BANDSPREAD SHORT-WAVE CONVERTER

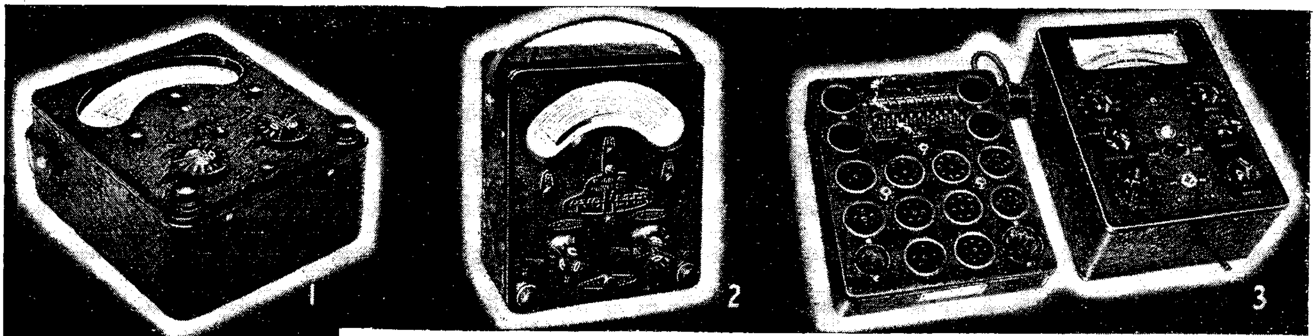
MONTHLY
ONE SHILLING

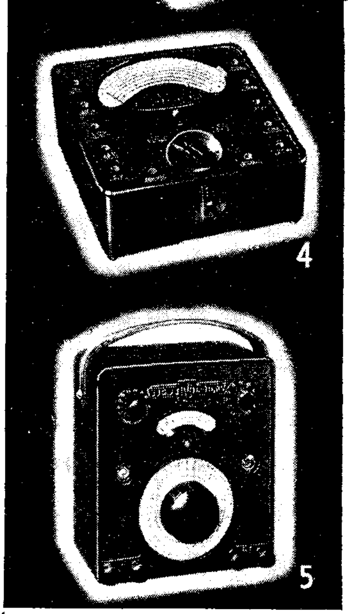
The Wireless World

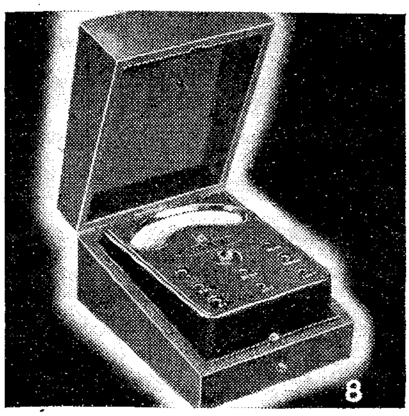
COVERING EVERY WIRELESS INTEREST

MARCH, 1940

No. 1053. Vol. XLVI. No. 5







AVO

Regd. Trade Mark

ELECTRICAL MEASURING INSTRUMENTS

BRITISH MADE

THE world-famous range of "AVO" Instruments is the outcome of many years of intensive research and experience in designing and producing high-grade electrical testing equipment. To-day, the word "AVO" is synonymous with simplicity, versatility and absolute accuracy. In the comprehensive "AVO" range there is an instrument to meet every electrical testing need of both expert and experimenter.

Write for fully descriptive literature dealing with any instrument in which you are interested, and for current prices.

1. 46-range Model 7 Universal AvoMeter.
2. 40-range Model 40 Universal AvoMeter.
3. "Avo" Valve Tester.
4. Universal AvoMinor.
5. "Avo" Test Bridge.
6. "Avo" Capacity Meter.
7. All-Wave "Avo" Oscillator.
8. D.C. AvoMinor.

Other "Avo" Instruments:

22-range D.C. AvoMeter.
High Resistance AvoMinor.
"Avo" Low Resistance Ohmmeter.
The AvoDapter.
9-pin AvoCoupler.

PRECISION METERS

that Master every Testing Problem

Sole Proprietors and Manufacturers:

THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD., Winder House, Douglas St., London, S.W.1. *Telephone: Victoria 3404/7.*

A 1

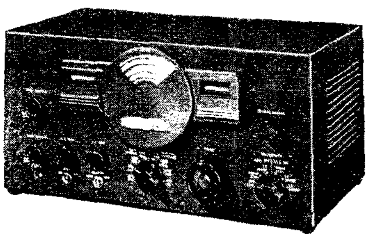
Communication Receivers

NEW IN CONCEPTION—
NEW IN DESIGN—
NEW IN PERFORMANCE

The Skyrider SX23

The difference between an ordinary receiver and a modern Communication Receiver is that in the first you hope to secure a great amount of entertainment on the short-waves, whilst with the second you are certain of securing it in addition to all the usual broadcasts up to 556 metres. This is the reason why the public demand is for precision-built and highly selective receivers such as the famous

HALLICRAFTER SKYRIDER MODEL SX23



This Communication Receiver sets an entirely new standard for high frequency stability, selectivity and noise reduction. It covers, without a break, from 8·8 to 556 metres. Employs 11 valves and the purpose of each control is clearly indicated on the panel.

The Hallicrafter Skyrider SX23 is as easy to operate as any ordinary commercial receiver.

Here is an opportunity for you to purchase one

AT PRE-WAR PRICE

We fortunately secured good stocks in August, only one month after this outstanding Communication Receiver was made available to the public.

No price increase on present stock of this model only.

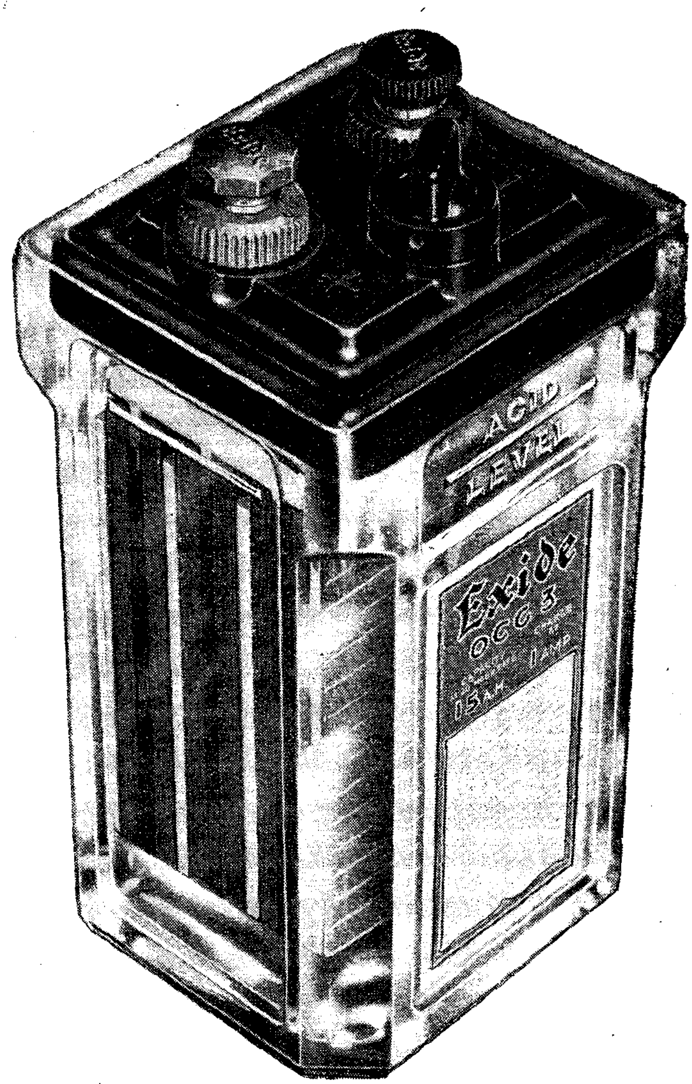
Pre-War Price **£33-10-0**

Place your order now. Terms cash or deferred payments. If you desire further details write for Folder "W."

WEBB'S RADIO

14 SOHO ST., OXFORD ST., LONDON, W.1

(Open 9 a.m. to 6 p.m., Sats. 1 o'clock.) Telephone: GERard 2089
Emergency Branch: 58 Victoria St., St. Albans, Herts. 'Phone: 4924
Birmingham Depot: 41, Carrs Lane. Phone: Midland 5669.



Exide

BATTERIES

'Still keep going when the rest have stopped'

The Chloride Electrical Storage Co. Ltd., Exide Works, Clifton Junction, near Manchester. Also at London, Manchester, Birmingham, Bristol, Glasgow, and Belfast.

To Manufacturers and Designers

have you investigated the *Speed Nut* system?

Simmonds Speed Nuts are revolutionary and quite unique. Their amazing flexibility of adaptation is enabling designers to solve all manner of assembly problems in every industry. Designed on the spring tension principle, they eliminate need for conventional threaded nuts and lock washers. The number of parts handled is reduced by half and the time saved means speedier assembly with less effort and considerable saving in costs.

Speed Nuts are unaffected by vibration and absorb any movement due to temperature changes. They are invaluable for 'blind' locations, and porcelain, plastics or glass may be securely held without damage

There is practically no assembly problem that cannot be solved by the SPEED NUT SYSTEM.

A wide range of Standard SPEED NUTS is available from stock for all sizes of metal screws, sheet metal screws, rivets and plastic studs.

We cordially invite you to get in touch with our Development Department. Close collaboration will enable the best types of Speed Nuts to be designed to meet your own particular needs. It will pay you to investigate.

Simmonds Speed Nuts
(PATENTS APPLIED FOR)

SIMMONDS AEROCESSORIES LTD
GREAT WEST ROAD, LONDON.

Longleys

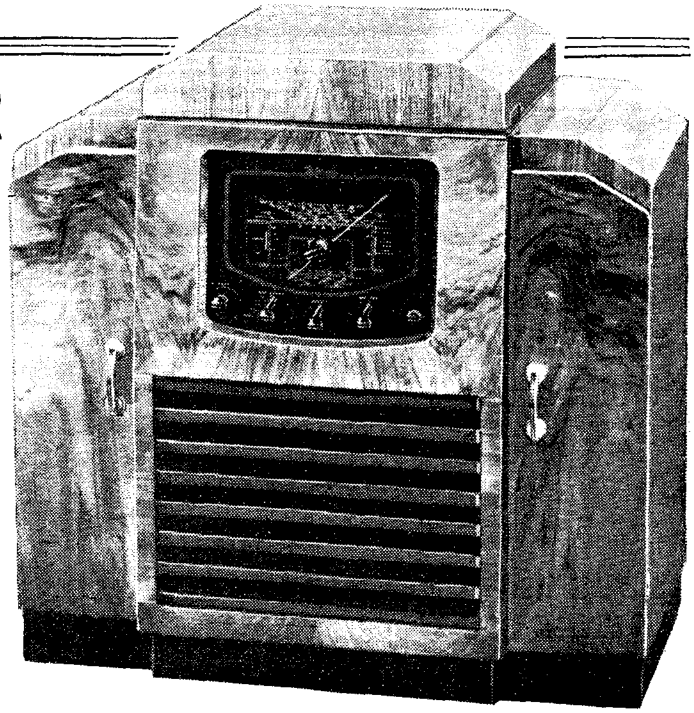
AMBASSADOR

The Supreme Name
in
RADIO GRAMOPHONES

Model RG 6779 - - - - £24 - 5
Model RG 6779/A - - - £30 - 10
(Fitted Garrard Auto-change.)

Supreme because of their unchallenged performance and value. These two AMBASSADOR 6779 Radio-gramophones are by far superior to instruments costing half as much again. Features include: Six valve Superhet; R.F. stage on three bands; Tuning from 12.5/2,000 metres; Electrical Band spread control; High speed A.V.C.; 10" dynamic reproducer; etc. Cabinet provides accommodation for over 200 records.

For illustrated details of the above and other models write to the manufacturers.



R. N. FITTON LTD., HUTCHINSON LANE, BRIGHOUSE, YORKS
Sole Export Concessionaires: Thomson & Co., Edmund St., Bradford.

ROLA

TRANSFORMER
LAMINATIONS

Stamped from High Grade Steel, wired and packed in the same consecutive order as they leave the press, ROLA laminations create low transformer costs by their saving on labour. Eight standard sizes of E's and I's are available from stock, together with associated clamps and covers. Core dimensions $\frac{9}{16}''$ to $1\frac{1}{2}''$. A comprehensive Bulletin with design data for manufacturers will be sent on request.

BRITISH ROLA LIMITED
MINERVA ROAD, PARK ROYAL, N.W.10
WILLESDEN 4322

LEARNING MORSE

AN EASY METHOD OF MASTERING THE INTERNATIONAL SIGNAL CODE

Everyone interested in acquiring skill in the use of Morse should obtain this little handbook, which not only explains the code itself, but also provides an easy method of learning.

PRICE **6d.** By post 7d.

Published from the Offices of

"THE WIRELESS WORLD"
DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1.

W.W.94

PREMIER RADIO

SPECIAL OFFER

DUAL RANGE SCREENED COILS by well-known manufacturer. Aerial or H.F. transformer. All accurately matched. Suitable for Band Pass. Medium and Long Wave operation. Complete with full diagrams. **2/9 EACH**

PREMIER SHORT-WAVE KITS for OVERSEAS NEWS

Incorporating the Premier 3-Band S.W. Coil. 11-86 Metres without coil changing. Each Kit is complete with all components, diagrams and 2-volt valves. 3-Band S.W. 1 Valve Kit, **14/9.** 3-Band S.W. 2 Valve Kit, **22/6.**

DE LUXE S.W. KITS

Complete to the last detail, including all Valves and coils, wiring diagrams and lucid instructions for building and working. Each Kit is supplied with a steel Chassis and Panel and uses plug-in coils to tune from 13 to 170 metres.

1 Valve Short-Wave Receiver or Adaptor Kit ...	20/-
1 Valve Short-Wave Superhet Converter Kit ...	23/-
1 Valve Short-Wave A.C. Superhet Converter Kit ...	26/3
2 Valve Short-Wave Receiver Kit ...	29/-
3 Valve Short-Wave Screen Grid and Pentode Kit ...	68/-

PREMIER 1940 HIGH FIDELITY

AMPLIFIER KITS

Each Kit is complete with ready-drilled chassis, selected components, specially matched valves and full diagrams and instructions.

	Kit of Parts with Valves.	Completely Wired and Tested.
3-watt A.C. Amplifier ...	£2 6 6	£3 4 0
3-watt A.C./D.C. „ ...	£2 6 6	£3 4 0
6-watt A.C. „ ...	£6 2 6	£7 0 0
8-10-watt A.C./D.C.„ ...	£5 5 0	£6 2 6
15-watt A.C. „ ...	£6 14 0	£8 2 6

Black Crackle Steel Cabinet 15/- extra.

NEW PREMIER SELF-POWERED RF TUNING UNIT, incorporating a Var.-Mu pentode amplifier followed by a power grid detector. Designed for high-fidelity reception. Wave range 200-560 and 800-2,000 metres. Complete with valves. **£5 . 5 . 0**

GRAMOPHONE MOTORS and PICK-UPS

Collaro A.C. Gramophone Motors.

100-250 v. 12-inch turntable. Auto. stop. Hum free ...	35/-
A.C./D.C. Model ...	52/6

Collaro A.C. Gramophone Unit.

Complete motor and pick-up. Auto stop and start ...	52/6
A.C./D.C. Model ...	77/6

Premier Pick-up Heads.

Will fit any tone-arm ... 5/3

ANOTHER SPECIAL OFFER.

Piezo Xtal Pick-ups.

With arm. Famous make. Output 1.7 v. Response 40-8,000 cycles ... **35/-**

U.S.A. MAINS TRANSFORMERS

at less than pre-war prices.

Input 110 v. + 220 v. A.C.
Output 325-325 v. 120 mA.
5 v. 2 amps. C.T. 6.3 v. 2-3 amps. **7/6 EACH**

Input 230 v. A.C.
Output 325-325 v. 75 mA.
5 v. 2 amps. C.T. 6.3 v. 2-3 amps. **6/6 EACH**

Input 100-250 v. A.C.
Output 300-300 v. 80 mA.
4 v. 5 amps. C.T. 4 v. 1 amp. **6/11 EACH**

PREMIER BATTERY CHARGERS for A.C. Mains.

Westinghouse Rectification complete and ready for use.

To Charge:

2 volts at ½ amp. ...	11/9
6 volts at ½ amp. ...	19/-
6 volts at 1 amp. ...	22/6
12 volts at 1 amp. ...	24/6
6 volts at 2 amps. ...	37/6

MOVING COIL SPEAKERS

All complete with transformer. Rola 8 in. P.M.s, **16/6**; 10 in. P.M.s, **22/6**; G.12 P.M.s, **66/-**.

ENERGISED MODELS

Plessy 8 in., 2,500 or 7,500 ohm field, **7/6**; G.12 energised, **59/6.**

SHORT-WAVE CONDENSERS

Trolitul insulation. Certified superior to ceramic. All - brass construction. Easily ganged.

15 m.mfd. ...	1/9
25 m.mfd. ...	2/-
40 m.mfd. ...	2/-
100 m.mfd. ...	2/3
160 m.mfd. ...	2/6
250 m.mfd. ...	2/11

TRANSFORMERS

Auto Transformers. Step up or down. 100-125 v. to 200, 230 or 250 v. A.C., 60 watts, **9/11**; 125 watts, **13/6**; 250 watts, **18/6.**

L.T. Transformers, all C.T.

4 v. 2-3 a.	9/11	6.3 v. 2-3 a.	9/11
2.5 v. 5 a. ...	9/11	7.5 v. 3 a. ...	9/11
5 v. 2-3 a. ...	9/11	12 v. 3-4 a.	15/-

Lissen Hypernik QPP Driver Transformers. Ratio 8 : 1 .... 4/3

Push-Pull Driver Transformers 6/6

Universal Output Transformers. 11 Ratios. Single or Push-Pull ... 6/6

SHORT-WAVE GEAR

Short-Wave Coils, 4- and 6-pin types, 13-26, 22-47, 41-94, 78-170 metres, **2/-** each, with circuit. Premier 3-Band S.W. Coil, 11-25, 19-43, 38-86 metres. Suitable any type circuit, **2/11.**

4-pin or 6-pin Coil Formers. Plain or Threaded, **1/2** each.

Utility Micro Cursor Dials, Direct and 100 : 1 Ratios, **4/3.**

New Premier 2-Gang S.W. Condenser. 2 x .00015 mf. with integral slow motion, **5/9.**

Bakelite Dielectric Variable Condensers. .0003 and .0005 mf. Suitable Tuning or Reaction, **1/6** each.

Short-Wave H.F. Chokes. 10-100 m., **10½d.** each. High grade Pie Wound U.S.A. type, **1/9** each.

REPLACEMENT VALVES FOR ALL SETS

Europa Mains Valves. 4 v. A.C. Types A.C./H.L., A.C./L., A.C./S.G., A.C./V.M.S.G., A.C./H.P., A.C./V.H.P., A.C.P., all **5/3** each. A.C./H.P., A.C./V.H.P., 7 pin, **7/6.** A.C./Pens, I.H., **7/6**; A.C./P.X.4, **7/3**; Oct. Freq. Changers, **8/6**; Double Diode Triodes, **7/6**; 3½-watt D.H. Triode, **9/9.** 350 v. F.W. Rect., **5/6**; 500 v., **6/6.** **13 v. .2 amp.** Gen. Purpose Triodes, **5/6**; H.F. Pens. and Var.-Mu H.F. Pen., Double Diode Triodes, Oct. Freq. Changers, **7/6** each. Full and Half-wave Rectifiers, **6/6** each.

Triad U.S.A. Valves.

We hold the largest stocks of U.S.A. tubes in this country and are sole British Distributors for **TRIAD** High-grade American Valves. All types in stock. Standard types, **5/6** each. All the new Octal Base tubes at **6/6** each.

Clearance Line U.S.A. Valves.

U.S.A. Types, 24, 30, 35/51, 55, 56, 57, 58, 71, 85, 2A5, 2A6, 2A7, 2B7, 6A7, 210, 250, all 2 for **3/-.**

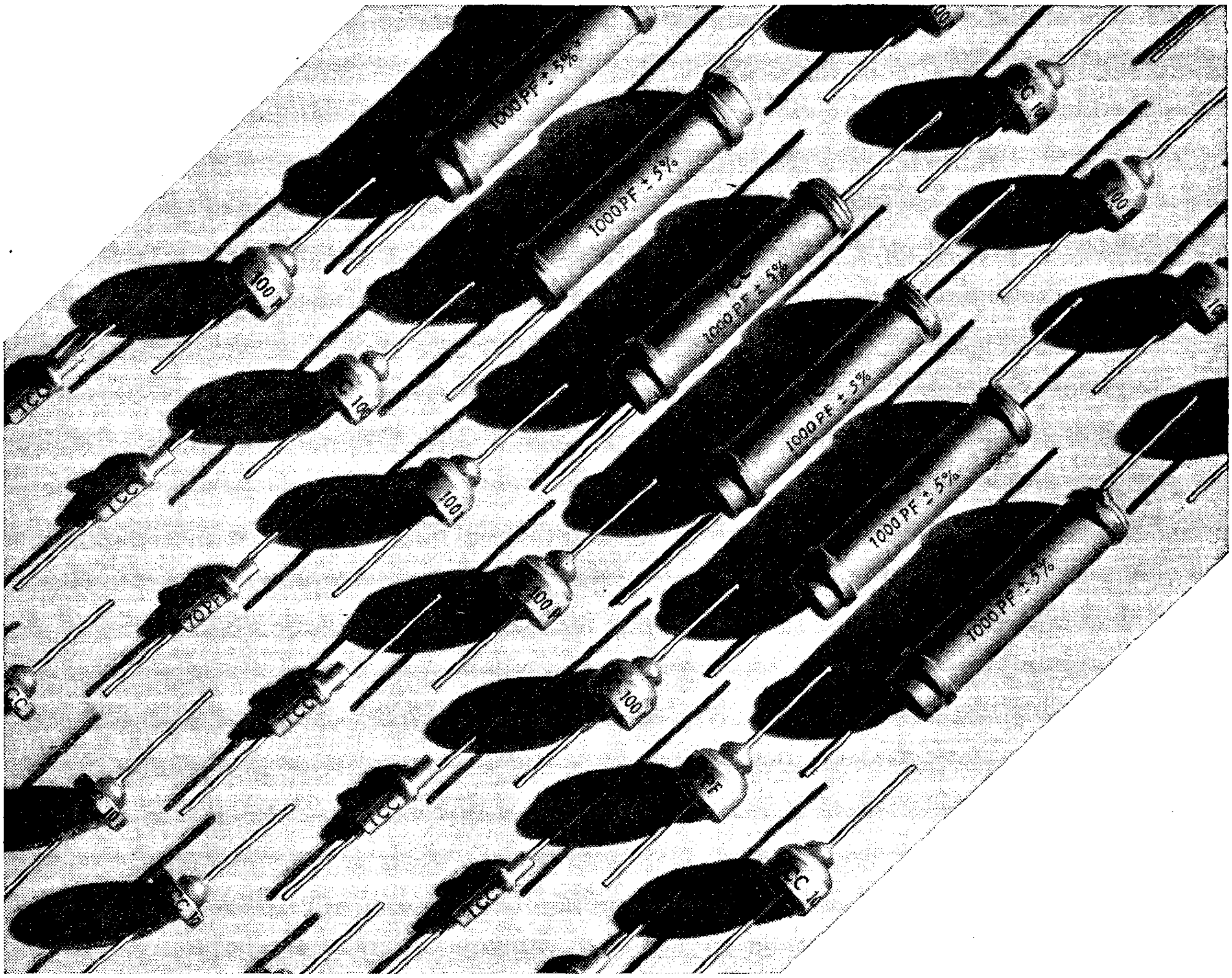
YOU MUST HAVE OUR GIANT 1940 ILLUSTRATED CATALOGUE AND VALVE MANUAL — OVER 100 PAGES. PRICE 6d.

PREMIER RADIO CO.

ALL POST ORDERS to: **JUBILEE WORKS, 167, LOWER CLAPTON ROAD, LONDON, E.5** (*Amherst 4723*).

CALLERS to: **Jubilee Works, or 169, Fleet Street, E.C.4** (*Central 2833*), **or 50, High Street, Clapham, S.W.4** (*Macaulay 2381*).

HELPING TO MAKE GOOD SETS better!



THERE'S a wealth of significance for Radio designers in the old saying "Trifles make perfection." Take T.C.C. Ceramic Condensers for instance. Perhaps the smallest components in a radio chassis—but certainly some of its most important. For the ceramic condenser plays a vital part in *maintaining* the efficiency of a Receiver. T.C.C. Ceramic Condensers are made to exceptionally low **tolerances—their** electrical losses are small—they are non-inductive—their insulation resistance is high—they are almost indestructible and unaffected by humidity changes and they are available with either positive or negative temperature co-efficient to choice. Further, according to capacity requirements they are available in Discs, Cups and Tubes.

T.C.C. CERAMIC CONDENSERS

THE TELEGRAPH CONDENSER CO. LTD., WALES FARM ROAD, NORTH ACTON, LONDON, W.3.

GA. 9019

The
Wireless World

COVERING EVERY WIRELESS INTEREST

29th Year of Publication

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone : Waterloo 3333 (50 lines).
Telegrams : " Ethaworld, Sedist, London."

COVENTRY : 8-10, Corporation Street.
Telegrams : "Autocar, Coventry." Telephone : 5210 Coventry.

BIRMINGHAM :
Guildhall Buildings, Navigation Street, 2.
Telegrams : "Autopress, Birmingham." Telephone : 2971 Midland (5 lines).

MANCHESTER : 260, Deansgate, 3.
Telegrams : "Iliffe, Manchester." Telephone : Blackfriars 4412 (4 lines).

GLASGOW : 26B, Renfield Street, C.2.
Telegrams : "Iliffe, Glasgow." Telephone : Central 4857.

PUBLISHED MONTHLY.
Price : One Shilling
(Publication date 20th of preceding month.)

Subscription Rates :
Home and Abroad, 14/- per annum.

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

No. 1053 VOL. XLVI. No. 5

MARCH 1940

Contents

The
Wireless World

COVERING EVERY WIRELESS INTEREST

ESTABLISHED 1911

No. 1053. Vol. XLVI. No. 5 MARCH 1940 Price One Shilling

Editorial Comment

Jamming: A Two-edged Weapon

BEFORE the outbreak of hostilities it was, we believe, generally expected that one of the results of a large-scale war in Europe would be wholesale jamming of wireless transmissions—and particularly of broadcasting—on the part of all belligerents. Instead, there have been remarkably few cases of deliberate jamming, and by no means all the few incidents that have been reported can be confirmed. In general, there has been strict adherence to allotted wavelengths.

This is so different from what we have been led to expect that it seems worth while to consider why jamming is not taking place and whether such a state of affairs is likely to continue.

As in the last war, Germany is largely cut off from communication with the outside world except by wireless. In 1914-1918 she depended mainly on the long-wave station at Nauen for the dissemination of propaganda; that station gave dependable radio-telegraphic coverage of but a small part of the earth's surface; world-wide short-wave transmission and telephonic broadcasting had not then come into being.

Britain's Advantage

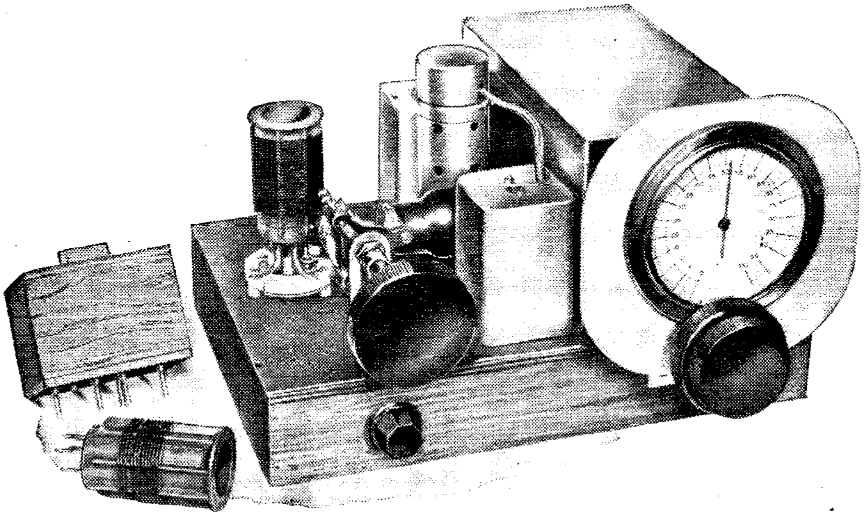
Now, as a result of the developments of the past twenty years, Germany can maintain a wireless communication service covering the whole world, not only by means of broadcasting, but by telegraphy and facsimile transmission. We in this country have other channels of communication open to us, and have less to lose by interruption of wireless services than has our enemy.

Why, then, it may be asked, do we not institute a campaign of intensive jamming against all German transmissions? It is known that the successful interruption of communications is not so easy as it might at first sight appear, but Great Britain and her ally France, having access to sites for jamming stations throughout the world, are very favourably situated geographically for hampering the enemy's wireless communications.

Respect for Law and Order

The answer to this question is not far to seek. In the first place, jamming of non-military communications is a typical example of the kind of international lawlessness that we are fighting against, and one can rest assured that it would only be resorted to by way of reprisal in the face of the most severe provocation. Large-scale jamming, it must be remembered, would interfere not only with Germany but also with the rights of neutral nations maintaining their own communications. Again, and considering the matter purely in the national interest, it is doubtful whether German propaganda (of which the efficiency is often greatly exaggerated) is considered as a serious menace to the allied cause.

Germany, it can be assumed, refrains on her part from jamming our broadcasts and other wireless communications largely through fear of reprisals, and in the knowledge that anything approaching a complete interruption of our various services would be quite impossible. The geographical advantages to which we have referred would operate even more strongly in our favour for overcoming deliberate jamming than for jamming enemy transmissions. The Allies have a wide choice of sites for installing emergency stations, which, for example, could be used for broadcasting in such a way that it would be impossible for the enemy to interfere with them.



Bandspread

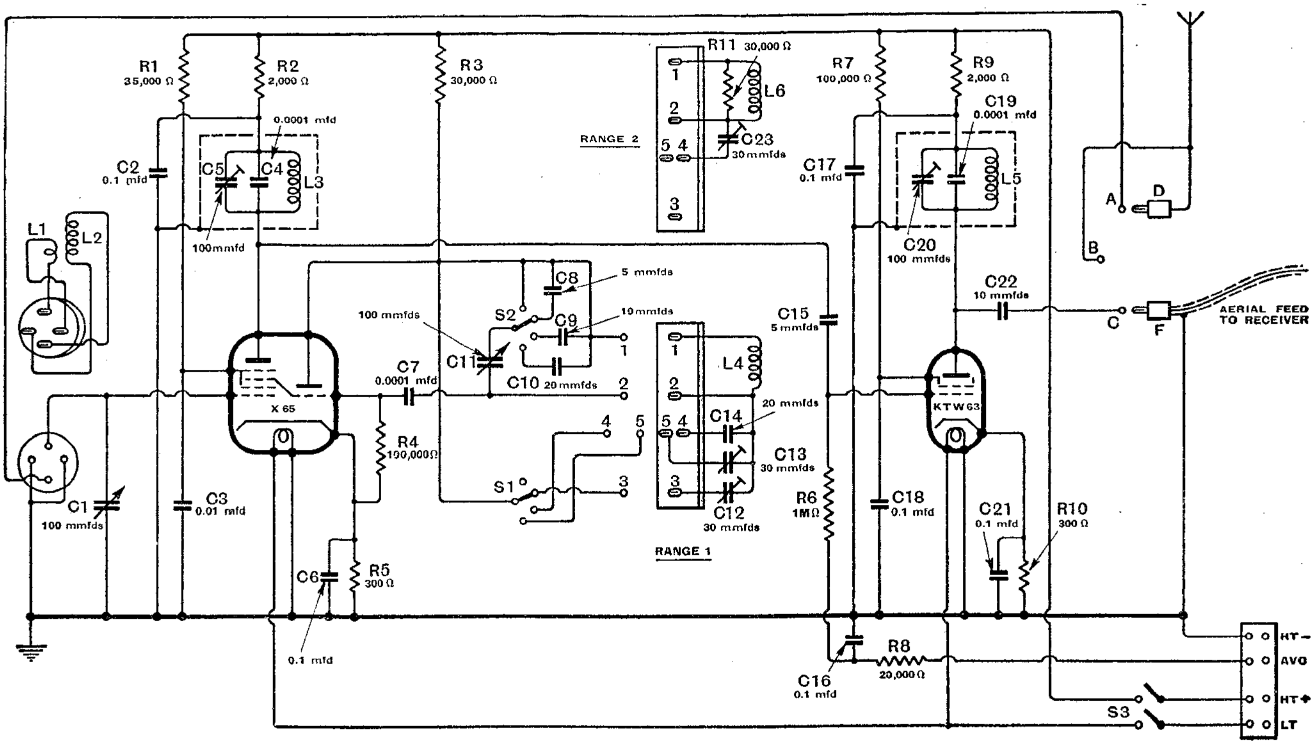
A new and unusual system of bandspread tuning is employed in the SW converter described in this article. Preliminary details appeared in last month's issue, and since a good deal of information was given then which is not repeated in the present article it is desirable that readers should refer to it in order to understand the principles underlying the design

CONTINUOUS TUNING FROM 13 TO 72 METRES

THE majority of SW converters are designed with a view to being used in conjunction with a superhet receiver, and for reasons which we need not elaborate here are not particularly suitable for preceding a straight TRF receiver. The converter described in this article is, however, designed specially for use with such a receiver, and although it is actually intended for use with a particular TRF receiver, namely, *The Wireless World* 2RF Straight Set,[1] it is quite suitable, with minor modifications for any straight set of conventional type.

It will be noticed at the outset that the converter incorporates an IF stage instead of a signal frequency amplifying stage as is customary with conventional converters. The reason for this is that it is to be used in a straight set as already mentioned, and some additional sensitivity and selectivity are required in addition to that provided by the normal RF amplifying stages of the set. A signal-frequency stage would provide sensitivity but comparatively little extra selectivity; an IF stage

[1] *The Wireless World*, November 18, 1937.



The circuit diagram. The connections of the band-stop condensers C8, C9 and C10 and the band-set condensers C12, C13, C14 and C23 in the oscillator circuit, is controlled by the ganged switches, S1 and S2.

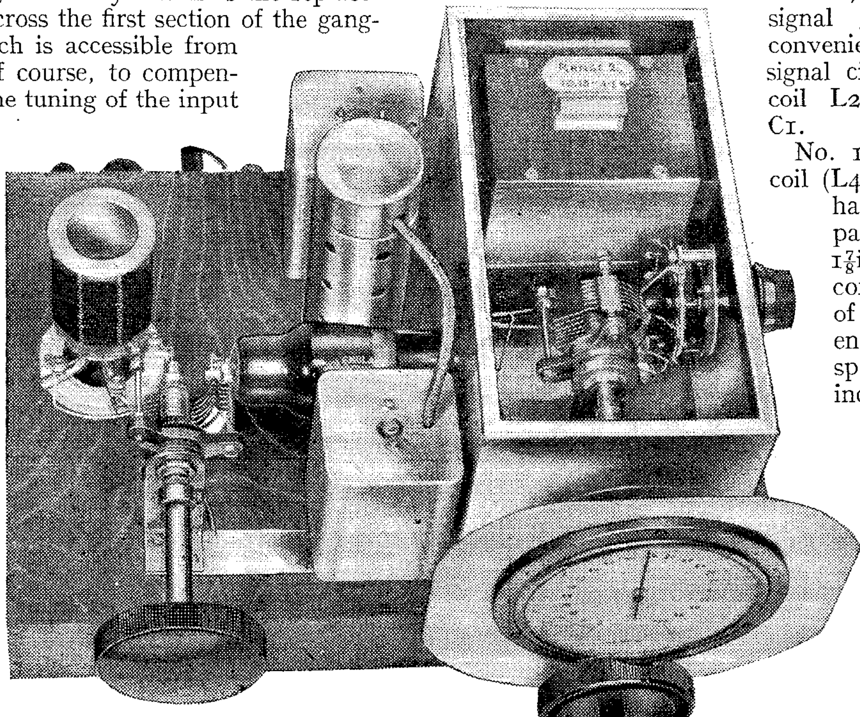
Short-wave Converter

will provide both, and is therefore employed. Since we shall now have three IF stages, one in the converter and two in the main receiver, instability will be experienced unless we make a slight amendment to the design of the original receiver by decoupling its two RF stages. This is done by providing in each stage a 1,000-ohm anode decoupling resistance of ½ W. rating, a 0.1-mfd. anode decoupling condenser and a 0.1-mfd. screen grid by-pass condenser, the latter being in each case fixed as closely as possible to the particular valve-holder concerned. A further modification is advisable although not absolutely necessary. This is the replacement of the trimmer across the first section of the gang-condenser by one which is accessible from the panel. This is, of course, to compensate for the fact that the tuning of the input circuit will differ according to whether an aerial or the SW converter is connected to it.

It may be mentioned that HT and LT supplies for the converter are obtained from the power pack embodied in *The Wireless World* Small Quality Amplifier[2], which is part and parcel of the design of the 2RF set. It is suggested that a valve-holder be fitted to the back of the chassis of the 2RF set rather than to the power pack as by so doing a five-way cable and plug will not only provide the necessary power supply but one of the leads can be utilised to feed AVC voltages to the IF amplifier in the converter For the benefit of those intending to use other sources of power supply, it may be mentioned that the HT consumption of this converter is 16 mA at 230 volts, and the LT consumption 0.6 amps. at 6.3 volts.

On examination of the circuit diagram of the converter it will be noticed that the system of bandspread described in last month's issue of *The Wireless World* has been adopted. It is applied, however, to the oscillator circuit only as the tuning of the signal circuit is not critical enough to justify using it there. Signal and oscillator circuits are not ganged but are separately tuned. Any IF between 1,000 kc/s and 1,500 kc/s can be used, although one in the neighbourhood of a 1,000 kc/s was found to answer best, and is advised.

The oscillator coil units, of which there are two, consist of the coils L4 and L6, the preset condensers C12, C13, C14 and C23, together with the resistance R11. These are assembled in wooden boxes measuring 3¼in. × 2½in. × 2½in. in outside dimensions. Each box is fitted with a paxolin base on which are mounted five Clix pins. The plug-in oscillator coil unit, together with the oscillator tuning condenser C11, condensers C3, C6, C7, C8, C9 and C10, resistances R4 and R5 and switches S1 and S2, are contained in a screening box measuring 8in. × 4¼in. × 4¼in. A one-inch hole is cut in the left-hand side of this box to take an octal valve-holder for the X65 frequency changer valve. This valve is mounted horizontally, and its top connection, which is the signal grid, thus falls conveniently close to the signal circuit comprising coil L2 and condenser C1.



Plan view of the converter. The interchangeable oscillator coil unit is contained in the small wooden box seen in the screened compartment on the right.

No. 1 range oscillator coil (L4) is wound on a half-inch diameter paxolin former 1⅞in. long, and consists of 19 turns of No. 24 SWG enamelled wire spaced 20 turns per inch. With a tuning condenser of 100 mmfds capacity, the actual frequency coverage is 25.4 to 10 Mc/s, i.e., 11.8 to 30 metres. The calculated inductance of the coil wound as described is 1.9 μH. and the wiring amounts to about 0.3 μH. so that the minimum capacity in circuit, including that of the condenser C11, works out to 17.5 mmfds. These values may be useful in designing coils for other ranges than those given in this article.

This coil comfortably covers the 21, 17, 15 and 11 Mc/s broadcast bands (13, 16, 19 and 25 metres). With the oscillator working on the higher of the two beat frequencies and using a 1,000 kc/s, IF the bandspread coverage on the first three broadcast bands is 22.6 to 20.3 Mc/s (13.2 to 14.7 metres); 18.7 to 16.6 Mc/s (16 to 17 metres) and 16.4 to 13.9 Mc/s (18.3 to 21.5 metres) respectively. For the first S2 is connected so that C8 of 5 mmfds is in circuit; for the second C9 of 10 mmfds

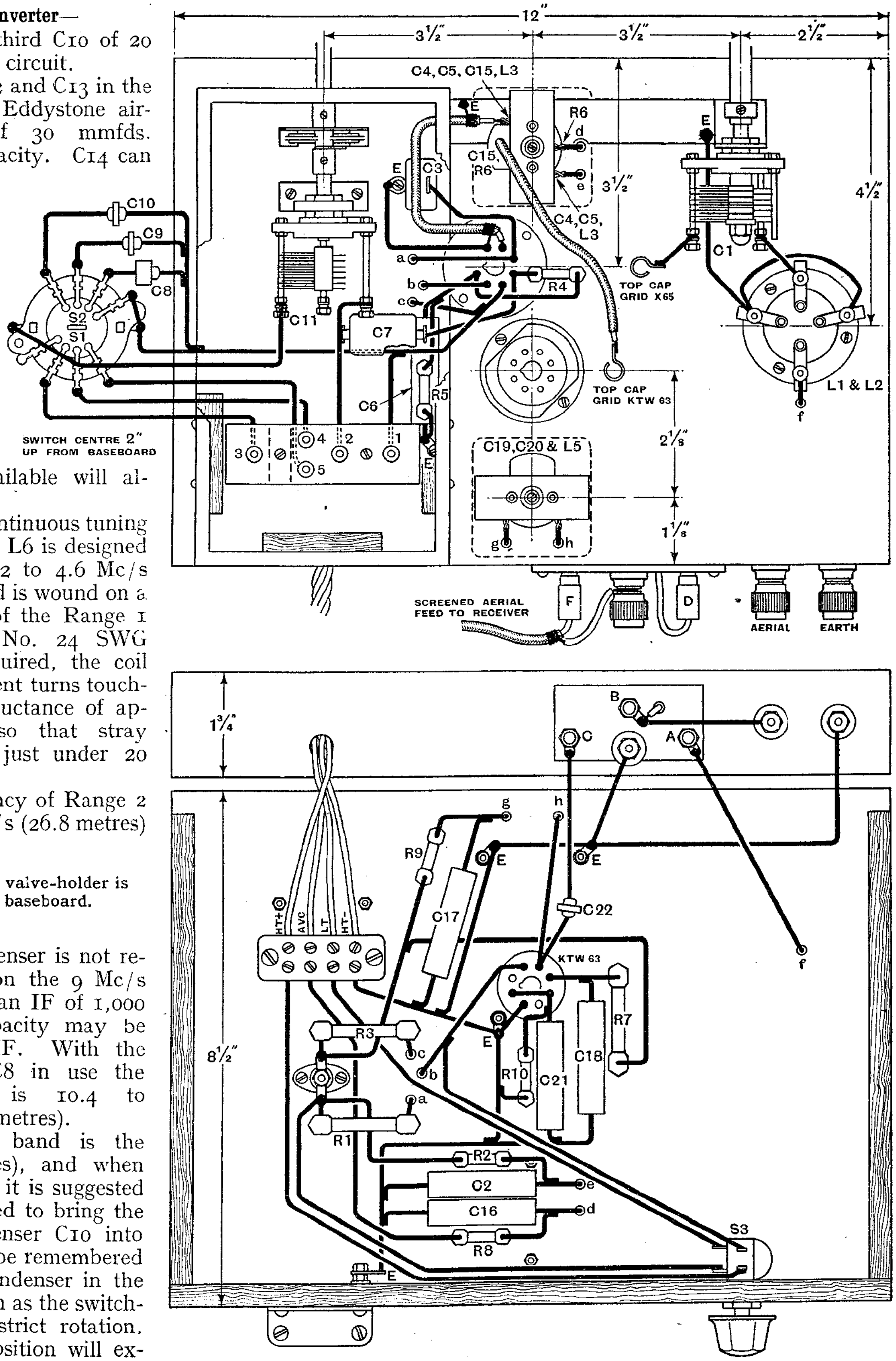
[2] *The Wireless World*, November 4, 1937.

Bandspread Short-wave Converter—
is used, while for the third C10 of 20 mmfds. is brought into circuit.

Preset condensers C12 and C13 in the oscillator coil box are Eddystone air-dielectric trimmers of 30 mmfds. nominal maximum capacity. C14 can be one of this type, although in the model illustrated here a Dubilier ceramic fixed condenser of 20 mmfds. was fitted. It is advisable to use fixed condensers whenever possible in preference to semi-variables, but it does not always work out in practice that the standard capacities available will always meet the case.

In order to provide continuous tuning the second oscillator coil L6 is designed to have a range of 11.2 to 4.6 Mc/s (26.8 to 65.2 metres) and is wound on a similar former to that of the Range 1 coil. Fifty turns of No. 24 SWG enamelled wire are required, the coil being wound with adjacent turns touching. This gives an inductance of approximately 10 μH so that stray capacity works out at just under 20 mmfds.

As the highest frequency of Range 2 oscillator coil is 11.2 Mc/s (26.8 metres)



The wiring plan. The X65 valve-holder is raised 1½ in. from the baseboard.

a parallel padding condenser is not required to bandspread on the 9 Mc/s band (31 metres), with an IF of 1,000 kc/s, but a small capacity may be needed with a lower IF. With the 5 m-mfds condensers C8 in use the bandspread coverage is 10.4 to 9.1 Mc/s (28.8 to 32.9 metres).

The next broadcast band is the 6 Mc/s one (49 metres), and when bandspread is employed it is suggested that the switch be turned to bring the 20 mmfds. series condenser C10 into circuit. It will have to be remembered to connect the preset condenser in the coil box to the correct pin as the switching will not follow in strict rotation. The first bandspread position will expand the 9 Mc/s (31 metres) band, the next will be inoperative and the third will expand the 6 Mc/s (49 metres) band. Using the 20 mmfds. series condenser a coverage of 7.7 to 6 Mc/s (38.9 to 50 metres) is obtained.

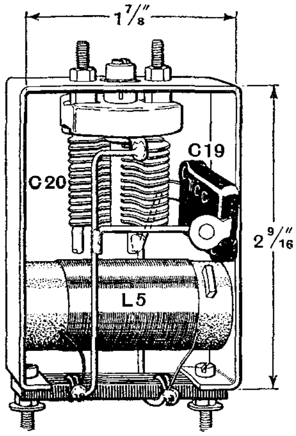
If, however, the 10 mmfds. condenser be employed in the second switch position the coverage on the 6 Mc/s (49 metres) band becomes 6.7 to 6 Mc/s (44.7 to 50 metres). No provision has been made to expand the

11 Mc/s (25 metres) band, but this can be done if desired by sacrificing bandspread on one of the higher frequency ranges.

Measurements made with Range 1 oscillator coil showed that the oscillator voltage was of the correct amplitude for the X65 frequency changer valve, but with Range 2 coil in position it was about 50 per cent. too great. In order to bring it down to the optimum value a resistance of 30,000 ohms (R11) must be connected across the coil. A half watt size will suffice.

The aerial input transformer (L1, L2) for both ranges are wound on grooved Eddystone 4-pin formers having 14 threads per inch. The secondary coil, L2, of Range 1 transformer consists of 8 turns of No. 20 or No. 22 SWG enamelled wire. The aerial coil, L1, consists of 3 turns wound on the former at the "earthy" end of the secondary coil. The tuned winding has an inductance of 3 μH. and with a condenser of a 100 mmfds. gives a coverage of 23 to 9 Mc/s (13 to 33 metres). Total stray capacity across the circuit is thus 16 mmfds. The aerial transformer for Range 2 is wound on a former of the same type as is used for Range 1. In this case 25 turns of No. 20 or 22 SWG enamelled wire are required for the secondary winding.

The actual aerial winding, L1, consists of 5 turns, two of which are interwound at the "earthy" end of the 25 turn secondary coil, L2. Any convenient gauge of DSC wire can be used in this case; No. 36 SWG is suggested.



The details of the second IF unit can be clearly seen in this illustration. The first unit differs slightly as explained in the text.

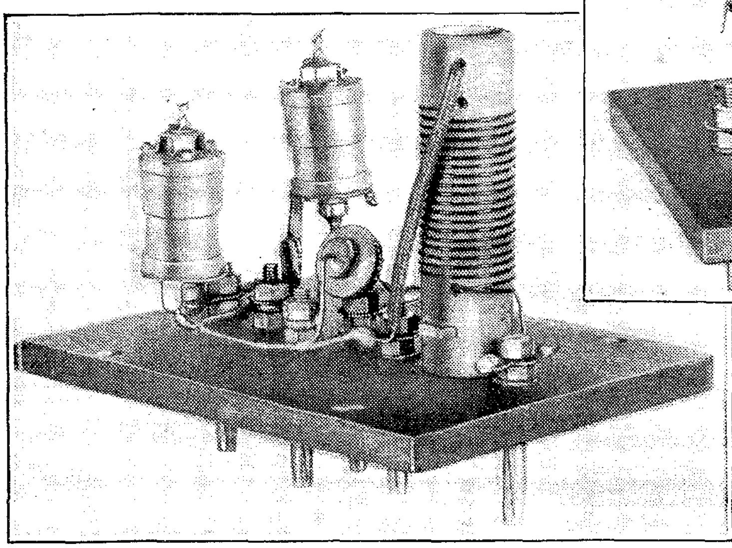
This coil will be found to cover from 10.15 to 4.1 Mc/s (29.5 to 73.1 metres).

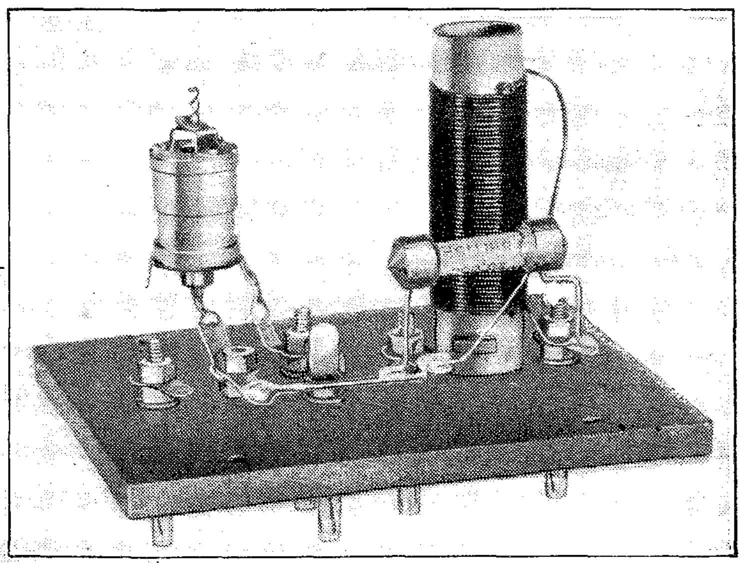
The two IF coil units, one in the anode circuit of the frequency changer and the other in the anode circuit of the IF valve of the converter are identical in character. Tuned anode circuits take the place of the customary IF transformers as these are easier to make with the tools possessed by most home constructors. These units are assembled in aluminium cans measuring 2in. × 2in. × 3in. The coil is a single-layer solenoid close-wound on a paxolin tube ¾in. in diameter and 1⅞in. long. It is wound with 130 turns of No. 36 SWG enamelled wire and is tuned by an air-dielectric condenser of 100 mmfds. maximum capacity.

Whilst the construction of the two IF coils is identical, the contents of the two units does differ in some detail. The first unit, i.e., that in the anode circuit of the frequency changer valve contains the coupling condenser C15 and the grid leak R6. Precautions must be taken to prevent the metal tags and wire ends of the condensers and resistance from coming into contact with this metal can and it is suggested that they be protected by winding round them a strip of paper and securing it with gum.

The various illustrations and drawings will provide all the information needed to construct the converter and while it is advisable to adhere as faithfully as possible to the layout, there is, of course, no reason why the size and even the shape of the chassis should not be modified to suit individual requirements. A metal chassis has not been found necessary as all those parts that require screening are enclosed in metal boxes.

The only other part of the set requiring explanation is the arrangement of plugs and





The two oscillator units. In the case of the Range 2 unit, (right) the voltage developed across the coil tends to overload the succeeding valve. This is prevented by the resistance shown in shunt with the coil.

Bandspread Short-wave Converter—

THE LIST OF PARTS

2 Condensers, variable, 100 m-mfds., **C1, C11** — Eddystone Microdensers 1130
1 Dial, 2-speed slow motion — Eddystone
2 Trimmers, air, 100 m-mfds., **C5, C20** — Polar C801
3 Trimmers, air, 3-30 m-mfds., **C12, C13, C23** — Eddystone 1100

Fixed Condensers:—
- 2 5 m-mfds. ceramic **C8, C15** — Dubilier CCE or T.C.C. CUP
- 2 10 m-mfds. ceramic **C9, C22** — Dubilier CDS3 or T.C.C. DISC
- 2 20 m-mfds. ceramic, **C10, C14** — Dubilier CDS3 or T.C.C. DISC
- 3 0.0001 mfd. mica, **C4, C7, C19** — Dubilier 690/W or T.C.C. "M"
- 1 0.01 mfd. mica, **C3** — Dubilier 691/W or T.C.C. "M"
- 6 0.1 mfd. 350 v. working, tubular, **C2, C6, C16, C17, C18, C21** — Dubilier 4603/S or T.C.C. 341

Resistances:—
- 2 300 ohms, $\frac{1}{2}$ watt, **R5, R10** — Bulgin HW40
- 2 2,000 ohms, $\frac{1}{2}$ watt, **R2, R9** — Bulgin HW5
- 1 20,000 ohms, $\frac{1}{2}$ watt, **R8** — Bulgin HW19
- 1 30,000 ohms, $\frac{1}{2}$ watt, **R11** — Bulgin HW21
- 1 100,000 ohms, $\frac{1}{2}$ watt, **R4** — Bulgin HW25
- 1 30,000, 1 watt, **R3** — Bulgin WE5
- 1 35,000 ohms, 1 watt, **R1** — Bulgin WE20
- 1 100,000 ohms, 1 watt, **R7** — Bulgin WE9
- 1 1 megohm, $\frac{1}{2}$ watt, **R6** — Bulgin HW33

1 Switch, 4-way, 2-pole, "wafer" (with locator plate, short spindle and knob), **S1, S2** — Peto Scott
1 Switch, on-off, 2-pole, toggle, **S3** — Bulgin S126
2 Formers, 4-pin, $1\frac{1}{2}$in. dia., threaded 14 t.p.i. — Eddystone 936
2 Valveholders, Octal — Clix X218
1 Valveholder, 4-pin base board mounting — Eddystone 949
2 Screening cans, 2in. × 2in. × 3in. aluminium — Goltone
1 Metal screening box, 8in. × $4\frac{1}{4}$in. × $4\frac{1}{4}$in., with lid — Peto Scott
1 Screening can, valve, $1\frac{5}{8}$in. dia., $4\frac{1}{2}$in. high — Peto Scott
1 Cable, 5-way, with plug — Goltone R36/144
1 Connector, 4-way — Bryce 5C2
1 Knob, plain, for **C1** — Bulgin
1 Spindle, insulated, for **C1** — Eddystone
2 Terminals, insulated (Aerial and Earth) — Belling-Lee "B"
1 Terminal, plain — Belling-Lee "B"
1 Insulator, midget stand-off — Eddystone 1019
1 Length of screened sleeving — Goltone
1 Chassis, 12in. × $8\frac{1}{2}$in. × 2in. (top of $\frac{1}{4}$in. 3-ply wood, sides $\frac{1}{2}$in. thick) — Peto Scott
1 Condenser bracket, $2\frac{1}{2}$in. high — Peto Scott
1 Condenser bracket, insulated, adjustable — Eddystone 1007
1 Variable coupler, insulated — Eddystone

Valves:—
- 1 X65 — Osram
- 1 KTW63 — Osram

Miscellaneous:—

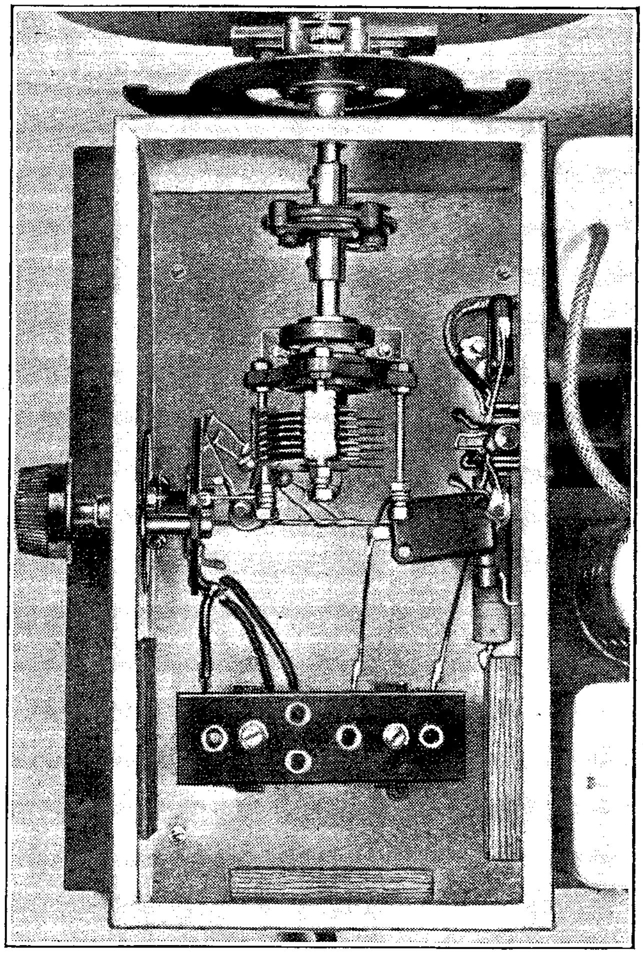
2 $1\frac{7}{8}$in. lengths of $\frac{3}{4}$in. dia. paxolin tube, 1 2in. length of $\frac{1}{2}$in. dia. paxolin tube threaded 20 t.p.i. for 1in., 8 sockets to take $\frac{1}{8}$in. dia. pins, 10 $\frac{1}{8}$in. dia. pins with 6BA screwed ends, 2 wander plugs, 2 aluminium strips $8\frac{1}{2}$in. × 1in. for IF coils, 2 paxolin bases for oscillator coil boxes ($3\frac{1}{4}$in. × $2\frac{1}{2}$in. × $\frac{1}{8}$in.), 1 piece of $\frac{1}{8}$in. paxolin ($3\frac{1}{4}$in. × 1in.) for oscillator coil base, 1 piece of paxolin or ebonite ($3\frac{1}{4}$in. × $1\frac{1}{2}$in. × $\frac{3}{16}$in.), No. 36 SWG enamelled copper wire, No. 24 SWG do., No. 20 or No. 22 SWG do., No. 18 SWG and No. 20 SWG tinned copper wire, insulated sleeving and $\frac{1}{4}$in. 3-ply wood for 2 oscillator coil boxes ($3\frac{1}{4}$in. × $2\frac{1}{2}$in. × $2\frac{1}{2}$in.).

Extra Components for Decoupling the 2RF Set

4 Condensers, 0.1 mfd. 350 v. working, tubular — Dubilier 4603/S or T.C.C. 341
2 Resistances, 1,000 ohms, $\frac{1}{2}$-watt — Bulgin HW3
2 Octal valve top connectors — Bulgin P96

sockets on the right-hand side of the diagram. These are marked A, B, C, D and F. Actually these take the place of switches and merely serve to change over aerial from the input circuit of the SW converter to the 2RF set for normal broadcast reception.

For reception on ordinary medium and long wave-



The screening box with the plug-in oscillator unit removed. The knob on the left of the picture operates the switch controlling the fixed band-set and band-stop condensers.

lengths, switch S3 is put to the off position in order to interrupt the HT and LT supply. Plug F is inserted in socket B and plug D is removed from socket A. For SW reception S3 is put to the "on" position, plug F is inserted in socket C and plug D into socket A. It will be noticed that the inter-connecting lead between the receiver and the converter is screened. This is most essential otherwise it will act as an aerial when receiving on the short waves and will introduce a background of medium wave broadcasting. If for any reason it is not possible to apply AVC voltages to the IF valve in the converter the "earthy" end of R6 must be joined to the earth line.

If the reader has a modulated test oscillator available it will be a simple matter to line up the two IF circuits in the converter with the corresponding circuits in the

Bandspread Short-wave Converter—

receiver; otherwise the following procedure is advised.

Connect up to converter and, after switching on, measure HT and LT voltages to ensure that the unit is in working order. Now remove the KTW63 valve from the converter and connect its grid lead to the plug F after removing this plug from socket C. This leaves only the first IF coil unit in circuit. Plug in Range 1 coils, and with the switches S1 and S2 set for normal tuning, i.e., fully anti-clockwise, set the oscillator condenser C11 to the middle of the 15 Mc/s (19 metre) band. If the receiver has been adjusted to a thousand kc/s (300 metres) this will be between 27 and 28 on the Eddystone dial.

Now trim C5, at the same time making a slight adjustment on C11 to tune in the signal. If conditions are not favourable for 15 Mc/s (19 metre) reception other wavebands must be tried. The 11 Mc/s (19 metre) band falls between 53 and 54 degrees, the 17 Mc/s (16 metre) band between 19.5 and 20.5, and the 21 Mc/s (13 metre) band in the region of 14.5 degrees. The aerial condenser C1 should also be adjusted to optimum tuning. This can usually be determined by an increase in the background noise. A rise in background noise will also serve as an indication of correct trimming of C5.

When signals have been received and the best adjustments made the KTW63 valve can be replaced and the plug F inserted into socket C. Do not forget to make sure that plug D is in socket A. Leaving condensers C1 and C11 in the position where a signal was heard during the first test, adjust C20 for loudest signals then retrim C5 for best results.

The correct adjustment of C12, C13 and C14 for bandspread on the three ranges chosen must be found by experiment. If one of these ranges is the 11 Mc/s (25 metre) band, a small ceramic fixed condenser of 20 mmfds. will have to be connected in parallel with the Eddystone 3-30 mmfds. trimmer as this alone will not provide sufficient capacity. Trimming for bandspread on the 6 Mc/s (49 metre) band is carried out in the same way when Range 2 coils are used. But, of course, the IF trimming does not have to be touched.

Book Review

Ariel and All His Quality. By Richard S. Lambert. Pp. 318. Price 10/6 net. Victor Gollancz, Ltd., 14, Henrietta Street, London, W.C.2.

Normally *The Wireless World* concerns itself with the means rather than the end of broadcasting, studiously avoiding the trivialities of what most wireless men would describe as "the programme side." However, the journal does not neglect the more fundamental or basic aspects of broadcasting organisation, and the book under review is sufficiently important from this point of view to come within its orbit.

The author, Mr. R. S. Lambert, who was for some 12 years in the B.B.C., edited *The Listener* for 10 years, and so is in a good position to present the "inside story" of the Corporation. When he indulges in the favourite national sport of B.B.C.-baiting—and the book is extremely critical of British broadcasting and its organisation—he at least has the advantage of knowing more than most other critics of what goes on behind the scenes at Langham Place. Mr. Lambert claims to criticise constructively, maintaining that broadcasting "is so good that it ought to be much better," and that "constructive criticism is one of the best services that an individual can render to a rich, powerful and monopolistic Public Corporation."

Some of the pioneer leaders of broadcast organisation are accorded unqualified praise, but many other prominent figures are not so fortunate. Sir John Reith is not spared, though in many passages Mr. Lambert pays tribute to his abilities; he believes, for instance, that Sir John's greatest service to the B.B.C. was the "presentation of a bold front to its external critics, particularly during the formative years, when the B.B.C. might have been subjected to direct personal interference, or weakened by unscrupulous attacks in the Press."

In general, the book deals with the less frivolous aspects of broadcasting, and is a valuable source of information to everyone seriously interested in the subject. This is not to imply that the style is heavy; on the contrary, it is extremely easy to read. It should be added, however, that the three chapters dealing with the famous but surely rather trivial "Mongoose Case," in which the author was the central figure, add little to the real value of the book, except in so far as they draw attention to B.B.C. interference with the private lives of its staff and to the seemingly rather unpleasant atmosphere that then prevailed in Broadcasting House.

Mr. Lambert's experience brought him into touch with most aspects of B.B.C. activity (except, apparently, the technical). Although he writes interestingly on most of them, he is perhaps at his best on his own particular topic—that of B.B.C. publications. Of these he says: "I am doubtful, as a result of my own experience, whether a great radio corporation is well adapted to the running of newspapers."

H. F. S.

Henry Farrad's Problem Corner

No. 44.—Push-button Trouble

An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction:—

90, Fays Way, Vectorford.

Dear Mr. Farrad,

Our wireless is in trouble, and my husband, who usually sees to it, is away on war work, and I know he writes to you whenever he is in difficulties, so perhaps you would be so kind as to give me some advice. The set is about two years old, one of the first that came out with push-buttons, and since the war started we have been using the one marked "N. Reg." Yesterday I'm afraid the set got a bit of a bump, and when I turned it on I could hardly hear anything. The other buttons seem to work all right, those that still have stations broadcasting. I studied the instructions and found a place where there were two little screws for adjusting the tuning of each push-button. One of these for "N. Reg." seemed quite all right, but I found that the other hardly had any effect, though it was just a little louder if I screwed it right up to the end. I feel it ought to be screwed farther, but it won't go. Can you suggest anything, please, because the other B.B.C. war stations have never been much good, and we depend on "N. Reg."?

Sincerely yours,
(Mrs.) F. New.

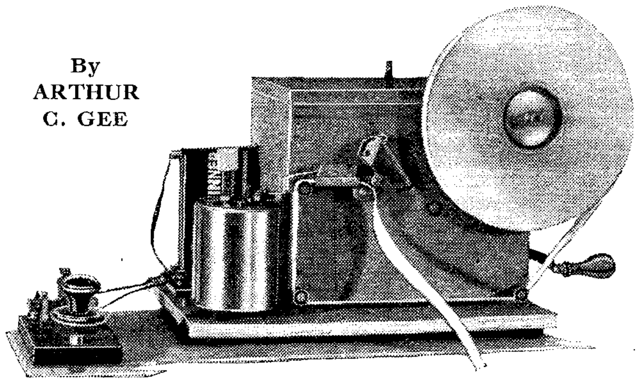
Henry Farrad's solution is on page 172.

Morse Recorder

HOME CONSTRUCTED INKER FOR CODE PRACTICE

By ARTHUR C. GEE

MANY readers are now learning the morse code and are thereby becoming more useful members of the community. In a recent issue of *The Wireless World* some very helpful information was given on learning the code itself and on recognising and memorising the characters quickly. Much of this applied to the receiving side of the business; when it comes to sending, the beginner is not likely to make such rapid progress unless he has someone to listen to his practices who can point out and correct his errors for him. Most beginners seem to be under the impression that it is much more difficult to receive than to send decently. This is not so. Once the fundamentals have been mastered, it will take much more practice to become a good "key thumper" than it will to get up one's speed on the receiving side.



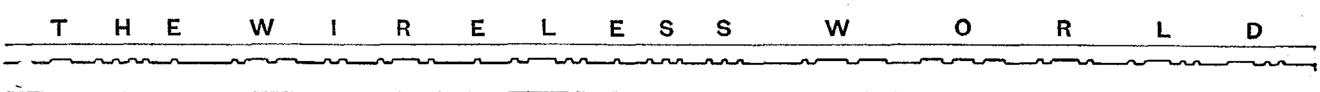
Next to a good instructor, one of the best ways of improving one's "fist" is to study carefully a record of one's keying recorded on a morse inker. With its help it is possible to see at a glance any faults which are not so noticeable or so easy to correct if one relies solely on listening to an oscillator or buzzer. With the inker, a complete record is obtained on paper tape of exactly how a test exercise was sent. Bad or irregular spacing can be instantly spotted, while "short" dashes and missed dots become painfully obvious. Occasional practice with an inker will help very greatly in getting that regular, crisp, well-spaced keying characteristic of a good operator.

The inker described herewith was constructed for code practice purposes, and as it has proved so useful and is very easy to construct, it was thought that a description of it would prove of interest to other readers of *The Wireless World.*

As can be seen from the photographs, the morse recorder consists of a wooden case housing a gramophone motor, the spindle of which protrudes through the side of the case. A short piece of rubber tubing is slipped over this spindle and a jockey wheel is held against it by a spring. These two wheels grip the edge of the paper tape, thus pulling it past the pen when the gramophone motor is set in motion. The path of travel of the tape can be easily followed from the photograph. The reel is mounted on a short spindle attached to one end of the wooden case. The paper tape then passes over two guides, made of short lengths of ebonite or brass tubing and a couple of brass washers held together by a one-and-a-quarter inch screw, up to the level of the pen. Here it passes over another guide similar to the first two on to a small platform made of channel brass. As the paper tape is half an inch wide the inside measurement of this channel brass should also be half an inch, so that the paper is held squarely as it passes under the pen. As was said before, the tape is pulled from the reel over the guides and platform by the gramophone motor spindle with its rubber covering and the jockey wheel. It should be noted that these two should grip only the edge of the tape, not the whole width of it, otherwise the ink trace will be smudged. Once past the pulling wheels the tape is allowed to drop over the edge of the table into a waste-paper basket or other receptacle. So much for the tape and its pulling mechanism. Now for the pen.

The pen itself consists of a small cone-shaped cup made from thin sheet brass. A small hole is made in its apex so that, when the cup is filled with ink, the latter will flow very slowly out on to the point and mark the paper tape as it passes. The cup is attached by a light brass arm to the armature of an old G.P.O. upright-type glass-topped relay. These are very cheap to buy and can be easily obtained from dealers in second-hand electrical goods. The names and addresses of such firms can be found by reference to the advertisement pages of this journal.

This relay needs a little altering. As purchased, it will probably be mounted on a magnificent circular mahogany base, round the circumference of which are six or eight massive brass terminals. The relay should be removed from this base and its leads disconnected from the various terminals. The glass top should be removed and a piece of springy brass strip soldered to the contact arm. This is easily done, as the contact arm can be removed without difficulty for the process

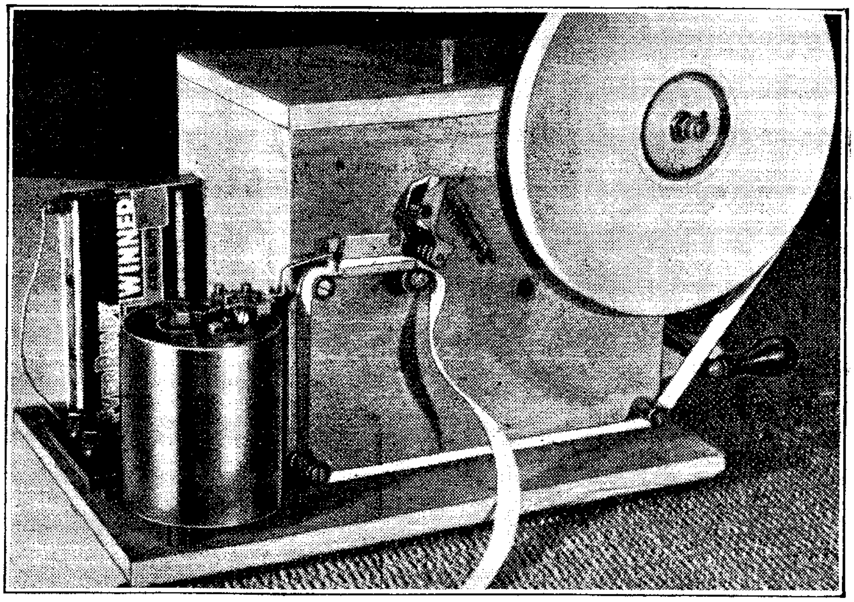


A specimen of inked tape from the recorder described. Morse symbols are formed by long or short excursions above the line.

Morse Recorder—

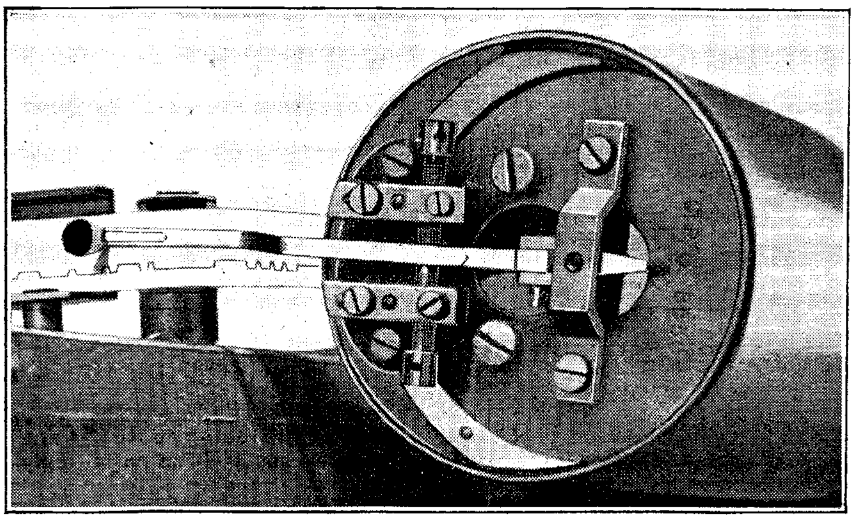
by undoing a small set screw provided for this purpose. Reference to the second photograph shows in detail the construction of the pen mechanism.

The relay is energised by a 10-volt grid-bias battery, which is connected up in series with the relay coils and the two terminals shown for the key leads.



The complete instrument, showing how the paper tape is drawn past the pen.

The above outline will enable most readers to build this inker up without further details. There are one or two points which need a little comment, however. First about the pen. Cut out a piece of thin sheet brass—a vane from an old variable condenser was used in the writer's case—about the size of a halfpenny. Cut in half with shears and twist one of the resulting semicircular pieces into a little cone with the aid of a pair of round-nosed pliers. Run some solder down the seam and leave a little bead at the apex of the cone. Solder the cone to the brass strip extension of the relay armature. Now drive the point of a darning needle through the bead of solder at the apex of the cone. Do this from inside the cone and try to get it so that it comes out fair and square at the point of the cone. This makes the channel for the ink. Sharpen up the apex of the cone with emery paper so that it forms a fine point. When the cone is filled with ink it will seep through on to this point and trace a fine line on the paper tape. The sharper the point the finer will the line be. The cone will hold several drops of ink, which is ample for most test exercises. It can be filled with a fountain-pen filler or from a fountain pen itself. Stephens' red ink has been found very satisfactory.



The pen is mounted on an extension of the relay tongue.

Before fitting the relay on to the base board, clean it up and trace out the leads which were previously connected to the terminals on the base. Those going to the relay coils will have to be extended with flex so that they are long enough to go to the battery and terminal strip. The leads which go to the relay contacts can be disconnected, as they are no longer needed. The contact screws, which can be seen clearly in the second photograph, come in very useful for adjusting the position of the pen on the paper tape. These, therefore, should not be removed.

The jockey wheel can be made from two round terminal tops screwed on to a piece of screwed rod, the milled edges on the terminals helping to grip the tape. A pivot for this can be made from brass strip, and a Meccano spring is very suitable for holding the wheel against the gramophone spindle. It is fitted as shown in the photograph.

The spindle carrying the reel of paper tape should have a short compression spring slipped on, and held in position by a collar and set screw, so that it presses against the reel sufficiently strongly to prevent over-running. A piece of $\frac{3}{8}$in. rod is quite suitable for this spindle, and the right kind of spring will be found in most junk boxes.

The general construction of the rest of the recorder can be clearly seen from the photographs. The baseboard and motor case can be made from plywood or half-inch oak or other wood, according to taste. Exact sizes depend on the dimensions of the gramophone motor. In the writer's model, the baseboard is 13 inches by 8 inches, whilst the case is 9 by 6 by 8 inches. An

Morse Recorder—

old second-hand spring gramophone motor has proved quite satisfactory in the writer's case. The winding handle comes out at the end of the case and the speed control lever at the top. A carrying handle can be fixed to the top of the case if it is proposed to take the recorder from one training centre to another. Two clips for the battery and a terminal strip are fitted as shown.

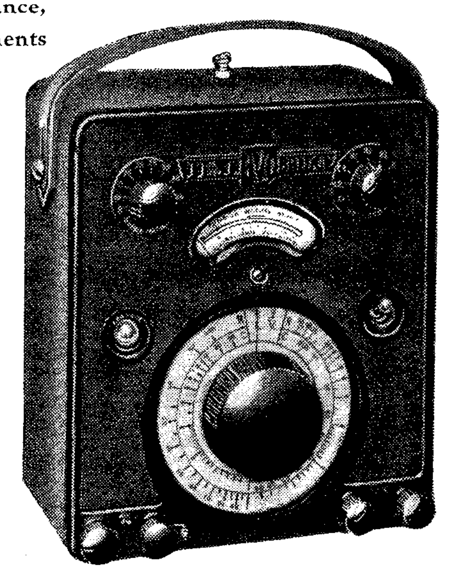
The paper tape is half-inch wide, and can be obtained from Messrs. Creed, Telegraph House, Croydon, London. The reels contain several hundred yards—quite enough to keep even the most ardent beginner going for many a long black-out evening!

"Avo" Test Bridge

A Compact Instrument for Resistance, Capacity and Power-factor Measurements

HOUSED in a carrying case of the same size as the well-known "Avometer," this bridge is designed primarily for the rapid measurement of capacities and resistances in common use. In addition, it can be used for measurements of inductance from 0.1 H. upwards against an external standard, and also as a valve voltmeter for measurements of AF outputs.

On the resistance and capacity ranges calibrated internal standards are used and the scale reading at balance gives a factor by which the standard should be multiplied to give the unknown resistance or capacity. The ranges are as follows.



The "Avo" test bridge performs many useful functions in addition to its primary purpose of rapid capacity and resistance measurement.

Range	Standard	Min.	Max.
C1	0.0001 mfd.	5 $\mu\mu$F.	0.005 mfd.
C2	0.01 mfd.	0.0005 mfd.	0.5 mfd.
C3	1.0 mfd.	0.05 mfd.	50.0 mfd.
R1	100 ohms	5 ohms	5,000 ohms
R2	10,000 ohms	500 ohms	500,000 ohms
R3	1 megohm	50,000 ohms	50 megohms

Power-factor measurements may be made on range C3, which will be used for large paper and electrolytic condensers. The control is directly calibrated and has a range of 0 to 50 per cent. Condensers of all capacities can be tested for leakage by a flashing neon circuit.

Tests with condensers and resistances of known value and comparisons of readings on adjacent ranges showed that the errors of measurement are generally within 5 per cent., except at the extreme ends of each range. As there is a generous overlap between ranges, it should usually be possible to find a part of the scale where the accuracy is well within these limits.

A valve voltmeter is used as the indicating device and the out-of-balance voltage is adjusted within full-scale deflection so that the instrument cannot be damaged. The circuit employed gives an approximately logarithmic scale and the sensitivity near zero (which indicates balance) is about twenty times the sensitivity at full scale.

The meter is calibrated to read in volts (0-15) and a check against a sub-standard voltmeter at 50 cycles showed the accuracy to be within the thickness of the pointer. A number of uncalibrated but closely spaced divisions above the voltage scale facilitates the exact estimation of "minimum" when adjusting the bridge.

Leads are provided for connection to a 220-240-volt, 50-cycle supply. The price is 8 guineas, and a leather carrying case is available, priced 25s.

From the World's Technical Journals

ABSTRACTS from, and references to, some 450 articles on wireless and allied subjects recently published in the world's technical journals are included in the Abstracts and References section of the February issue of *The Wireless Engineer*, which was published on the first of the month. This regular monthly feature of *The Wireless Engineer*, which for easy reference is sectionised under fifteen headings, is compiled by the Radio Research Board and published by arrangement with the Department of Scientific and Industrial Research. Another monthly feature is a two- or three-page summary of recently accepted wireless patent specifications.

The February issue, which is obtainable through newsagents, or direct from the Publishers, Dorset House, Stamford Street, London, S.E.1, at 2s. 8d. post free, contains an article on a method of obtaining curves for the electron density distribution down the length of a velocity-modulated beam. In another article trapezium distortion in electrostatically deflected cathode-ray tubes is considered.

Technical Information

SUSPENSION OF INDIVIDUAL SERVICE

THE war has naturally made its call upon the technical personnel of *The Wireless World*, several members having already departed to war service tasks. With a reduced staff we find it necessary to suspend the postal reply service to readers' technical enquiries, which we have hitherto conducted.

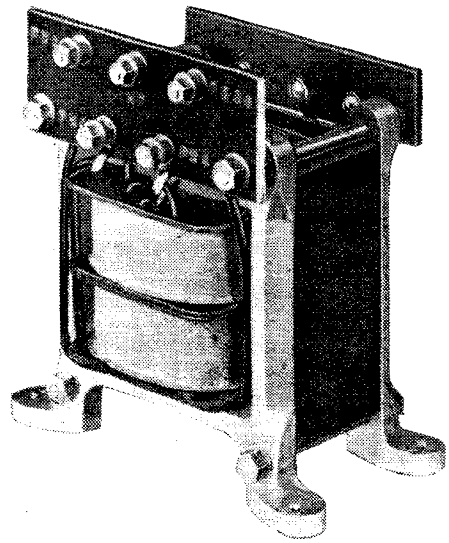
We feel that in the present circumstances we should be failing in our duty to our readers as a whole if we continued to allow the time of technical members of the staff to be largely occupied with answering enquiries from individuals when, by relieving them of this work, their whole time can be devoted to the production of the best possible *Wireless World* for the benefit of all readers. Will those, therefore, who have been accustomed to send us their technical problems to solve please accept this intimation that individual requests for technical information must regretfully be declined so long as present conditions prevail?

The World's finest Output Transformer!

THERE is no evidence to dispute or even challenge our claim—the S.S. 036 Output Transformer, first designed and produced by SOUND SALES in 1936, acclaimed by "The Wireless World" in their test report of June 19th, 1936, as "something of an achievement," and certified in their Laboratory to have a flat response of plus or minus only 0.5 db. over an amazing range of 20 to 20,000 cycles.

THERE is no point in showing a curve, as the deviation from a straight line would be imperceptible. When you take into consideration that the primary inductance is no less than 77 Henrys, measured at 3.5 volts A.C., our claim is undoubtedly justified. The inductance figure would be even better if measured at working voltage. but SOUND SALES, who have *specialised* in the design and construction of transformers for years, prefer to base their claims on the conservative and unbiased figures of an independent Laboratory.

SUITABLE for anode-to-anode impedances up to 12,000 ohms A.C., powers to 18 watts, standard specification 10,000 ohms anode-to-anode impedance, secondary 15 ohms. This transformer is suitable for triode and all modern types of output valves .. .. **PRICE 35/-**



SPECIAL MODELS TO SPECIFICATION WITHOUT ADDITIONAL CHARGE.

SOUND SALES TRANSFORMERS ARE INDIVIDUALLY BUILT BY EXPERTS

SOUND SALES LIMITED
(OF LONDON)

Address for the duration of war :
WEST STREET, FARNHAM, SURREY
Telephone: Farnham 6461-2-3

RADIOMART
G5NI (B'HAM) LTD.

THE SHORT-WAVE SPECIALISTS

WE CARRY LARGE STOCKS OF ALL TYPES OF SHORT-WAVE AND COMMUNICATION EQUIPMENT, INCLUDING AMERICAN VALVES

RADIOMART SPECIAL OFFERS ! Fully shrouded Transformers by America's largest manufacturer. While they last, all 230 v. 50 cy.

T.850 Y—350/350 v. 150 m/A. 4 v. 6 a., 4 v. 2.5 a.	15/-
T.19610—350/350 v. 150 m/A. 2.5 v. 6 a., 2.5 v. 2 a., 5 v. 3 a.	12/6
T.7236—375/375 v. 120 m/A. 6.3 v. 4 a., 5 v. 3 a.	10/6
T.6025—320/320 v. 80 m/A. 2.5 v. 6 a., 5 v. 3 a.	7/6
T.464919—10 v. 4 a., primary tapped 110-250 v.	5/6
W.379Y—440/440 v. 200 m/A., 6.3 v. 3 a. CT., 5 v. 3 a.	25/-
W.308Y—550/550 v. 200 m/A. 6.3 v. 3 a. CT., 5 v. 3 a.	25/-
T1113AB—230 to 110 v. 500 watt auto transformer	29/6
T.2311A—230 v. to 110 v. 100 watt auto transformer	12/6
The following chokes are interleaved and impregnated.	
T7007—250 m/A., 135 ohms, 20-8 Hy., cadmium shrouded	12/6
T7007A—150 m/A., 250 ohms, 30-12 Hy., cadmium shrouded	12/6
100 m/A., 20 Hy., 500 ohms, unshrouded	4/11
60 m/A., 15 Hy., 250 ohms	1/11

FERRANTI Meters at less than half price. 3½in. Moving Coil, projecting 25, 50, 100 m/A., **16/6**; Ditto, flush models, **17/6.** Flush, 0-1 m/A, **20/-.** All boxed, as new. COSSOR 8in. M.C. Speakers, permanent magnet, **14/6.** 2,000 or 2,500-ohms energised, **8/6.**

MOVING COIL SPEAKERS. Rola, Magnavox, etc. 8in. cone; 1,200, 2,000, 2,500, 6,500 ohms, **8/6.** 10in. cone; 400, 800, 1,650, 2,000, 2,500 ohms, **12/6.** Magna 10in.; 1,650, 2,500 ohms, **17/6.** M.C. Speaker Transformers, Power, Pentode or Push-Pull, **1/11.**

GANG CONDENSERS with Airplane Dial, 8 and 80-1. Cost 35/-. Few only. **4/11.** Utility Microdials. List 7/6. Our Price, **3/9.** Ideal for Short Waves.

PUSHBACK Wire, 6 yds., **6d.**, heavy, **9d.** Resin-cored Solder, 6ft., **6d.**; Screened Flex, single. **6d.** yd.; twin, **9d.** yd. Assorted Solder Tags, **6d.** packet. Humdinners, 6d. each. Centralab pots, all sizes, **1/9**; switched, **2/3**; tubular fuses, **2d.** Milliammeters, 25 m/A. upwards, **6/9.**

VALVES : Reliable replacements for all types, British and American, showing saving of over 50 per cent.

OUR NEW 66-PAGE MANUAL, packed full of valuable information. Metre-Kilocycle Charts, Shortwave Stations, times of News Bulletins, Shortwave Receivers, constructional articles, etc. 7½d. post free.

THE NEW RAYMART CATALOGUE shows dozens of New Short-Wave Components and is yours for 1½d. post free.

TRADE ENQUIRIES solicited for all types of communication equipment receivers, etc.

RADIOMART G5NI (Birmingham) Ltd. **44, HOLLOWAY HEAD, BIRMINGHAM**

RADIO IS NOT RATIONED—YET

. . . So why not follow your Editor's suggestion and install Extension Speakers in all the main rooms of your home NOW ? STENTORIANS combine economy of price with a quality of reproduction that you will readily appreciate.

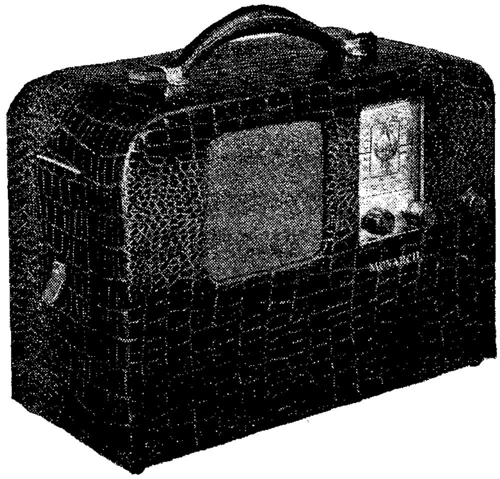
Price from 21/6 complete in Cabinet.

W B **Stentorian**

THE PERFECT EXTRA SPEAKER FOR ANY SET.

WHITELEY ELECTRICAL RADIO CO. LTD., MANSFIELD, NOTTS.

Something really NEW IN RADIO



AN ALL-DRY PORTABLE AN ALL-MAINS RECEIVER

In one cabinet and not even a switch required to change over

Everybody needs *two* sets in war-time—one for fireside listening, and one for taking with you to the Warden's Post, the Fire Station, for wearisome train journeys in the "black out" and a hundred and one other times when a portable means all the difference between boredom and amusement. The new Monarch set gives you two sets in one—at a price you would normally pay for an all-mains receiver only. It is the complete answer to present-day radio requirements.

Make a point of seeing this new set. It is being demonstrated at all the big stores and at good radio dealers everywhere.

TAKE A NOTE OF THESE TECHNICAL DETAILS

ALL-DRY DETAILS: Two G.E.C. 45 volt and one G.E.C. 6 volt long life dry batteries. Running cost ½d. an hour. Battery life 300 hours.

ALL-MAINS DETAILS: Suitable for AC/DC mains 100-250 volts.

BRIEF SPECIFICATION

2 Wave Band, 200-2000 metres, 5 Valve Superhet with full automatic volume control, highly efficient Moving Coil Speaker, Litz wound frame aerial, which makes the use of an outside aerial or earth unnecessary. The Monarch will receive clearly 30 or more Continental Stations.

10 GNS. complete.

Carrying cover in De Luxe Morocco Leather, 12/6.

We also offer for immediate delivery:

Monarch All-Dry Portable 200-2000 metres 5 valve Superhet. 300 hour Batteries ...	**£7.7.0**
Mighty Mite Boudoir Radio in beautiful Ivory and Gold Case. 100-250 volts AC/DC	**£4.4.0**
Everlasting Generator Torches, *no batteries or accumulators required*, precision made	**£1.5.0**

MONARCH *Radio*

2, HOLBORN BUILDINGS, LONDON, E.C.1.

Telephone: HOLborn 4543.

JOHN McCLURE

TUNING UNITS, FEEDER UNITS and complete RECEIVER CHASSIS

continue to be in great demand, and we are glad to be able to inform readers that deliveries of the more popular models are rapidly improving in promptness, though there are still delays in some cases due to delays in material deliveries.

If you are thinking of buying a completely new set, try one of the alternatives described below.

TWO-UNIT RECEIVER

consisting of one of our Feeder units type ACF 4, and a push-pull amplifier, with triode output valves, giving 14-15 watts undistorted output. The output stage is driven by a special triode phase-splitter, and the amplifier has a generously designed power unit, capable of supplying both units.

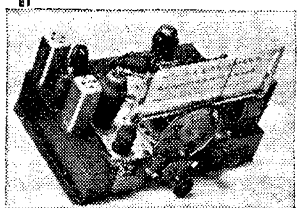
PRICE, complete with valves and large output transformer **£16.16.0**

SINGLE-UNIT RECEIVER

consisting of ACT 4 Tuner, feeding single I.F. stage with iron-cored transformers, double diode triode detector/AVC/first audio stage and single beam-power pentode output, giving 4½ watts undistorted.

PRICE, complete with valves, less output transformer **£12.1.6**

Send for full details of these or any other standard products.



A. C. FEEDER UNIT

DEMONSTRATIONS can be arranged at our works by appointment at almost any hour—telephone and let us know when you are coming.

JOHN McCLURE LTD

ERSKINE ROAD, LONDON, N.W.3

PRImrose 5435-6.

M·R· SUPPLIES

have the goods you require at the right prices. All goods brand new and satisfaction is always guaranteed.

GOOD NEWS—special adaptors now available, making these fine **ROTHERMEL-BRUSH PIEZO-CRYSTAL PICK-UP HEADS** (de Luxe) suitable for either tone-arm or tracking arm. Our February offer, which sold several hundreds, is now made more interesting. The 33/6 head is offered at only **18/6** and the adaptor at **2/-**. Never again will this offer be presented, enabling you to employ the very finest type of Crystal Pick-up at so low a price. We also offer the new **JUNIOR ROTHERMEL PIEZO-CRYSTAL PICK-UP,** complete with easy-fix tracking arm and rest, at **19/6**; also the de Luxe Model, with ball-bearing tracking arm and rest (world's finest pick-up), **45/-**.

VERY SUPERIOR MOVING COIL MICROPHONES (by most prominent Maker). Genuine offer of the 8-guinea Model, brand new, at **59/6**. The free-floating diaphragm and powerful alni-magnet give the best response and sensitivity we have yet met in a m/coil mike. Neatly housed in anodysed aluminium with cushioned mounting boss.

MINIATURE P.M. M/COIL UNITS, only 3in. dia., 15 ohms coil. For mike or speaker, ideal for intercom. Final supply from U.S.A., **11/6** each.

MINIATURE NICKEL ALLOY TRANSFORMERS, for m/coil or carbon mike. Suitable for above. Size only 1¼in. by 1¾in., **2/11**. Also **G.E.C. MICROPHONE TRANSFORMERS** (Model 1576), fully shielded with plug-type terminals, 4in. × 4in. × 2½in. For m/c or carbon mikes. (List, 35/-.) **7/6**.

AUTOMATIC RECORD-CHANGERS (best British make). Latest model, changing eight mixed records without pre-selection. Completely assembled on bronze unit plate, adjusted, mechanically precise and utterly reliable. Approx. £10 model, brand new in carton, A.C. mains, 100/250 v., **£6/19/6** (plus 3/6 pt. carriage). Also large stock of Gramophone Motors.

UNIVERSAL HEAVY DUTY OUTPUT TRANSFORMERS. Exact "W.W." spec. for low-loss all-ratio matching. 11 ratios from 11/1 to 75/1 with C.T. for P.P. Response 25 to 10,000 c/s. Weight 7½ lbs. (Usually 45/-.) Unbeatable value at **28/6**.

I.F. CHOKES, properly rated, 20 h. 100 m.a., 100 ohms D.C. res., **6/6**. Also 20 h. 60 m.a., **4/11**.

L.T. METAL RECTIFIERS (Standard) for battery chargers, model railways, etc. Delivery 12/14 v. 1.5 amp., **10/9**. Suitable Mains **TRANSFORMERS,** 200/250 v. to 7/11/15 v. (tapped) for 2, 4 and 6 v. charging, **10/11**. Also to 22 v. (2 amp.) for 12-volt charging. **12/-**. Suitable **AMMETERS,** flush panel mtg., 2½in. dia. Measure A.C./D.C. readings either 0–1½, 0–3, 0–5 or 0–10, any one, **5/11**. Here are the essential components for an efficient charger.

FINE AMPLIFIER BARGAIN—"Shaftesbury" £16/10/- model (6 only). Operation A.C./D.C., 200/250 v. Output sufficient for large assemblies. Complete and new equipment with high-grade microphone, floor stand, speaker, all leads, etc., in portable case, 18in. × 17in. × 9in. Ready for use, **£9/10/-**. Don't miss these few. Also £25 model complete at half-price, **£12/10/-**. Also special High-fidelity 8/10-watt A.C./D.C. Chassis for mike and p/u, with fader-mixer, **£7/10/-**.

ROLA P.M. M/COIL SPEAKERS, latest alni-magnets. 8in. dia., **17/6**; 10in. dia., **21/-**. Both with multi-transformer. Also G.12 P.M., 12in. dia., finest high-fidelity speaker, **69/6**.

DEWAR type SWITCHES. 2-pole change over, tungsten contacts. Cost 6/- each under contract. Extremely useful, **2/6** each. Or banks of 7 switches, wired, with panel, **14/6** per bank.

STANDARD RESISTANCE BOXES by Cambridge, Pye, Elliott, Muirhead, etc. (Please give choice of make.) Total resistance 120 ohms in 16 taps from .05 to 40 ohms. Plug type, manganin elements. New condition. (Cost over £12.) Fine laboratory bargain, **42/6**.

CENTRALAB POTENTIOMETERS (with 3 amp. switch). All values, 5,000 to 1 megohm. Guaranteed regular stock—no rejects. **2/6** each.

M·R· SUPPLIES

68, NEW OXFORD ST., LONDON, W.C.1. *'Phone: MUS. 2958*

Aids to Hearing

SOME PROBLEMS OF DESIGN : METHODS OF TESTING

By T. S. LITTLER, M.Sc., Ph.D.

IN a previous article in this journal[1] constructional details of a small hearing aid were given. The instrument used a carbon microphone, and it was suggested that an article would be written later on hearing aids with non-carbon microphones. Correspondence received has shown that not only would alternative circuits be welcomed but many other points have been raised on which readers would like further information and guidance. It has therefore been decided to include as much information as possible in the present article.

This is the first of a short series of articles dealing with the design, performance and choice of electro-acoustic aids to hearing. In the present instalment some practical information is given on the use of non-carbon microphones, especially those of the piezo-electric type

The main advantage of the carbon type of microphone is its high sensitivity when compared with other microphones, but its inherent background noise is a great disadvantage. Its noise-to-sensitivity ratio is greater than for any other type, so that, although less amplification is required than with alternative microphones, the resulting background noise is more serious. Suitable non-carbon microphones have on the average a valve input sensitivity of about 1 to 5 millivolts per bar compared with 30 millivolts per bar obtainable from the carbon microphone and transformer. This means an extra amplification amounting to an additional valve stage in the amplifier of the hearing aid when the non-carbon microphone replaces the carbon type.

The most suitable microphones for this purpose are the moving-coil, condenser and piezo-electric types. A very good commercial moving-coil microphone with metal diaphragm is available, which has the advantages of an excellent frequency response, high sensitivity, and small size, but it costs about nine pounds. To obtain an instrument at a cost of not more than two or three pounds one has, therefore, to use a paper diaphragm instrument rather like a small moving-coil loud speaker, and, for compactness, one must use permanent magnets of special alloys.

The customary type of condenser microphone with stretched diaphragm is not only too expensive to be used in a hearing aid but it requires a very high polarising voltage and is quite large. There is, however, a form of condenser microphone with solid dielectric invented by Dr. Helmuth Sell,[2] which is more sensitive and which requires polarising voltages of the order of 60 to 90 volts only. It is, unfortunately, not available commercially in quantity, and those interested are therefore advised to build their own from the original description.

On account of its small size and high sensitivity, and also its cheapness, the piezo-electric microphone is the most popular non-carbon microphone at the present time. It requires no polarising voltage, transformer or exciting circuit, and therefore can be used when an instrument of minimum size is required. Suitable microphones are the Rothermel Lapel type, having a paper diaphragm, and the D.104 insert with a metal diaphragm. Owing to its delicacy, the makers do not like to supply the latter to anyone who is not a manufacturer or skilled in the manipulation of piezo-electric microphones, but the Lapel microphone is a completely assembled instrument and relatively safe to handle.

Although in what follows the three-valve circuits are primarily for a piezo-electric microphone, it will be obvious that with slight alterations of the input circuit any alternative type of microphone may be used.

In the choice of valves for a hearing aid a number of factors have to be considered; perhaps the first point is that of filament voltage, which is related to the type of low-tension supply to be used. If the use of an accumulator is not objectionable or desired, then two-volt filaments must be used, but if, for convenience, dry batteries are to be used, then 1.4-volt filaments give the greatest economy. When all filaments of the amplifying valves are wired in parallel, a single 1.5-volt cell can be used. When a series arrangement of the filaments is employed we can use the familiar 3-volt cycle battery for a two-valve circuit or the 4.5-volt torch or cycle battery for the three-valve circuit.

In the previous two-valve circuit described the series arrangement was not discussed, because valve makers would then only supply 1.4-volt valves to scientific workers and manufacturers. Since such valves are now more generally available, circuits will be given for

[1] *The Wireless World*, January 19th, 1939.

[2] *Zeitschrift für Technische Physik*, No. 1, 1937.

Aids to Hearing—

using them in the series arrangement. Obvious alternative parallel arrangements will suggest themselves to those desiring to use accumulators with 2-volt valves or single cells with 1.4 volt valves.

If the two-valve circuit previously described is modified by the addition of another first-stage valve we have

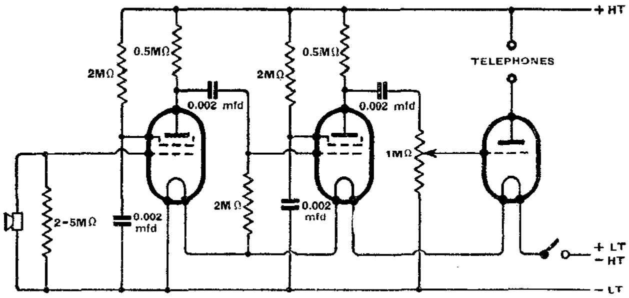


Fig. 1.—A three-valve resistance-coupled amplifier suitable for use with a microphone of low sensitivity.

a circuit which can be used with a non-carbon microphone, as shown in Fig. 1. As alternatives to the screen-grid valves one can use triodes which, although giving slightly less amplification, allow an economy of components, as the screen-grid resistances and condensers can be dispensed with. For maximum amplification a transformer stage can be incorporated as shown in Fig. 2. This circuit is particularly valuable when tone control arrangements are to be incorporated, since tone control circuits of simple type nearly always result in a general lowering in amplification except at the extreme ends of the range.

A point that often arises is whether an accumulator or dry battery shall be used for the LT supply. On grounds of cleanliness and convenience the dry battery is more desirable, while on grounds of cost the matter can be decided by simple calculations. Also it matters whether or not extreme care is taken in charging and looking after the accumulator. Even with care a small jelly type accumulator may only remain in efficient condition for six to nine months. Suppose we take as an example a cell costing about 7s. 6d. and giving about 30 hours' life per charge. At two hours' use per day, and allowing a leakage loss equivalent to about one hour per day, this would involve about 25 charges during nine months. If these are paid for at 3d. per charge the net cost over the period would be about 15s., or one-third of a penny per hour. If the 8d.[3] (3 volts) cycle battery were used the cost would be about one-third of a penny per hour for the two-valve circuit with filaments in series or two-thirds of a penny per hour for filaments in parallel. With a 4.5-volt torch battery costing 5d., a three-valve amplifier with filaments in series would last about 12 hours, costing about ½d. per hour, or with filaments in parallel an 8d. cycle battery would last about 12 hours (two-thirds of a penny per hour). It can be seen that in certain cases the use of a small accumulator is not more economical than the use of dry batteries unless charging costs are negligible, and for this reason the use of dry batteries is in general more satisfactory.

For high-tension supply in a portable hearing aid there are now many types of small batteries available, marketed by Ever-Ready, Exide and Pertrix. Consistent with small size, the most economical cells are those making use of cylindrical zinc cans of diameter ½in. by 1½in. high. On intermittent discharge of two or three hours per day use in a hearing aid, such cells have a useful life of something like 450 milliampere-hours. When minimum size is desired, batteries using cells of ½in. diameter by ¾in. high may be used. Such cells have a useful life of about 210 milliampere-hours. The very small cells, however, have the disadvantage of a short shelf life of two or three months, and must therefore be used as soon as possible after they are made up if the utmost working life is to be obtained from them.

Hearing aids can be made up in a number of forms. The two-stage aid previously described was assembled in a single container, and it is possible to assemble a three-valve instrument of the circuit of Fig. 1 in a single box of slightly smaller dimensions. Non-carbon instruments can be made up in separable parts in a form convenient for wearing on the person.

The purpose of a hearing aid being to increase the acoustic energy operating on the ear, a determination of this increase is of utmost importance in hearing-aid design. At the same time, a knowledge of the amount of such amplification as is obtainable from present-day apparatus tells us how far it is possible or desirable to incorporate frequency response adjustment or tone control in such apparatus. In the case of an air-conduction hearing aid the effective amplification or gain of the aid may be defined as "The ratio of the acoustic pressure operating on the ear drum of the user of the apparatus when it is placed in a sound field to that operating on the ear drum when the unaided ear replaces the apparatus." It can be expressed in decibel units (for example, a pressure ratio of ten times is equal to an energy ratio of 20 decibels). It can be measured by means of a threshold measurement or by aural balancing if certain precautions are taken, and it can also be determined objectively by means of an artificial apparatus. In the Department of Education of the Deaf at Manchester

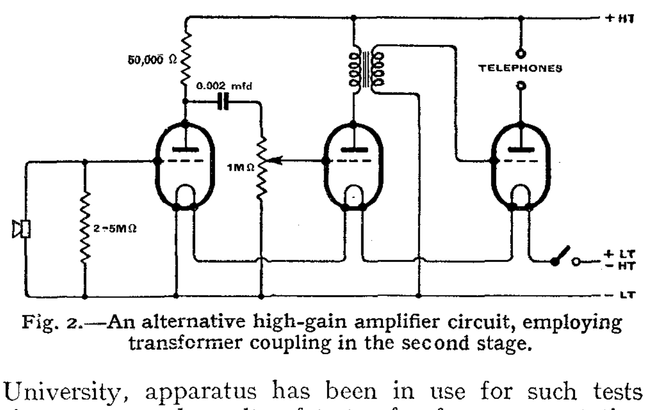


Fig. 2.—An alternative high-gain amplifier circuit, employing transformer coupling in the second stage.

University, apparatus has been in use for such tests since 1933, and results of tests of a few representative instruments were first published in 1936.[4]

Another important characteristic of a hearing aid is

[3] Prices of batteries have increased since this article was written.—Ed.

[4] *Journal of Scientific Instruments*, May, 1936.

Aids to Hearing—

the ratio between sensitivity and background noise. All electrical aids have inherent parasitic noise which sets a limit to the weakest sound that is audible through the aid. For this reason with most hearing-aid apparatus weak sounds near the normal threshold level cannot be made audible to deaf subjects whatever the degree of deafness or however much the amplification used. In a carbon microphone the parasitic noise is due to the carbon roar, whereas in a non-carbon aid the noise is due to the thermal agitation and valve noise of the amplifying system. The apparatus used for measuring the effective amplification of a hearing aid can also be used for determining its noise level.

Fig. 3 is a diagram of the testing apparatus used. A source of sound is arranged inside a sound-proof or sound-insulated room of which the walls are lagged with about 5in. of cotton-wool or suitable absorbent material. In front of the source is placed the hearing aid to be tested, with its microphone facing the source, the aim being to test the aid under its working conditions. The output telephone of the instrument is then attached to an artificial ear coupler for the purely objective test.

For the test involving the use of a human ear leads are taken from the output of the aid through an attenuator network control to the listening telephone outside the sound-proof room. The attenuator is arranged so that the load on the apparatus is always approximately the same as that when the listening telephone is connected to the aid direct as in the actual conditions of use. Tests are made to determine the level of the background noise by introducing attenuation until the noise is just inaudible. This gives one characteristic of the apparatus.

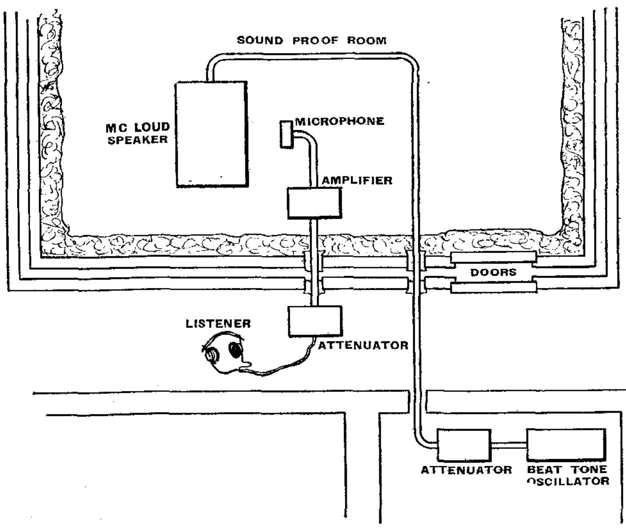
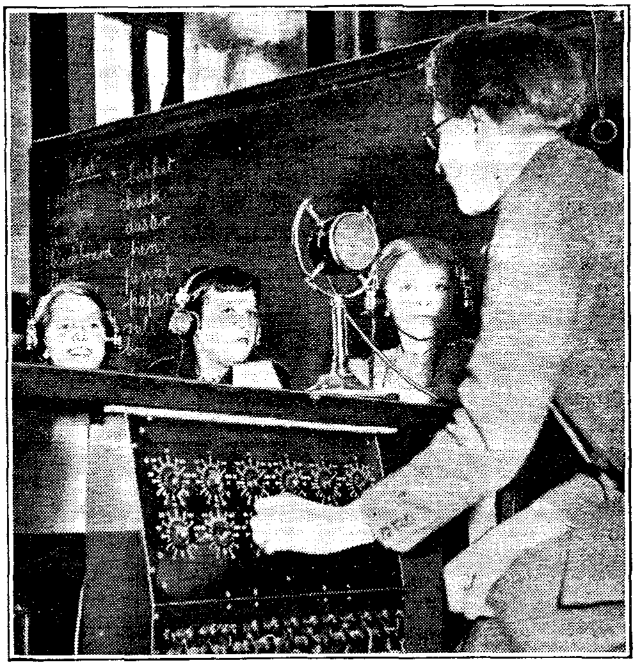


Fig. 3.—Layout of apparatus for testing the performance of hearing aids.

Before making the actual amplification test the instrument is tested to determine the least sound it will respond to effectively; that is, the sound level that is just audible above the background noise when it is used with unattenuated output. For the test of effective amplification attenuation is introduced sufficient either to



Teaching deaf children: the apparatus provides an individual control for each pupil.

eliminate the background noise or to make it of negligible masking effect, and the reduction factor noted. The intensity of the source is adjusted for each of a series of test frequencies throughout the range until the sound in the output telephone is just audible to the listener, and all the results are tabulated. When this series of measurements is completed the hearing aid is removed from its position in the sound-proof room and the listener, now in the sound-proof room, places his ear (the same as that used for the previous test) in the position previously occupied by the microphone of the instrument. The same series of test frequencies as those used for the aided listening is repeated and the intensities of the source when each can just be heard are again tabulated. These two series of tests are referred to as the "aided" and "free air unaided" respectively, and, knowing the reduction factor of the output attenuator, we can calculate the effective amplification as follows:

If "I_a" and "I_u" are the intensities of the source required to produce an audible sound in the aided and unaided conditions respectively, and R is the reduction factor of the attenuator.

$$\text{Effective amplification} = R\,\frac{I_a}{I_u}.$$

The method can be used with satisfaction with a deaf subject as well as with a normal subject. Owing to the differences in the physical characteristics of human ears one does not always get the same result with different subjects, and variations of plus or minus 5 decibels are possible in the results obtained.

The same procedure, when undertaken by means of an artificial ear, is accomplished without an attenuator network connected to the output of the aid, but with the telephone of the instrument connected to the receiving cup of the artificial ear. The artificial ear used for these

Aids to Hearing—

tests makes use of a metal tube of about $1\frac{1}{4}$in. long and $\frac{1}{4}$in. diameter, closed at one end by a small microphone of about $\frac{3}{8}$in. diameter. Absorbent material is used in the tube in an effort to simulate the damped resonance of an average ear. Actually the response of the artificial ear is compared with the responses of a number of normal ears both in free air unaided and aided conditions, and a correction can be applied for any lack of simulation. When once this correction is known for the various types of telephones used, tests of hearing aids can be made without the use of a human listener. It should be pointed out, however, that although a human ear is made use of in the threshold type of test the method is not subjective in the usual meaning of the word. The ear is not allowed to interpret or estimate the results in any way, but merely used as an indicator of the point at which the acoustic pressure reaches a certain limit of audibility.

In the method of testing hearing aids by aural balancing, a source of sound is used which is operated from a calibrated attenuator. A listener adjusts the level of the sound from the source by means of the attenuator and estimates how much more intense the sound heard unaided must be made in order to appear as loud as that heard by means of the aid which is placed in front of the source. It is necessary to make the change-over very quickly to get satisfactory results, and to cover the telephone of the aid as it is moved from the ear to prevent disagreeable effects due to howling. This method, however, is not by any means as satisfactory as the previous ones described, and appears to give results which are too low. It is, however, very useful for comparing rapidly the responses of different aids.

The accompanying table gives experimental results on a number of different types of electrical and non-electrical hearing aids. It can be seen that the valve amplifier instruments give the best responses. No small hearing aid is available at the present time that gives approximately uniform amplification over the range 200 to 4,000 cycles, although an approach is obtainable by means of a large school apparatus using moving-coil or ribbon telephones. The causes of the serious departures from uniform acoustic amplification lie in the characteristics of the telephones and microphones used. The valve amplifiers of hearing-aid apparatus have usually a very uniform response, but both the telephones and microphones used have peaks and troughs in their characteristics. With the usual form of moving-iron telephones used there is a peak response in the region of 700 to 1,200 cycles per sec. which accounts for some 10 decibels increase of response in that region. In crystal telephones there is usually a first resonant point in the region of 2,000 cycles per sec. Other peaks in small hearing aids are caused by fundamental and secondary resonances in the diaphragm and components of the microphones. These sources of irregularity are, of course, eliminated in the high-quality microphones of larger apparatus.

EFFECTIVE AMPLIFICATION OF VARIOUS HEARING AIDS.

(i) Non-electric Aids.

Frequency (cycles per sec.)	Effective Amplification in decibels		
	Tortoishell Auricles	Ear Trumpets or Horns	
	average 3 types	metal	non-metal
200	−5	0	5
500	0	10	5
800	5	5	0
1000	0	15	15
2000	10	10	5
3000	−5	5	−5
4000	−5	5	−5

(ii) Electrical Aids without Valve Amplifiers.

Frequency (cycles per sec.)	Effective Amplification in Decibels		
	Shot microphone type	Double carbon granule mic, with carbon amplifier	High quality** carbon powder mic. carbon amplifier moulded nipple phone
200	−10	5	15
500	5	25	15
800	10	20	30
1000	10	25	40
2000	−10	10	30
3000	−15	5	10
4000	−25	−15	−10

** The response of this instrument is exceptional for a non-valve hearing aid. It is not widely advertised and is the product of one firm only.

(iii) Electrical Aids with Valve Amplifiers.

Frequency (cycles per sec.)	Effective Amplification in Decibels				
	"*W.W.*" Differential carbon aid	Crystal mic. 3 valve amp. 52 volt HT		Vest pocket crystal mic. 37 volt HT	Classroom amplifier 4 stage M. Coil phones
		MI phone	Cryst. phone		
200	25	25	15	15	30
500	30	30	25	15	45
800	40	45	35	25	50
1000	45	50	50	25	50
2000	35	40	50	35	50
3000	30	40	40	30	45
4000	10	30	30	25	40

For Home Constructors

A NUMBER of "Technical Bulletins" giving circuits, constructional information and operating data for short-wave receivers, AF amplifiers and other apparatus are issued by Premier Radio, of Jubilee Works, 167, Lower Clapton Road, London, E.5. The Bulletins, which cost 6d. each, deal with 3-watt amplifiers for AC or AC/DC, a 6-watt AC high-gain amplifier, an 8-10-watt AC/DC amplifier, 15-watt and 30-60-watt AC amplifiers, 1-valve SW receiver or adaptor, 2-valve SW receiver, 3-valve SW receiver, and a multi-range test set.

Letters to the Editor

THE EDITOR DOES NOT NECESSARILY ENDORSE THE OPINIONS OF HIS CORRESPONDENTS

Probe Valve Voltmeter

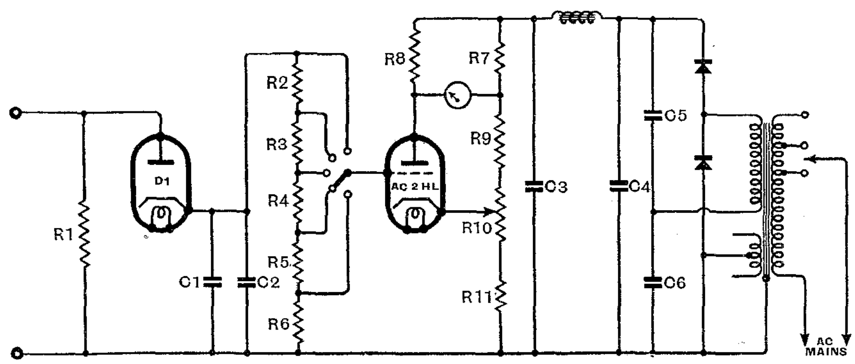
IN reference to the instrument described in the current issue of *The Wireless World,* I would like to point out what I believe to be a discrepancy which occurs between Fig. 1 and Fig. 2 in the development of the circuit. In Fig. 1 the anode of V1 is at the same potential as the cathode, but in Fig. 2 the cathode is at a potential of from 0 to 2 volts negative with respect to the anode. Therefore, a current is passed through the diode and through the resistance R1.

If the probe is applied to a low-resistance circuit, the current through the diode is large enough seriously to alter the bias applied to V2, and on the most sensitive range I found it impossible to obtain zero setting of the mA meter.

This difficulty may be overcome by returning the earthy ends of R1 and C1 to the slider of the bias potentiometer.

To eliminate the battery problem, the circuit was modified to operate from AC mains. This modified voltmeter, the circuit of which is given herewith, has a sensitivity of more than double that of the battery version, full scale deflection being obtained for an input of 0.35V using the original potential divider.

As the meter was required to have ranges of from 0.5V to 100V, the values of the PD resistances were altered to give these ranges, and these are the value shown in my circuit diagram. This reduces the effective impedance of the instrument to 4 MΩ.



If this reduced impedance is a disadvantage, the sensitivity may be reduced by lowering the HT potential.

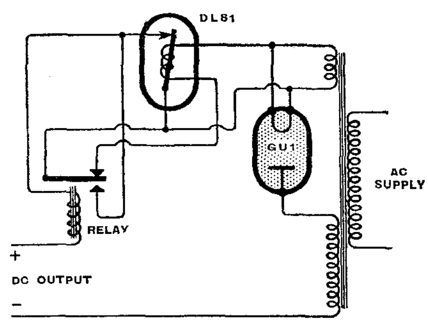
I am very satisfied with the final design and am very grateful to the authors for providing me with the initial design. J. HARRIS.

Coventry.

Protection for Gas-filled Rectifiers

I HAVE, for about eight years now, used a simpler circuit for cathode protection than that described in your February, 1940, issue.

It does not require the use of a second contact on the thermal delay switch, a contact which it is obviously impossible to provide on the valve-type thermionic switches. The telephone-type relay, which will probably be of the order of about 1,000 ohms, should be shunted so that the wattage dissipation for the coil does not exceed about 1 watt.



As shown in the accompanying circuit, the relay is "hot," but this is easily allowed for in the mechanical design. It will be noted that the relay is in series with the main HT; thus there is no additional drain on the HT supply. EDWARD F. WOODS.

Esher, Surrey.

Learning Morse

YOUR article on learning morse in *The Wireless World* of November, 1939, rightly points out that in that code the various letters and other signs are represented by rhythmic sounds rather than by collections of "dots" and "dashes." At the same time the suggestion of using the spoken syllable "dit" to represent the short sound is unsatisfactory, as it leads to incorrect spacing.

For instance, while "dah-dit" is quite a passable representation of "N," any normal person reading out "dit-dah" will make a sound much more like "ET" than like the "A" which is meant. Similarly, "dah-dit-dit-dah" and "dit-dah-dah-dit" will respectively sound like "NET" and "EG" instead of the intended "X" and "P."

By substituting "de" (as in "defence") for "dit," we obtain, instead of the above, the sounds "dah-de," "de-dah," "dah-de-de-dah," and "de-dah-dah-de," each of which, when read naturally, gives a satisfactory imitation of the real thing by running the sounds more closely together than is possible when using "dit."

Another aid to good spacing is to remember that, although "dah" is three times as long as "de," yet the "dah" only takes as long to send as "de-de," since we must allow for the short, silent period between the two elements of the latter signal. It follows that each of the following four signs should take identically the same total time to send: "F," "G," "B," "5," and similarly in other cases.

"EX. O.T.C. SIGNALS."

Letters to the Editor—

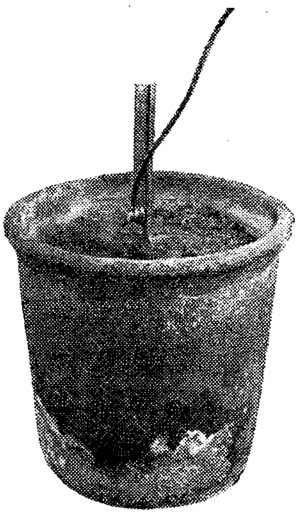
Reducing Gramophone Scratch

HERE is a recipe for the non-technical, if you care to publish it. I may add that an authority on gramophones gave me a "pat on the back" when he listened to my H.M.V. £105 electrical reproducer fitted as follows:—Burmese needles (kept very sharp) and Aladdinite (a kind of graphite) sprinkled lightly on the record pad. The scratch is practically non-existent, and the records after much use show no signs of wear.

Torquay. WALTER MEARS.

Believe It or Not!: It Still Exists

THE manageress of my wartime billets has achieved the reputation of being able to produce anything from a soldering iron to a bathing hut.



Not even the remark that it would be a good idea to have a radio receiver in our sitting room was beyond her, for she invited me to look in the attic for relics. Sure enough, there was a set, an ancient 4-valve battery affair with a loudspeaker that was far from being a Rice Kellog achievement. But who was caring for that when the set had an earth, in a flower-pot with a knife sprouting out and a terminal neatly screwed to the handle.

Believe it or not; the camera does not lie!

Somewhere in Scotland. TRANSIENT.

"Dangerous Catch Phrases"

ON page 238 of your September 7th number I note this sentence:

"Designers have been finding that frame aerials, properly screened, are helpful against types of interference in which the electrostatic field preponderates."

Such statements are common, but are, I think, most confusing. I do not wish to take Mr. Scroggie to task for using the particular nomenclature, as I admit that it is quite normal in our literature, and it may in the present case be a quotation. However, it would be of interest if Mr. Scroggie or any of your readers could briefly explain how an electrostatic field can *preponderate* in electric radiation.

Electric and magnetic fields are surely both necessary manifestations or convenient analytical conceptions of a wave, and you cannot destroy the balance between the two. Then an electric field fluctuating at radio frequencies is not an electro-*static* field.

However, this apparently harmless and orthodox statement deserves a still closer examination. What is it that a screened frame does? It avoids the *antenna effect* and limits the input to the receiver to the vector difference between the voltages produced *by the electric field* in opposite sides of the frame, the antenna circuit formed between the frame and earth having no effect on the receiver. But, note, the receiving system is still actuated by the electric field of the wave. Screening a frame is not to avoid "a preponderance of electrostatic field," but to use a whole wave with a full quota of magnetic and electric fields to best advantage by neutralising the system against the effects of an undesirable or antenna mode of vibration. In other words, it is the receiving system which has two "degrees of freedom," or two "modes of vibration," rather than the wave which can have different proportions of electric and magnetic fields.

I would suggest that it would have been more straightforward if the article had referred to the advantages of using a balanced or screened system—which would not allow the receiver to be affected by any "antenna" effect—when trying to avoid radio interference from sources which are often capacitively coupled to the receiving system.

My purpose in commenting on the matter is to make a plea for a more descriptive and exact nomenclature and the avoidance of dangerous catch phrases. (See *The Wireless Engineer*, June, 1930, p. 322.)

E. H. R. GREEN.

Wellington, New Zealand.

Induction

THE article by Mr. G. A. V. Sowter on inductive systems in *The Wireless World*, December issue, recalled to me another use of this principle which should be of interest to recording enthusiasts.

A suitable inductor coil connected to a recording amplifier and placed on the ringer box of a telephone will provide sufficient pick-up for recording both sides of a telephone conversation. No direct contact with the telephone wiring is required. The Presto Recording Corporation (U.S.A.) markets a model with the coil enclosed in a bakelite case 1in. diameter, $3\frac{3}{4}$in. long with a 25ft. cord and plug. A similar device has also been developed by a member of The British Sound Recording Association. DONALD W. ALDOUS.

Torquay, Devon.

Henry Farrad's Solution

(See Page 163)

As the receiver is one of the first of the push-button type, and adjusted by screw trimmers, it is almost certainly capacity trimmed. To tune to North Regional's wavelength (449 metres) the trimmer has to be supplemented by a fixed capacity in parallel; this is of such a value as to allow the trimmer corresponding to that button to be adjusted to any station within a certain range of wavelengths, including 449. As the trouble appears to be confined to this button the fault can be localised. One of the two trimmers is correctly set, but the other has to be screwed right up and even then reception is only faint. As the oscillator trimming in a superhet is critical and the preselector comparatively broad, it is evident that it is the latter that is at fault (otherwise no reception at all of the required station would have been likely), and the symptoms could be accounted for if the jolt mentioned had opened the connection to the parallel fixed capacity. The trimmer would then be insufficient, even at maximum capacity, but would only make some slight approach to the correct tuning.

NEWS IN ENGLISH FROM ABROAD

REGULAR SHORT-WAVE TRANSMISSIONS

Country : Station	Mc/s	Metres	Daily Bulletins (G.M.T.)
America			
WNBI (Bound Brook) ..	17.78	16.87	3.0 a.m., 5.0.
WRCA (Bound Brook) ..	9.67	31.02	3.0 a.m.
WCBX (Wayne) ..	6.17	48.62	6.55 a.m.
	9.65	31.09	4.0 a.m.
	11.83	25.36	1.55 a.m., 10.50§‡, 11.30§‡, 11.45*.
	15.27	19.65	6.30§‡, 7.45.
	17.83	16.82	1.0, 2.0†, 4.0*†.
WGEO (Schenectady) ..	9.53	31.48	4.0 a.m.‡, 8.30†, 9.55§‡, 10.15*, 11.25‡.
WGEA (Schenectady) ..	15.33	19.57	1.0, 2.0‡, 9.55§‡.
WPIT (Pittsburgh) ..	6.14	48.86	4.0 a.m.‡.
	11.87	25.26	3.0 a.m.‡, 11.45§‡.
	15.21	19.72	2.0‡, 4.0†, 5.0.
WCAB (Philadelphia) ..	6.06	49.50	1.55 a.m., 11.30§‡.
	9.59	31.28	1.55 a.m., 4.0a.m.§, 6.55a.m.§, 11.45*.
WRUL (Boston) ..	6.04	49.67	11.0‡.
	11.79	25.45	8.30§‡.
WRUW (Boston) ..	11.73	25.58	11.0‡.
	15.12	19.83	8.30§‡.
Australia			
VLQ	9.61	31.20	8.15 a.m., 12.30, 4.0.
VLQ2	11.87	25.27	8.15 a.m.
VLR	9.58	31.32	9.0 a.m. (9.20 Sun.), 1.20‡.
VLR3	11.88	25.25	2.20 a.m., 8.45§, 10.0.
China			
XGOY (Chungking) ..	11.90	25.21	11.0 a.m., 10.0.
Finland			
OFD (Lahti)	6.12	49.02	6.40, 8.40.
	9.50	31.58	6.40, 8.40.
France			
TPB6 (Paris-Mondial) ..	15.13	19.83	8.15 a.m.
TPB11	7.28	41.21	7.0.
TPA2	15.24	19.68	11.0 a.m.
TPA4	9.68	30.99	1.0 a.m., 2.50 a.m., 4.30 a.m., 5.15 a.m.
TPB7	11.88	25.24	4.30 a.m., 8.15 a.m., 7.0.
Fort de France	9.70	30.91	11.15.
French Indo-China			
Saigon	11.78	25.47	11.0 a.m., 3.50.
Germany			
DJA (Zeesen)	9.56	31.38	5.15, 11.15.
DXB	9.61	31.22	8.15, 9.15.
DJB	15.20	19.74	10.15 a.m., 2.15.
OLR5A (Poděbrady) ..	15.23	19.70	7.50.
SP48 (Warsaw) ..	6.14	48.86	7.45.
Hungary			
HAT4 (Budapest) ..	9.12	32.88	12.30 a.m.§.
HAS3	15.37	19.52	2.15†.

Country : Station	Mc/s	Metres	Daily Bulletins (G.M.T.)
Ireland			
Athlone	9.59	31.27	6.45, 10.0 (10.5 Sun.)
	17.84	16.82	6.45, 10.0 (10.5 Sun.)
Italy			
I2RO3 (Rome)	9.63	31.15	12.30 a.m., 6.18, 9.15.
I2RO4	11.81	25.40	12.30 a.m.. 11.0 a.m., 3.45, 6.18.
I2RO6	15.30	19.61	12.30 a.m., 9.40 a.m., 3.45, 8.30.
I2RO8	17.82	16.83	11.0 a.m.
I2RO9	9.67	31.02	8.30, 11.16.
Japan			
JVW (Tokio)	7.25	41.34	8.5.
JZI	9.53	31.46	8.5.
Manchukuo			
MYCY (Hsinking) ..	11.77	25.48	2.50, 6.30, 9.0.
Newfoundland			
St. John's	9.48	31.64	10.30.
Portugal			
—	3.71	80.80	8.0 (Tues., Thurs., and Sat.)
Rumania			
—	9.28	32.33	9.45‡.
Russia			
RNE (Moscow) ..	12.00	25.00	3.0†, 12.0 midnight.
	6.00	50.00	9.30, 10.30.
RW96	6.03	49.75	8.0, 12.0 midnight.
	15.18	19.76	8.0 a.m.
RKI	7.51	39.89	9.30, 10.30.
	15.04	19.95	12.0 midnight.
RAL	9.60	31.25	8.0, 10.30, 12.0 midnight.
RWG	7.36	40.76	9.30, 10.30.
—	8.06	37.22	8.0.
—	9.68	30.98	8.0.
—	11.64	25.77	11.0 a.m.
—	11.90	25.21	9.30, 10.30.
Spain			
FET1 (Valladolid) ..	7.07	42.43	7.45.
EAQ1 (Madrid) ..	9.86	30.43	3.25.
Sweden			
SPO (Motala)	6.06	49.46	9.30.
SBU	9.53	31.46	9.30.
Turkey			
TAP (Ankara)	9.46	31.70	7.15.
TAQ	15.19	19.74	12.15.
Yugoslavia			
YUC (Belgrade) ..	9.50	31.56	9.0.

REGULAR LONG- AND MEDIUM-WAVE TRANSMISSIONS

Country : Station	kc/s	Metres	Daily Bulletins (G.M.T.)
Estonia			
Tartu	731	410.4	9.5.
Finland			
Lahti 1	166	1,807	6.40, 8.40.
France			
Radio-Paris	182	1,648	10.0.
Germany			
Hamburg	904	331.9	12.15 a.m., 10.15 a.m., 2.15, 5.15, 8.15, 9.15, 11.15.
Bremen	758	395.8	
Hungary			
Budapest 1	546	549.5	10.10.
Ireland			
Radio-Eireann	565	531	6.45‡, 10.0 (10.5 Sun.)
Dublin	1,348	222.6	
Cork	1,235	242.9	

Country : Station	kc/s	Metres	Daily Bulletins (G.M.T.)
Italy			
Rome 1	713	420.8	6.18, 9.15, 11.16.
Latvia			
Madona	583	514.6	9.0 (Tues. and Fri.)
Kuldiga	1,104	271.7	9.0 (Tues. and Fri.)
Rumania			
Radio-Romania ..	160	1,875	9.55‡.
Bucharest	823	364.5	9.55‡.
Spain			
Burgos	1,258	238.5	10.15.
Sweden			
Motala	216	1,389	9.45.
Stockholm	704	426.1	9.45.
Hörby	1,131	265.3	9.45‡.

All times are p.m. unless otherwise stated. * Saturdays only. § Saturdays excepted. † Sundays only. ‡ Sundays excepted.

Test Report

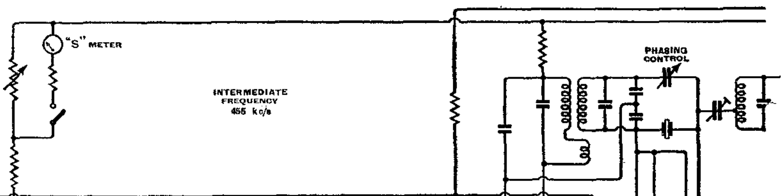
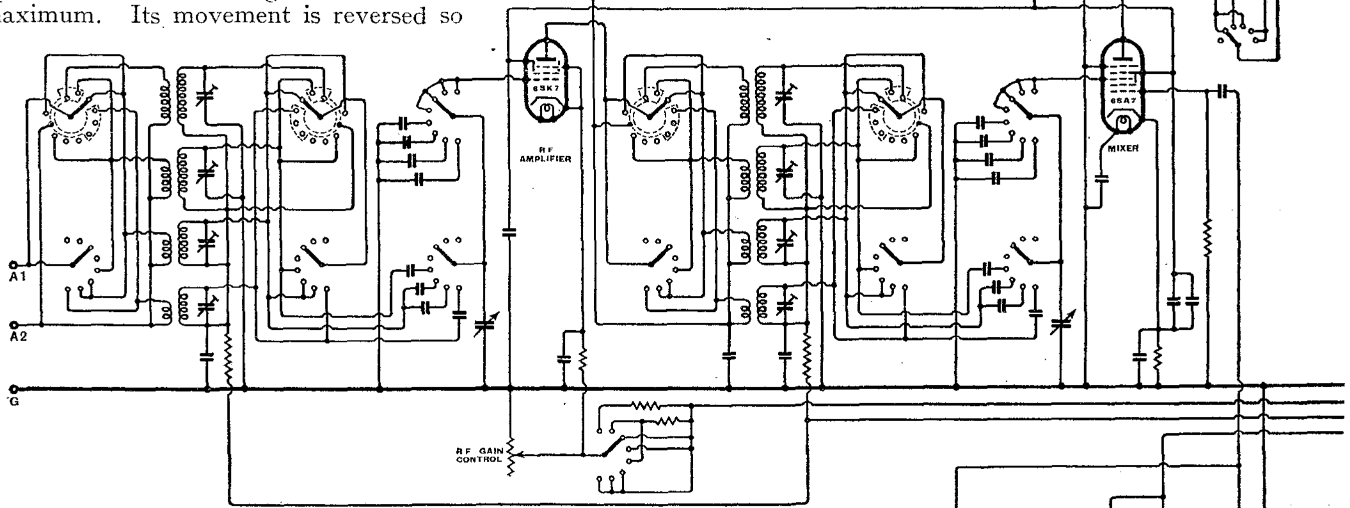
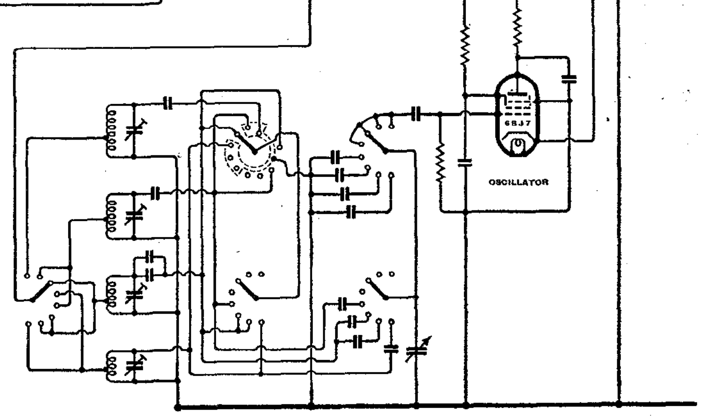
Hallicrafters Skyrider 23

AC COMMUNICATION RECEIVER (TEN VALVES + RECTIFIER). AUTOMATIC NOISE LIMITER. CRYSTAL IF FILTER.

PRICE: £33 10s. (LESS SPEAKER)

THE makers of this receiver have had long experience in catering for the requirements of discriminating amateurs in America. While building to an advanced specification, they have not overlooked the added pleasure which is given by an instrument which looks the part. For systematic listening on short waves it would be difficult to find a receiver which is better equipped to meet the changes in the type of signal and conditions of transmission which are encountered.

Circuit.—The aerial input is designed for either an ordinary elevated aerial or a dipole working in conjunction with a 400-ohm transmission line. The RF stage, which functions on all wavebands, carries the signal strength meter in its anode circuit. This meter only comes into operation when the RF gain control is at maximum. Its movement is reversed so

Complete circuit diagram of the Hallicrafters Skyrider 23. In the choice of components, condensers with negative temperature coefficient have been used wherever possible to compensate for the positive coefficient of inductances.

that increasing signal strength gives a left-to-right movement of the needle. Calibration is on the "S" scale (0 to 9) and also in db.

Band spreading is by means of series fixed condensers covering the principal amateur bands. All the tuned circuits are temperature compensated, and station settings can be repeated with accuracy on the 100-degree scale provided.

Separate oscillator and mixer valves are used in the frequency-changer stage, and the output is amplified by two IF stages. Control of band width is effected both in the crystal filter and in the coupling of the IF transformers. In all, there are four degrees of selectivity, and the selectivity switch, which also controls AVC, has six positions as follows: (1) CW crystal (AVC off), (2) Phone crystal (AVC off), (3) IF sharp (AVC off), (4) Phone crystal (AVC on), (5) IF sharp (AVC on), (6) IF broad (AVC on).

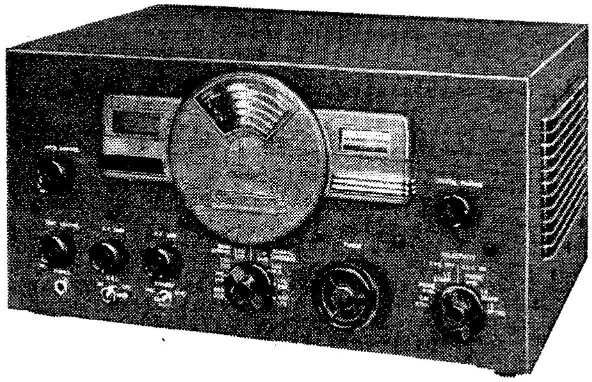
A separate amplifier-rectifier valve is employed for

AVC, and the bias is applied to RF amplifier, frequency changer and first IF amplifier on all wavebands.

The noise-limiting diode is shunted across the grid circuit of the first AF stage, and appears to be a modification of the Dickert circuit. The anode is fed through a filter from the top of the signal diode load resistance, and its potential is substantially that of the steady carrier. The cathode, on the other hand, is allowed to follow the modulation, and is connected to a point on the load resistance such that for acceptable modulation depths the cathode is always less negative than the anode, and the diode is non-conducting. For pulses equivalent to 100 per cent. or more the cathode goes more negative than the anode, and the input to the AF amplifier is reduced.

The rest of the circuit is straightforward, and consists of a resistance-coupled pentode output valve with provision for phones. The loud speaker terminals are for 500 ohms or 5,000 ohms loads.

Performance.—The superiority of this receiver over the ordinary broadcast set with a short-wave range is most apparent when comparisons are made of selectivity, sensitivity and the range of AVC.



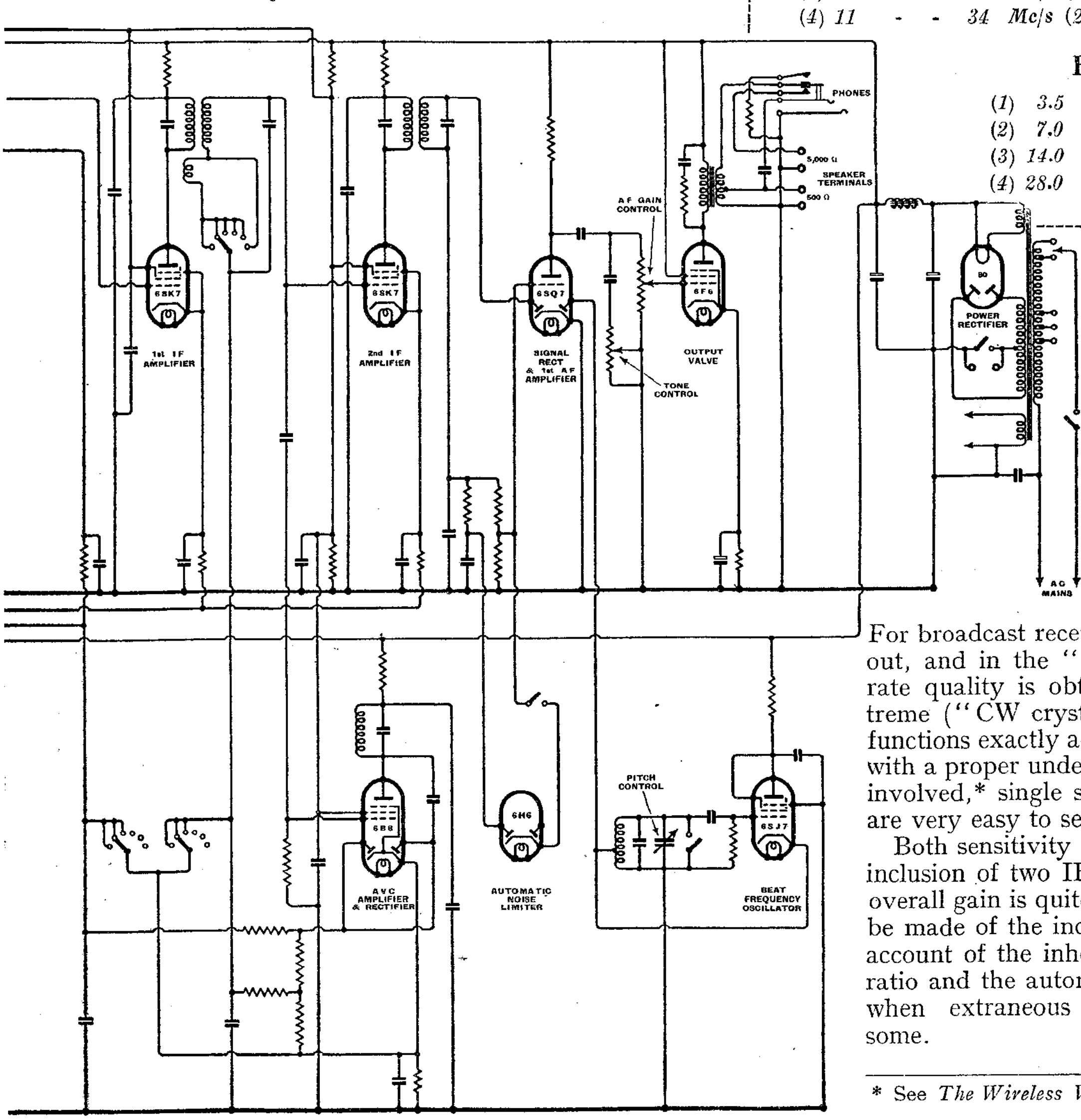
WAVERANGES

General

(1) 540	- - 1,700 kc/s (556	- - 176 metres)
(2) 1.7	- - 5.2 Mc/s (176	- - 57.7 metres)
(3) 5.2	- - 16.5 Mc/s (57.7	- - 18 metres)
(4) 11	- - 34 Mc/s (27.3	- - 8.8 metres)

Band Spread

(1) 3.5	- - - 4.0 Mc/s
(2) 7.0	- - - 7.3 Mc/s
(3) 14.0	- - - 14.4 Mc/s
(4) 28.0	- - - 30.0 Mc/s



The inclusion of a crystal filter in a balanced circuit gives separation varying from a few cycles on CW signals to the band-width necessary for good-quality reception of telephony. For broadcast reception the crystal is shorted out, and in the "IF broad" position first-rate quality is obtained. At the other extreme ("CW crystal") the phasing control functions exactly according to the book, and, with a proper understanding of the principles involved,* single signal reception conditions are very easy to secure.

Both sensitivity and AVC benefit from the inclusion of two IF stages. The increase in overall gain is quite marked, and full use can be made of the increased sensitivity both on account of the inherently low signal-to-noise ratio and the automatic noise-limiting circuit when extraneous interference is troublesome.

* See *The Wireless World*, September 29th, 1938.

Hallicrafters Skyrider 23

With amplified AVC operating on three stages, a rock-steady signal is obtained when the "S" meter is showing fluctuations of 20 or 30 db. The sensitivity of this meter, incidentally, is much superior to that of the conventional cathode-ray tuning indicator.

The noise-limiting control works well, and may be left in circuit with but little effect on the volume of the received signal when atmospherics and local interference are low. It is most effective at high frequencies in reducing motor car ignition interference which would otherwise blot out weak signals, and on certain CW transmissions key clicks are effectively rounded off, thus making the signal less tiring to read.

From the broadcasting point of view, it is a pity that band-spreading is confined to the amateur bands, but as this is primarily a communication receiver, one can have no legitimate grievance on this score. The stand-by switch with its terminals for extension leads is in the present circumstances redundant, but the provision of a phone jack—if it is used—will be appreciated by the families of those enthusiasts who listen well into the small hours.

Constructional Features.—The finish of the metal cabinet both inside and out is an attractive dark grey enamel offset by an oxidised gunmetal escutcheon and aluminium ventilating louvres at the sides. Uniform illumination of the tuning scales is achieved by engraving them on overlapping bevelled steps inclined to the line of sight. The "S" meter on the left and the waveband indicator on the right are internally illuminated.

The principal controls fall easily to the hand, and are smooth in action. A very neatly designed "flick-over" switch is used for the automatic noise-limiter circuit. The mains voltage adjustment on the transformer is also effected by a switch.

With the exception of the output valve and rectifier, all the valves are of the metal bulb type.

The overall dimensions of the cabinet are 19in. × 12½in. × 9¼in.

Distributors.—Webb's Radio, 14, Soho Street, London, W.1.

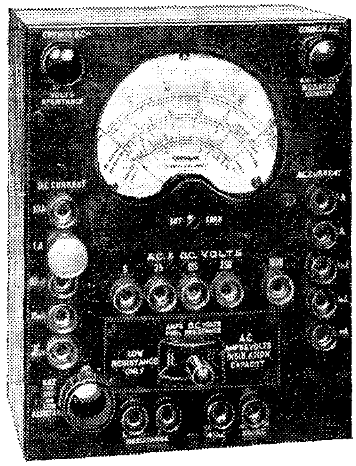
Automatic Morse Transmitter

DESIGNED for the automatic transmission of call signs and code numerals, the R.W. Mechanical Morse Transmitter measures only 6 inches cube. It transmits at a speed equivalent to fifteen words per minute, and may also be obtained with keyboards suitable for sending latitude and longitude or letters of the alphabet. It is obtainable through R. A. Rothermel, Ltd., Canterbury Road, London, N.W.6.

New "Radiolab" Tester

THE latest model of this useful test instrument is fitted with additional ranges, including voltages up to 1,000, AC current up to 5 amps., DC current for car radio work up to 10 amps., and an insulation range for use with an external AC mains supply reading up to 7.5 MΩ.

For use with an external 4-volt AC supply, which is readily available from most mains transformers, a capacity range is also incorporated, and this may be employed for testing electrolytic condensers.



In the latest model "Radiolab" tester the 7½in. × 5in. bakelite panel is mounted in a hardwood case 3¼in. deep

In view of the additional high-voltage and heavy-current ranges, plug and socket connectors are now used instead of the multi-range selector switch, and the instrument conforms to British Standard First Grade requirements. The price is 8 guineas, and the makers are Everett, Edgcumbe and Co., Ltd., Colindale Works, Hendon, London, N.W.9.

Getting the Best from Records

Part II.—THE PICK-UP

By P. G. A. H. VOIGT, B.Sc., A.M.I.E.E.

The electrical and mechanical properties of pick-up types in common use are compared and simple forms of volume and tone control are suggested. The article also draws attention to several types of resonance which are frequently overlooked and shows how they may be controlled

IN the Patent Office Library are described a number of ideas for using light rays and photocells in specialised gramophone pick-ups. So long as these arrangements rely on tilting mirrors or vibrating shutters there must be some doubt as to their advantages. When, however, record grooves become so perfect that they will reflect light beams without diffusion, or when they can themselves be used as apertures, possibly in conjunction with wedge-shaped beams, then photocell methods might become very attractive since they would offer the possibility of eliminating a mechanical reproducing point.

However, these things may never happen. They would in any case be complex and costly, so we must content ourselves with mechanical reproducing points whose movements are converted into electric alternations by suitable means.

Pick-ups may be classified by the basic principle they employ for converting the mechanical into electric alternations. Among possible methods are: (1) Moving iron; (2) moving coil; (3) piezo-electric; (4) electrostatic; (5) variable resistance. Of these the moving iron and the moving coil are basically constant velocity methods and thus differ from the other three types, which are basically constant amplitude devices.

A moving coil situated in a magnetic field generates a voltage only while there is a change of flux through it. Therefore, if it is twisted through a small angle and then held the voltage which is generated while it is moving ceases immediately the coil comes to rest. The same applies to moving iron pick-ups in which a voltage is generated only while the flux through the armature is changing. As the flux changes (ignoring eddy currents) only while the armature is moving we find in both cases that if the movement is faithful to that of the needle point, then only constant needle point velocity (i.e., the velocity when passing through the mid-position) will give us constant voltage output.

As was explained in the first article of this series the recording characteristic is a rising one, and it is therefore natural for the output from constant velocity pick-ups to be excessive in treble and deficient in bass.

In practice, it must be remembered that these pick-ups, especially those of the moving iron type, have windings which may be inductive. Consequently if such a pick-up is feeding into a resistive load, such as a volume control, then the inherent inductance of the pick-up will act as a series choke and reduce the high frequencies. This inherent compensating action is helped at the other end of the scale by a bass lift, normally due to the tone arm resonance.

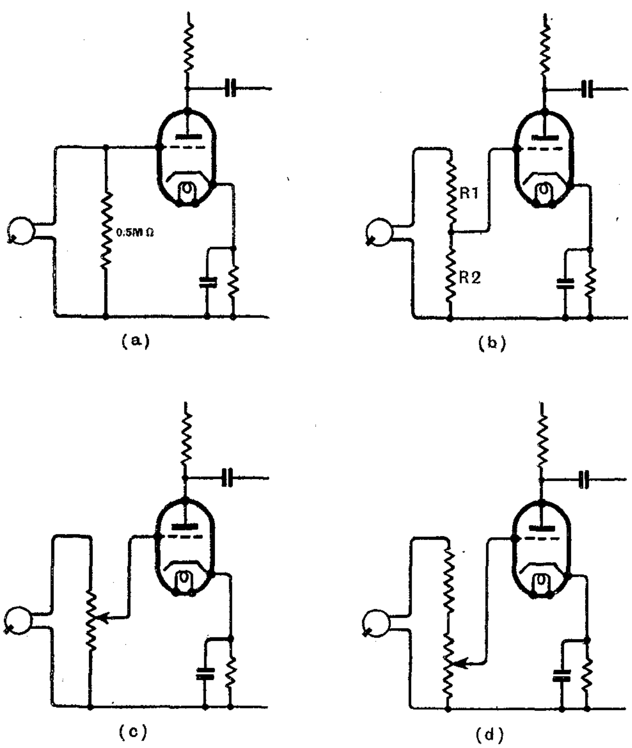


Fig. 7.—Volume control circuits. (a) Overloading may occur with a piezo pick-up and a valve with a short grid base; (b) fixed potentiometer to prevent overloading; (c) normal volume control circuit; (d) combined circuit to prevent overloading and open out range of volume control.

In the case of the other three types of pick-up, the open circuit voltage is not dependent on the velocity of movement but upon the displacement, i.e., amplitude. With an electrostatic arrangement, the capacity change depends upon the displacement of the electrodes. As, however, the recording characteristic lies in between constant amplitude and constant velocity the output will tend to contain excess bass and insufficient treble.

This would also apply to the piezo pick-ups if they were used on open circuit. In both cases the pick-ups behave electrically rather as capacities and therefore if they feed into suitable resistances (as is normally done with piezo pick-ups) then the current through these resistances discharges the pick-ups partially at low frequencies and thus prevents the bass from becoming excessive. Furthermore, in practice the primary resonance of the moving parts usually causes a rise in the treble which minimises still further any natural tendency to "bass heaviness."

Electrostatic pick-ups have never become commercial propositions, probably on account of their inherently low voltage output. With piezo pick-ups, however, the output is so high that valve distortion may easily result.

The average quality lover usually has at least two amplifying stages in front of the power valve. For convenience, it is usual to employ the same volume control for radio as for gramophone reproduction, and with many circuits this volume control is placed after the first valve. If the full output of the piezo pick-up goes directly to the grid of a valve with a short grid base, then the pick-up output *on some records* may easily exceed the safe input

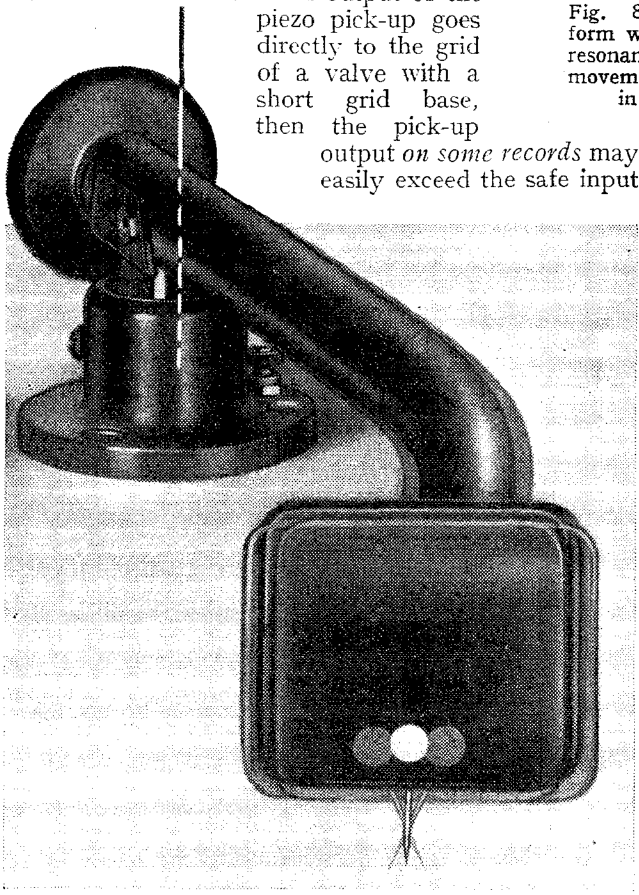


Fig. 9.—Lateral tone arm oscillation about a vertical axis produced by the mass of the tone arm, pick-up head and balance weight in conjunction with the restoring forces associated with the needle. The vibration at the pick-up head at resonance may exceed the record amplitude, and the armature movement is made up of the two amplitudes together.

to the valve. No amount of juggling with a volume control after this valve can then get rid of the resulting distortion.

The cure is particularly simple and consists of stepping down before the first valve as shown in Fig. 7(b). If the loud speaker does not lose bass, I find in most cases that 0.5 MΩ as pick-up load is often too high, and that 0.25 MΩ and 25,000 ohms are generally more suitable for R_1 and R_2 respectively. When the pick-up load is also the volume control as in Fig. 7(c) premature overloading is automatically avoided, but with two amplifying stages, the operating region of the volume control tends to be concentrated at one end, and to be very fierce. This may easily be avoided by using a lower value control, and putting in series with it a fixed resistor as in Fig. 7(d).

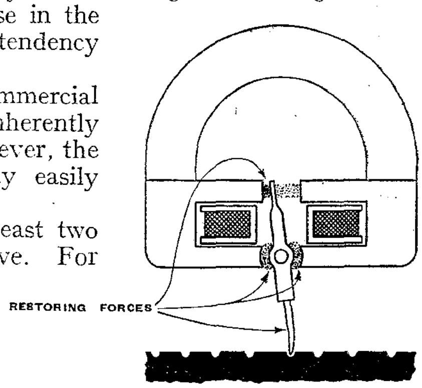


Fig. 8.—Showing in exaggerated form what happens at the armature resonance. The excessive armature movement tends to bend the needle in an unexpected direction.

I mentioned above that tone arm and other resonances help to compensate on occasions. Actually, of course, resonances are a doubtful blessing. However, by considering what causes them, it may be possible to determine whether they should be used or eliminated.

Pick-up curves as published some years ago were as full of peaks and troughs as temperature charts. Most of these peaks and troughs could be disregarded, as many of them were due to the way in which the curve was obtained, and not to the pick-up at all.

The number of resonances which a pick-up can have depends upon how many possible modes of vibration there are. Simplicity in the design is therefore highly desirable.

The moving iron pick-up of orthodox construction has a tendency to three resonances only. The first (in the treble) is due to the combined mass of the needle, needle holder, needle screw, armature, etc., resonating in conjunction with the elastic control of: (1) the springyness of the needle *when its point is resting on the record*; (2) the "damping" on the armature, etc.; (3) the springyness of the pivoting arrangements, all acting in parallel. This type of resonance is illustrated in Fig. 8.

The second and third resonances are low down and the tone arm is involved in both. The lowest is due to the mass of the tone arm, pick-up head and balance weight (if any) swinging about the tone arm support as shown in Fig. 9. There is only one controlling force, and that is the stiffness with which

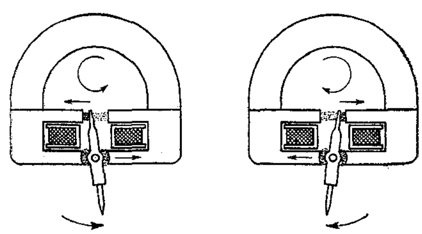


Fig. 10.—The forces resulting from the displacement of the needle tend to make the pick-up head rotate and may induce torsional resonance in the tone arm.

Getting the Best from Records—

the needle is held in the pick-up head, and which tends to bring it back into a central position.

The third resonance (which is generally overlooked) is illustrated in Fig. 10, and is caused by the pick-up head plus tone arm twisting on itself. The resilient forces are the torsional stiffness of the tone arm plus the turning moment caused by the stiffness with which the needle is held, both acting in parallel.

This last resonance has little effect on the tonal balance, as when it occurs (usually between 100 and 400 cycles) it tends to be very local, and consist of a peak with a trough immediately below. It does not, therefore, boost either end of the scale. From a design point of view, the tone arm itself and the disposition of mass affects this resonance materially, but since this resonance can only be set up by the torsional reaction of the needle restoring forces in the pick-up head, a design in which these forces are slight minimises the possibility of the resonance being set up.

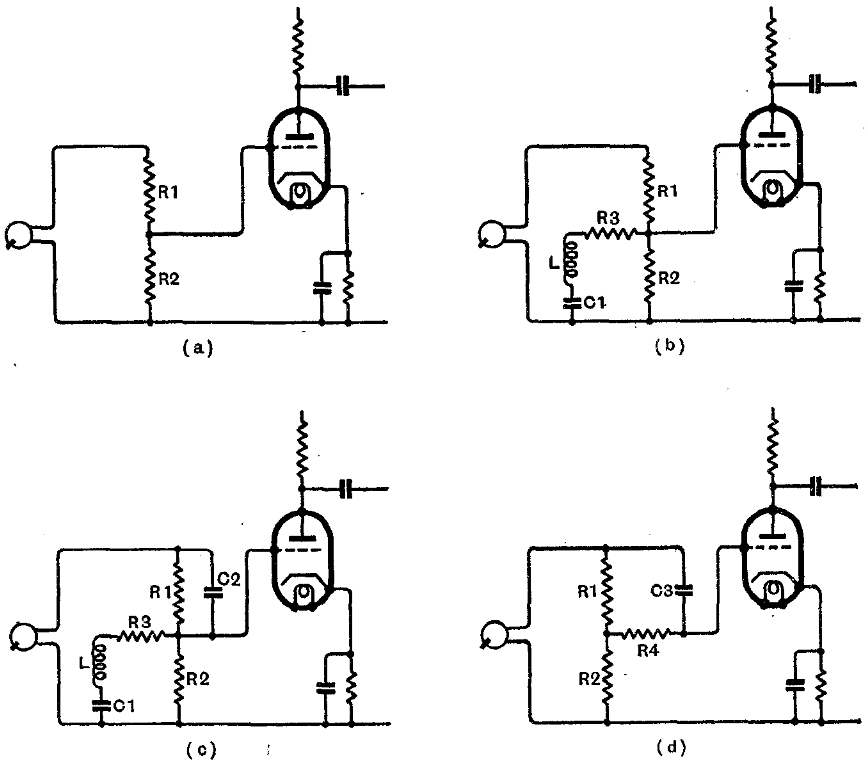


Fig. 11.—Tone correction circuits for a piezo pick-up which can be switched out together with the pick-up when receiving broadcasting. (a) Basic step-down potentiometer; (b) absorption circuit for treble resonance; (c) additional condenser to give a general top lift; (d) when using thorn or fibre needles a top lift without an absorption circuit is often the best. Recommended component values are as follows: R1, 250,000 ohms, R2, 25,000 ohms, R3, 20,000 ohms, R4, 50,000 ohms, C1, 0.002 mfd., C2, 0.0002 or 0.0003 mfd., C3, 0.0005 mfd. (max.), L, 2.5H.

Keeping the needle restoring forces low also helps in the case of the low-frequency lateral tone arm resonance, since this also can only be set up by the transverse reaction of these forces. Moreover, as in this case they are the sole elastic forces involved, it follows that their reduction will cause this resonance to go down the scale. By weighting the tone arm (and balancing if necessary) this resonance can be sent farther down still, and in the majority of commercial pick-ups it has been driven below 50 cycles. It lifts the output in its resonant region and the fact that the output at frequencies still lower falls away rapidly usually passes unnoticed.

Damping

The sharpness of the lower peak is naturally a function of the damping, and in the ordinary case the only damping is that inherent in the means which have been employed to return the needle to its central position. Rubber has some natural damping action and that may explain why this material is so popular as the control medium in pick-ups. There is room for improvement here and some pick-ups employ specialised materials.

Of the several resonances, the most serious is the first which generally occurs in the treble. The peak resulting from it can invest the brass in certain jazz records with a most spectacular brilliance. After a time this tires the ear, and then the listener will seek relief from the hard effect it produces, and from the resulting over-prominent scratch, by turning the tone control knob to "mellow" or switching off altogether. A further disadvantage is that normally the response falls away rapidly at frequencies above resonance. In some crystal pick-ups, however, an additional resonance which occurs very high up, due to the crystal itself, maintains the output above the main treble resonance.

When the output is not maintained in some such manner, the obvious thing is to try to drive the main top resonance so high that the cut-off beyond it has no effect. The resonance should if possible also be damped so that it does not cause excessive surface noise.

There are already several designs which trend in this direction, but unfortunately they are either not sold loose or they are built abroad as laboratory instruments, and the care with which they are made and the cost of the research work are reflected in the price. It is therefore useful to know that in many cases an electrical rejector or absorption circuit can correct for the effect which the peak has on the response curve. Naturally, such a rejector or absorption circuit will not lift the cut-off region, but this can often be done by other methods.

The type and position of the corrector circuit to be employed depend upon many factors. If the amplifier is used only with records, there is a wide choice. If

Getting the Best from Records—

however, it is to be used for radio or other work as well, switching is much simplified by using a corrector circuit which can be inserted between the pick-up and the amplifier.

Fig. 11(a) repeats the step-down circuit previously show in Fig. 7(b) for use when a piezo circuit feeds a 3-valve amplifier. Some piezo pick-ups show a peak in the treble, and even though it may be only 6 db or so high, there is no question that results can be improved in such cases by adding an absorption circuit as shown in Fig. 11(b). The values given were found suitable with Rothermel Standard S8 piezo pick-up when using H.M.V. High Fidelity needles.

It should be remembered when listening to the effect of such a circuit that only one part of the frequency spectrum will be affected, and it cannot therefore remove any musical note having a fundamental and harmonics. In any case the absorber should not reduce any frequency below the correct level. Its effect is mainly to improve the smoothness of the reproduction without affecting the frequency range. This is easily noticeable when listening to the surface noise, which should sound smooth and velvety rather like an escape of steam.

If the surface noise seems to hiss with a particular note, then it is almost certain that that frequency is being over-emphasised in the reproducing chain somewhere. The scientific way of adjusting such a corrector is by means of a suitable heterodyne record[1] used in conjunction with a meter, but when these two items are not available the sound of the surface noise is a most valuable guide.

Sometimes when such a corrector is used to cancel the effect of the peak the sound may become slightly dull. This may be due to the fact that the reduction in output above the resonant peak becomes noticeable when the peak is removed. The simplest way of lifting the region above resonance in the case of the circuit of Fig. 11(b) is by means of a top lift condenser as shown in Fig. 11(c). Such a top lift is especially useful when using fibre or thorn needles. With these needles the stiffness is less than with steel ones, and the position of the peak generally shifts downward; also it may be more damped, thus making the absorber less necessary. Fig. 11(d) therefore shows a simple top lifting circuit without absorber or corrector.

There is no question that suitable compensating circuits are worth while. The subject is, however, a large one, so a discussion of circuits suitable for moving iron pick-ups and how to adjust them will be left over till next month.

[1] H.M.V. No. DB4037 is eminently suitable.

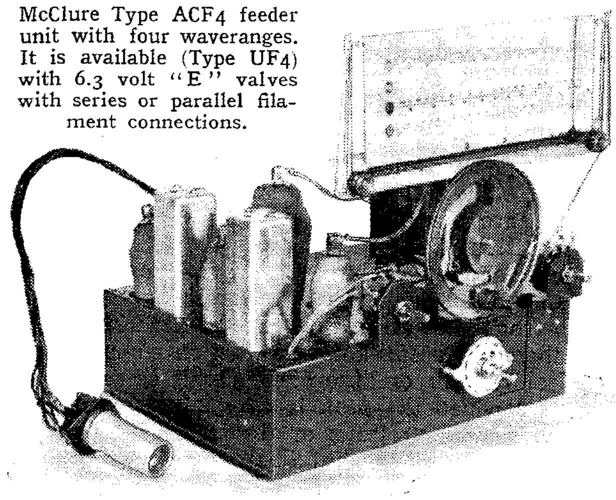
McClure Feeder Units

VERSATILE RECEIVERS FOR USE WITH EXISTING AMPLIFIERS

THE range of feeder chassis developed by John McClure, Ltd., Erskine Road, London, N.W.3, provide the means of extending the usefulness and enjoyment to be derived from quality amplifiers which may have been hitherto used exclusively for local station or gramophone reproduction.

They are designed to draw their power supply from the main amplifier, and require an average HT current of about 25 mA at 250 volts and LT of 4.5 amp. at 4 volts. The superheterodyne circuit consists of an RF stage working on all wavebands, a triode-hexode frequency changer, single IF amplifier and double-diode-triode signal and AVC rectifier and first AF stage. Normally, the output feeds a single grid, but a phase splitting stage is available (priced 16s. extra) for amplifiers requiring a push-pull input.

McClure Type ACF4 feeder unit with four waveranges. It is available (Type UF4) with 6.3 volt "E" valves with series or parallel filament connections.



The specification is generous and includes a cathode ray tuning indicator. The illuminated horizontal scale with two-speed slow motion dial is calibrated in both wavelength and frequency. Ceramic base trimmers are used throughout and all coil formers are impregnated to resist humidity. The wiring is neat and heavy-gauge wire is used for stability.

We have recently had an opportunity of testing one of these units in our laboratory. This was the ACF4 with four wavebands of 12-35 metres, 30-80 metres, 200-550 metres and 750-2,000 metres, costing £8 18s. 6d. There can be little doubt of its ability to make the most of every transmission fully within its waverange. The sensitivity is high and the signal-to-noise ratio very good indeed. For convenience in coupling to an existing amplifier the unit tested was fitted with 4 volt valves, and with 6.3 volt "E" type valves the signal-to-noise ratio would no doubt be even better. We were particularly impressed with the performance on the shortest wavelengths and there is no apparent falling off in sensitivity down to 12 metres.

The preselection inherent in the RF stage is adequate and the few self-generated whistles which were traced were of negligible volume. The oscillator has good frequency stability; AVC action is smooth and has a wide range.

On medium and long waves a very clean performance is obtained with plenty of range and adequate selectivity, though not enough to affect adversely the quality of reproduction. In fact the quality enthusiast has nothing to fear in substituting one of these units for his "local station only" tuner. Sockets are provided for a gramophone pick-up and these are connected to the grid of the triode output stage by contacts on the Yaxley type waverange switch.

From every point of view this is a well thought out and executed design which can be recommended.

Unbiased

By FREE GRID

A Scotsman Robs Himself

I WONDER how many of you noticed in the "Letters to the Editor" page of the December issue the unique exhibition of a Scotsman mentally doing himself down in a financial transaction. One of them wrote to the Editor from his lair to express his satisfaction that now *The Wireless World* came out once a month at the cost of a shilling, instead of once a week at a cost of sixpence, he was able to keep himself fully abreast of wireless developments at a weekly cost of threepence, instead of sixpence as in pre-war days. The actual weekly cost is, of course, a little over $2\frac{3}{4}$d. or to be precise 2.7692307 pence. I will not insult your intelligence by explaining why, but it is the discovery of this sort of financial error that helps to make Caledonia stern and wild.

Stern and wild.

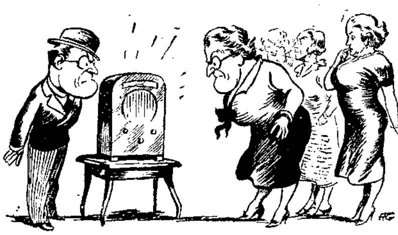
Englischer Freiheitsender

THIS war won't last for ever. Although to many people it may at present seem rather like a B.B.C. chamber music concert, just drooling along on and on without rhythm or reason, it will end at some time or another. To continue our chamber concert analogy, I would remind you that these nearly always seem to collapse suddenly in the middle of an apparently endless *motif*, and it may be the same with the war. It therefore behoves us wireless men to be prepared for it. For this reason I am going to outline a little post-war scheme which I had in mind for a long time before the fatal third of September.

For reasons which will be apparent when I disclose the details to you, there is not the slightest hope of putting the scheme into operation before the war ends, but that is no reason why we should not be all prepared to put the scheme into operation immediately peace returns. I will, therefore, give you a brief outline of the scheme, dealing first with the manner in which it originated in my mind.

For a long time before the war I was getting more and more fed up with the oily unctuousness of the B.B.C. programmes, and was wondering what I could do to free both you and myself from the shackles of moral uplift and doleful dirges with which the B.B.C. panjandrums were trying to enslave us. The usual antidote recommended for this sort of thing was a stiff dose of Radio Luxemburg, but, to my mind, this cure was far worse than the original complaint. We were compelled to put up with indelicate references to our internal economy just as though we were a class of medical students.

There seemed to be only one thing to be done to escape from B.B.C. bondage on the one hand and medical indelicacies on the other, and that was to establish a Freiheitsender of my own, from which joyous and carefree programmes would be radiated free of all suggestion of bureaucratic control or of the doctor's consulting room. I had it in mind for the scheme to be financed by subscriptions made by you, each subscriber being entitled to have a say in the matter of programme selection in exact proportion to the amount of his subscription. In other words, I was



Indelicate references.

intending to sell time on the air, but with the difference that instead of selling it to patent medicine venders I was going to sell it to any of you who wanted some particular musical item broadcast.

For obvious reasons the war knocked all this on the head, but, as I have already remarked, the war won't last for ever, and it is as well to have all plans cut and dried ready for the eventual return of normal times. I should like all of you who are interested in this scheme to drop me a line, and then I can arrange a public meeting in some hall or another to discuss the matter.

The Black-out Blues

DURING the black-out the other evening when I was sauntering along the road wrapped in thought and a fur coat, I was struck simultaneously by a car and the profound foolishness of the powers that be in ordaining that the hours of this compulsory darkening should be governed by the clock rather than by

Arguments with the local A.R.P. people.

the light prevailing at any given moment. As most people know, in this climate of ours at this time of the year it quite frequently happens that it is far darker at 6 p.m. than is the case two or three hours later when the clouds may have rolled away and the moon risen.

As a result of my meditations I have been very busily engaged in fitting my house with a complete system of photocell-controlled roller blinds so that each window is darkened or otherwise according to the amount of light in its neighbourhood at any time of the day or night.

Unbiased—

I have, unfortunately, already had one or two arguments with the local A.R.P. people about it. These people, I find, have not the faintest knowledge of the scientific measurement of light, and all my demonstrations with a foot-candle meter have so far failed to convince them, with the result that an interesting court case is at present *sub judice*, for which reason I am not permitted to comment on it for the moment although I shall have some strong words to say on the matter later on.

Invisible Morse Lamp

THE other day I was reading an article by a "special correspondent" who had been getting some first-hand impressions of the running of a marine convoy. I was greatly astonished, however, when he referred in his article to "the fairy-like effect of the winking morse lamps piercing the midnight gloom as ship spoke to ship." This war must *indeed* differ from the last one, as I was not without some considerable experience of convoys in that conflict, and if any ship had started "piercing the midnight gloom with a winking morse lamp," the Commodore of the convoy would have had a few words to say; almost as much, in fact, as if some ship had started her wireless transmitter up.

Piercing the midnight gloom.

Still, *autres temps, autres mœurs*. The incident has, however, reminded me of an occasion upwards of twenty years ago when certain shipowners called me in to advise them about a quite different morse lamp difficulty which they were experiencing in the piping times of peace. As some of you may know, all Masters and Mates of our merchant navy are required to have a knowledge of morse lamp signalling before they can get very far in their profession. No doubt in these modern times all of them are proficient morse signallers, but a few years ago it was otherwise in the case of small cargo boats, and the rule was honoured more in the breach than in the observance. Often, in fact, when a lordly liner signalled to a passing tramp the wireless operator of the latter was dragged out of his bunk to read the signals, although even he didn't make much of a hand at it, as he was trained to read by sound rather than by sight.

It was actually the fact that the wireless operator was a first-class sound reader which gave me the solution to the problem. All I did was to affix a very sensitive photo-cell arrangement to the masthead of each tramp and run the leads to a multi-stage amplifier in the wireless room, where, of course, the feeble electrical impulses were magnified, and, after being rectified and converted into sound, were taken down by the wireless operator in the ordinary way. There was no difficulty about transmitting, since the keying of a morse lamp and a wireless transmitter are identical.

It has just occurred to me that it should be quite a simple matter to substitute for the morse lamp a device for generating invisible rays such as were developed a few years ago to take the place of the ordinary visible light rays in operating burglar alarms, etc. Morse lamp signalling would then be quite invisible, and, needless to say, I am writing forthwith to the Admiralty about it. Any reward I receive for the idea I will gladly distribute among *Wireless World* readers.

North of Ninety

A READER who is shouldering his share of the war "somewhere in the Polar Regions" has sent me his photograph, which I produce herewith as evidence of what he describes as the almost unbelievable rigour of the climatic conditions in which he is carrying out his duties as a sea-going wireless operator. The whole point about the photograph is that it was, according to my correspondent, taken *inside* the wireless cabin, and this is why he uses the word "unbelievable." Possibly there may be some of you

Almost unbelievable.

sun-lounging lotus eaters who have never been "North of 90," and may accordingly plead that the word "unbelievable" is, indeed, the correct one to use. If so, it only shows how woefully ignorant some people in this country are of conditions in other parts of the globe, no matter whether in peace or in war.

I well recollect that the same sneeringly incredulous criticisms were levelled at my own person some time ago when I related some wartime experiences of mine. I refer, of course, to the last war. To those of you whose experiences of "heathen lands afar" extend no farther than a visit to Southend, some of these things may seem strange and well-nigh unbelievable, but my fellow globe-trotters will know better.

By the way, if any of you happen to have any stories or photographs, similar to the above, dealing with your own or your friends' wartime experiences do not forget that your fellow readers might like to learn of them. All stories must, of course, be fit to pass the censor.

Current Topics

RECENT EVENTS IN THE WORLD OF WIRELESS

FREQUENCY MODULATION STATIONS

American Combine Formed : Royalty Rates Fixed

THE attendance in New York of representatives of forty-nine organisations actively working on F-M transmitters to discuss the formation of a group for the operation of such stations is indicative of the rapid growth of this new type of transmission. The group, which is to be known as F-M Broadcasters Inc., has formulated recommendations which are to be presented to the F.C.C.

Among the recommendations are: regular instead of experimental licences for F-M stations; maximum power to be raised from 1 kW to 50 kW; minimum separation of 200 kc/s to be maintained; the increase of the five channels between 42.5 and 43.5 Mc/s to fifteen channels between 41 and 44 Mc/s; that permission be granted for a regular retransmission by F-M stations of normal broadcast programmes; and the establishment of relay stations.

Another interesting move is announced in *Broadcasting* of January 15th. Major Edwin H. Armstrong, the inventor of the system which is officially known as the Armstrong Wide-Swing Frequency Modulation System, has issued a scale of royalties to be paid by F-M stations. The scale of charges ranges from $300 for stations with a power of 250 watts, or less, to $5,000 for 50-kW stations, plus $50 for each additional kilowatt.

BOUND BROOK'S NEW AERIALS

TWO new aerial arrays have been erected at Bound Brook, New Jersey, for the three recently installed 25-kW transmitters of the well-known R.C.A.-N.B.C. international short-wave stations WRCA and WNBI. Each of these aerials, which are of the broadside type and consist of five directional beams, is supported by two 150-ft. towers, 350 ft. apart. They are so constructed that the centre of the beam can be changed through an angle of 20 degrees. Power is conducted to the aerials by means of coaxial transmission lines. These consist of an outer tube of approximately 3.5 in. in diameter, concentric with which there is an inner conductor and the space between them is filled with nitrogen under pressure.

SERVICING PROBLEMS

Registration of Servicemen

WHEN it was made known that men up to 28 years of age were to be called up, a letter was sent by the National Association of Radio Retailers to all its members, drawing their attention to the necessity for stressing to their engineers the need for a correct designation of their employment when registering. Various designations are included in the Schedule of Reserved Occupations, such as wireless engineer, wireless engineer foreman or charge-hand, wireless or radio repairer, wireless or radio mechanic and wireless or radio serviceman, and it has been urged that men concerned should adopt one of these. This precaution will at least have the effect of seeing that the men are put into their correct category and not enlisted unless required in their trade capacity.

The Association's statistics show that just over half of the service engineers employed will be called up.

THE MONTREUX PLAN

WE learn from our Geneva correspondent that it has been decided by the Union Internationale de Radiodiffusion (U.I.R.) to postpone the application of the Montreux Wavelength Plan which should have come into force on the night of March 3rd-4th. Recommendations were received from the signatories to the plan and the majority were in favour of this move. The position will be reviewed in September.

RECEIVING LICENCES FOR SOLDIERS

P.M.G.'s Ruling

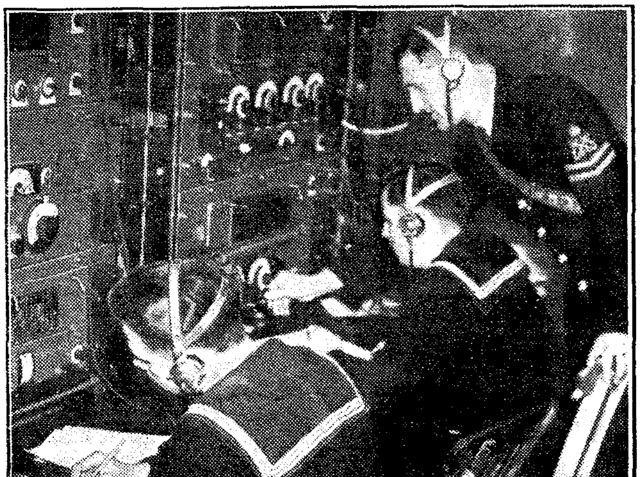
CAPTAIN C. WATERHOUSE, assistant Postmaster - General, replying to a question in the House of Commons on the necessity of wireless receiving licences for troops, said that the use of a wireless receiving set by a soldier in camp in this country would be covered by an existing licence for his home set, if the latter had been removed or disconnected, and the local postmaster had been informed of the change of address. A single licence, however, would not cover the continued use of both a set at home and a set in camp.

Arrangements are available, however, whereby a responsible officer in this country may take out a single 10s. receiving licence to cover the use of any number of receiving sets in barrack rooms contained in a single block of buildings. Where troops occupy huts, special arrangements can be made with the local postmaster, under which a single wireless licence will cover a number of huts, including any that are used for canteen or entertainment purposes.

NO RESUMPTION OF TELEVISION

MAJOR TRYON, the Postmaster-General, was recently asked in the House of Commons whether he would consider an early resumption of television broadcasting as an encouragement both to research work and to manufacturers of television sets, en-

WIRELESS TELEGRAPHISTS in the making. Instructing trainees under service conditions in one of the well-equipped schools established for this important branch of the senior service. There are still vacancies in all the three services for men with some knowledge of morse operating. Full particulars can be obtained from any Combined Recruiting Office.



abling them to establish a British product in world markets. In reply, he said that he was sorry that he could hold out no hope of the early resumption of the London television service, which was suspended in the national interest on the outbreak of war.

RADIO MECHANICS FOR THE R.A.F.

New Opportunities

A NEW specialist trade category—that of Radio Mechanic—has just been inaugurated by the Royal Air Force, and vacancies now exist for men aged 18 to 50 years.

After passing an entrance examination, entrants will enjoy the privilege of being reclassified immediately after enlistment as Leading Aircraftmen at the rate of pay of 5/6 per day, plus allowances.

Qualifications required are just those likely to be possessed by the better type of service man or amateur, who should be able to pass the test without great difficulty. R.A.F. Radio Mechanics will work on apparatus that represents the last word in scientific development, and the experience gained should prove valuable in civilian life after the war. Application should be made to the candidate's nearest Combined Recruiting Office or to the Air Ministry Information Bureau, Kingsway, London, W.C.2.

CONCERT PITCH

British Standard Specification

IT will be remembered that an international conference was held at Broadcasting House last May on the question of concert pitch, and agreement was reached on an international standard of 440 c/s for the note A in the treble clef.

The British Standards Institution has adopted this frequency as a British Standard and has issued the international findings together with a set of technical recommendations as a British Standard Specification No. 880/1939. Copies can be obtained from the British Standards Institution, Publications Department, 28, Victoria Street, London, S.W.1., price 1s. 2d. post free.

As soon as the international situation permits, the B.B.C. has agreed to broadcast a note of the standard pitch each morning before the commencement of the normal transmission from the long-wave National transmitter.

"WIRED WIRELESS" BROADCASTING

RF Distribution via the Mains

IN a lecture recently given before members of the Electrical Power Engineers' Association, Capt. P. P. Eckersley dealt with some of the technical problems incidental to the relaying of broadcasting at radio frequency over electrical supply mains. By using a suitable system of distribution it was claimed that noise was eliminated and entire independence of load fluctuations was attained. For a large town with many sub-stations it would be uneconomical to install radio-frequency apparatus at each sub-station; it was proposed to install the apparatus outside the town, distributing the radio-frequency currents through the supply system by means of existing pilot wires, etc., or by specially installed wires. Most of the problems had been overcome, though special difficulties attached to overhead line systems.

In reply to the objection that radio-frequency distribution via the mains was inherently "full of vice and trouble," Capt. Eckersley replied that he had come to the conclusion that the system would work, not on all networks or under all conditions, but in enough cases to make it commercially worth while.

WLWO'S 50-KW TRANSMITTER

War Delays Construction

THE construction of the new 50-kW transmitter for the Crosley Corporation's international broadcasting station WLWO is being delayed by the war. It was planned to have the station ready for operation by January 1st, but two shipments of Mycalex from England had failed to arrive by the middle of January.

Within a few weeks of the arrival of the Mycalex, it is hoped the transmitter will be ready for operation. WLWO is at present working on 10 kW.

AMERICAN TELEVISION PROBLEM

MUTUAL interference between two American television stations working on the same frequency band (50-56 Mc/s) has resulted in a time-sharing agreement between the Philco Radio and Television Corporation and the Columbia Broadcasting System. The two stations concerned are Philco's W3XE at Philadelphia, and Columbia's W2XAX, New York, which are approximately only 90 miles apart.

LONG-DISTANCE BROADCASTING

The Propagation of Short Waves

SIR NOEL ASHBRIDGE opened his lecture on Long-Distance Broadcasting, which he delivered at the Royal Institution on January 26th, with an explanation of the functions of the ionosphere in propagating waves round the curvature of the earth and pointed out that the knowledge now accumulated enabled us to choose with certainty the optimum wavelength for communication between any two points on the earth's surface at any time of the day or season of the year. There were regions in the vicinity of the earth's magnetic poles where these rules broke down, and magnetic storms might affect short-wave communication in any part of the world.

The necessity for flexibility both as regards wavelength and direction of transmission was exemplified by slides showing the complex aerial systems and "antenna exchange" at the pre-war B.B.C. Empire station.

Some very interesting records of broadcast reception in South Africa, America and Australia served to illustrate the point that whereas speech could be transmitted with good intelligibility, we had not yet reached the stage where long-distance transmission of music was satisfying to the critical ear.

HUNGARIAN PEOPLE'S SET

HAVING disposed of 20,000 people's mains receivers, Hungary is to produce a further 60,000. This receiver, which is similar to the German Volksempfanger, is obtainable by hire purchase at two pengós (approx 1/6) per month for two years. The circuit employs a triode-tetrode and the set and moving-iron loud speaker are housed in a bakelite case.

A considerable portion of Hungary has not an electric power supply, and it is therefore proposed to market a people's battery set which will incorporate the new 1.4 volt all-dry battery valves.

I.E.E. MEETINGS RESUMED

AT the first of the monthly meetings of the Wireless Section of the Institution of Electrical Engineers to be held in London since the outbreak of the war, Mr. T. L. Eckersley, on February 7th, analysed the effect of "scattering" in radio transmission. He suggested that the phenomenon, which he considered a major factor in practically all transmissions, rendered the MUSA system of reception ineffective at distances greatly in excess of 3,000 miles.

At the March meeting of the Wireless Section, which will be held at 6 p.m. on March 6th, Dr. T. Walmsley, of the G.P.O., will deliver a paper on "Wire Broadcasting Investigations at Audio and Carrier Frequencies."

R.M.A. REPORT

I.F. Standardisation : Frequency Modulation Experiments

IT is revealed in the technical section of the annual report of the Radio Manufacturers' Association that following the Montreux Wavelength Conference the R.M.A. received a communication from the Chambre Syndicale des Industries Radio-électriques asking whether it would consider the choice of a common IF for all radio manufacturers in Europe.

A reply was sent to the effect that if it were found possible to agree a national standard, it must be subject to alteration in the light of experience gained when the Montreux plan came into force. At present the tendency is towards the standardisation of 465 kc/s.

After the outbreak of war, the R.M.A. Technical Advisory Committee considered the desirability of experiments being undertaken during the war to ascertain the usefulness of frequency-modulation transmission.

It was felt that to ignore the new system now would mean that, at the end of the war, the British radio industry might find itself far behind American technical progress.

The possibility of employing frequency modulation for the operation of a high quality ultra-short-wave regional scheme prompted the R.M.A. to request the B.B.C. to set up an experimental F-M transmitter during the war, so that experiments might be made by the industry.

SWISS S-W TRANSMISSIONS

THE Swiss short-wave transmitting station at Schwarzenburg, which was destroyed by fire last July shortly before its inauguration, has been rebuilt of brick and reinforced concrete, whereas the original building was partly of wood. Tests with a low-power transmitter on the undamaged aerial are being conducted on 9.535 Mc/s (31.46 metres) and 11.865 Mc/s (25.28 metres). The transmitter is being reassembled, and it is hoped that tests will begin in March. A second transmitter is to be included which will permit simultaneous working on two wavelengths.

FROM ALL QUARTERS

HT Batteries Rationed

OWING to the scarcity of batteries in Germany, a scheme of rationing has been introduced. Each listener requiring an HT battery must fill in a form and give it to his wireless dealer, who then sends the application to the suppliers where it is dealt with in rotation.

Wireless Operators

THE age of reservation of the occupation of wireless operators (air crew) in civil aviation has been lowered from 30 to 18. This change does not involve the release from the forces of men who were previously in this occupation.

Italian Television Drive

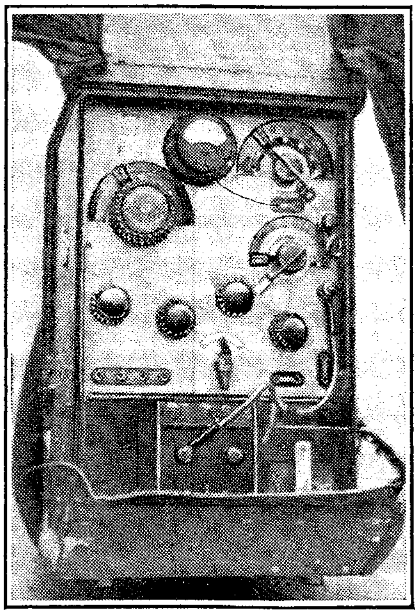
A TELEVISION advisory committee has been set up by the Italian Minister of Communications to investigate the television situation and to formulate plans for the advancement of the television service.

New Dutch Stations

Two new 125-kW broadcasting transmitters will shortly be completed at Lopik, Holland's new broadcasting centre. The 500-ft. aerial masts are already completed.

Television in Germany

IN addition to the public television viewing halls now in use in Berlin, one has been opened in Hamburg, which, like those in the capital, receives the Berlin-studio transmissions by cable.



AMONG THE SPOILS of the battle of Soumussalmi secured by the Finns after they had routed the Russian 44th Division, at the beginning of January, was this Russian pack transmitter-receiver.

Ultra Shorts

THE American Radio Relay League has announced a contest to discover who can work the most States using the ultra-high frequencies during 1940. All work must be from one locality with the transmitter working on the 56-60-Mc/s or 112-116-Mc/s bands, or above 224 Mc/s.

Wireless School for Empire Airmen

THE Canadian Minister of National Defence announced at the end of January that the first wireless school under the Commonwealth's air-training scheme would be established at Montreal with accommodation for 900 students.

Amateur "Broadcasting" Station

AT the invitation of the Government of Jamaica, Mr. J. Grinan is operating his station, VP5PZ, for broadcasting purposes for the duration of the war. Using his own call sign the station is working on 4.8 Mc/s (62.5 metres).

A Wartime Training Record?

MR. ALBERT PARSONS, senior lecturer in radio engineering and radio telegraphy and telephony at the Portsmouth Municipal College, informs us that the College's first wartime course for marine radio officers was completed in just over three months.

R.M.A. Council

MR. W. W. BURNHAM, of Ediswan, was elected chairman, and Mr. E. J. Power, of Murphy Radio, vice-chairman of the R.M.A. Executive Council for 1940 at the annual general meeting. The work of Mr. R. P. Browne, the Association's efficient secretary, was highly praised by the members.

Foire de Paris

THE committee of the Foire de Paris has decided that in spite of the war the thirty-second annual Trade Fair will be held from May 11th to the 27th at the Porte de Versailles, Paris. Offers of support from all quarters have encouraged this step. As usual the Inventions Competition is being organised which last year drew 769 entries. Application forms for those wishing to compete are obtainable from 17, Tothill Street, London, S.W.1, or from 23, rue Notre-Dame des Victoires, Paris, 2. The forms have to be returned to the Paris address by March 20th.

The Y.L.R.L.

THIS abbreviation stands for the Young Ladies' Radio League, which is the latest addition to American amateur radio societies. All women in the United States who hold amateur transmitting permits are eligible for membership.

French Receivers

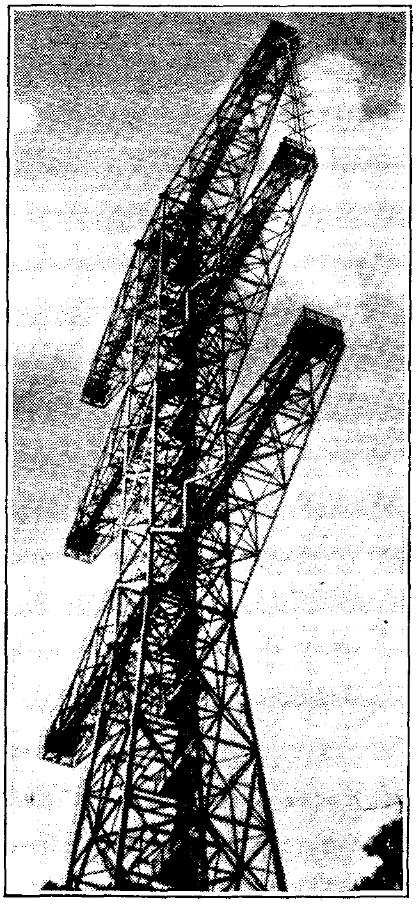
AT the end of 1939 there was a total of 5,204,389 licensed wireless sets in France. This means that there is one receiver to every eight inhabitants.

Frequency or Amplitude Modulation?

INTERESTING COMPARISONS FROM AMERICA

Of late years, largely owing to the work of Major Armstrong, radio engineers have been coming more and more round to the point of view that where high quality and freedom from interference is of paramount importance, frequency modulation shows a marked superiority over the conventional amplitude modulation system.

Vague statements concerning the freedom from electrical interference which characterises frequency modulation are of no interest to engineers or serious experimenters. Quantitative data alone will compel their attention. For this reason a paper read before the Radio Club of America by Mr. Irwin R. Weir, of the General Electric Company of America, in which he gives the results of certain comparative field tests between frequency and amplitude modulation, will be of particular interest.



The aerial tower of Major Armstrong's experimental frequency-modulated station at Alpine, New Jersey.

Comparative Tests

The tests were carried out to determine on a quantitative basis the advantages given by frequency modulation over the more conventional method, when both are employed under identical conditions. The most interesting part of the tests were undoubtedly those dealing with the reactions of the two systems to noise, both internally and externally produced, and these are dealt with in the following paragraphs.

For the purpose of the tests, two separate transmitters, one using amplitude modulation and the other using frequency modulation, were employed at Schenectady, the carrier wave output being maintained at 50 watts in each case. The wavelength used was 7.3 metres (41 Mc/s). A transmitter installed at Albany was also used, this being a 150 - watt transmitter convertible to either system of modulation. Reception was carried out on a special portable receiver, which was adaptable to deal with incoming signals modulated by either system, a quick change-over being arranged.

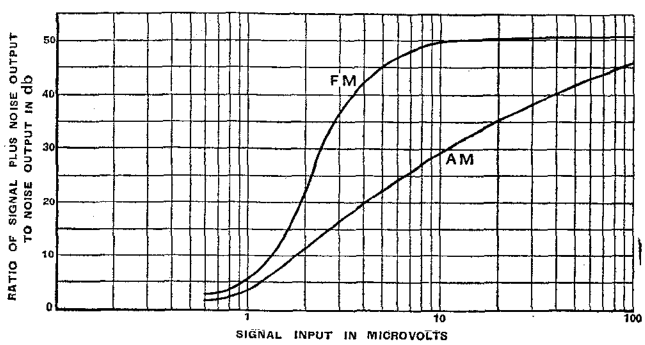


Fig. 1. For this comparative test, the noise was solely that present in the transmitting and receiving circuits.

The first test observations were made in a district remote from any possibility of outside interference, the object being to determine the ratio between the internal noise of the receiver when dealing with a plain carrier wave unmodulated by either system, and when receiving a signal employing first one and then the other system of modulation. The result of this test is best understood by reference to the curve in Fig. 1. As will be seen the ordinates in this diagram give the ratio, expressed in decibels, of signal-plus-noise output to noise output alone; that is, the ordinates give, in decibels, the increase of receiver output which occurs when modulation was applied at the transmitter. It can be seen from these curves that for any desired output ratio of signal-plus-noise to noise alone, which experience may indicate is required for satisfactory service, considerably less signal input, and hence considerably less transmitted field strength is required with frequency than with amplitude modulation.

General Conclusions

For the second test, the receiver was taken to a district where electrical interference was known to be bad, as it was desired to carry out the same comparisons when external noises were present. Fig. 2 illustrates the results of these tests. Viewed either from the standpoint of the ratio of signal-plus-noise to noise resulting from a given signal input, or of the input required for any acceptable ratio of signal-plus-noise to noise, it is obvious that, under the conditions of external noise met with, the superiority of frequency modulation is even greater than in the first case.

A large number of other tests were carried out, the detailed discussion of which is ruled out by considerations of space, but

Frequency or Amplitude Modulation ?—it is interesting to study the conclusions at which the investigators arrived as a result of these tests. Their conclusions are given below.

(1) The design, construction and operation of a frequency modulated transmitter need be no more complicated nor markedly different as to details from that of an amplitude modulated transmitter.

(2) The frequency modulated transmitter can be smaller, lighter and more economical of power than the amplitude transmitter of the same power rating.

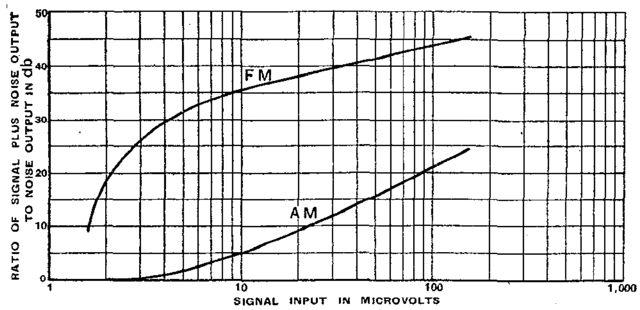


Fig. 2. Here, however, severe noise, arising externally, was present.

(3) The frequency modulation receiver need be no greater in size or weight than the conventional amplitude modulation type.

(4) A given area can be satisfactorily served by means of frequency modulation with considerably less power than by means of amplitude modulation.

(5) A given transmitter power will provide service to a markedly larger area, or with a markedly lower noise level when employing frequency modulation than when employing amplitude modulation.

(6) Simultaneous operation of frequency modulated transmitters on the same frequency with a given degree of inter-station interference, can be carried on with relatively minute geographical separation between transmitters as compared with that required for the similar operation of amplitude modulated transmitters.

(7) The number of frequency modulated transmitters that might be simultaneously operated within any large area on a given number of frequency modulation channels, and with given permissible interference areas, is so great compared with the number of amplitude modulated transmitters, that might be so operated, as to more than compensate for the width of the frequency band required to take substantial advantage of the superiority of frequency modulation.

Mr. Weir reaches the sweeping conclusion that frequency modulation is the only system which is worthy of consideration for use in ultra-short-wave broadcasting, and it will eventually supplant the other system.

The Wireless Industry

THE rating of the Osram U10 rectifier has been revised and the maximum current available is now 100 mA instead of 60 mA.

◇ ◇ ◇ ◇

Murphy Radio, Ltd., ask us to point out that their advertisement on page 8 of last month's issue should have read, "All Murphy sets, *exclusive* of valves and batteries, guaranteed for one year."

◇ ◇ ◇ ◇

Taylor Electrical Instruments, Ltd., announce that now extensions to their main factory have been completed, they have transferred their London works and offices to 419-422, Montrose Avenue, Slough. Telephone Number: Slough 20061.

Second and third revised editions of the catalogues dealing respectively with the R7 and R5 commercial receivers have been issued by Standard Telephones and Cables, Ltd.

◇ ◇ ◇ ◇

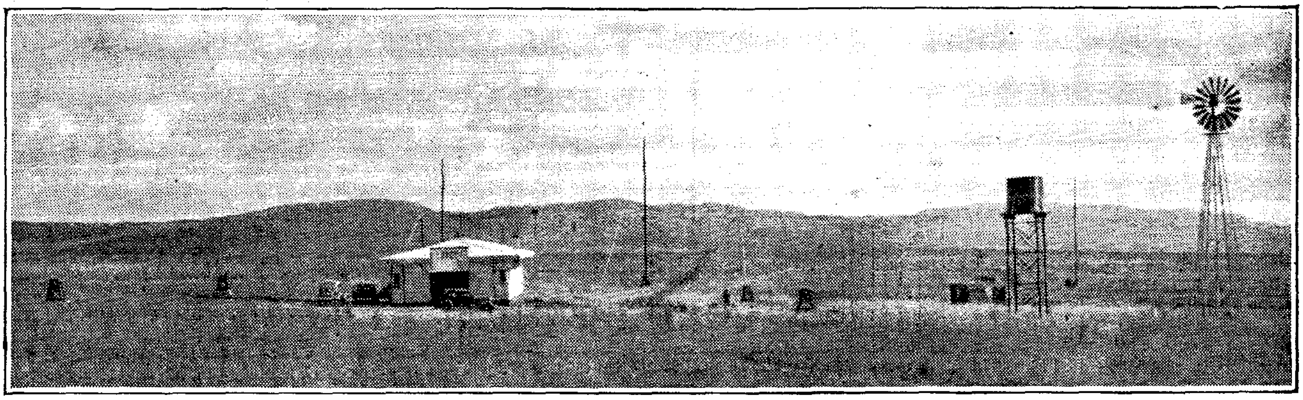
It should be noted that the Eddystone Improved Everyman Short-Wave receiver advertised on page 14 of the February number is designed for battery operation.

◇ ◇ ◇ ◇

The new Hivac company (address: Greenhill Crescent, Harrow-on-the-Hill, Middlesex) is now manufacturing midget valves, and can supply any type from stock. A list giving characteristics of the various types will be available shortly.

"Diversity" in South Africa

RECEIVING EUROPEAN SIGNALS FOR RE-BROADCASTING



FOLLOWING a visit to the B.B.C. Receiving Station by the Director of the South African Broadcasting Corporation, it was decided that a similar station should be erected in South Africa and that it should be fitted for "diversity" reception of European short-wave programmes. The potential interest in overseas relays by listeners in South Africa is probably greater than is normally the case in Great Britain and, despite the greater distance to the source of transmission, it was expected that quality of reception would be equal to—or possibly better than—that attained in England when receiving transatlantic programmes. This would be so in the main, because of the greater power of the main European transmitters and because of the relatively inferior propagation conditions on the transatlantic path.

Help from the B.B.C.

It was considered desirable that the receiving site should be near Johannesburg; sufficiently close to the city to avoid the necessity for more than a few miles of land-line in order to link the receivers to the broadcasting network. The order for the receiving equipment was placed in England, and it was arranged that the engineer-in-charge of the B.B.C. Receiving Station should pay a short visit to the new station in order that the experience of the B.B.C. in this special type of reception technique should be available to the staff there during the inaugural few weeks.

The site chosen is some fourteen miles from Johannesburg, the name "Panorama" being that of the farm of which the land originally formed part. The station is 5,300 feet above sea-level.

At Panorama the land slopes gently away in the northward direction, the aerials being free from "screening" effects, and also from any electrical interference from motor cars—the nearest main road being several miles away. Building equipment and aerials were planned on the lines of the B.B.C. station, although the receiving and other apparatus are as yet rather less comprehensive in scope, since the work carried out at Panorama will be principally concerned with relaying, which represents only a part of the service undertaken by its English prototype.

The main aerials at Panorama are of the Bruce-Rhombic design, supported upon stayed poles 60ft. high. The major dimension of each aerial is almost 500ft., each side of the rhomboid being 315ft. long.

The four main relaying receivers are rack-mounted, each receiver occupying a "bay" six feet high and embodying a superheterodyne circuit and separate AVC for each receiver, which may thus be operated either as a separate unit or alternatively, in conjunction with other receivers, in "diversity reception."

In addition to these four receiver bays, there are, at present, three others. The first of these carries the screened plugs and sockets which permit the connection of the receivers to the aerials. The rhombic aerials are, of course, remote from the building, and buried concentric "co-axial" feeder-cables are used to convey the signals from them to the distribution panel. The most distant aerial has 1,500ft. of this screened cable in circuit, with a loss of less than 6 db.

A further bay carries panels upon which the "output combining" and "AVC linking" circuits for diversity reception are arranged, together with the test oscillators used in lining-up the receiver circuits.

The third bay is concerned solely with audio-frequency equipment, comprising line amplifier, filters, and the usual control equipment for line working. A fourth bay, to enable dual relaying to be carried out when necessary, is projected.

Selectivity Control

Full output sensitivity of the receivers is obtained from an input signal of 5 microvolts, at which level the AVC circuits are in complete operation. The intermediate-frequency amplifiers of the receivers have a bandwidth—at 6 db. down with reference to resonance—of either ± 2.7 kc/s, ± 5 ks/s, or ± 7.5 kc/s, depending on the position of the selectivity switch. The corresponding figures for attenuation of 60 db are 10 kc/s, 15.5 kc/s, and 25 kc/s, respectively, referred to in the mid-band frequency.

All equipment is battery operated, charging facilities being provided by rectifiers fed from the AC lighting system. Current is obtained from a petrol-electric plant which is automatically started when a small load (such as a single light) is switched on. By means of change-over switching, the lighting load of the station may, however, be obtained from the main high-tension battery whenever it is undesirable for the generator plant to be running, although the plant does not cause any

"Diversity" in South Africa—

appreciable interference to radio reception. In order to provide for this facility, the rating of the high-tension battery is abnormally high, being 80 ampère-hours.

Altogether, Panorama is an extremely interesting—and should be a very useful—station. It is almost completely self-contained and accommodation for junior staff is provided in the building. Water supply is obtained from a deep boring with its adjacent wind-operated pump. The average signal strength of Daventry and other European transmitters, as received during Panorama's inaugural few weeks, was very good, with a correspondingly low background noise.

H. V. G.

Random Radiations

By "DIALLIST"

No Need to Fuss

THERE is, I see, a movement on foot to urge the authorities to restore the television broadcasting service. Though I don't claim to be specially in the know, my personal opinion is that the re-establishment of the service on its pre-war basis hasn't the proverbial cat's chance in Hades. It is definitely undesirable at the present time to run transmissions on the ultra-short waves, and those who feel like agitating for them had better get that clear. Television is one of the most important of modern scientific developments and everyone wants to see it going right ahead. But we've got to win this war before television can go right ahead, and the winning of the war must come just now before any other consideration. It is regrettable that other countries may forge in front of us whilst we suspend operations in the television field; but, if they do so for the time being, there's no reason why they should stay in front once the present spot of trouble is over. In the past we have shown that we can take and overcome the handicap of having to allow others to get a long way ahead of us for a time owing to national exigencies.

We Soon Caught Up

Do you remember what happened when the Great War was over? On the other side of the Herring Pond, the United States were remote from the still seething centre of the turmoil. Their authorities were able to relax fairly early in 1919 the wartime restrictions on wireless. We just couldn't. Not, in fact, until a year or two later did it become a simple business to obtain even a receiving licence. In broadcasting, the U.S. gained a whole year's lead on us. They started it in 1921, we didn't follow till the autumn of 1922. But we weren't long out of the race. They started with a multiplicity of indifferent stations, the majority of very low power. We felt the way with a few good transmitters. Low power was used here only for areas where a relay station offered the best solution of reception difficulties due to local conditions. You needn't fear, therefore, that we are going to be hopelessly outclassed because we have to close down our television broadcasting for the duration. We're not. We'll go ahead like anything once peaceful conditions return.

Losing Nothing

Actually we're not losing a fat lot, even if television is brought to a standstill for a year or two. The technical side of television possibly isn't capable of very great improvements, unless some basic new invention is made. We know already how to ensure well-nigh perfect reception in service areas of what is presented in the studio, or of great open-air events. The technical side of television, in a word, need not worry us a great deal. We've already worked out—or, at any rate, broken the back of—such problems as wired television and the increasing of service areas by means of relays. What we still haven't got our hooks into is the way in which to use television artistically to the best advantage. We don't yet know the ideal forms of entertainment to send out. We've done a great deal of experimental work, but we don't seem to have hit the nail right on the head yet. If the U.S.A. profit by what they have learned from us about the technicalities of television transmission and reception, they may do much useful work in discovering how best to apply this new side of radio in order to give the public what it wants. The greater their success in this direction the better for us. Once peace returns we'll be able to avoid our own mistakes of the past—and theirs—and to take the fullest advantage of any discoveries they make about the right way of building and presenting television programmes.

A Great Brotherhood

SINCE I rejoined the bloodthirsty and licentious soldiery after an interval of twenty years, I've been delighted to find how many radio enthusiasts there are amongst all ranks of the Army of to-day. A visiting General came the other day to the scene of the somewhat hush-hush operations of which I am in charge. During his tour he spotted a certain piece of apparatus, studded with knobs and switches and bearing two finely graduated dials, which reposes on a shelf above my table. "H'm," said he, "this, I presume, is *very* secret." "Very, Sir," sez I; "perhaps you'd like to try it for yourself." I'd noticed a twinkle in his eye as he surveyed the said apparatus. But I must say I was surprised at the masterly way in which he handled this not-too-simple communication receiver which is my own private property, and no part of any hush-hush outfit. He became so engrossed in exploring the world on the short waves that he far overran the time he ought to have given me. Still, he thoroughly enjoyed himself and we swapped endless DX stories.

The Younger Generation, Too

A day or two later I had a visit from some young subalterns—a brace of them. They, too, spotted the communication receiver and asked, rather diffidently, if it was part of the equipment. When they heard that it wasn't they begged to be allowed to hear what it could do, and in a moment we were knob-twiddling in the best manner. Both were not only radio enthusiasts, but ardent readers of *The Wireless World*. They and a third subaltern, who has lately joined my mess, are (or were in peacetime) keen constructors, fellows who like to build their own receiving sets and are constantly rigging up any new circuits that appear.

Puzzling

THE long period of bad short-wave reception—or of no reception at all from some countries—was pretty boring. Short-wave black-outs and semi-black-outs can cause even old hands at the game to puzzle their heads. Are prevailing conditions to blame, or is the set to blame? I confess that I began to wonder whether something hadn't wandered out of alignment; nor could I do anything to make sure one way or the other, for I have no proper instruments available. It's a relief when you yourself have found stations difficult if not impossible to get, to run across another enthusiast and to be able to swap notes with him. Unfortunately, though the enthusiasts aren't lacking in the Army, as I've said already, few of them have any means of indulging in short-wave listening.

Comparisons Not Always Odious

THE battery position is improving a little. There's no longer the acute famine in HT and flash-lamp batteries that there was from September onwards. You can get a refill for your wireless set or your torch without much trouble, unless either happens to require some outlandish size or shape. One result of the shortage last autumn was the appearance here of batteries of American brands that we haven't seen for a long time. They helped us to tide over the gap in our own supplies. I know we ought to be able to supply our own needs, and all that, but I don't regret the fact that these batteries came into our shops. We haven't for a long time now had any of the products of other countries with which to compare our own, though it's always salutary to be able to do that kind of thing. The best of the U.S.A. batteries *are* good, and their arrival here once more should provide our battery manufacturers with a fresh incentive to turn out absolutely first-class products, in line with the most up-to-date discoveries of the research laboratories.

A Queer "Short"

Talking of batteries and torches reminds me of a strange short-circuit that came my way the other day. My torch is one of those long tubular affairs containing a trio of large (1¼in. by 2¼in.) cells. It has a focusing arrangement, worked by a thumb-wheel on the case. The battery had run down, and when the chance came I bought three new cells and put them in. I switched on. Everything seemed all right. Then I put the torch away for the hour or so of daylight that remained. When it was dark, I switched on again and got but a feeble light. To my surprise, the case of the torch was distinctly warm. The end was unscrewed and the cells shaken out. The two nearest the base were *hot* and had exuded a sticky beastliness. Clearly a dead short, but where? It took some finding, and you may be interested to know how and where it happened. The focusing is done by means of a toothed rack, carrying the bulb-holder, with which the thumb-wheel engages. One part of the focusing gear was touching the can of the forward cell and so shorting the two behind it. Got it? Well, the can of cell No. 1 is in contact with the positive cell No. 2, the can of No. 2 in contact with the positive of No. 3 and the can of No. 3 in contact with the metal case of the torch. Hence, if the can of No. 1 is making contact with the case *via* the focusing gear, Nos. 2 and 3 are shorted. A little work with a file and all was well.

Brass Hats and Quality

THE other night I dined with the General and the gilded staff, thereby consuming my first decent meal for some 25 days. Otherwise the only change from eggs and bacon as an evening (as well as a morning) repast has been either eggs and bacon or bacon and eggs. Having dined, we adjourned to the anteroom and the S.M.O. was instructed to manipulate the wireless set. S.M.O., by the way, stands for Senior Medical Officer; the "doc." has, I imagine, been appointed Staff Wireless Operator because of his presumed familiarity with electrical gadgets. Having now heard his performances on the wireless set I do not think that working the apparatus used in electro-medical plumbing necessarily qualifies a fellow as a radio operator. Anyhow, he tuned in the light music which the General demanded, with a fine free disregard of the resonance point that means so much to superhets. No one, however, appeared at all put out by the strange noises that filled the room. The General, in fact, asked me beamingly if I did not think that the set had a lovely tone. As I had eaten his excellent dinner (and hoped, incidentally, that I might have the chance of doing the like again), was smoking his cigar and had heard that the set was his, I deemed discretion the better part of valour and told him (may the gods forgive me!) that I had never heard a better.

Nailing 'Em Down

THOUGH most of the German propaganda from the Fatherland's radio stations is clumsy and likely to cut little ice, some of it is clever, for it manages to present events in an entirely false light by only small distortions of the real facts. For this reason, I have been glad to hear some of the mis-statements dealt with and refuted by the B.B.C. I don't believe in radio squabbles of the "No-I-didn't, yes-you-did" kind; but I do think that certain things shouldn't be allowed to pass. In our country we know just what the German news is worth, and most neutral countries have probably come to realise that not grains but handfuls of salt are necessary for the digestion of the Nazi bulletins. Still, a lie, if not nailed down to the counter, may have its effect; hence it's as well to do the nailing down promptly and firmly.

Clear as Mud

I WISH you could have been with me to hear a lecture that I attended the other day. The General thought it would be a good idea for senior officers to know something of a certain aspect of wireless; he therefore arranged for the reputed expert on the subject to give a talk that would make everything plain. Never have I heard such a hash as that fellow made of it. He had as fine a subject to talk on as anyone could have prayed for; he could have kept his audience thrilled from the first word to the last. Instead, he talked right over their heads. In five minutes they were bored stiff; in ten most of them had given up any attempt to understand; before the end of the full hour during which the lecturer babbled on they would willingly have torn the man limb from limb. When a man does that kind of thing it is often because he doesn't know his stuff and thinks that he can get away with it by repeating parrot-wise a lot of abstruse stuff that he has mugged up without grasping what it meant. I soon realised that, despite the eminence indicated by the badges on his shoulder-straps, this chappy was not an authority on his subject. He paused and enquired if there were any questions. I put but a single simple one. Growing reddish about the gills, he said that he would deal with the point if I would speak to him at the end of the lecture. But when the end came he hastily packed up his traps and fled! 'Twas a lamentable show. I couldn't help thinking how different it would have been had the lecture been given by a master of simple explanation such as "Cathode Ray."

BOOKS RECEIVED

Quartz Oscillators and their Applications. By P. Vigoreux, D.Sc. Some years ago the Department of Scientific and Industrial Research issued a book summarising knowledge then existing on the nature, properties, and applications of piezo-electric crystals. This book has now been revised and largely rewritten. All the better-known applications of quartz crystals are dealt with, including their use in band-pass filters. Pp. 131, with 86 diagrams and photographs. Published by H.M. Stationery Office, York House, Kingsway, London, W.C.2. Price 4s. 6d. net (postage extra).

French for Travellers and the Troops. By J. O. Kettridge, F.S.A.A. Pp. 256. Published by George Routledge & Sons, Ltd., Broadway House, 68-74, Carter Lane, London, E.C.4. Price 2s. 6d. net.

An English-French pocket phrase book, with a military supplement for the use of the troops.

Radio Variety. Compèred by John Watt. Pp. 173, with 20 photographs. Published by J. M. Dent & Sons, Ltd., Aldine House, Bedford Street, London, W.C.2. Price 5s. net.

Containing the scripts of a representative selection of light entertainments as radiated by the B.B.C. from the early days of broadcasting up to the present time. The author, who is head of the variety department of the B.B.C., introduces a "running commentary" throughout the text.

Club News

British Sound Recording Association

Hon. Sec.: Mr. F. J. Chinn, 170a, Addington Road, Selsdon, Croydon, Surrey.

It has become necessary to curtail certain activities of the Association during the war, but it is hoped to maintain contact with members by means of the Association's publications. The Information Bureau is still ready to deal with technical queries on sound recording.

Eastbourne and District Radio Society

Headquarters: The Science Room, Cavendish Senior School, Eastbourne, Sussex.
Hon. Sec.: Mr. T. G. R. Dowsett, 48, Grove Road, Eastbourne, Sussex.

At a recent meeting Mr. J. A. Penfold gave a lecture entitled, "Mains Transformer Design." The annual general meeting was held on January 9th.

Stafford and District Short Wave Club

Headquarters: 21a, Sandon Road, Stafford.
Hon. Sec.: Mr. G. L. Wale, "Branksome," Acton Gate, Stafford.

This club is closing down for the duration of the war.

Ashton-under-Lyne & District Amateur Radio Society

Headquarters: 17a, Oldham Road, Ashton-under-Lyne.
Meetings: Wednesday evenings.
Hon. Sec.: Mr. K. Gooding, 7, Broadbent Avenue, Smallshaw, Ashton-under-Lyne.

It has been decided that all members on active service should be made honorary members for the duration of the war.

It is intended that a signal generator should be constructed for the use of members.

Slough and District Short Wave Club

Headquarters: Toc H. Headquarters, William Street, Slough, Bucks.
Meetings: Alternate Thursdays at 7.30 p.m.
Hon. Sec.: Mr. K. A. Sly, 16, Buckland Avenue, Slough, Bucks.

At a meeting held on January 18th, Mr. Houchin gave a talk on aerials. The next meeting was devoted to a discussion of a theory put forward by Mr. Baldwin to the effect that the earth forms the rotor of a generator, the ionised layers of the atmosphere forming the stator.

The next meeting will be held on February 29th.

Short-wave Stations of the World

Arranged in Order of Frequency and Wavelength

Station	Call Sign	Mc/s	Metres	kW
Moscow (U.S.S.R)	RIA	5.85	51.24	15
Moscow (U.S.S.R)	RNE	6.00	50.00	20
Zeesen (Germany)	DJC	6.02	49.83	5–40
Moscow (U.S.S.R)	RW96	6.03	49.75	100
Vatican City	HVJ	6.03	49.75	25
Boston (U.S.A.)	WRUL	6.04	49.67	20
British Oversea Service	GSA	6.05	49.59	10–50
Cincinnati (U.S.A.)	WLWO	6.06	49.50	10
Philadelphia (U.S.A.)	WCAB	6.06	49.50	10
Motala (Sweden)	SPO	6.06	49.46	12
Zeesen (Germany)	DJN	6.08	49.35	5–40
Bound Brook (U.S.A.)	WNBI	6.10	49.18	25
British Oversea Service	GSL	6.11	49.10	10–50
Wayne (U.S.A.)	WCBX	6.12	49.02	10
Hsinking (Manchukuo)	MYCY	6.12	49.02	—
Warsaw (Poland)	SP48	6.14	48.86	—
Pittsburgh (U.S.A.)	WPIT	6.14	48.86	28
Winnipeg (Canada)	CJRO	6.15	48.78	2
Wayne (U.S.A.)	WCBX	6.17	48.62	10
Vatican City	HVJ	6.19	48.47	25
Rome (Italy)	IAC	6.35	47.20	50
Radio-Nations (Switzerland)	HBQ	6.67	44.94	20
Barcelona (Spain)	EAQ1	7.03	42.7	—
Valladolid (Spain)	FET1	7.07	42.43	0.25
Burgos (Spain)	EA1BO	7.07	42.43	—
Tokio (Japan)	JVW	7.25	41.34	50
Lisbon (Portugal)	CSW8	7.26	41.32	10
Paris-Mondial (France)	TPB7/11	7.28	41.21	25
Moscow (U.S.S.R.)	RWG	7.36	40.76	15
Moscow (U.S.S.R.)	RKI	7.51	39.89	25
Budapest (Hungary)	HAT4	9.12	32.88	5
Radio-Nations (Switzerland)	HBL	9.34	32.1	20
Ankara (Turkey)	TAP	9.46	31.70	20
Belgrade (Jugoslavia)	YUC	9.50	31.56	10
Lahti (Finland)	OFD	9.50	31.58	1
Belgrade (Jugoslavia)	YUC	9.50	31.56	—
Melbourne (Australia)	VK3ME	9.51	31.55	5
British Oversea Service	GSB	9.51	31.55	10–50
Moscow (U.S.S.R).	RW96	9.52	31.51	100
Warsaw (Poland)	SP31	9.52	31.49	5
Schenectady (U.S.A.)	WGEO	9.53	31.48	100
Calcutta (India)	VUC2	9.53	31.48	10
Tokio (Japan)	JZI	9.53	31.46	50
Motala (Sweden)	SBU	9.53	31.46	12
Vatican City	HVJ	9.55	31.41	25
Schenectady (U.S.A.)	WGEA	9.55	31.41	20–25
Bombay (India)	VUB2	9.55	31.40	10
Zeesen (Germany)	DJA	9.56	31.38	5–40
Millis (U.S.A.)	WBOS	9.57	31.35	10
British Oversea Service	GSC	9.58	31.32	10–50
Melbourne (Australia)	VLR	9.58	31.32	2
Sydney (Australia)	VK2ME	9.59	31.28	20
Huizen (Holland)	PCJ	9.59	31.28	60
Philadephia (U.S.A.)	WCAB	9.59	31.28	10
Delhi (India)	VUD2	9.59	31.28	10
Athlone (Ireland)	—	9.59	31.27	—
British Oversea Service	GRY	9.60	31.25	10–50
Moscow (U.S.S.R.)	RAL	9.60	31.25	20
Cape Town (S. Africa)	ZRL	9.61	31.22	5
Zeesen (Germany)	DXB	9.61	31.22	5–40
Budapest (Hungary)	HAD	9.62	31.17	—
Rome (Italy)	I2RO3	9.63	31.15	25–100
Wayne (U.S.A.)	WCBX	9.65	31.09	10
Vatican City	HVJ	9.66	31.06	25
Buenos Aires (Argentine)	LRX	9.66	31.06	7
Rome (Italy)	I2RO9	9.67	31.02	25
Zeesen (Germany)	DJX	9.67	31.02	5–40
Bound Brook (U.S.A.)	WRCA	9.67	31.02	35
British Oversea Service	GRX	9.69	30.96	10–50
Buenos Aires (Argentine)	LRA1	9.69	30.96	7
Lisbon (Portugal)	CSW7	9.74	30.80	10
Rome (Italy)	IRF	9.83	30.52	30
Madrid (Spain)	EAQ	9.86	30.43	10
Buenos Aires (Argentine)	LSX	10.35	28.99	12
Lisbon (Portugal)	CSW6	11.04	27.17	10
Radio-Nations (Switzerland)	HBO	11.40	26.31	20
Warsaw (Poland)	SPD	11.53	26.01	2
Rome (Italy)	IQY	11.67	25.70	—
Motala (Sweden)	SBP	11.70	25.63	12
Moscow (U.S.S.R.)	RIA	11.71	25.62	15
Paris-Mondial (France)	TPA4	11.72	25.60	12
Winnipeg (Canada)	CJRX	11.72	25.60	2
Huizen (Holland)	PHI	11.73	25.58	20
Boston (U.S.A.)	WRUL	11.73	25.56	20
Vatican City	HVJ	11.74	25.55	25
Warsaw (Poland)	SP25	11.74	25.55	5
British Oversea Service	GSD	11.75	25.53	10–50
Rome (Italy)	I2RO15	11.76	25.51	—
Zeesen (Germany)	DJD	11.77	25.49	5–40
Saigon (Fr. Indo-China)	—	11.78	25.47	12
Boston (U.S.A.)	WRUL	11.79	25.45	20
Tokio (Japan)	JZJ	11.80	25.42	50
Zeesen (Germany)	DJO	11.80	25.42	5–40
Rome (Italy)	I2RO4	11.81	25.40	100
British Oversea Service	GSN	11.82	25.38	10–50
Wayne (U.S.A.)	WCBX	11.83	25.36	10
Lisbon (Portugal)	CSW5	11.84	25.34	10
Zeesen (Germany)	DJP	11.85	25.31	5–40
Budapest (Hungary)	HAD	11.85	25.31	—
British Oversea Service	GSE	11.86	25.29	10–50
Madras (India)	VUM2	11.87	25.28	10
Pittsburgh (U.S.A.)	WPIT	11.87	25.26	24
Melbourne (Australia)	VLR3	11.88	25.25	2
Paris-Mondial (France)	TPA11/12	11.88	25.24	12
Chungking (China)	XGOY	11.90	25.21	35
Moscow (U.S.S.R.)	RNE	12.00	25.00	20
Warsaw (Poland)	SPW	13.63	22.00	10
Radio-Nations (Switzerland)	HPJ	14.54	20.64	20
Rome (Italy)	IQA	14.79	20.28	—
Moscow (U.S.S.R.)	RKI	15.04	19.95	25
Rome (Italy)	I2RO12	15.10	19.87	—
Zeesen (Germany)	DJL	15.11	19.85	5–40
Vatican City	HVJ	15.12	19.84	25
Warsaw (Poland)	SP19	15.12	19.84	5
Paris-Mondial (France)	TPB6	15.13	19.83	25
British Oversea Service	GSF	15.14	19.82	10–50
Motala (Sweden	SPT	15.15	19.80	12
Tokio (Japan)	JZK	15.16	19.79	50
Moscow (U.S.S.R.)	RW96	15.18	19.76	100
British Oversea Service	GSO	15.18	19.76	10–50
Lahti (Finland)	OFD	15.19	19.75	1
Zeesen (Germany)	DJB	15.20	19.74	5–40
Ankara (Turkey)	TAQ	15.20	19.74	20
Pittsburgh (U.S.A.)	WPIT	15.21	19.72	18
Lisbon (Portugal)	CSW4	15.21	19.72	10
Huizen (Holland)	PCJ2	15.22	19.71	60
Podebrady (Bohemia)	OLR5A	15.23	19.70	15–30
Rome (Italy)	I2RO14	15.23	19.70	—
Paris-Mondial (France)	TPA2	15.24	19.68	12
British Oversea Service	GSI	15.26	19.66	10–50
Wayne (U.S.A.)	WCBX	15.27	19.65	10
Philadelphia (U.S.A.)	WCAB	15.27	19.65	10
Schenectady (U.S.A.)	WGEA	15.27	19.65	20–25
Zeesen (Germany)	DJQ	15.28	19.63	5–40
Delhi (India)	VUD4	15.29	19.62	10
Buenos Aires (Argentine)	LRU	15.29	19.62	7
Rome (Italy)	I2RO6	15.30	19.61	50
British Oversea Service	GSP	15.31	19.60	10–50
Schenectady (U.S.A.)	WGEA	15.33	19.57	20–25
Zeesen (Germany)	DJR	15.34	19.56	5–40
Budapest (Hungary)	HAS3	15.37	19.52	5
Moscow (U.S.S.R.)	RAL	15.50	19.35	15
Zeesen (Germany)	DJE	17.76	16.89	5–40
Huizen (Holland)	PHI	17.77	16.88	20
Bound Brook (U.S.A.)	WNBI	17.78	16.87	35
Tokio (Japan)	JZL	17.78	16.87	50
British Oversea Service	GSG	17.79	16.86	10–50
British Oversea Service	GSV	17.81	16.84	10–50
Rome (Italy)	I2RO8	17.82	16.83	50
Wayne (U.S.A.)	WCBX	17.83	16.83	10
Athlone (Ireland)	—	17.84	16.82	—
Paris-Mondial (France)	TPB3	17.85	16.81	25
Radio-Nations (Switzerland)	HBH	18.48	16.23	20
Zeesen (Germany)	DJS	21.45	13.99	5–40
British Oversea Service	GSH	21.47	13.97	10–50
Schenectady (U.S.A.)	WGEA	20.50	13.95	20–25
Rome (Italy)	I2RO16	21.51	13.95	—
Philadelphia (U.S.A.)	WCAB	21.52	13.94	10
British Oversea Service	GSJ	21.53	13.93	10–50
Pittsburgh (U.S.A.)	WPIT	21.53	13.93	6
British Oversea Service	GST	21.55	13.92	10–50
Wayne (U.S.A.)	WCBX	21.57	13.91	10

Recent Inventions

Brief descriptions of the more interesting radio devices and developments disclosed in Patent Specifications will be included in these columns.

AIRCRAFT LANDING BEAMS

AN airport with several independent runways is provided with mobile radio beacons which can be located so as to define the particular landing path to be taken by an approaching pilot, according to traffic congestion, the direction of the prevailing wind, or other local conditions.

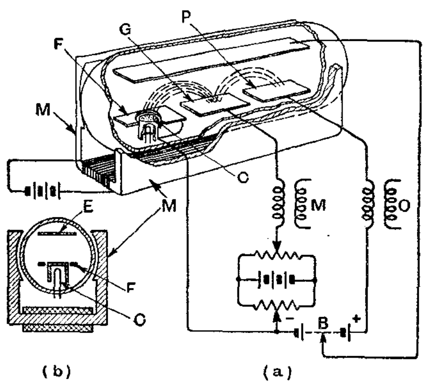
The beacons are selectively energised from a central control station as required, and means are provided to signal back to the central control when the selected beacon has been brought into operation. An indicator at the central control also shows the condition of each beacon transmitter in the system, i.e., whether it is in operation or not.

G. L. Davies and G. H. Wintermote. Application date, February 20th, 1939. No. 514080.

o o o o

ELECTRON MULTIPLIERS

A LIMIT is set to the effective amplification of an ordinary thermionic valve by inherent "noise," which makes it impossible to maintain a satisfactory signal-to-noise ratio. The object of the invention is to overcome this difficulty by utilising the principle of the electron multiplier to combine a high "transconductance" with high amplification.



Electron multiplier designed for minimum noise.

The Fig. (a) shows a three-stage multiplier in which an indirectly heated cathode C is surrounded by a flat field plate F, which is followed by a control grid G and an anode P, all arranged in the same plane. Above them is an elongated accelerating electrode E, whilst the tube as a whole is surrounded by an external magnet M (as shown more clearly in Fig. (b)), which applies a field at right angles to the axis of the tube. The control grid G is at the same potential as the field plate F, or slightly negative to it, whilst the accelerating electrode E and anode P are tapped to positive points on the battery B, as shown. Modulating potentials are applied at M, and the output is taken from the winding O.

The effect of the electric and magnetic control fields causes the electron stream to take the curved path shown in dotted lines, those electrons with a velocity sufficient to overcome the negative bias of the grid G being absorbed by it, whilst those of lower energy are rejected and follow the dotted-line path towards the anode P. These are subsequently amplified by impacting against other target electrodes (not shown).

Marconi's Wireless Telegraph Co., Ltd. (assignees of H. Nelson). Convention date (U.S.A.), February 26th, 1937. No. 513111.

o o o o

TELEVISION TRANSMITTER IMPROVEMENT

IN television transmitters of the kind in which the signals are produced by scanning a "storage" screen on which an electric image of the picture has been built up, there is a tendency for the marginal parts of the screen to become charged by the random deposition of stray electrons. These stray charges produce disturbances which affect the clearness of the picture at the receiving end.

As a remedy it is now proposed to provide a marginal strip on the screen which extends beyond the part occupied by the electric image. This margin is deliberately traversed by the beam of electrons at the beginning and end of each scanning line, so that it assumes a uniform potential equal to a "dark" portion of the picture, and is therefore no longer a source of disturbance.

Since the extra length of traverse of the scanning beam must be accomplished in the normal time, means are provided for accelerating the speed of the beam as it reaches the margin, and also during the whole of the fly-back stroke.

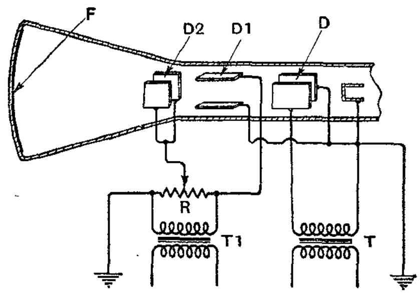
Fernseh Akt. Convention date (Germany), March 6th, 1937. No. 512489.

o o o o

PREVENTING "KEYSTONE" DISTORTION

THE scanning stream in a cathode-ray tube is usually controlled by two pairs of deflecting plates, one for moving the stream rapidly to and fro over each "line" of the picture, and the other for traversing the stream slowly up and down the "frame." In practice, the simultaneous application of different deflecting voltages, at right angles to each other, sets up a form of interaction which is responsible for what is called "keystone" distortion.

The purpose of the invention is to avoid this by applying a correcting voltage to an additional pair of plates. As shown, one pair of plates D is supplied with deflecting voltages at line frequency from a transformer T, whilst a second pair of plates D1 is energised at "framing" frequency from a transformer T1. A third pair of plates D2 is placed between the fluorescent screen F and the framing plates D1, and at right angles to the latter; these are fed with a correcting voltage which is taken from a variable tapping on a resistance R shunting the secondary of the transformer T1. The correcting plates may



Extra deflecting plates are used to minimise distortion.

be placed outside the glass walls of the CR tube, instead of inside, as shown.

Marconi's Wireless Telegraph Co., Ltd. (assignees of J. B. Sherman). Convention date (U.S.A.), March 30th, 1937. No. 513019.

o o o o

PREVENTING CABINET RESONANCE

ONE way of preventing loud speaker distortion due to cabinet resonance is to absorb the internal vibrations set up between the front and rear walls, either by lining the inside with absorbent material, or by constructing the walls of material having a high coefficient of damping.

According to the invention, the desired effect is secured by making the casing of spaced sheets of non-porous material, and increasing their damping action by adding layers of felt, spongy rubber, corrugated paper, or thin sheet lead. These layers are made capable of independent vibration so as to absorb the undesired sound waves. Non-porous material is defined as being that which transmits sounds by the vibration of its solid particles, and not by the vibration of air contained in the crevices of the material.

W. West and D. McMillan. Application date March 3rd, 1938. No. 512610.

o o o o

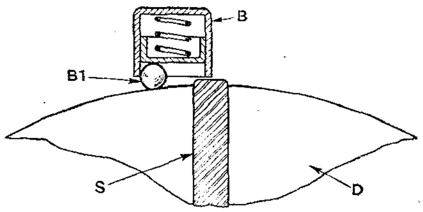
PRESS-BUTTON TUNING

IN one well-known method of press-button tuning the variable condenser is rotated by an electric motor until it reaches a point determined by the

Recent Inventions—

operation of the button that selects the desired station. The circuit of the driving-motor is then broken at this point, and it is, of course, necessary that the break should be sharp and precise.

The figure shows a form of contact-maker designed to meet this requirement. A circular disc D is mounted on or driven through gearing from the shaft to be stopped, and the motor circuit is broken when the brush rides on to an insulating strip S. The width of the strip cannot be reduced beyond a certain limit, nor can the brush, for obvious reasons, be made with too sharp an edge. The consequence is that the point at which the tuning condenser is arrested may vary by an amount corresponding to the width of the strip, according to whether contact is first made at the right- or left-hand side of the strip.



Spring-loaded ball as contact-maker.

This degree of lag is avoided, according to the invention, by making the brush B in the form shown, because frictional drag will always keep the spring-pressed ball B1 at the far side of its casing, no matter from which direction it approaches the strip S.

Murphy Radio, Ltd.; G. B. Baker; and J. D. A. Boyd. Application date, April 23rd, 1938. No. 513965.

○ ○ ○ ○

CR TUBE IMPROVEMENTS

RELATES to a cathode-ray television transmitter of the kind in which an electrostatic image of the picture is built-up on a mosaic electrode and then discharged by a scanning beam. In such transmitters it is found difficult to maintain, in front of the mosaic electrode, the potential gradient required to ensure that all the electrons released by the scanning beam pass to the anode of the CR tube, and so become available as signalling energy. In practice a proportion of the liberated electrons are attracted to adjacent elements on the mosaic, particularly those that are, for the moment, positively charged.

This difficulty is overcome, according to the invention, by first coating the mosaic electrode with a continuous layer of transparent photo-sensitive material, on which a mosaic of separate insulating elements is then deposited. The mosaic elements are, of course, coated with a photo-sensitive material. The continuous layer is biased negatively with respect to the anode, and, during the scanning operation, keeps negative relative to the mosaic elements, so that there is no tendency for the liberated electrons to drift back to it and away from the anode. The effective sensitivity of the mosaic electrode is thereby increased, and distortion is avoided.

Baird Television, Ltd., and V. A. Jones. Application date January 19th, 1938. No. 513628.

○ ○ ○ ○

GAS-FILLED VALVES

THE ordinary gas-filled valve is "triggered" into action, so that once current begins to flow it is not possible to control it quantitatively by voltages applied to the grid. To overcome this difficulty it is now proposed to make use of a second cathode, in the form of a circular arrangement of parallel wires, inserted between the usual control grid and the anode. The grid is directly "shorted" to the anode, and is positively biased with respect to both of the cathodes.

A varying input voltage applied between the first cathode and the control grid will then cause electrons to pass, through the grid, into the space occupied by the second cathode and the anode, where it ionizes the gas to an extent which depends upon the velocity of the electrons, i.e., upon the value of the applied voltage.

The output current, which is drawn off between the second cathode and the anode, accordingly keeps step with the applied input, so that the device can be used as a low-frequency amplifier. When used as a rectifier, the biasing voltages are adjusted to the bend or "knee" of the characteristic curve.

Marconi's Wireless Telegraph Co., Ltd. (assignees of H. Nelson). Convention date (U.S.A.) March 27th, 1937. No. 512995.

○ ○ ○ ○

ENLARGING TELEVISION PICTURES

THE usual fluorescent screen of a cathode-ray tube is replaced by a flat crystal of an alkali halide, such as potassium chloride. This is coated on each side with a sputtered layer of metal, the two coatings carrying different voltages so that an electric field passes through the crystal.

When the crystal screen is scanned by a modulated electron beam from the "gun" of the tube, certain point-to-point changes occur in the crystal, one of which is a variation in the refractive index of each local point. The effect is utilised to modulate a ray of light projected from a lamp located outside the cathode-ray tube. In effect, the point-to-point transparency of the crystal screen changes instantaneously under the impact of the scanning stream of electrons, so that the light from the lamp after passing through the screen throws an image of the received picture on to a viewing surface. The latter is mounted on the opposite side of the CR tube to the projection lamp, and may be of large size.

Scophony, Ltd., and A. H. Rosenthal. Application date, March 18th, 1938. No. 514155.

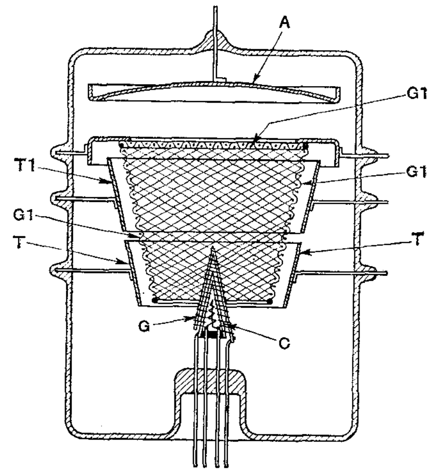
○ ○ ○ ○

ELECTRON MULTIPLIERS

THE figure shows the arrangement of the "target" and "accelerating" electrodes in an electron multiplier. In this type of tube, primary electrons are made to impact at speed against a series of target electrodes, and the "secondary" electrons so liberated are collected to form the output.

In the construction shown, "primary" electrons are supplied by an indirectly heated cathode C of conical form, closely surrounded by an open control grid G of similar shape. The target electrodes consist of two metal rings T, T1, which are coated with a highly emissive substance, such as cæsium silver oxide. A positively biased accelerating grid G1 of open meshwork helps to control the path of the electrons.

In operation, primary electrons from the cathode are drawn out by the signal voltage applied to the control grid G until they come within range of the



Improved secondary-emission valve.

accelerating grid G1, which throws them at high speed against the first ring or target T. The secondary electrons released by the impact are attracted through the accelerating grid G1, and across the internal space, on to the inner surface of the second target T1, where the same process is repeated. The multiplied current is finally collected by the anode A at the top of the tube. The targets T, T1 and the anode A carry progressively increasing voltages. The path of the electrons is automatically determined by the conical arrangement of the targets and grids.

Farnsworth Television Inc. Convention date (U.S.A.), March 22nd, 1937. No. 512040.

CLASSIFIED ADVERTISEMENTS

THE CHARGE for advertisements in these columns is 12 words or less 3/-, 3d. for every additional word. Each paragraph is charged separately.

ADVERTISEMENTS, with remittance, should reach Dorset House, Stamford Street, S.E.1, not later than first post Friday, March 8th, for the April issue, or one day earlier at the Branch Offices, 8-10, Corporation Street, Coventry ; Guildhall Buildings, Navigation Street, Birmingham, 2 ; 260, Deansgate, Manchester, 3 ; 26B, Renfield Street, Glasgow, C.2.

SERIES DISCOUNTS are allowed to trade advertisers on orders for consecutive insertions provided a contract is placed in advance, and in the absence of fresh instructions the entire copy is repeated from the previous issue. 3 insertions, 5 per cent.; 6 ins., 10 per cent. ; 12 ins., 15 per cent.

Advertisements received too late for one issue, or crowded out, are published in the first following in which there is space. The Proprietors retain the right to refuse or withdraw advertisements at their discretion.

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

BOX NO. ADVERTISERS should include the words "Box 000 c/o 'The Wireless World'" which must be paid for. An additional 6d. is charged for registration and cost of forwarding replies.

Letters addressed to Box Nos. are simply forwarded to the advertiser. No responsibility is accepted in connection with these advertisements.

DEPOSIT SYSTEM. Readers may deal with advertisers in safety through our Deposit System. Purchase money payable to Iliffe & Sons Ltd. should be deposited with "The Wireless World," when both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For transactions up to £10 a deposit fee of 1/- is charged ; over £10 and under £50, 2/6 ; over £50 and under £75, 5/- ; over £75 and under £100, 7/6 ; over £100 one-half per cent. All correspondence must be sent to Dorset House, Stamford Street, London, S.E.1.

Cheques and Postal Orders sent in payment for deposits or advertisements should be made payable to Iliffe & Sons Ltd., and crossed. Notes cannot be traced if lost in transit. They must therefore be regarded as being despatched at sender's risk. Alternatively, they may be sent per registered post.

NEW RECEIVERS AND AMPLIFIERS

A.

A.

"CHALLENGER RADIO CORPORATION," the best firm for reliable and fully guaranteed ultra-short-wave radio, have on view in London some of the finest receivers ever made; for instance, a five-valve TRF Midget (2 bands) at 75/-; a mains-battery transportable (operating without alteration on A.C., D.C., or batteries), at £8; an 8-valve radiogram chassis with valves and speaker, 4 wave-bands, at £8/8; a 6-valve tuning unit with five wave-bands, including 4½-10 metres, at £8/18/6; tuning unit with output stage and speaker at £11; a 13-valve receiver with five wave-bands, including 5-10 metres, variable selectivity, inter-station noise silencer, auditorium weighing 23 lbs., with valves and speaker complete, £16/16; an 18-valve twin chassis including such refinements as variable selectivity, contrast expansion, C.W. beat oscillator, variable sensitivity, inter-station noise silencer, with valves and auditorium speaker, £28/17/6; any American valve for 1925-1940 receivers for 6/- each (only firsts such as Raytheon, National Union, &c., supplied). Why not call and handle these receivers at your leisure? There is no obligation to purchase. Alternatively, fully illustrated catalogues will be forwarded on receipt of 1½d. stamp.

CHALLENGER RADIO CORPORATION, 31, Craven Terrace, London, W.2. Paddington 6492. Nearest point Marble Arch, down Bayswater Rd., turn 5th right. [8787

A.C.S. Radio, 46, Widmore Rd., Bromley (Ravensbourne 0156).—Communication and all-wave receivers and recording equipment; part exchange, easy payments. [8775

THE famous Hallicrafter SX23, released by the makers only in July, 1939, can still be supplied by Webb's Radio at pre-war prices. We fortunately had good supplies delivered in August. No price increase on present stock of this model only; £33/10., H.P. terms available. Write for descriptive folder "W."—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089. [8786

COMMUNICATION RECEIVERS

THE Famous Hallicrafter SX23, released by the makers only in July, 1939, can still be supplied by Webb's Radio at

PRE WAR Prices.

WE Fortunately Had Good Supplies Delivered in August; no price increase on present stock of this model only: £33/10; H.P. terms available; write for descriptive folder.—W. Webb's Radio, 14, Soho St., London, W.1. 'Phone: Gerrard 2089. [8818

Wanted

WANTED, R.M.E.69 and D.B.20, cash.—Lownds, Laurel Cottage, Eakring, Newark, Notts. [8850

USED SETS FOR SALE

H.M.V.

H.M.V. All World Radio, 13-2,000 metres, in beautiful console cabinet, complete with large screen mirror television, purchased new at Radio Exhibition, cost 80 gns.; first offer over £30 secures.—Box 1671, c/o *The Wireless World*. [8771

McMURDO

McMURDO Silver "Homeric" Console, 4½-2,000 metres, 15in. speaker, as new, cost 55 gns.; accept £30.—Box 1672, c/o *The Wireless World*. [8772

SCOTT

SCOTT Quaranta, 41 valves, five speakers, Auto-radiogram, in two magnificent cabinets, cost nearly £1,000, perfect; £175.—A.C.S. Radio, 46, Widmore Rd., Bromley. [8773

STANDARD

STANDARD Model, crystal, speaker, and D.B.20 unit, like new; £41/10.—A.C.S. Radio, 46, Widmore Rd., Bromley. [8774

Wanted

WANTED, Armstrong A.W. 125 P.P., 12v. 5-band, R.G. chassis, 1939, in sound order.—Pettit, Lyonshall. [8843

WANTED For Cash, W.W. pre-tuned receiver and amplifier (1939).—Elliott, 10, College Close, Harrow Weald. [8862

PUBLIC ADDRESS

V

VORTEXION P.A. Equipment.

IMITATED, but unequalled.

WE Invite You to a Demonstration.

A.C.-D.C. Dance Band Amplifier, 10 watts output, complete in case, with moving coil microphone, speaker and cables weight 22lb.; 12 gns.

A.C.-20 15-20-watt Amplifier, 38-18,000 cycles, independent mike and gram., inputs and controls, 0.037 volts required to full load, output for 4, 7.5, and 15 ohms speakers, or to specification, inaudible hum level, ready for use; 8½ gns. complete.

C.P. 20 12-volt Battery and A.C. Mains Model, as used by R.A.F., output as above; 12 gns.

A.C.-20, in portable case, with Collard motor, Piezo pick-up, etc., £14; C.P.20 ditto, £17/17.

50-WATT Output 6L6s, under 60-watt conditions, with negative feed back, separate rectifiers for anode screen and bias, with better than 4% regulation level response, 20-25,000 cycles, excellent driver, driver transformer, and output transformer matching 2-30 ohms impedance electronic mixing for mike and pick-up, with tone control, complete with valve and plugs; £17/10.

(This advertisement continued on next page.)

100 PER CENT.

of our time, energy and experience is put into the design and manufacture of

Partridge

TRANSFORMERS & CHOKES

We make nothing else!

For Manufacturers and the Trade

We have a confidential consultattive service undertaking the design of Transformers and Chokes for special purposes. No problem has yet baffled us. Firms experiencing difficulty in obtaining supplies from their usual source should get into touch with us—we can give immediate delivery and invite your enquiries.

For the Experimenter

Whilst we are equipped for and handle large orders, we continue to cater for the individual reader. If you want a guaranteed component which will not let you down, drop us a line and we will send your our catalogue.

N.B.—'The Wireless World' wanted a High Quality Transformer for the Magnetic Television Receiver— they specified PARTRIDGE!

N. Partridge B.Sc., A.M.I.E.E.

King's Bldgs., Dean Stanley St., London, S.W.1.

Phone: VICtoria 5035.

JUSTICE DEMANDS

that only a first-class pick-up should be used with your VOIGT Loudspeaker.

We believe we have solved the major problems of gramophone reproduction with experimental **moving coil** pick-ups now under test.

Except for low output, which necessitates a pre-stage, their performance is most promising.

Price (anticipated) about £6.

THE WISE MAN BUYS VOIGT

VOIGT SPEAKER UNITS *from* £15-0-0 (*EX WORKS*)

HORNS *from* £2-15-0

Consult us if you wish to improve your record reproduction.

VOIGT PATENTS LTD., The Courts, Silverdale, London, S.E.26

'Phone: SYDenham 6666.

Regd. Office: 22, Castle Street, E.C.1.

PUBLIC ADDRESS

(This advertisement continued from previous page.)

COMPLETE in Case, with turntable, B.T.H., Piezo pick-up and shielded microphone transformer; £22/10.

80-WATT Model, with negative feed back; £25, complete.

120-WATT Model, with negative feed back; £40, complete.

250-VOLT 250 m.a., Full Wave Speaker, field supply unit; 25/-, with valve.

6- or 12-volt Car Battery Charger, 30/-; complete in gauze case, 35/-.

ALL P.A. Accessories in Stock; trade supplied.

SEE Our Display Advertisement on Page 191.

VORTEXION, Ltd., 182, The Broadway, Wimbledon, S.W.19. 'Phone: Lib. 2814. [8241

"PARTRIDGE P.A. Manual," standard handbook on electro-acoustics, amplifiers, and audio circuits; price 2/6 (free to trade).

"PARTRIDGE Amplifier Circuits," describes many modern constructional amplifiers, 2w. to 45w. output, battery, A.C.-D.C., etc.; price 2/- (no free copies).

PARTRIDGE, N., B.Sc., A.M.I.E.E., King's Buildings, Dean Stanley St., London, S.W.1. [0630

AMPLIFIERS, speakers, microphones, turntables and converters for hire and repairs departments.—Easco, 18, Brixton Rd., S.W.9. 'Phone: Rel. 1693. [0643

NEW MAINS EQUIPMENT

V

VORTEXION Mains Transformers, chokes, etc., are supplied to G.P.O., B.B.C., L.P.T.B.; why not you?

VORTEXION, Ltd., 182, The Broadway, Wimbledon, London, S.W.19. Telephone: Liberty 2814. [8242

ALL-POWER TRANSFORMERS, Ltd.—Transformers and chokes to specification, rewinds; write for quotation.—8a, Gladstone Rd., Wimbledon, S.W.19. Liberty 3303. [8869

SHORT-WAVE EQUIPMENT

G5NI for Short Wave Equipment; largest stocks in the country; communication receivers; National agents; American and British Valves, etc. See advertisement on page 9.—44, Holloway Head, Birmingham. [0531

NEW LOUD-SPEAKERS

BRAND New Speakers.

SAVE Pounds. 1½d. stamp for list of British and American P.A. speakers. Example: P.A. speaker with transformer, weight 21lb., incorporating curved cone; 52/-.

CHALLENGER RADIO CORPORATION, 31, Craven Terrace, London, W.2. Paddington 6492. [8789

BAKERS' Brand New Surplus Speaker Bargains.

EVERY Music Lover Interested in Realistic Reproduction Should Write for Details Now.

BAKERS' New Corner Horn Speakers.

£9 Only.—Usual price £16; brand new corner horn speakers in beautifully finished polished walnut corner horn cabinet, frequency range 30-12,000 cycles, amazingly realistic reproduction.

BAKERS' New Super Power Speakers.

£3/10.—Usual price £6; brand new Baker super power electro magnet speakers, as solely specified for the "Wireless World" Quality Four receiver.

45/-.—Usual price £5 brand new Bakers' super power permanent magnet speakers, ideal for use with Quality receivers, exceptional bargain.

BAKERS' New Infinite Baffle Speakers.

65/-.—Usual price £9; brand new Bakers' permanent magnet speakers with new type infinite baffle, wide frequency range and exceptional transient response.

IDEAL for Use with Quality Receivers and also the Electric Gramophone Recently Decribed in the "Wireless World."

BAKERS SELHURST RADIO, The Pioneer Manufacturers, 75, Sussex Rd., South Croydon. [8725

SECOND-HAND LOUD-SPEAKERS

VOIGT Unit, 200-400-volt field, twin diaphragm, as new; 10 gns., or reasonable offer.—Box 1627, c/o *The Wireless World* [8858

Wanted

MAGNAVOX 66. 1,250 ohms. field, good condition, state price.—Box 1662, c/o *The Wireless World.* [8763

No complaints, Sergeant!

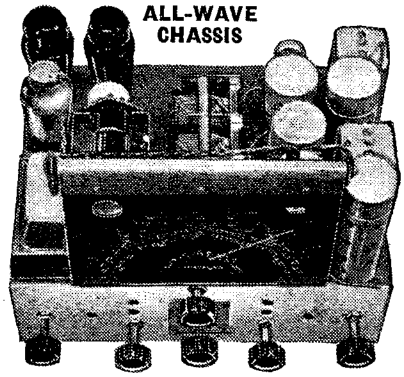
That would be the reply from the Army of Readers who have bought Radio and Electrical goods on

L·R·S EASY TERMS

Fifteen years' regular advertising in the *Wireless World* is your guarantee of Good Service and proof that we supply only apparatus of undoubted reliability. For example:—

ARMSTRONG Model SS10

10-VALVE SUPERHET—STRAIGHT ALL-WAVE CHASSIS



Fully described in Armstrong advert., P. 12

Cash or C.O.D. **£13.4.0** or **45/-** with order and 10 monthly instalments of **23/-**.

Write for illustrated literature of their other Models, all on similar terms.

In addition we shall be glad to quote for all other high-grade equipment, such as Sound Sales Amplifiers, Voigt Speakers, Haynes Radio, McClure Feeder Units, Tuners, etc., Avometers, and PORTABLE A.R.P. RECEIVERS.

● DRY SHAVERS ●

ON 14 DAYS' APPROVAL

against cash, or on first instalment of **10/-**. Should Shaver be returned, **7/6** will be refunded

VICEROY Non-electric

Made by Rolls Razors Ltd., this is the ideal Shaver for men in the Services and at home where electricity is not available. No brush, soap or water is needed. Just press the lever as the Shaver glides over the face and you get an amazingly smooth and comfortable shave—anywhere at any time. Complete in case. **£2.10.0**

Or **10/-** with order and 6 monthly payments of **7/2**

SHAVEMASTER Electric

Still the best made. The new "475" comb with its **hollow-ground** Cutter is a revelation even to those who had nothing but praise for the earlier model. It gives a closer and speedier shave than ever, and so easy.

For 100/250 v. mains, A.C. or D.C. Complete in leather case. **£4.4.0**

or **10/-** with order and 8 monthly payments of **10/-**.

● TO PRESENT USERS ●

The new "475" Comb and Cutter will bring your old Shavemaster right up to date. It fits all earlier types. We can supply these heads from stock. **7/9** post free.

ELECTRICAL APPLIANCES

Fires, Vacuum Cleaners, Clocks, Irons, Fans are all available on our convenient terms.

Write TO-DAY for illustrated details.

Evacuation address: **Est. 1925**

THE LONDON RADIO SUPPLY COMPANY

"Winden," Ardingly Road, Balcombe, Sussex

COMPONENTS—SECOND-HAND CLEARANCE, SURPLUS, ETC.

R.

RADIO CLEARANCE, Ltd.,

63, High Holborn, W.C.1. 'Phone: Holborn 4631.

AMAZING Offer.

5-VALVE A.C. All Wave Superhet Chassis, latest Mullard valves (T.H.4B, V.P.4B, T.D.D.4, Pen.A.4, I.W.4-350v.), ranges: short wave 16-48 metres, med. wave 200-560 metres, long wave 800-2,200 metres. Size of chassis 14½in. long, 7½in. deep, height overall 8½in., control tuning at side, volume on-off at side, wave change, provision for pick-up; complete with valves and knobs, £4/17/6; special speaker, 1,500 ohms field, 10/6.

RICE-KELLOGG Senior 12in. Moving Coil Speakers, 20 watts, 1,000 ohms, 11 ohms speech coil; without speech transformer, 32/6; with transformer tapped 3,000 ohms and 7,000 ohms, 35/-.

GRAMPIAN 10in., 10-watt, 2,500 ohm energised speaker, heavy cast frame, 15/- each; with heavy-duty pentode speech transformer, 17/6 each; heavy-duty speech transformers, pentode matching, 2/11 each.

PLESSEY 2-gang Straight Condensers, 1/6 each; ditto, 3-gang, 2/- each; Plessey motor drive press button unit, supplied complete with 8-way press button control, precision job throughout, first grade motor, A.C. 24 volts, 21/- each.

POLAR 100,000 Volume Controls, with S.P. switch, 1/6 each; 250,000 ohm, 500,000 ohm and 1 meg., and same value less switch, 1/3 each; 2,500 ohm field coils, 9d. each; 1 (one) gross assorted resistances, 5/- per gross; metal chassis, drilled, 15in.×6in.×1¾in. and 11½in.×8in.×2¾in., 1/6 each; push back wire, 12 yds., 1/-.

ROLA P.M. Speakers, latest type, 7½in. cone, with pentode transformer, boxed, 14/6 each; clock-faced dials, 5in.×3½in., with printed 3-wave scale, oxcopper escutcheons and glass, 3/6 each; ditto, less escutcheons, 2/6 each; horizontal dials, with plain scale 7¼in.×3¼in. and pointer, 1/- each; 465 k.c. I.F. transformers, 2/- each.

PLESSEY Mains Transformers, 350-0-350 90 m.a., 4v. 2.5 amps., 4v. 6 amps.; 8/6 each.

FILAMENT Transformers, input 200-250 volts, output 4 volts 4 amps., 4 volts 6 amp.; 4/11 each.

G.E.C. Mains Transformer, American windings, 350-0-350 volts, 65 m.a., 5 volts 2 amps., 6.3 volts 2.5 amps., suitable for replacements in G.E.C. models, 5/6 each; 24 mfd. can type electrolytics, 450 volts working, 1/- each.

PRESS Button Units, with 6 press buttons, ready for wiring into set, with circuit; 4/11 each.

CHASSIS Mounting Valve Holders, American, 4-, 5-, 6- and 7-pin, 4d. each; Octals, 6d. each; Loctals, 10d. each; 7-pin English type, 3d. each.

ROTHERMEL Piezo Crystal Speakers, 7½in. cone, list 55/-, our price 10/6 each; 10in. cone, 12/6 each.

POLAR N.S.F. 1 watt Resistances, 4d. each, 3/9 dozen; all sizes up to 2 meg.

WEARITE Mains Transformers, R.C.B. type, 350-0-350v. 80 m.a., 5 volts 2 amps., 6.3 volts 5 amps., 6/11 each; Type R.C.4, 500-0-500v. 150 m.a. 4 volts 2 amps., 4 volts 2 amps., 4 volts 2.5 amps., 4 volts 5.6 amps., 21/- each; type R.C.2, 350-0-350v. 120 m.a., 4v. 2.5 amps., 4v. 4 amps., 12/6 each; type R.C.1, 250-0-250v. 80 m.a., 4v. 2.5 amps., 4v. 4 amps., 9/11 each.

PHILCO Mains Transformers, American windings, 350-350 volts 65 m.a., 6 volts 3 amps., 5 volts 2 amps., 5/- each; ditto, but 80 m.a., 6/6 each; ditto, but 90 m.a., 7/6 each.

WEARITE 110 k.c. I.F. Transformers; 1/- each.

AMERICAN C.T.S. Volume Controls, finest made, divided spindles, length 2½in., with switch, 2,000, 5,000, 10,000, 25,000, 100,000, 250,000 500,000 and 1 meg., 2/6 each; wire wound 5 watt (less switch), 2,000, 5,000, 10,000, 20,000, 25,000 ohms, 2/- each.

B.I. Wire-end Type Bias Electrolytics, 50 mfd. 12 volts, 1/6 each; 50 mfd. 50 volts, 2/- each; tubular wire-end non-inductive paper, all sizes up to 0.1, 5d. each, 4/9 dozen; volume controls, 1,000 ohms, with switch, 1/3 each.

PLESSEY Energised Speakers, 6in. cone, 2,500 and 1,500 ohm field; 5/11 each.

RUBBER Grommets; 4d. dozen.

BATTERY Output Pentodes, well-known make; 3/11 each.

BATTERY Double Diode Triode, well-known make; 3/6 each.

RAYTHEON First-grade Valves, largest stockists, all types in stock, including Glass Series, Glass Octal Series, Metal Series, Bantom Series, Single-ended Metal Series, and Resistance Tubes, all at most competitive prices; send for valve lists.

ALL Orders Must Include Sufficient Postage to Cover.

HOURS of Business: 9 a.m-6 p.m. week-days, Saturdays 9 am-1 p.m.

RADIO CLEARANCE, Ltd., 63, High Holborn, London, W.C.1. Telephone: Holborn 4631. [8793

GALPINS
ELECTRICAL STORES
75, LEE HIGH ROAD, LEWISHAM, LONDON, S.E.13
Telephone: LEE GREEN 5240

Terms: Cash with Order.
ALL GOODS SENT ON THREE DAYS' APPROVAL AGAINST CASH

This Advertisement cancels all previous issues

PORTABLE LIGHTING ENGINES, 2¾ twin Douglas, special, air cooling, complete with all fittings, including petrol tanks, etc., fully protected, condition as new, **£12/10/-,** C/F.

SPARK COILS, ex-Naval, 2in. spark, complete for 12-volt working, **25/-** each, post 1/6.

SILVERTOWN HORIZONTAL GALVANOMETERS, jewelled movements, **5/-** each, post 6d.

KEITH BLACKMAN MOTOR-DRIVEN PUMPS, for water, ¼ h.p., 110-volt D.C., ball-bearing, shunt-wound, 1,200 r.p.m., gear type gunmetal pump, ⅝in. inlet and outlet, total head 30 feet, 300 gallons per hour, **45/-** each, C/F; 220-volt ditto, **55/-** each, C/F.

SMALL D.C. MOTORS, 100 volts, shunt-wound, laminated field, 2-pole, ⅛ h.p., **12/6** each, post 1/-. Another, 50/100-volt D.C., shunt-wound, ball-bearing, totally enclosed, **7/6** each, post 1/-.

EVERETT EDGCUMBE ELECTROSTATIC VOLTMETER, 8in. dial, 0 to 6,000 volts, in good condition, **55/-,** post 2/-.

EX-NAVAL HETERODYNE WAVEMETERS, 1-valve, buzzer type, 200 to 24,000 meters, in solid teak case, **7/6** each, C/F.

A.C. INDUCTION MOTORS, 200/250 volts, 1 ph. 50 cy., approx. ⅛ h.p., 1,440 r.p.m., in new condition, **25/-** each, post 1/-.

E.C.C. SHUNT-WOUND DYNAMO, 100 volts 50 amps., 1,500 r.p.m., **£6 10s.** C/F.

STANDARD TELEPHONE CONDENSERS, 1 mf. 400-volt wkg., **4d.** each, or 4 for **1/-**; 2 mf. 400-v. wkg., **6d.** each. Muirhead, 1 mf. 4,000-volt test, **2/-** each. Philips, 1 mf. 8,000-volt test, **5/-** each. T.C.C., 2 mf. 1,000-volt test, **1/-** each. T.C.C., 2,000 mf. 12-volt wkg., **2/-** each.

X-RAY TRANSFORMERS. All in good condition, fully guaranteed 120 volts, 50 cy. 1-ph. input, 64,000 volts 2 kVA. output, with winding for Coolidge Tube, **£11 10s.** Another, same input, 80,000 volts 3 kVA. output, **£14 10s.** Another, 200/240-volt input, 4,000 volts 12 m/a. output, **£6.** All Carriage Forward.

WESTON (501) AND E. TURNER (909) 2in. DIAL MOVING-COIL MILLIAMPMETERS, as new. 0 to 5 m/a., **17/6**; 0 to 25 m/a., **16/6**; 0 to 50 m/a., **15/-**; 0 to 250 m/a., **15/-** each.

MULTI-CONTACT RELAYS, EX-G.P.O., as used in automatic exchange, condition as new, small size, suitable for automatic tuning for press-button control, heavy platinoid contacts, **2/6,** post 3d.; 2 for **4/-,** post 6d.; 3 for **6/-,** post 6d.

VOLTAGE CHANGING TRANSFORMERS (Auto. wound), 12 months' guarantee, 100/110 to 200/240 volts or vice versa, 250 watts, **21/-**; 500 watts, **26/-**; 750 watts, **32/6**; 1,000 watts, **37/6**; 1,500 watts, **50/-**; 2,000 watts, **62/6.**

HIGH VOLTAGE TRANSFORMERS for Television, Neon, etc., 200/240 v. 50 cy. 1-ph. primary 5,000 and 7,000 volts secondary, enclosed in petroleum jelly. Size: 5⅜in. × 4½in. × 4½in., **7/6** each, post 1/-. Ditto, skeleton type, **5/6,** post 9d. All brand new.

MAINS TRANSFORMERS, 200/240 volts input, 12 and 24 volts at 4 to 6 amps. output (useful for model trains, etc.), **15/-** each, post 1/-.

EVERSHED EX-R.A.F. HAND-DRIVEN GENERATOR, in new condition, 800 volts 30 m/a. and 6 volts 2½ amps. D.C. Useful as megger genies and all test work, **20/-** each, post 1/6.

EX-G.P.O. GLASS TOP RELAYS, Type B. Useful as Keying Relays, **5/-** each, post 6d. Also a few only that need points, which are easily fitted, **2/6** each. P/F.

T.C.C. 2,000 MF. ELECTROLYTIC CONDENSERS, 50-volt working (brand new), **5/-** each, post 6d.

STANDARD TELEPHONE BELL WIRE, all brand new, 150-yd. coils, twin 22 gauge, **4/-,** post 9d.; 250-yd. coils, single 18 gauge, **4/-,** post 1/-; 300-yd. coils, single 22 gauge, **3/-,** post 6d.

MOVING COIL MOVEMENTS, complete in case with pointer, very low m/a., full deflections, 2½in. dia., **5/-,** post 6d.; 4in. dia., **6/-,** post 9d.; and 6in. scale, **7/-** each, post 9d.

PUSH-BACK WIRE, 22 gauge, 220-yd. coils, as new, price per coil, **8/6,** post free.

DYNAMOS, for charging or lighting, etc., all shunt wound and fully guaranteed. 100-volt 10 amp., 4-pole, 1,500 r.p.m., **90/-**; 50/75-volt 15 amp., 1,750 r.p.m., 4-pole **90/-**; 30-volt 10 amp., ball bearings, 1,500 r.p.m., 4-pole, **70/-**; 25-volt 8 amp., 1,750 r.p.m., 2-pole, ball-bearing, **37/6**; 50/75-volt, 25 amp., 4-pole, 1,500 r.p.m., **110/-.**

ELECTRIC LIGHT CHECK METERS, for sub-lettings, garages, etc. 200/250 volts, 50 cy. 1-ph., supply 5, 10 or 20 amps., **6/-** each, post 1/-.

COMPONENTS—SECOND-HAND CLEARANCE, SURPLUS, ETC.

RYALL'S RADIO, 280, High Holborn, London, W.C.1, offer new goods, post free.

ELLIPTICAL Speakers, Celestion, suitable Ekco replacements, 750 ohms, less transformers, speech 25 ohms, new, handle 8 watts, carry up to 120 m.a., 3/9 each to clear.

SPEAKERS, pairs, brand new, elliptical cone speakers, made by first class firm, quality of reproduction outstanding, push-pull pentode transformer, fields 325 ohm for smoothing choke, 8,600 as bleeder, circuit available, handle 10-15w.; 10/9 pair.

MAINS Transformers, drop through chassis type, top cover with mains adjustment, input 200-250v., outputs 350-350, 80 m.a. 4v. 2½a., 4v. 4-5 amp., heavy jobs, 6/9 each; T.M.C. 0.5 mf. paper type tubulars, 400v. DC wkg., 3 for 1/3.

FERRANTI Air Core Type Tuning Coils, transformer wound, can be used as band pass, tuned grid with reaction, chassis type; three for 2/6, with coil connections.

I.F. Cans, Ali. size 1¾×1½×4in. high, complete with double trimmers, 4/9 dozen; Erie 60 ohm ½-watt resistances, 1/3 dozen; NSF 1 watt ¼ megs, 1/3 dozen; 600 ohm. wire wound 3 watt resistances, four for 1/3; Cornel-Dubilier mica, sizes 001, 002, 003, 1/3 dozen.

THIMBLE Top Caps, 24 for 1/3; clip on bulb holders, 12 for 1/3; volume controls, ½ meg. with switch, Morganic Stackpole, ex K.B., 1/9; Murphy type ½ meg. with D.P. switch, 1/9.

BRITISH Type Magic Eye Valves, 4v. ½a. heater, octal base, 3/3; UD2 super power 2v. valves, 2/3 each; similar Triotrons.

MAGNAVOX 7in. Cone Speakers (8in. overall), ribbed pattern, ideal replacement speakers, 2,000 ohms pentode transformers, 7/-; new; also R. & A. 2,500 ohm 7in. type speakers, pentode transformers, 7/9; Plessey 6,500 ohm, 8in. speakers, with pentode transformer, 6/6.

ELECTROLYTICS, B.1 2×2×2, 400v. peak, 1/3 each, 9/- dozen; 25×25v., two for 1/6; Plessey 50×8×2, 300v. wkg., 1/6 each, 12/- dozen; TCC 8 mf. wet type 802 upright cans, 440v. wkg., 460v. peak, 1/9 each, 15/9 dozen.

U.S.A. Tubes, first grade, in sealed cartons; 80's 4/3, 6A7 4/9, 42 4/9, 43 4/9, 25Z5 4/9, 77 4/9, 78 4/9.

SATOR 1,500v. Test Tubular Condensers, assorted, equal numbers, 0.0002-3-5, 0.001, 0.03, 0.05, 0.002-3, mica; all at 50 for 2/6.

ASSORTED Resistances, 50 for 2/6; 1-watt carbon, U.S.A. make, reasonable assortment given, sizes approx. 450-12,000-17-60-70-90-120 thousand ohms.

TRIMMERS on Porcelain Plessey, double and single, 50-100-200-160 ohm. approx.; 50 for 2/6; special price quantities.

ULTRA Type Brown Knobs, octangle, plain arrow, L.S. 1/9 dozen, 8/6 gross assorted, 10/6 gross plain or arrow.

SMALL Iron Core Coils, made by Varley, aerial and oscillator, 465 k/c, 2/6 pair, with coil connections for straight type gang.

FERRANTI Wire-wound 2½-watt Resistances, with metal end caps, tubular sizes 3,000, 4,000, 6,000, 8,000, 35,000; four for 1/3.

CLIX Valve Holders, 4- and 5- and 7-pin, square and oblong, 1/3 dozen; chassis types, 4- and 5- and 7-pin, round type, with cover, 2/6 dozen.

REX Type Switches, 4B, 2P, 4w., with shorting plates on 5 switches, 2/6; 4B, 2P, 3w., 1/6; 3B, 4P, 3w., 1/3; screens, 3¾×3⅝, 5 for 1/3.

PLESSEY 3-gang Fully Screened Straight Type Condensers, with top trimmers, 2/9; Plessey 3-gang straight type all wave, ceramic insulators with SM cord drive, fitted antimicro feet, 2/9.

9-PIN Plugs with cap and socket, 2 for 1/6; Octal top caps with hood and screened lead, 4 for 1/3; Octal valve holders, wafer type, 3 for 1/3.

BEST Known Make, 1-watt, colour coded carbon resistances, 20 sizes, as ordered; 2/6 dozen; ½-watt type, 2/- dozen.

SATOR 5,000 ohm. Pots with Switch, 1/3; Sator 100,000 ohm. pots less switch, 1/3; 10,000 ohm. with broad base for tone control, less switch, 1/3; Centralab ¼-meg. pots with long spindle and switch, 2/6; Centralab 11,000 ohm. pots, less switch, short spindles, 2 for 1/3. [8870

SOUTHERN RADIO'S Bargains.

ALL Guaranteed; postage extra.

5/- Parcel of Useful Components, comprising condensers, resistances, volume controls, wire, circuits, etc., value 25/-; 5/- per parcel.

15/-.—Service man's component kit; electrolytic condensers, volume controls, resistances, tubular, mica, paper condensers, valve holders, etc., 120 articles, contained in strong carrying case, 9in. × 7in.×7in.; 15/- the kit.

5/-.—100 wire end resistances, assorted capacities, ½ and 1 watt; 5/- per 100.

ORMOND Loud Speaker Units, 2/6; Westectors, type W2, 2/6; Crystal Detectors, 2/-; Crystals, 6d.; Marconi V24 Valves, 9d.

2/-.—Tool or instrument carrying cases, ex Government stock; wood, 9in.×7in.×7in.; 2/-.

SOUTHERN RADIO, 46, Lisle St., London, W.C. Gerrard 6653. [8904

COMPONENTS—SECOND-HAND CLEARANCE, SURPLUS, ETC.

LONDON CENTRAL RADIO STORES,

23, Lisle St., W.C.2. Gerrard 2969.

MIKE Transformers, 80-1, 2/- each; L.F. chokes, 400 ohms, 60 m.a., 2/6 each; Mazda Universal Pentodes, 3520, 4/3 each; Philips step-down transformers, input 200-240 volts, output 6 volts 3 amp., 2/9 each; Cossor battery, 210 S.P.T., 4/6 each; 5lb. boxes of surplus condensers, resistance trimmers, knobs, etc., 2/6 each; save money! Protect your radio-amplifier with a relay, big variety available, 3/6 each, post 6d.; complete with circuit; look at previous issues.

LONDON CENTRAL RADIO STORES, 23, Lisle St., W.C.2. Gerrard 2969. [8872

VAUXHALL.—Rola P.M. speakers, 8in. 14/9, 10in. 18/6; Rola energised 1,500 ohm speakers, 8in. 12/6, 10in. 15/3.

VAUXHALL.—Rola G.12 P.M. speakers, 69/6; G.12 energised, 55/-; brand new, with input transformer; flat sheet copper, 12×12in. 3/9, 12×24in 6/6, 24×24in. 9/3.

VAUXHALL.—Collaro A.C. gramophone motors, turntable, 29/-; Collaro A.C. motors, with magnetic pick-up complete, 50/-; Collaro A.C. motor, with crystal pick-up complete, 65/-.

VAUXHALL.—Bar type condensers, straight 0.0005 mfd., trimmers, 2-gang 6/6, 3-gang 8/6; Full-vision drives, station named, 6/-

VAUXHALL.—Iron cored coils on base, with switch, terminals, circuit, 2-gang 12/6, 3-gang 19/6; 1-watt resistors, 4d.

VAUXHALL.—High class electric dry shavers, for A.C./D.C. mains, 27/6; guaranteed electric lamps, 1,000-hour service, all voltages, 1/-, post 2½d.

VAUXHALL.—Skeleton metal rectifiers, H.T.10 11/-, H.T.9 9/-; valve-holders, 7-pin 6d., 5-pin 5d.; volume controls, 2/-, with switch 3/-.

VAUXHALL.—T.C.C. aluminium containers, 8 mfd., 600v., 3/-; T.C.C. cardboard containers, 8 mfd., 500v., 2/-; 8 plus 8 mfd., 3/6; 6 plus 4 mfd., 350v., 1/9.

VAUXHALL.—Electrolytic condensers, 50 mfd. 50v. 1/9, 50 mfd. 12v. 1/6, 0.1 mfd. 3d.; tubular types.

VAUXHALL UTILITIES, 163a, Strand, London, W.C.2. Write for new free list. [8867

MAINS RADIO DEVELOPMENT COMPANY'S Super Service. Orders sent immediately, carriage paid or C.O.D. Please note new address, telephone Tudor 4046. Stamp for list 233.

T.C.C. Unused Metal Can Dry Electrolytics, 8 mfd.; 500 volt, 2/9; Hunts card, 50 mfd., 12 volt, 1/-; 25 mfd., 25 volt, 1/-.

T.C.C. Card Case Electrolytics 600 volt surge, 8 mfd., 2/-; 8×8 mfd., 3/6; B.I.C. 50 mfd., 50 volt, 1/9.

N.S.F. Unused Wire End Resistors, marked and colour coded, ½, 1 and 2 watt, ten different useful sizes in each parcel of 20 resistors; 1/- the 20, only.

TUBULAR Condensers, unused, wire ends, best make, 400 volt working, 0.0001 to 0.1 mfd., 5d.; 0.25, 0.5 mfd., 8d.

CLIX Latest Unused Chassis Valve Holders, English 5-pin, 7-pin, 4d.; all American sizes, 6d.; standard sleeving, 1½d. yard.

CENTRALAB Unused Latest Potentiometers, long standard spindle, all sizes, 2/3, with switch 2/6.

DUBILIER Unused Mica Condensers, midget tags, 0.00005 to 0.00005 mfd., 3d. each, 2/9 dozen.

ERIE Unused One-watt Resistors, all sizes; 4d. each, 3/6 dozen; two-watt, 7d.

MAINS RADIO DEVELOPMENT COMPANY, 52a, Church Crescent, Muswell Hill, London, N.10. [8709

COULPHONE RADIO, 22, Grimshaw Lane, Ormskirk.—Collaro A.C. gramophone motors, 12in. turntable, 25/-; crystal pick-ups, 22/6. Valves, midgets, all-dry portables at lower prices. 1½d. stamp for list. [8764

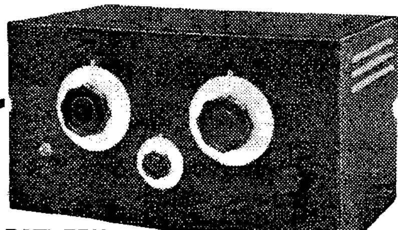
5/- Only.—Bargain parcel comprising speaker cabinet, drilled steel chassis, condensers, resistances, and many other useful components, worth 35/-, limited number; postage 1/-.—Bakers Selhurst Radio, 75, Sussex Rd., South Croydon. [8723

MISCELLANEOUS

CARDS, memos, billheads; 1,000, 5/9; samples.—"B," Tices, 11, Oaklands Grove, London, W.12. [8861

TORCH Batteries, cases and bulbs from actual importers; also large stock of British made non-Association cable and conduit at considerably less than to-day's market prices.—W. H. Armytage, Ltd., 26, Aldermanbury, Bradford, Yorks. [8770

AN EMERGENCY SET IS VITAL



BATTERY OPERATED.

GET THIS

EDDYSTONE

"IMPROVED EVERYMAN" SHORT-WAVE RECEIVER

This Improved "Everyman" Short-wave Receiver is ideal for the listener who is looking for a simple yet reliable and efficient short-wave set at a cost below that of the more elaborate and complicated Superheterodyne models. The "Everyman" gives a splendid all-round performance and has the professional appearance of the latest communication type sets; and what is more, it "puts the World at your finger-tips"—it gives a remarkable variety of stations from all over the World whenever you choose to "switch on."

THE IDEAL RECEIVER FOR STAND-BY SERVICE

L.T. 2 V. ·5 AMP. H.T. 120 V. 12 mA.

The circuit comprises an aperiodic high frequency valve, a screened-grid detector and a two-stage audio amplifier section. The aperiodic high frequency circuit is fitted with a specific purpose in mind. The stage does not, in itself, afford much degree of gain *but it ensures completely stable operation with freedom from blind tuning spots and hand capacity, and a smooth consistent reaction control.* It also prevents re-radiation on the aerial when regeneration is applied so that no interference is caused and further enables much greater degree of gain and selectivity to be obtained from the high magnification screened-grid detector stage.
The first audio stage is resistance-coupled and is followed by an L.F. transformer. The bandspread method of tuning makes the receiver easy to handle and facilitates the thrill of long distance reception on the short wavebands—which this Set provides in ample measure.
This Receiver enables you to tune from 9.85 metres to 2,000 metres and covers all popular wavebands including the Empire transmitters at Daventry, such stations as Rome, Moscow, Berlin, Pittsburg, Schenectady, etc.; also ships at sea, coast stations, trawlers, aircraft, police and the medium and long-wave broadcast—lively interest all the time.
Together with valves and coils tuning 9.85 metres to 96 metres, simply outstanding value at—

£10 - 15 - 0

for World-wide Listening

(Coils for wavelengths up to 2,000 are available.)

WRITE NOW FOR AN "EVERYMAN" SET—OR LITERATURE, to:—

STRATTON & Co. Ltd.

EDDYSTONE WORKS, BROMSGROVE STREET, BIRMINGHAM

OR SERVICE DEPOTS

WEBB'S LONDON: 14 Soho Street, W.1. BIRMINGHAM: 133 New St., 41 Carr's Lane, 23 Shirley Road, Acocks Green.

COUPON

To STRATTON & Co., Ltd., EDDYSTONE WORKS, BROMSGROVE ST., BIRMINGHAM
Please send me full descriptive details of the Improved "Everyman" Short-wave Receiver and address of my nearest stockist.

Name ....

Address ....

....

MISCELLANEOUS

EVERY Radio Dealer Who is Not a Regular Reader of "The Wireless and Electrical Trader" should send his trade card at once for a specimen copy and full details of the "Trader" Services. "The Wireless and Electrical Trader" has the widest influence, the largest weekly circulation, and is read by all the leading manufacturers and traders. Trade only. 15/- per annum, post free. Published at Dorset House, Stamford St., London, S.E.1. [0615

REPAIRS AND SERVICE

LOUD-SPEAKER Repairs, British, American, any make, 24 hours' service; moderate prices.—Sinclair Speakers, Pulteney Terrace, Copenhagen St., N.1. [8876

GUARANTEED Repairs, any transformers, choke, motor armature, converter, dynamo, etc.; keenest prices, immediate quotation, prompt, dependable service.—See below.

L.T.P. (LONDON TRANSFORMER PRODUCTS, Ltd.), Willesden, N.W.10. Willesden 6486 (3 lines). [6892

MAINS Transformer Service, repairs, rewinds, or construction to specification of any type, competitive prices and prompt service.—Sturdy Electric Co., Dipton, Newcastle-on-Tyne. [0516

"SERVICE with a Smile."—Repairers of all types of British and American receivers; coil rewinds; American valves, spares, line cords.—F.R.I., Ltd., 22, Howland St., W.1. Museum 5675. [8776

METROPOLITAN RADIO SERVICE.—Guaranteed repairs to American and British receivers; American valves, service parts and rewinds; trade supplied.—1021, Finchley Rd., N.W.1. Speedwell 3000. [0435

REPAIRS to Moving Coil Speakers; cones/coils fitted or rewound; fields altered or wound; prices quoted, including eliminators; pick-ups and speaker transformers rewound, 4/6; trade invited; guaranteed satisfaction; prompt service.—L. S. Repair Works, 5, Balham Grove, London, S.W.12. Battersea 1321. [0394

CHALLENGER RADIO CORPORATION.—Repairers of British and American receivers to the trade; lowest prices with good workmanship; "service with a guarantee"; also speakers, transformers, coils, etc., rewound.—Challenger Radio Corporation, 31, Craven Terrace, Lancaster Gate, London, W.2. Paddington 6492. [8788

SITUATIONS VACANT

AIR MINISTRY.

AERONAUTICAL Inspection Directorate.

VACANCIES Exist for Unestablished Appointments as Examiners in the General Engineering and W./T. and Instrument Branches.

QUALIFICATIONS:

ALL Candidates Must Have a Good General Education, be able to read drawings, understand specifications, use micrometers and other measuring instruments.

(A) Applicants for the General Engineering Branch must have had practical experience in an engineering works. An elementary knowledge of materials testing is desirable.

(B) Applicants for the Instrument Branch must have knowledge of physics and training in light engineering or instrument making. Candidates with knowledge of optical instruments are also required.

(C) Applicants for the W./T. Branch must have practical knowledge of W./T. and electrical equipment, with technical training in radio communication equal to City and Guilds final examination standard.

APPLICATIONS from Candidates Previously Interviewed and Declared Unsuccessful will be considered provided the necessary additional experience has been gained.

ACCEPTED Candidates Will Undergo a Period of Training in Inspection as Applied to the Above Subjects, not exceeding three months, and will be paid £3/10 weekly during training. Subsistence allowance of £1/5 weekly during training is payable to married men normally residing outside the training area. On successful completion of training, candidates will be appointed as Examiners at a salary of £246/9 per annum (payable monthly in arrear) if service is satisfactory, and must be prepared to serve in any part of the United Kingdom.

NORMAL Age Limits 25 to 55.

CANDIDATES Should Indicate on Their Applications for Which Vacancy They Wish to be Considered—A, B, or C.

APPLICATION Must be Made on Form 786, copies of which can be obtained on application, by postcard only, to: The Inspector-in-Charge, A.I.D. Training School (I.C.S./REC 521), Brandon Steep, Bristol, 1. [8851

WARD

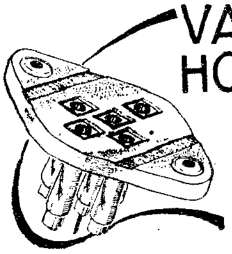
WE MANUFACTURE:
ROTARY CONVERTERS DC/AC for operating P.A. amplifiers, Radio Receivers, etc.
DC/DC ROTARY TRANSFORMERS, SMALL ALTERNATORS, SMALL D/C MOTORS, H.T. GENERATORS. MAINS TRANSFORMERS up to 10 k.v.a. **PETROL ELECTRIC** generator sets up to 50 k.v.a.
BATTERY CHARGERS for private and industrial use.

We can also handle general small engineering work.

Full details of any of the above upon request

CHAS. F. WARD
46, FARRINGDON ST., LONDON, E.C.4
Telephone: Holborn 9703.
Works: Bow, E.

VALVE-HOLDERS

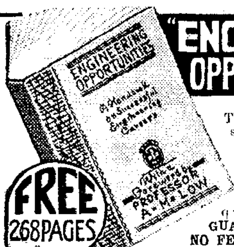


Valve-holders embodying the perfect contact helically slotted CLIX socket built on laminated plastic or Frequentite CERAMIC plates—for all standard valves and all conditions of service.

CLIX

BRITISH MECHANICAL PRODUCTIONS LTD.
1, Church Road, Leatherhead, Surrey.

"ENGINEERING OPPORTUNITIES"



This unique Handbook shows the easy way to secure A.M.I.C.E. A.M.I.Mech.E. A.M.I.E.E., A.M.I.A.E. A.M.I.W.T., A.M.I.R.E. and similar qualifications. WE GUARANTEE—"NO PASS—NO FEE." Details are given of over 150 Diploma Courses in all branches of Civil, Mech., Elec., Motor, Aero, Radio and Television Engineering, Building, Government Employment, etc. Write for this enlightening Handbook to-day, FREE and post free.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY
367 Shakespeare House,
17, 18, 19 Stratford Place, London, W.1

LEONARD HEYS for REMINGTON-RAND, PACKARD, CASCO, RABALDO, and SHAVE MASTER Electrical Dry Shavers.
LEONARD HEYS for the BEST lines in Electrical FIRES, IRONS, TOASTERS, HAIR-DRYERS, VACUUMS, SUNLAMPS, KETTLES.
Send TRADE CARD for our lists.

LEONARD HEYS
Faraday House, 36, Henry Street, BLACKPOOL, Lancs.

TRIX

SOUND EQUIPMENT

for QUALITY & RELIABILITY
The TRIX ELECTRICAL COMPANY LTD.
65, Bolsover St., London, W.1. Euston 5471

SITUATIONS VACANT

ROYAL ARMY ORDNANCE CORPS.

FULLY Qualified Radio Engineers are Urgently Required by the Royal Army Ordnance Corps for the maintenance and repair of wireless and signalling equipment.

EMERGENCY Commissions in the rank of Lieutenant will be granted to suitable applicants, who should be between the ages of 23 and 40 years.

CANDIDATES Must Fulfil All the Following Conditions:—

(1) They must have had practical experience in the design, manufacture, or repair of short wave transmitters and receivers; or laboratory experience in short wave communication work.

(2) They must possess a University degree in electrical engineering, with specialisation in radio or telecommunications; or equivalent academic qualifications.

THE rate of pay in force at present is approximately £300 per annum, with, in addition, an allowance of approximately £200 for married, and £130 for single, officers in lieu of lodging, rations, etc., when not granted in kind. Initial allowances of £30 for uniform and £5 for camp kit are also granted.

ACCEPTED Candidates Will be Required to Serve at Home or Overseas as necessary.

APPLICATIONS should be made in Writing to the Under-Secretary of State (A.G.9), The War Office, Hobart House, Grosvenor Place, London, S.W.1.

IT is emphasised that the qualifications stated are essential, and applicants not so qualified cannot be considered for the appointment. [8860

AIR MINISTRY.—Civilian Wireless Instructors Required.

VACANCIES Exist for Civilian Wireless Instructors at the Electrical and Wireless Schools, Royal Air Force. The commencing rate of pay is £4/5 a week, inclusive, which may be increased to £4/10 a week after a short period of satisfactory service. Candidates must be capable of lecturing and must have a sound knowledge of electrical principles and their application to radio and low-power electrical engineering. Applications should be addressed to the Under-Secretary of State (S.5.d.), Air Ministry, Kingsway, W.C.2, giving particulars as to previous experience, age, &c. Suitable candidates will be required to appear before a Selection Board at the School for interview and trade test, but may be reimbursed the cost of third class travelling expenses for this purpose. The test will include the giving of a lecture on any subject which may be chosen by the candidate involving the principles of modern radio. Lecturing sequence and style are most important. [0616

TECHNICAL Assistant Required, electro-acoustical engineer; must possess initiative and knowledge.—Write experience, etc., Tannoy Products, West Norwood, S.E.27. [8849

WANTED, experienced relay service linesman; provincial town; state age, weekly wage; send references; permanent work.—Box 1595, c/o *The Wireless World.* [8854

SCOTLAND.—Constructional engineer with factory experience in building radio-telephone transmitters, business interest to right man.—Box 1690, c/o *The Wireless World.* [8866

EXPERIENCED Instrument Makers Required, rate 1/8 to 2/- per hour for 46¼hr. week.—Apply Employment Dept., Murphy Radio, Ltd., Welwyn Garden City, or nearest Employment Exchange. [8828

WANTED, picture telegraphy operators in London, Manchester and Glasgow; no previous experience; good audio-frequency technicians; salary £250-£350; age 35-40.—Box 1696, c/o *The Wireless World.* [8874

ASSEMBLERS and Wiremen.—A number of good experienced assemblers and wiremen required, special radio and amplifier work; write, stating experience and rate.—Tannoy Products, West Norwood, S.E.27. [8848

RADIO Service Engineers Required Immediately by Radio Rentals, Ltd., own saloon cars essential; vacancies London and Provinces.—Write, stating age and experience, to Service Manager, 89, Newington Butts, S.E.11. [8879

RADIO Testers Required, applicants must have had technical training and experience of receiver circuit trimming on factory production lines.—Apply Employment Dept., Murphy Radio, Ltd., Welwyn Garden City, or nearest employment exchange. [8820

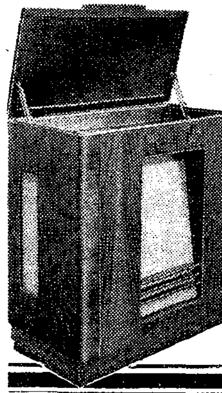
JUNIOR and Senior Inspectors Required for Transmission equipment operating in the voice and carrier frequency ranges. Applications from radio service engineers invited.—Reply, stating age, salary and experience to Box 1518, c/o *The Wireless World.* [8878

RADIO and Electrical Service Engineer Required by West London dealer specialising Murphy, H.M.V., Pye, undertake aerial installations, familiar all makes, able drive car.—Write full particulars, wages required and references to Box 1601, c/o *The Wireless World.* [8855

Lockwood CABINETS

ACOUSTICALLY DESIGNED

The only Standard Radio Cabinets with acoustic lining.



Our Model AD500 has been designed for Quality Reproduction. An idea of its efficiency and freedom from "box resonance" can be obtained from the weight which is approximately ¾ cwt.

For full details of this and other standard models send 1½d. stamp.

Special designs to your requirements — FREE on request.

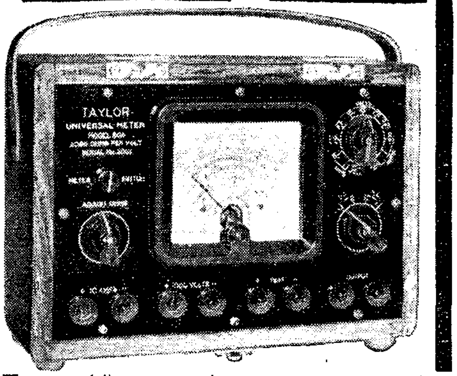
LOCKWOOD & CO.
65, LOWLANDS RD., HARROW, MIDDX.
'Phone: BYRon 1818

Mains Transformers to customers' own specifications, or in accordance with our standard list—of which we would be glad to send you a copy.

W. BRYAN SAVAGE LTD.
Westmoreland Rd., London, N.W.9. 'Phone: Colindale 7131

THE 70-RANGE, BRITISH-MADE

TAYLOR METER



is a fully guaranteed, most comprehensive, precision-built instrument, very low in price considering its sensitivity, accuracy and reliability. Fitted with a sturdy 4½ in. moving-coil jewelled movement, it covers D.C. volts 0.002-2,000; A.C. output and volts 0.2-2,000; D.C. current 10 mA-20 Amps; A.C. current 10 mA-5 Amps; Resistance 0.1 ohm-5 megohms with internal battery. Output, —18 to +60 DB. Adaptors are available for extending still further the voltage ranges.

MODEL 80A
2,000 ohms per volt.
A.C. & D.C.
11 GNS.

Our range of precision-built instruments include Single and Multi-Range Meters...Valve Testers...Signal Generators...Oscilloscopes...If you will please put a tick after which interests you, we shall be pleased to send you particulars/arrange for you to have a free test (cross out which you do not require). Then cut out this advertisement, and send it together with your name and address, to:—

TAYLOR ELECTRICAL INSTRUMENTS LTD.
NOTE NEW ADDRESS 419-422, Montrose Avenue, Slough Trading Estate, Bucks.
Phone: Slough 20061.

SITUATIONS VACANT

RADIO Service Man, over 30, wanted, some knowledge of amplifiers preferred.—Send full details, age and wage; permanent job for right man.—Box 1594, c/o *The Wireless World.* [8853

FOREMAN Wanted for Radio Assembly Shop for Established Works in Lancashire Area; applicants should have had actual experience in supervision and organisation of up-to-date radio set assembly and should give full details of experience, qualifications and salary required.—Write Box 716, Dorlands, 14-16, Regent St., S.W.1. [8867

VACANCIES Exist for Valve Designers in the Laboratory of a Well-known Firm of Wireless Valve Manufacturers; applicants must have had considerable personal experience in the design of receiving and/or transmitting valves, and should possess academic qualifications in physics or electrical engineering.—Applications should be made by letter, giving full details of experience and salary required, to Box 1525, c/o *The Wireless World.* [8847

ENGINEERING Technical Assistants Required by London Aircraft Engineering Firm, with previous experience on aero engines, some technical training essential, intermediate B.Sc. or similar; applicants should be capable of acting on their own initiative, staff position, good prospects to suitable applicants.—Write fully, in confidence, experience, age and salary required, to Box 7830, A.K. Advg., 4, Talbot Mansions, Museum St., W.C.1. [8875

A RESEARCH Engineer for Deaf Aids, London, W., age 30-35, to design microphones, miniature amplifiers, earphones, calibrated oscillators. Commencing wage up to £8. Excellent prospects for first class man with ability, practical mind and imagination wishing for scope for original work with young company seeking to manufacture the best hearing aids for world markets.—Write full experience Box 1610, c/o *The Wireless World.* [8856

A VACANCY Exists for a Senior Research Assistant in the laboratory of a well-known firm of wireless valve manufacturers. The subject for research is connected with secondary emission phenomena, and applicants must have had considerable experience in this or some nearly related subject.—Good academic qualifications should be held and full details should be given, including salary required, by letter to Box 1524, c/o *The Wireless World.* [8846

VACANCIES Exist for Civilian Morse and Procedure Instructors at the Electrical and Wireless Schools, Royal Air Force, at an initial rate of pay of £4/5 per week, increasing to £4/10 per week on the satisfactory completion of a probationary period, and thereafter by annual increments of 2/6 per week to a maximum of £5 per week. Candidates must be able to send and receive morse at not less than 25 w.p.m. and should have had experience of lecturing and teaching, but consideration will be given to others who consider themselves capable. Applications should be addressed to the Under Secretary of State, Air Ministry (S.5.D.), London, W.C.2, giving full particulars as to previous experience, age, etc. Candidates will be required to appear before a Selection Board at the Schools for interview and test, but may be reimbursed the cost of third-class locomotion expenses for this purpose. [8824

SITUATIONS WANTED

A GRADUATE Engineer (Elect. Commun.), age 26 (exempt military service) desires position as executive's assistant or secretary, workshop and research laboratory experience, collaborative development with Air Ministry and War Office; salary of little importance as industrial experience is mainly desired.—Box 1620, c/o *The Wireless World.* [8857

THE INSTITUTE OF WIRELESS TECHNOLOGY
(Founded in 1925. Incorporated)
PROFESSIONAL MEMBERSHIP
The advantages of professional membership are open to all qualified wireless engineers.
Full information, with syllabus, may be obtained from the Assistant Secretary, Institute of Wireless Technology, 25, Firs Drive, Palmers Green, London, N.13
'Phone: PALMERS GREEN 2413

THE BEST WAY to LEARN MORSE
"MASTERS" INSTRUCTIONAL RECORDS
Prepared by an ex-R.A.F.V.R. Signal Instructor, these records contain messages at a speed from 2 to 15 words a minute. *Details on Request.*
Price 3/6 each or Complete Set of Three 9/-
C. E. MASTERS,
Forest Way, Pound Hill, Crawley, Sussex.

CORRECTION

Will readers kindly note that all MURPHY SETS are guaranteed for one year, EXCLUSIVE of valves and batteries, not "inclusive" as erroneously stated in our advertisement last month.

MURPHY RADIO LTD., WELWYN GARDEN CITY, HERTS.

KINVA WHISTLE SUPPRESSOR

V.5 BALANCE TYPE TUNABLE REJECTOR for Anode Circuit use in HI-FI Sets 30/-
Type V.6, similar, but for Grid Circuit use 28/-
Simpler Tuned Types:—V.2, with switched cut-off 19/6
"Q.A.S." Tunable 12/-
SCRATCH FILTERS, also **TONE CONTROL CHOKES,** are still available.
LIST, CURVES, DETAILS, FREE.
POSTLETHWAITE BROS.,
"Kinva Works," KINVER, STAFFS.

CLASSIFIED ADVERTISEMENTS
intended for the
APRIL ISSUE
can be accepted up to
Friday, March 8th.

MORSE EQUIPMENT

FULL Range of Transmitting Keys, practice sets, oscillators, recorders and other radio Telegraph apparatus, designed and manufactured by T. R. McElroy, world champion telegraphist. Sole distributors: Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089. [8768

PATENT AND TRADE MARK AGENTS

GEE and Co. (H. T. P. Gee, Mem. R.S.G.B., etc.), 51-52, Chancery Lane, London, W.C.2. Holborn 4547-8. Handbook free. [0001

TECHNICAL TRAINING

BEST Wartime Training in Engineering is Home-study With The T.I.G.B. free from black-out and travel difficulties. Write to-day for "The Engineer's Guide to Success"—free—containing the world's widest choice of engineering courses—over 200—covering all branches—and which alone gives the Regulations for A.M.Inst.C.E., A.M.I.Mech.E., A.M.I.E.E., A.F.R.Ae.S., A.M.I.A.E., M.I.M.T., C. & G., etc. The T.I.G.B. guarantees training until successful.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN, 82, Temple Bar House, London, E.C.4. (Founded 1917; 20,000 Successes.) [8852

TUITION

RADIO Training.—P.M.G. exams. and I.E.E. Diploma; prospectus free.—Technical College, Hull. [0611

RADIO Officers (Marine), P.M.G. Special Certificate; free prospectus.—Marine School, South Shields. [8825

PRACTICAL Postal Courses, radio television; test equipment design; I.P.R.E. and I.W.T. exams.—Write I.P.E., 3, Shirley Rd., London, W.4. [8838

BUSINESS & PROPERTY FOR SALE, TO BE LET, OR WANTED

"THE Wireless and Electrical Trader" is an essential part of the equipment of every Wireless Trader; its pages reflect the very latest turn of trade events, and it is read by all the leading dealers and manufacturers, for particulars of businesses offered or wanted. By subscription, to the trade only, 15/- per annum, post free.—Send your trade card for specimen copy to Dorset House, Stamford St., London, S.E.1. [0614

BOOKS, INSTRUCTION, ETC.

NEW Edition, American Amateur Relay League Handbook, 500 pages of up-to-the-minute technical information, 7/- post free. 1940 JONES Handbook; approximately 700 pages dealing with every aspect of short-wave radio, 8/6 post free.—Webb's Radio, 14, Soho St., London, W.1. 'Phone: Gerrard 2089. [8765

WEBB'S Radio Map of the World Enables You to Locate Any Station Heard. Size 40in. by 30in. 2-colour heavy art paper, 4/6. Limited supply on linen, 10/6. Webb's Radio Globe, superb, 12in. full-colour model. Radio prefixes, zones, etc. Heavy oxydised mount. Post paid, 27/6.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089. [8767

INDEX TO ADVERTISEMENTS

Printed in England 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. "The Wireless World" can be obtained abroad from the following: FRANCE: W. H. Smith & Son, 248, Rue Rivoli, Paris; Hachette et Cie, Rue Réaumur, Paris, and branches; Messageries Dawson, 4, Rue de Faubourg Poissoniere, Paris. BELGIUM: W. H. Smith & Son, 74-75, Boulevard Adolphe Max, Brussels. AUSTRALIA: Gordon & Gotch, Ltd., Melbourne (Victoria), Sydney (N.S.W.), Brisbane (Queensland), Adelaide (S.A.), Perth (W.A.), and Launceston (Tasmania). NEW ZEALAND: Gordon & Gotch, Ltd., Wellington, Auckland, Christchurch and Dunedin. INDIA: A. H. Wheeler & Co., Bombay, Allahabad and Calcutta. CANADA: Imperial News Co., Toronto, Winnipeg and Vancouver; Benjamin News Co., Montreal; Gordon & Gotch, Ltd., Toronto. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd., Cape Town. UNITED STATES: The International News Co., New York.

"HIS MASTER'S VOICE"

announce model 1403

AN ALL-DRY BATTERY PORTABLE

"HIS MASTERS VOICE"

Just out! This new, good-looking, popular-priced 4-valve *all-dry battery* portable, with "H.M.V." true-to-life tone ● As cheap to run as an equivalent model worked from an accumulator ● No accumulator charging ● H.T. and L.T. batteries combined in one unit, giving approximately 250 hours' service.

PRICE £8 : 10 : 6

- Two wavebands: M.W. 200–565 metres; L.W. 850–2,000 metres.
- Three simple controls, comprising Tuner, Volume and combined Waveband-On/off switch.
- Station-name and wave-length calibrated scale.
- Automatic waveband and "off" Indicator.
- High efficiency lightweight moving-coil speaker.
- Automatic grid bias.
- Lightweight cabinet covered in mid-night blue high-grade leather cloth.
- Smooth-running turntable.
- Supplied complete with combined H.T. and L.T. battery unit (Type B.140).
- Provision for connection of separate batteries if desired.
- Size: Height 10⅞". Width 14⅜". Depth 7⅝". Weight with battery, 21 lb. 13 oz.

★ *Model 1403 incorporates a frame aerial of entirely new design which contributes to the exceptional efficiency of the circuit both on medium and long waves.*