thoroughly the system of distributing radio programmes by wire and have thorough knowledge of superheterodyne shortwave receivers; knowledge of gramophone disc recording desirable.—Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, and mentioning this paper, to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M/N/13418 on both letter and envelope. [8341

RADIO service engineers required for car radio installation and maintenance; all parts of U.K., local employment.—Box 2812. [8374

REQUIRED urgently, competent radio service engineer, able to drive; good opportunity for right man.—Box 2534. [8314

QUALIFIED radio television engineer required; excellent opportunities to keen capable man.—Write Robert Bennett, Ltd., 73, Stroud Green Rd., N.4. [8366

A PERMANENT position is offered to an experienced and skilful radio and television service engineer; good wages and conditions; Harrow district.—Write full details to Box 2985. [8472

THE Air Ministry has vacancies in the Meteorological Office organization for a number of civilian Radio (Meteorological) Mechanics to maintain radio and radar equipment.

APPLICANTS must possess a knowledge of the fundamental principles of radio and radar and have had practical experience in the use of tools, filing, drilling, hard and soft soldering, wiring, and in the maintenance and use of electrical radio and radar instruments, including cathode ray oscilloscopes

PREFERENCE will be given to former R.A.F. personnel, and any other ex-Servicemen possessing the requisite qualifications; staff selected will be required to serve at any station at home or abroad, and in the case of appointments at home units, will generally be expected to make their own arrangements for accommodation; successful applicants will be engaged on a temporary non-pensionable basis only at commencing weekly wages (in the United Kingdom) of £6 5s per week (inclusive) for appointees aged 21 and over.

APPLICATIONS should be addressed to Air Ministry (S.5.h), Bush House, North-West Wing, Aldwych, London, W.C.2. [8450

RADIO service engineer required, able to drive, good wages and conditions for right man.—Thorogood Radio, Ltd., 44-5, Tamworth Rd., Croydon, Surrey. Tel. Croydon 7417-8. [8313

JUNIOR laboratory assistant with some knowledge of physics and some electrical training.—Write, giving details of experience, age, etc., to: A. H. Hunt, Ltd., Bendon Valley, S.W.18 [8354

WORKING charge hand for high frequency and power test department; preferably with knowledge of high power oscillators; West London; age, experience and wages required, to: Box 2885. [8378

MALE progress clerk required by large radio manufacturers, S.E. London area; must have experience of purchasing progress; write, stating age, experience and salary required, to: Box 2597. [8329

GENTLEMAN required immediately to handle export matters in connection with radio receivers; it is essential that he understands the radio market and has suitable contacts.—Box 2886. [8380

WELL established firm of quality radio manufacturers require sensible works manager, able to maintain production and keep records thereof in the customary manner; state age, exp. and salary required.—Box 8150.

SALESMAN to take over small radio department; experience and some technical knowledge essential; write fully, stating salary req.; W. London district.—Box 2813.

RADIO engineer-operator required for radio station in North London; applicants must have good servicing knowledge of communications receivers, be able to receive morse at 25-30 w.p.m. and have good typing speed.—Write Box 2595. [8327

DRAUGHTSMAN-ILLUSTRATOR wanted for Technigen Publications; practical knowledge of radio essential; write, with full particulars of career, age and salary required, to Lewis George Laboratories, 222 229, Hammersmith Rd., W.6. [8357

JUNIOR laboratory assistant, 20-22, with some knowledge of chemistry, preferably up to Inter-B.Sc. standard, for raw material and process testing.—Write, giving details of experience, age etc., to: A. H. Hunt, Ltd., Bendon Valley, S.W.18. [8353

TRANSFORMER designer required for development dept., S.E. Lancs radio firm, for work on transformers up to 5kva; capable of full design responsibility; qual. degree std. or Grad. I.E.E.—Apply, stating age, experience and salary required, to Box 2811. [8369

LARGE organization in West Middlesex requires field service and workshop engineers with good television and radio technical knowledge; smart appearance, car, an advantage, but not essential.—Reply, stating details past exp., age and salary reqd., Box 2145.

TEST gear superintendent required for expanding radio component factory, suburban, Surrey; qualifications, degree or equivalent, previous experience in development or mechanised testing desirable; salary £500 upwards, according to qualifications and experience.—Box 2537. [8316

DEVELOPMENT engineer required for laboratory investigation and measurements in connection with development of cables for radio frequencies; university degree or equivalent; salary up to £400 per annum.—Apply Personnel Manager, Standard Telephones & Cables, Ltd., North Woolwich, E.16. [8279

RADIO.—A vacancy arises for a junior engineer with engineering degree or Higher National certificate and with some experience of receiver design for production; age about 25 years, West Middlesex district. Apply, giving age, details of education and experience, with salary required, to Box 2533.

MAN required to call on customers of radio component manufacturers; some technical knowledge essential; previous experience unnecessary; only ex-Servicemen under 35 years of age in easy reach of Wembley district should apply; give full particulars, age, exp., salary required, to Box 2599.

DRAUGHTSMAN, first-class, urgently required for local engineering concern with experience in machine design and/or jig and tool work; 5-day week; excellent working conditions.—Write, stating age, experience and salary required, to: Personnel Officer, Ferguson Radio Corporation, Ltd., Great Cambridge Rd., Enfield. [8348

REQUIRED by large radio manufacturer in Greater London area engaged on modern high-speed production of complex receivers, chief of test and assembly foreman; also superintendent of radio production with experience of chassis assembly, coil winding and assembly methods.—Write full details, salary required to Box 2538. [8317

MURPHY RADIO, Ltd., have a vacancy for a senior engineer having considerable experience in the development and design of communication receivers and allied equipment.—Apply in the first place in writing, giving full particulars and stating salary required, to: Personnel Department, Murphy Radio, Ltd., Welwyn Garden City, Herts.

TECHNICAL advertising assistant for publicity department of important radio valve manufacturer; duties would include writing copy for advertisements, booklets, press articles; every facility for keeping in touch with latest developments.—Write in confidence, giving details of experience, present position, and salary required, to Box 2976. [8449

APPLICATIONS are invited for the position of manager, having comprehensive knowledge of design, production and rewinding of small electrical and radio transformers; previous practical experience essential; South London district.—Write full details please, stating salary required to Box 5052, Frost Smith Adve., 64, Finsbury Pavement, London, E.C.2.

REQUIRED for telecommunications research company near Maidenhead, engineer or physicist to undertake standardization and special measurements for the establishment and development of special purposes measuring apparatus if required; salary scales, with annual increments, and pension fund.—Apply in writing, Box No. 856, Dorlands, 18-20, Regent St., London, S.W.1. [8473

COMPETENT radio service engineer required, with experience on all makes of receivers; television knowledge useful; North London area.—Apply Ferguson Radio Corporation, Great Cambridge Rd., Enfield. [8347

RADIO mechanics.—Vacancies exist for experienced mechanics (preferably ex-Service) for the repair of test equipment; special knowledge of test equipment an advantage, but not essential; assisted travel from Nottingham, Leicester and Melton Mowbray is given.—For details, apply to the Establishment Officer Central Ordnance Depot, Old Dalby Leicestershire. [8343

WANTED for service in Indian State, dry healthy climate, signals officer to act as second in command police communications. Applicants must have technical experience operating and servicing medium power transmitters and receivers and have served in the Allied Forces in a rank not lower than sergeant.—Applications, with full particulars and salary expected, to Box 2938. [8411

CHIEF storekeeper required, age 35-45 years; applicants should be experienced in modern methods of storekeeping of large quantities of radio and similar components and capable of handling mixed labour; the position offers good prospects and salary in accordance with experience.—Write, stating age, experience and salary required, to the Labour Manager, Bush Radio, Ltd., Power Rd., Chiswick, W.4. [8342

MECHANICAL designers, age 30-40, capable of completing mechanical design of fixed or mobile transmitters to electrical information supplied, supervising detail drawings, preparation of stock lists and purchasing specifications; location South-West London.—Write, stating age, experience, salary required and when free to commence, to Group Staff Officer (31), Philips Lamps, Ltd., Century House, Shaftesbury Av., London, W.C.2.

TELECOMMUNICATIONS engineer required by Standard Telephones & Cables, Ltd., North Woolwich, E.16, for the design and development of radio frequency testing equipment for carrier telephone and television cables; applicants should possess an honours degree in engineering or physics and have had experience on comparable work; salary up to £450 per annum according to qualifications and experience.—Apply Personnel Manager.

FOREMAN for coil-winding shop urgently required for new factory in South Wales, small transformers, chokes, and F.H.P. motors; first-class equipment; good prospects of advancement for right man; accommodation available; only persons with many years' shop experience need apply.—Please reply in first instance, stating fully, previous experience, names of previous employers, to: Box T., c/o Smith's Library, Aberdare. [8360

DRAUGHTSMAN, senior jig and tool, urgently required to fill interesting and progressive vacancy in new light engineering factory in South Wales; only highly experienced people need apply; excellent working conditions and high remuneration and accommodation found within reasonable period.—Please reply in first instance, stating fully, previous experience, names of previous employers and salary required, to (Box No:— T) Smith's Library, Aberdare. [8361

ENTHUSIAST with a knowledge of amplifier construction and testing, electronics and preferably some experience of manufacture of light mechanical instruments, aged between 21 and 35, required for development and production work on a new type of sound recording instrument, progression possible for the right technician; extreme enthusiasm most essential qualification.—Write with details of experience, age, etc., to Boosey & Hawkes, Deansbrook Rd., Edgware. [8426

APPLICATIONS are invited for the position of senior engineer to take charge of a laboratory principally engaged upon the design and development of electronic devices; applicants should hold first-class honours degree in engineering or science and have had at least six years' development experience; salary range £700-£900 per annum, according to qualifications and experience.—Applications should be addressed to the Personnel Manager, Airmec Laboratories, Cressex, High Wycombe, Bucks.

THE ENGLISH ELECTRIC VALVE Co., Ltd., Chelmsford, require immediately one senior scientist and three assistant scientists for work in their research department; candidates should be graduates in science with experience in research, development or experimental manufacture of vacuum devices; for the senior post considerable experience of this type will be required, a knowledge of the preparation of photo-sensitive surfaces would be an advantage; salary paid would be commensurate with age, qualifications and experience.—Please address applications to Central Personnel Services, English Electric Co., Ltd., Queens House, Kingsway, W.C.2 [8275

RADIO and electronic draughtsman for lay-out work, etc., used to mechanical design of electronic equipment, required for Research Section; West London district; 38-hour, 5-day week.—In applying give full details of experience, qualifications, age and salary required, to Box 2596. [8328

SENIOR development engineer required in television design laboratory; good honours degree in Physics or Engineering and at least 4 years' industrial experience of television receiver development essential.—Applications, giving full particulars of training and experience, to Personnel Manager (Laboratory), Murphy Radio, Ltd., Welwyn Garden City, Herts. [8352

ASSOCIATED electrical Industries Research Laboratory for long-term research at Aldermaston Court, Aldermaston, Berkshire; graduates or equivalent required for posts in electronics section; sound knowledge of electronic circuitry and practical experience essential, for work on design and construction of all types of electronic circuits for use in the Laboratories.—Reply, stating full qualifications and salary required, to the Manager.

RADIO service engineers for employment in works and in field; vacancies exist in a well-known company with excellent prospects, primarily in the London area; applicants should have a comprehensive knowledge of radio servicing and a minimum of 2 to 3 years retail or industrial experience in repair work; 5-day, 44-hour week; wages according to experience and at prevailing levels.—Apply stating age, giving full details of experience and wages reqd. to Box 2536.

KINGSTON-UPON-HULL Education Authority, Municipal Technical College. REQUIRED, in October, 1947, a full-time assistant radio instructor for appointment to the Kingston-upon-Hull Municipal Technical College; candidates must have a First-Class P.M.G. Certificate in Wireless Telegraphy, and theoretical and practical knowledge of radar is essential; practical experience with modern radio equipment (marine and aircraft) an advantage; salary will be in accordance with the Burnham Scale for Technical Institutions, 1945; particulars of appointment and application forms (to be returned within 14 days of the date of this advertisement) can be obtained on receipt of a stamped ad dressed foolscap envelope, from the Director of Education, Guildhall, Kingston-on-Hull.

BRITISH OVERSEAS AIRWAYS CORPORATION have vacancies for ground radio operators, medically fit and willing to serve on a world-wide basis overseas. The upper age limit is 40 and preference will be given to single men. Basic rate of pay £5/15 to £6/10 a week, plus allowances overseas graded according to the local standard and cost of living. The initial tour of duty is three years, and successful candidates will be required to serve in any part of the world at the discretion of the Corporation. Essential qualifications: Postmaster-General's First or Second-class Certificate or equivalent service experience. Candidates not holding certificates will be given proficiency tests on ground radio operating.—Applications in writing to Staff Appointments Superintendent, Stratton House, Piccadilly, W.1, stating age, certificates held and giving brief details of radio operating experience. Replies will be sent only to candidates called for interview. Mark envelopes "Ground Radio Operator" [7960

B.B.C. invites applications for a number of appointments of Programme Engineers (Grade D), on a salary scale £375-£20-£475 (minimum age 21), for duty at the Corporation's studio centres; candidates who must be of British nationality and parentage, must possess theoretical knowledge in electrical engineering to Ordinary National Certificate or City and Guilds (Radio Communication, Grade II) standard, including a knowledge of acoustics and low frequency speech input equipment; they must have pronounced artistic leanings towards, and a certain minimum standard appreciation of, all branches of music and/or drama; selected candidates will be required to serve a probationary period of six months, which will include a three months' training course at the Corporation's Engineering Training School at Evesham, Worcestershire; confirmation of appointment will be subject to passing a qualifying technical examination at the end of the training course; entry to the permanent staff (contributory Pension Scheme) is subject to two years' qualifying service.—Applications, stating age, qualifications and experience, should reach the Engineering Establishment Officer, Broadcasting House, London, W.1, within 7 days of the appearance of this advertisement. [8390

SITUATIONS WANTED

EXPD. radio relay engr. reqs. change; cap able of taking full control.—Box 2525.

SVCE. mech. desires employment in London —Middleton, 169, Gloucester Place, N.W.1

EX-RADIO officer, 17 years at sea, 3 years fitting maintenance ashore requires shore position.—Box 2598. [8334

ENGINEER, 12 yrs.' wide experience radio industry, development, research, technical admin., seeks position.—Box 2941. [8421

RADIO mechanic desirous to train for specialized work, good radio and electrical knowledge, 10 yrs.' practical exp.—Box 2532.

FOREMAN small radio factory desires change, 20 yrs. exp., pref. radar, lab. or design.—Jackson, 12, Robert St., N.W.1.

R.A.F., F/S, wireless electrical mechanic, married, 27 yrs. age, A.I.D. and civilian exp., requires responsible position any branch radio; S. England preferred.—Box 2539.

EXPERT service engineer, 12 years' experience with leading manufacturers, 5 years' radar research; good organiser, desires post abroad, pref. in Colonies.—Box 2808.

WORKS manager, young, energetic, seeks post, administrative, technical, commercial; fully conversant design, organization, production, quality control, labour handling.—Box 2981. [8465

RADIO engineer, 35, 15 yrs.' exp. transmission and reception, installation and maint., wide exp., excep. refs., desires post in Canada or Australia; pres. sal. £500, accept less for opportunity.—Box 2943. [8424

MAN, 25, desires post in radio trade; I.C.S. "Complete Radio" diploma, spare time exper., keen, conscientious, hard-working; anything with prospects considered.—Gortacar, Clonelly, Enniskillen, Co. Ferm, N.I. [8446

EX-FOREMAN of Signals (W.O.2), 23; no pre-service experience, direct from school to Army; 5 years' Army experience of communications; good at maths. and exceptional ability to learn quickly; wishes to enter radio or other telecommunications trade in good progressive job. Box 2810. [8367

RADIO engineering student, age 30, extensive commercial experience, seeks position with technical firm; good organiser, administrator; able to take complete charge dept., and bear responsibility; experienced export procedure; keen to enter trade; at present in dead-end, non-technical employment; London area. Box 2541. [8321

WELL-KNOWN radio engineer, M.I.E.E., desires another managerial post in industry or with a trade association, etc., in which his abilities and knowledge of the industry can be used to the full, experience of radio, radar, television and electronic instrument development and production, a good, responsible post with real prospects is required. Box 2540.

EXECUTIVE engineer (British) with many years administrative experience in sales, publicity, marketing and installation of sound equipment and radio, seeks position in Belgium as large manufacturers' branch director/manager, capable of establishing, equipping and staffing works and securing materials and organizing manufacture from the start, fluent French, own car, many contacts in Northern Europe, keen and persistent worker with wide experience and good grounding.—Firms interested in widening their export field substantially please write Box 2937. [8408

TUITION

Printed in Great Britain for the Publishers, ILIFFE AND SONS LTD., Dorset House, Stamford Street, London, S.E.1, by THE CORNWALL PRESS LTD., Paris Garden, Stamford Street, London, S.E.1. "Wireless World" can be obtained abroad from the following—AUSTRALIA and NEW ZEALAND : Gordon & Gotch, Ltd. INDIA : A. H. Wheeler & Co. CANADA : Imperial News Co.: Gordon & Gotch, Ltd. SOUTH AFRICA : Central News Agency, Ltd.; William Dawson & Sons (S.A.), Ltd. UNITED STATES : The International News Co.