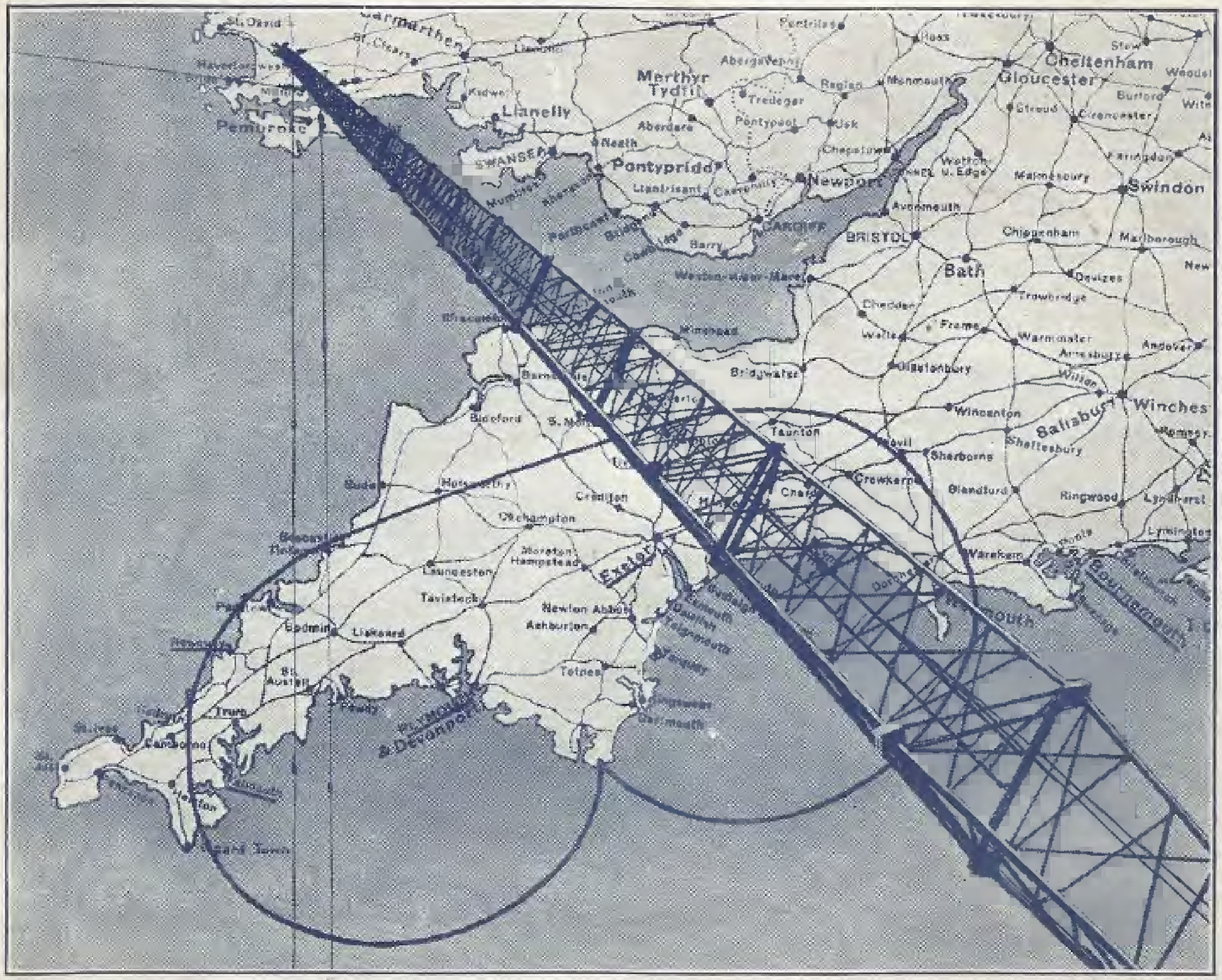
HIGH-TENSION BATTERY ECONOMY

The Wireless World

MONTHLY
ONE SHILLING

COVERING EVERY WIRELESS INTEREST

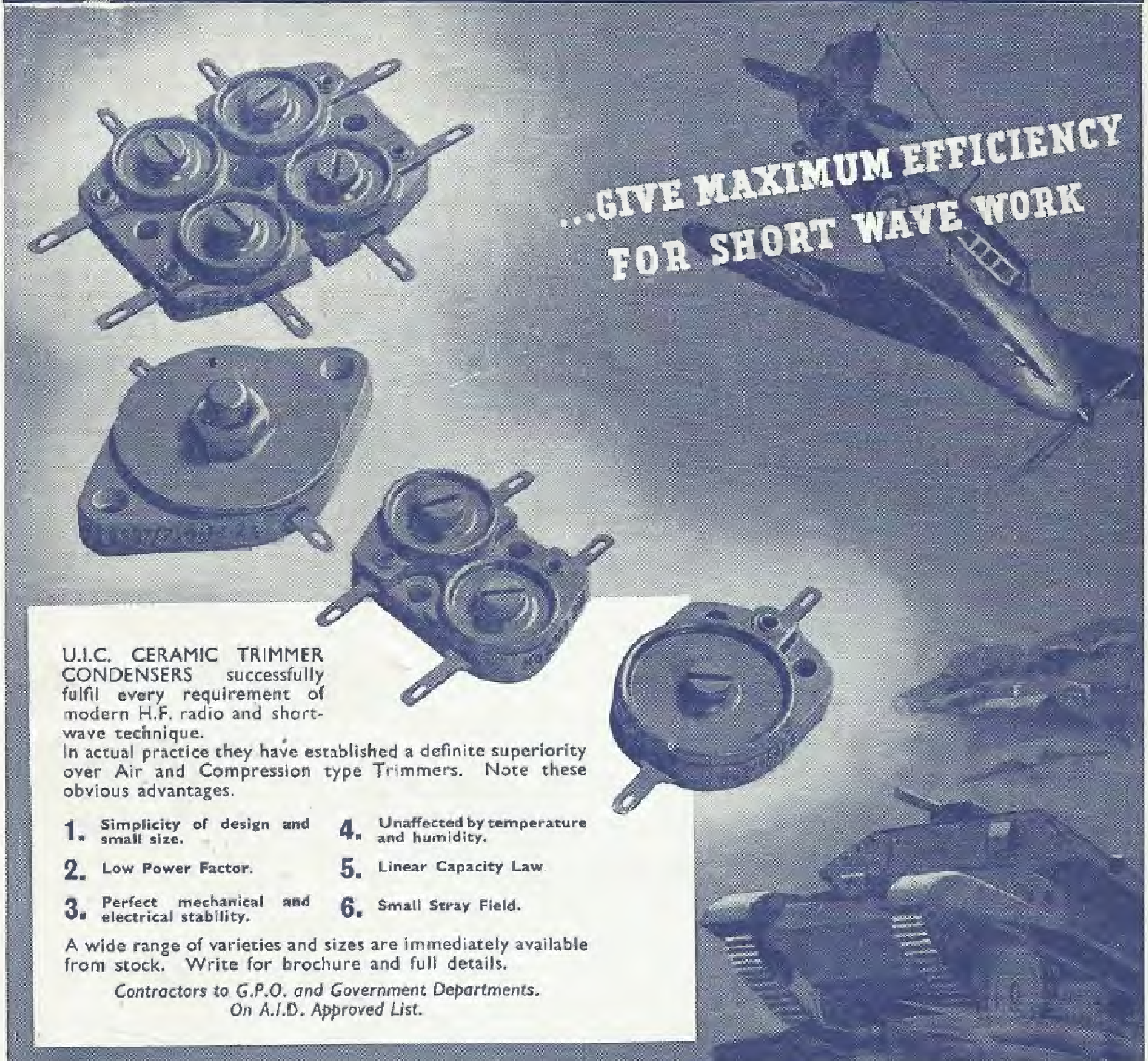
JANUARY, 1941



DIRECTIONAL BROADCASTING ON MEDIUM WAVES

No. 1063 Vol. XLVII No. 1

U.I.C. CERAMIC TRIMMER CONDENSERS



U.I.C. CERAMIC TRIMMER CONDENSERS successfully fulfil every requirement of modern H.F. radio and short-wave technique.

In actual practice they have established a definite superiority over Air and Compression type Trimmers. Note these obvious advantages.

1. Simplicity of design and small size.
2. Low Power Factor.
3. Perfect mechanical and electrical stability.
4. Unaffected by temperature and humidity.
5. Linear Capacity Law
6. Small Stray Field.

A wide range of varieties and sizes are immediately available from stock. Write for brochure and full details.

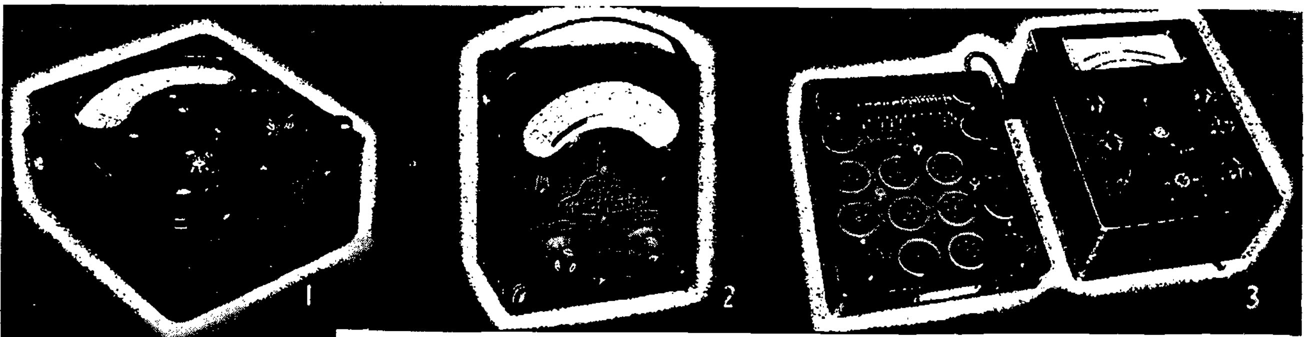
Contractors to G.P.O. and Government Departments.
On A.I.D. Approved List.

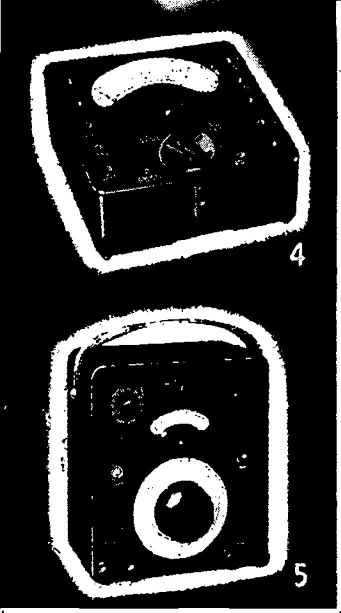
UNITED INSULATOR C^O L^TD

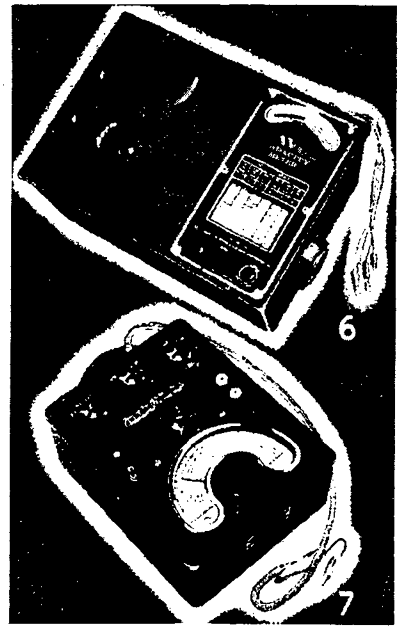
The Pioneers of Low Loss Ceramics

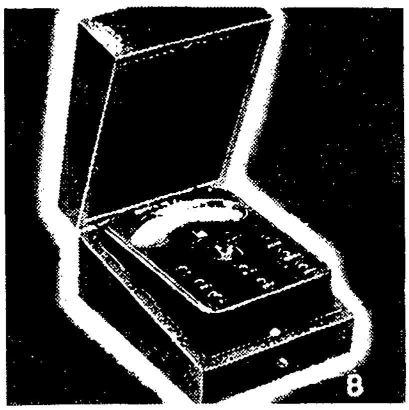
12-16 LAYSTALL STREET
LONDON. E.C.1

Tel: TERMINUS 4118-9 *Grams:* CALANEL, SMITH, LONDON









PREMIER RADIO

The Directors and Staff desire to express their Good Wishes to all Friends and Readers at Home and Overseas

PREMIER 1941 "5V5" COMMUNICATIONS RECEIVER

A 5-valve Superhet, covering 12-2,000 metres in 5 wave bands.

- Beat Frequency Oscillator.
- 2-spread Band-Spread Control.
- A.V.C. Switch.
- Illuminated Band-Spread Dial.
- Send-Receive Switch.
- Iron-Cored IF.s.
- Phone Jack.
- Over 4 Watts Output.

Built into Black Crackle Steel case providing complete screening. 10½in. Moving Coil Speaker in separate steel cabinet to match. Receiver, complete with all tubes and Speaker... ... **£9.9.0**

PREMIER 1941 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
4-watt A.C. Amplifier	£2 14 0	£3 11 6
4-watt A.C./D.C. ,,	3 0 0	3 17 6
6-watt A.C. ,,	6 16 6	7 13 6
8-10 watt A.C./D.C.,,	6 11 6	7 9 0
15-watt A.C. ,,	7 18 9	9 8 0

Black Crackle Steel Cabinet, 17/6 extra.

MAINS TRANSFORMERS

Wire-ends. All L.T. Windings Centre-Tapped

SP 250	250-0-250 v. 60 ma., 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 2-3 a.	11/9
SP 300	300-0-300 v. 60 ma., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a.	11/9
SP 301	300-300 v. 150 ma., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 1 a., 4 v. 1 a.	15/-
SP 350A	350-350 v. 100 ma., 5 v. 2 a. (not C.T.), 6.3 v. 2-3 a.	14/-
SP 350B	350-350 v. 100 ma., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a.	14/-
SP 351	350-350 v. 150 ma., 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 3-4 a.	15/-
SP 352	350-350 v. 150 ma., 5 v. 2 a., 6.3 v. 2 a., 6.3 v. 2 a.	15/9

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/-

Push-Pull Driver Transformers, 3:1 ... ... 6/6

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

MATCHMAKER UNIVERSAL OUTPUT TRANSFORMERS

Will match any output valves to any speaker impedance.
11 ratios from 13 : 1 to 80 : 1, 5-7 watts, 15/9. 10-15 watts, 20/6. 20-30 watts, 35/-.

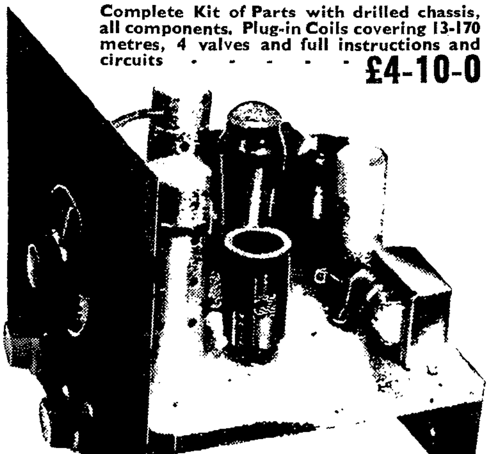
"LEARNING MORSE"

Premier Morse Key, Bakelite Base and Brass Movement	3/3
General Purpose Morse Key	5/10
Heavy Duty TX Key on Cast Base... ...	10/-
Bakelite Buzzers	2/-
3 Henry Chokes	7/6
Complete Kit of Parts for Valve Oscillator as described in W.W. "Learning Morse"	25/-

NEW PREMIER S.W. A.C. RECEIVER

In response to many requests we have now produced an A.C. version of the popular Premier Short Wave SG3 Kit. Circuit : Pentode H.F. Stage, Pentode Detector, Beam Power Output, and F.W. Rectifier. 200-250 v. A.C. Operation. Built-in Power Pack. Hum-free operation. For use with Phones or P.M. Speaker.

Complete Kit of Parts with drilled chassis, all components. Plug-in Coils covering 13-170 metres, 4 valves and full instructions and circuits - - - - - - £4-10-0



COMPLETE A.C. CHASSIS
Wired and Tested
£5.10.0

BATTERY VERSION also available. KIT £3 8 0
COMPLETE CHASSIS wired and Tested £3 18 6
EXTRA COILS 9—15, 200—2000m. also supplied

"The Wireless World" said they were "very much impressed . . . ."

See full Test Report pp. 492-3 December issue
Send for full details

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

ALL ENQUIRIES MUST BE ACCOMPANIED BY 2½d. STAMP

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

1-V. S.W. Receiver or Adaptor Kit ...	20/-
1-V. S.W. Superhet Converter Kit ...	23/-
1-V. S.W. A.C. Superhet Converter Kit	26/3
2-V. S.W. Receiver Kit	29/-

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, 7/6.
Bakelite Dielectric Variable Condensers. .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.
Lissen Dual Range Screened Coils. Medium and Long Waves, 2/9 each.

SHORT-WAVE CONDENSERS

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

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

PREMIER MICROPHONES

Transverse Current Mike, High grade large output unit. Response 45-7,500 cycles. Low hiss level, 23/-.
Moving Coil Mike. Permanent magnet model requiring no energising. Response 90-5,200 cycles. Output .25 volt average. Excellent reproduction of speech and music, 49/-.
Microphone Transformers. Suitable for all mikes. Tapped secondaries. A, 20 and 40 : 1 ; B, 30 and 60 : 1 ; C, 50 and 100 : 1, 6/6 each.
Microphone Stands. Bakelite table stand, 9in. ring, 7/6 each. **Adjustable Floor Stand**, 8in. ring, Chrome finish, 26/6.

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 5/6 each. A.C./H.P., A.C./V.H.P., 7-pin, 8/6. A.C./Pens. I.H., 8/6 ; A.C./P.X.4, 9/- ; Oct. Freq. Changers, 9/6 ; Double Diode Triodes, 7/6 ; 3½-watt D.H. Triode, 12/-. 350 v. F.W. Rect., 5/6 ; 500 v., 8/9. **13 v. .2 amp.** Gen. Purpose Triodes, 5/6 ; H.F. Pens. and Var.-Mu H.F. Pen., Double Diode Triodes, Oct. Freq. Changers 8/6 each. Full and Half wave Rectifiers, 6/6 each.

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

PREMIER RADIO CO.

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

Greetings to all our Friends

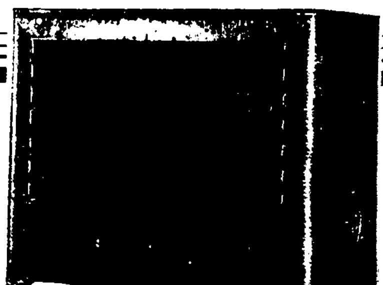
Wherever you may be, whatever duty you may be performing in to-day's fight for liberty and decency, we send to you sincere

Hearty Greetings and Good Wishes

May the Best of Luck attend you in the months to come.

THE DIRECTORS AND STAFF

McMichael Radio Ltd.



Size of Cabinet 15" × 12" × 6½"

WHARFEDALE

EXTENSION SPEAKERS

Prices from 24/-

List on application

The model illustrated is the "LOUVRE" Cabinet with BRONZE Unit and "TRUQUAL" Constant Impedance Volume Control.

Less Transformer **65/-** With Transformer **73/6**

ALL WHARFEDALE EXTENSION SPEAKERS are available WITHOUT Transformer in the following types:

Type "32" for 1½ to 4 Ohms.
Type "64" for 4 to 6 Ohms.
Type "98" for 7 to 10 Ohms.

WHARFEDALE WIRELESS WORKS

Sole Proprietor: D. E. BRIGGS,

HUTCHINSON LANE, BRIGHOUSE, YORKS.

'Phone: BRIGHOUSE 50

32 RANGE UNIVERSAL TAYLOR-METER

(Sensitivity 1,000 ohms per volt A.C. and D.C.)

The set testing functions of this precision instrument covers all ranges essential for carrying out accurate electrical measurements for Radio and General test work.

STUDY THESE FEATURES!

METER
4½" square type Taylor moving coil meter. Sensitivity of 900 microamps.

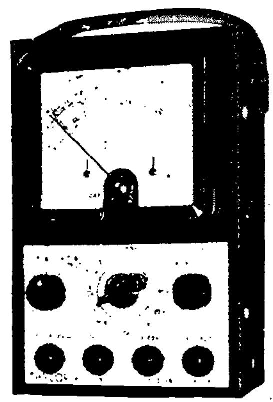
SCALES
The large dial has 3 clearly engraved scales for measurements of Resistance, A.C. and D.C. volts, A.C. volts and amps.

RANGES
The 32 ranges include the following:—
(7) **D.C. Volts** 0-0.25 up to 1,000.
(6) **Output Volts** 0-2.5 up to 1,000.
(6) **A.C. Volts** 0-2.5 up to 1,000.
(5) **D.C. Current** 0-1 mA. up to 2.5 amps.
(4) **Ohms** from 1 to 10 megohms.
(4) **A.C. Current** 0-1 mA. up to 2.5 amps.

SOCKETS
There are 4 on the front panel, "Common," "Test," "1,000v" and "Output."

ACCURACY
A high degree of accuracy is assured as every instrument is carefully checked against our standard.

A fully descriptive technical Brochure of this instrument, free on request.



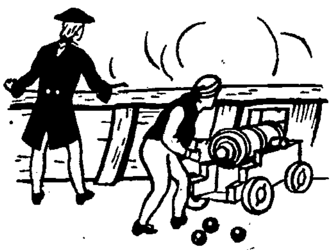
PRICE **£9 . 9 . 0**

(No purchase tax payable)

Complete with leads, test prods and comprehensive book of operating instructions.

Delivery at present ex stock.
BRITISH MADE.
GUARANTEED 6 MONTHS.

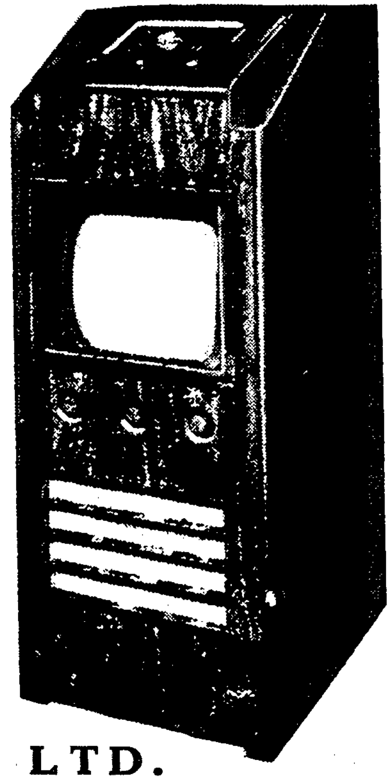
TAYLOR ELECTRICAL INSTRUMENTS LTD.
19-422, Montrose Avenue, SLOUGH, Bucks.
'Phone: Slough 20061



AMAZING OPPORTUNITY!

50 only COSSOR

SHOP SOILED DEMONSTRATION CONSOLES



First class radio receivers are hard to come by these days, and the name Cossor is in itself a guarantee of superlative quality.

- DE LUXE ALL-WAVE RADIO (16m.—2,000 metres).
- HIGH FIDELITY WORLD-WIDE RECEPTION.
- VARIABLE SELECTIVITY—A.V.C.
- CONCERT GRAND ENERGISED 10" MOVING COIL SPEAKER.
- SEPARATE POWER PACK.
- BEAUTIFUL WALNUT CABINET.
- CRYSTAL CLEAR 15" SCREEN TELEVISION READY FOR USE ON RESUMPTION OF TELEVISION PROGRAMMES.
- DELIVERED CARRIAGE PAID ANYWHERE WITHIN 20 MILES OF LONDON.

PRICE (covered by a 12 Months' Guarantee)

£28 · 10

LIST PRICE 53 GNS.

H. H. LINTON LTD.
GRAY'S INN ROAD, LONDON, W.C.1. HOLborn 4543.

RADIO LABORATORY HANDBOOK

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

Issued in conjunction with "The Wireless World"

384 pp.
211 illustrations

PRICE
8/6 net
By post 9/1

"Radio Laboratory Handbook" is the only practical and reliable handbook on the subject. It gives the serious wireless worker complete information from first-hand experience about laboratory equipment, the instruments which are necessary and the correct methods of operating them.

The fundamental principles are fully discussed, as well as the sources of power and signals, instruments and measurements. Other sections deal with ultra-high-frequency work, the working out of results, and reference data. There is also a collection of the most useful symbols, abbreviations, formulae, laws, curves, tables and other data.

A complete index, numbered sections and cross references enable the reader to find what is required without loss of time.

From Bookstalls and Booksellers or direct from the Publishers

ILIFFE & SONS LTD., Dorset House, Stamford St., London, S.E.1

W.W.22

FOUNDATIONS of WIRELESS

By A. L. Sowerby, M.Sc. (*Second Edition*)

A Book of First Principles

The aim of this book is to teach the wireless student the principles on which the design and operation of modern receivers are based. It covers the whole field from the simplest electrical phenomena to the construction of a modern set. All the vital points in receiver design are treated in full detail.

PRICE 5/- net By post 5/6

Issued in conjunction with "THE WIRELESS WORLD" and published by the Proprietors:

ILIFFE & SONS, LTD.
DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1

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

B.I.

COPPER EARTHING RODS

for

WIRELESS APPARATUS

(U.K. Patent Nos. 438598, 423385, 430040).

100% MORE SURFACE AREA

Designed to give a low resistance earth contact. Made from solid drawn H.C. copper. The multiple fins ensure larger surface area and better contact with the earth than any driving earth of similar diameter and weight at present on the market; giving nearly 50 per cent. more contact area than a circular rod of equal diameter, or 100 per cent. more than a solid rod of equal weight.

About 1½" of the rod is left exposed and the earth lead is simply clamped against the rod by means of the copper clamp ring and screw. No sweating or soldering is required. Supplied in two standard sizes, 18" and 24". Longer rods of similar type can be supplied, if desired, to meet special requirements.

B

Regd. Trade Mark.

BRITISH INSULATED CABLES LTD.,

CABLE MAKERS AND ELECTRICAL ENGINEERS,

Head Office: PRESCOT, LANCS.

Telephone No.: PRESCOT 6571.

IMMEDIATE DELIVERY !!!

We all know how difficult it is to get supplies of radio and other goods, owing to shortage of stocks; but here is a useful selection from stocks we hold ready for immediate delivery.

American and British Valves, Transmitting and Receiving.
HRO. and RME. 99 Receivers, and service spares for same.
A large range of Transmitters.
American and British Valve Testers and lab. equipment.
Electrolytic, paper and oil-filled **Condensers.**
Resistors from 1-100 watts, fixed and variable.
Ceramic Valveholders, British and American.
All types of Aerial, Stand-off and feed-through Insulators.
Mains Transformers. Speakers, PM. and energized.
American Public Address **Amplifiers.**
Meters: Moving Coil, Thermo and Moving Iron meters by Ferranti, etc.

IN FACT THE LARGEST STOCK OF RADIO COMPONENTS IN THE BRITISH ISLES.

RAYMART CATALOGUE	G5NI MANUAL
3d. Post Free.	**9d.** Post Free

Requests for quotations on any of the above materials should be accompanied by stamps to cover postage.

NOTE :—*Controlled Equipment can only be supplied to holders of Post Office Permits. Receivers, Transmitters, etc., are only offered to those on work of National importance, or, of course, to Government Departments.*

RADIOMART
G5NI (B'HAM) LTD.

'Phone: Midland 3254.

44 & 48 HOLLOWAY HEAD, BIRMINGHAM, I

ROLA

TRANSFORMER

LAMINATIONS

EIGHT STANDARD SIZES

CORE WIDTHS $\frac{9}{16}$" to 1½" (E's and I's)

AVAILABLE FROM STOCK

A Comprehensive Bulletin together with details of Associated Covers and Clamps with design data will be sent to manufacturers on request.

BRITISH ROLA LIMITED

MINERVA ROAD, PARK ROYAL, N.W.10

WILLESDEN 4322

ERIE

REPLACEMENT

VOLUME CONTROLS

at pre-war prices and pre-war quality

Nothing is skimped in the manufacture of Erie volume controls. Only the finest raw materials that are so essential for efficient operation are used. Even in the face of rising production costs cheaper substitutes that are almost-as-good do not find their way into Erie volume controls.

That is why Erie replacement volume controls are the best value on the market to-day,

SO REPLACE WITH ERIE or better still—*BUILD* with ERIE

Standard Controls

Less switch	**2/6** each
With single pole switch	**3/-** ,,
With double pole switch	**3/6** ,,

Centre tapped controls, Dual and Ganged controls have been withdrawn temporarily.

All fitted with 2½" Brass Spindle. Non-standard spindles 2/- extra.

DEALERS AND SERVICE MEN, who pride themselves on speedy repairs, are asked to remember that although we can offer pre-war quality, and pre-war prices, we cannot always offer pre-war delivery, and we shall appreciate any assistance they can give us by placing orders well in advance.

Complete price list sent on request.

ERIE RESISTOR LIMITED

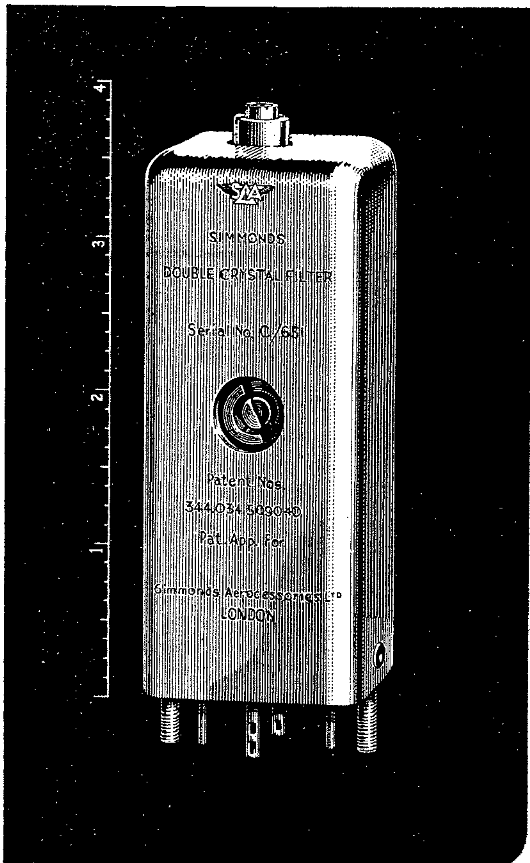
Carlisle Road, The Hyde, Hendon, N.W. 9.

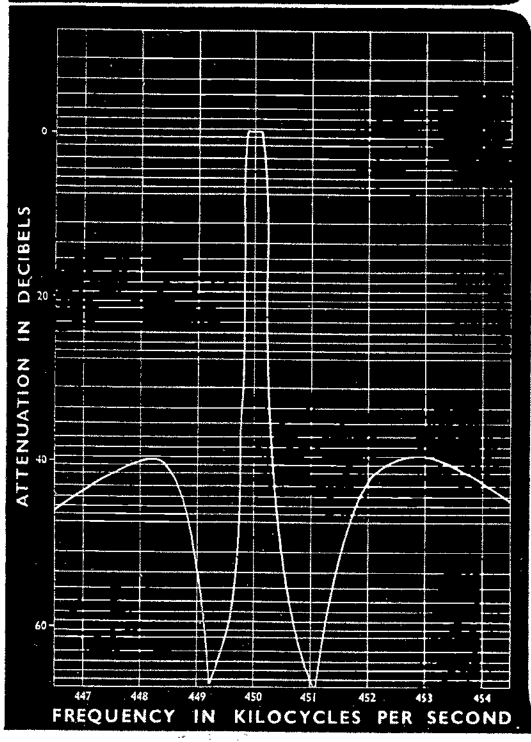
Telephone: COLINDALE 8011.

T.C.C.

Condensers

ADVERTISEMENT OF
THE TELEGRAPH CONDENSER
CO., LTD.





SELECTIVITY

The SIMMONDS Double Crystal Filter provides the simplest and most economical method of obtaining an ideal band-pass in a modern receiver.

Unlike the conventional crystal "gate," the Simmonds Filter gives an almost flat topped response curve with a sharp cut off. This is achieved by means of a pair of matched quartz crystals mounted in a new type holder in which is incorporated a balancing condenser with a rejection control.

Simmonds Crystal Filters are available for intermediate frequencies ranging from 110 kcs. to 1600 kcs. A TELEGRAPHY Filter can be supplied for band-widths from 100 to 500 cycles, while a TELEPHONY Filter is available for band-widths up to 3 kcs. This will be found ample for good quality telephony reception through a background of interference.

As an alternative to the complete filter, pairs of matched crystals can be supplied mounted in holder, for incorporating in I. F. Transformers.

SIMMONDS DOUBLE CRYSTAL FILTER

AN S.A. PRODUCT

SIMMONDS AEROCESSORIES LTD
GREAT WEST ROAD, LONDON.

The
Wireless World

COVERING EVERY WIRELESS INTEREST

30th 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 (35 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. 1063 Vol. XLVII. No. 1

JANUARY, 1941

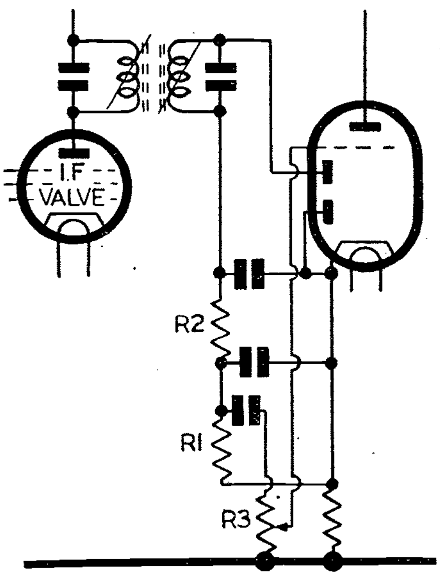
Contents

We wanted **470,000** Ohms...

PLUS or MINUS 10%

IN the "piping days of peace," when even detailed refinements in domestic receiver design were very properly among our most urgent problems, we standardised a tolerance of ± 10% for the resistors used in most parts of the circuit. But to-day, the output of close-tolerance resistors must be reserved for the Services' essential equipment—which leaves available for other purposes only the balance of wider tolerance-resistors. We must use these in broadcast receivers if we are to carry on supplying the public with even a proportion of the sets they need.

Obviously, a widened tolerance may have an effect on many aspects of the performance of the set. Let us take an example. In the diagram,



which shows part of the circuit of a straightforward mains set, R_1 (0.47 MΩ) is the diode load; R_2 (0.1 MΩ) the I.F. decoupling resistance; and R_3 (1.0 MΩ) the volume control. Before the war R_1 and R_2 had a standard tolerance of ± 10%, while R_3 was ± 20%. We have now increased the tolerance of all three to ± 20%, and this change has an effect on the gain, selectivity and quality of the receiver. The question which had to be answered before the change could be made was whether or not the effect would be serious enough to be noticeable in use.

With a diode load right on the low limit, the Q of the secondary of the second I.F. transformer is 4% worse than with the pre-war low limit, while on the high side it is 4% better. This means that the Q of the coupled pair swings approximately ± 2% beyond the old limits, and the gain changes rather more than this because some change of coupling occurs with change of Q. But it is fortunate that the first I.F. transformer is less damped and has a higher Q than the second, so that the overall effect on selectivity and on sideband cutting is quite small.

Some change of gain also occurs because of the change in the potentiometer ratio given by R_2 feeding R_1 and R_3 in parallel. The gain is least when R_1 and R_3 are a minimum and R_2 a maximum, and it is greatest when the reverse is true. With a tolerance of ± 10% the change of gain from this cause was about ± 0.50 dB, while for ± 20% tolerance on all values the change of gain is ± 0.81 dB. Such a variation of gain would really require a side-by-side change-over test to appreciate it, and under to-day's conditions can be ignored.

The AC/DC load ratio of the diode is also affected by these tolerance changes. The AC/DC load ratio is given by :—

$$a = \frac{\dfrac{R_1 R_3}{R_1 + R_3} + R_2}{R_1 + R_2}$$

Inspection of this fraction will show that the value of a is a minimum when R_1 is a maximum, and R_2, R_3 are at their minimum values. So that with the old tolerances the worst value was :—

$$a = \frac{\dfrac{517 \times 800}{1317} + 90}{607} = 0.67$$

while with the new values :—

$$a = \frac{\dfrac{564 \times 800}{1364} + 80}{644} = 0.64$$

Here, as in the other cases, we are a little worse off, but the effect is not serious.

Similar tolerance changes have been necessary in all parts of the receiver, and the overall effect is to produce variations in performance, which, while obvious on measurement and greater than we should like in peacetime, have little effect on the general utility of the receiver and none on its reliability.

It should also be borne in mind (apropos the case we are discussing) that only a small proportion of the resistors used is actually on the limit of tolerance; and sets in which all three resistors are right over to one limit are quite rare. The great majority of sets will still lie close to the mean performance.

And remember, too, that these small changes in the performance of the receiver make all the difference between being able to produce a set and not being able to produce it—the difference between somebody's getting the news and not getting it—and we believe that radio news and radio entertainment are needed to "do their bit" in keeping us cheerful.

MURPHY

All Murphy Sets, exclusive of Valves and Batteries, guaranteed for one year.

MURPHY RADIO LIMITED
WELWYN GARDEN CITY, HERTS

C.R.C.967

The
Wireless World

COVERING EVERY WIRELESS INTEREST

ESTABLISHED 1911

No. 1063. Vol. XLVII. No. 1. JANUARY, 1941 Price One Shilling

Editorial Comment

A Year of Wartime Wireless

WRITING in this journal a day or two after the outbreak of war, we said "there is one thing that we can face with the most serene confidence. The wireless service, though young in years, has already established a tradition of steadfast devotion to duty of which we are all justifiably proud . . . the various branches of the service may meet with difficulties that none of us can yet foresee, but . . . communication will be maintained." As we approach the end of the first full year of war, it is opportune to enquire how far that expectation has been fulfilled.

Wireless communication, in the widest possible sense of the term, *has* been maintained. Paradoxically, wireless is one of the most silent of services, but, although countless stories of devotion to duty will never be made public, enough is already known to prove conclusively that it has not been found wanting.

It is perhaps natural that the Royal Air Force have been most in the public eye, and the kind of cool courage that the wireless man is often called upon to show is well exemplified by the conduct of Sergeant Davidson, who was recently awarded the D.F.M. When the bomber in which he was acting as operator was hit by enemy fire, Davidson, in spite of the fact that he was dazed and temporarily blinded, continued to work his apparatus, though his burned fingers had to be guided to the controls by another member of the crew.

Much of what has been done by wireless personnel of the Navy must be left to the imagination, but we can rest assured that their task has been no enviable one. The casualty lists published after the battle of the River Plate included a high proportion of telegraphist ratings. Similarly, official reticence has cast a veil over the doings of Army wireless men, but enough has filtered through to show that they played a vital part in maintaining communication during the retreat on the Channel ports. Among the fighting Services must now be included the men of the Merchant Navy, who are now bearing the brunt of the intensified German submarine and aerial attacks against our shipping.

Another important link in the communication system of this beleaguered fortress is the B.B.C., which, as all listeners know, has maintained its service, sometimes under "front-line" conditions. The matter broadcast still does not meet with wide approval—it never did and probably never will—and it seems certain that a greater measure of Government control will be imposed on the Corporation's Overseas Service, which, it is good to hear, is to be extended.

In spite of shortage of staff and material, the supply of broadcast receivers has so far been adequately maintained by the wireless industry, which has also provided sinews of war, in the shape of foreign exchange, by its successful attempts to extend the export market. In addition, the industry is supplying vast quantities of equipment to the fighting Services. Altogether, wireless has no reason to be ashamed of itself, and we are confident that, when the history of the present war comes to be written, the contributions made by wireless will be admitted to have been even greater than they were in 1914-1918.

Greetings to Our Readers

IT is not inconsistent with the spirit that should prevail in a beleaguered fortress—especially in one that is so cheerfully and successfully resisting all attacks—to offer the usual Christmas Greetings to our readers. To all members of the big and more-than-ever united family of wireless, whether in the fortress or outside it, in the Services or on the civilian front, the Editor and staff of *The Wireless World* tender their sincere good wishes for Christmas and the New Year.

Directional Broadcasting

REDUCING WASTED RADIATION

The use of directional transmitting aerials—as opposed to "all-round" radiating systems—represents a relatively new and growing trend in the planning of M-W broadcasting services. Means of obtaining directional effects, and examples of their application, are described in this article

FOR many years directional aerials have been used for short-wave wireless services. In such cases the area which it is desired to serve generally subtends a small angle at the transmitter, and it is therefore possible to concentrate the energy into a narrow beam, thus increasing the field strength in the desired direction without increasing the transmitter power.

The use of directional aerial systems for medium-wave broadcasting is much more recent, and the need for these is not at first sight obvious. Generally speaking, a broadcast transmitter is placed at the centre of the area it is required to serve, and a circular horizontal polar diagram, as given by a single vertical aerial, is required.

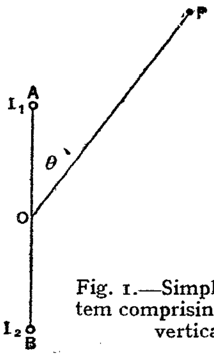


Fig. 1.—Simple directional system comprising a pair of spaced vertical aerials.

In special cases, however, it is desirable to be able to control the shape of the horizontal polar diagram by means of a directional system. The contour of the area to be served may not be circular, or, if circular, there may be advantages in not placing the transmitter at the centre. In serving a region having a long coast line, for instance, it may be better to take advantage of transmission over sea, over which the attenuation is low.

In addition, although theoretically a single aerial gives a circular horizontal polar diagram, in practice this may be far from the case, due to unequal ground attenuation in different directions. As a result of this, if a field strength contour (that is, a line joining points of equal field strength) is measured in the immediate vicinity of the aerial, it will be the same shape as the polar diagram of the aerial; but, as the distance is increased, ground attenuation begins to have an effect, and the shape of the contour changes, generally settling down to a fixed shape at a distance of a few miles. It is thus advantageous to concentrate the radiated energy in the directions in which the attenuation is high in order to improve the coverage of the transmitter.

Again, the use of directional aerials may be desirable on the score of reducing radiation in a certain direction with the object of protecting the service area of a distant transmitter which has to share the same wavelength. The new Montreux wave plan (which but for the war would now be in force) provides for the use of directional aerials for a number of transmitters with this end in view—and, indeed, without this protection it is probable that the plan would not have been accepted by several of the signatory countries.

Simple Aerial Systems

Directional aerial systems for medium-wave broadcasting differ greatly from those for short-wave services, inasmuch as the polar diagram must not be sharply directional. Simple types of aerial systems will, therefore, give the desired control of the polar diagram shape.

Two spaced vertical aerials, A B, as shown in Fig. 1, are generally used, the relative phase and amplitude of the currents in the aerials being controlled by appropriate impedance networks. Mast radiators, or aerials suspended between masts, may be used. The polar diagram of such an arrangement will, of course, be symmetrical about the line of the aerials. Both aerials may be driven—that is, excited directly from the transmitter—or one aerial may be driven and the other excited by radiation from the driven aerial. Such an undriven aerial is sometimes referred to as a parasitic reflector, and the spacing and termination are chosen to give the required phase and amplitude relationships.

If I_1, the current in A, lags I_2, the current in B, by an angle ϕ, and if the spacing and wavelength are d and λ respectively, the shape of the polar diagram is controlled by the ratio of I_1 to I_2, d, and ϕ. It is obvious that, because of the space and time-phase relationships of the fields due to A and B, in certain directions addition of the separate fields will occur, and in other directions partial or complete cancellation.

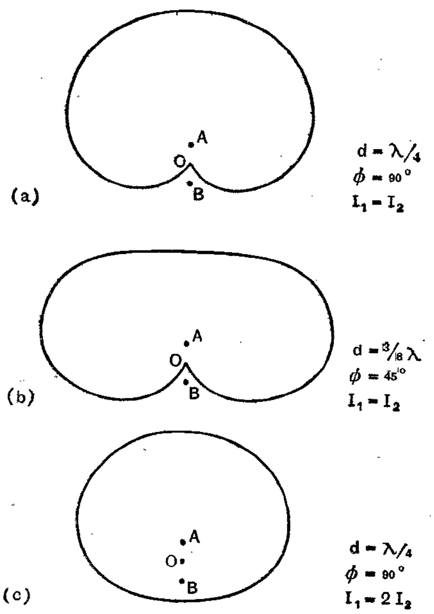


Fig. 2.—Typical polar diagrams obtainable from an aerial system as shown in Fig. 1.

Directional Broadcasting—

In general, the field in a direction OP, at an angle θ to the line of aerials, may be found by the vector addition of the fields due to A and B separately. This is proportional to:

$$\sqrt{(I_1 + I_2)^2 \cos^2 \left\{\frac{\pi d \cos \theta}{\lambda} - \frac{\phi}{2}\right\} + (I_1 - I_2)^2 \sin^2 \left\{\frac{\pi d \cos \theta}{\lambda} - \frac{\phi}{2}\right\}}$$

which is equal to:

$$\sqrt{I_1^2 + I_2^2 + 2 I_1 I_2 \cos\left\{\frac{2\pi d \cos \theta}{\lambda} - \phi\right\}}$$

In these expressions the angles are in radians, 2π radians being equal to 360 degrees.

If, therefore, I_1 is equal to I_2, it is possible, by suitably choosing d and ϕ, to obtain either one zero, or two zeros equally displaced about AB. The position of the maxima can also be controlled in the same way. If, however, I_1 is not equal to I_2, no zeros are obtained, but either one or two minima, equally displaced about AB.

By choosing the ratio of I_1 to I_2, and the values of d and ϕ, it is thus possible to obtain a polar diagram in which the maxima and the minima are in desired directions, the former giving an increase in field strength in the service area, and the latter reducing interference in specified directions. The fact that the field has been reduced in certain directions necessarily means that it is increased in other directions for the same radiated power.

Radiation Characteristics

Typical polar diagrams are shown in Fig. 2. In these O represents the centre of the system, and AB the line of aerials. The field strength in any direction is proportional to the distance from O to the point on the curve in that direction. Fig. 2a corresponds to a spacing of $\frac{\lambda}{4}$ and a lag of 90 deg., giving the well-known cardioid diagram; the radiation is reduced over a comparatively narrow sector, and the maximum increase in radiation occurs in the direction BA.

Fig. 2b corresponds to a spacing of $\frac{3}{8}\lambda$ and a lag of 45 deg.; the radiation is reduced over approximately the same sector, and the maximum increase is in a direction perpendicular to the line of aerials. In this direction the increase is equivalent to doubling the transmitter power.

Fig. 2c is similar to Fig. 2a, except that I_1 is equal to $2I_2$, giving a much smaller deformation of the polar diagram. This corresponds approximately to the case of a tuned parasitic reflector spaced $\frac{\lambda}{4}$ from the driven aerial.

Although some of the diagrams shown indicate zero values, these are never attained in practice; small amplitude and phase errors, and the effect of surrounding objects result in small minima instead of zeros, but this does not impair the efficiency of the system appreciably.

Practical Examples

The usefulness of the polar diagrams discussed will be more evident by considering specific cases of directional aerial systems installed and used by the British Broadcasting Corporation before the war.

Fig. 3 shows the service area of the Midland Regional transmitter. This transmitter was designed to serve the Midland counties from Gloucestershire in one direction to Nottinghamshire in the other. It was obviously inefficient to transmit as much energy in the direction of the Severn estuary as in the direction of Nottingham; in addition, the attenuation of the ground in the former direction is low, and this provided a further reason for concentrating the energy in the north-

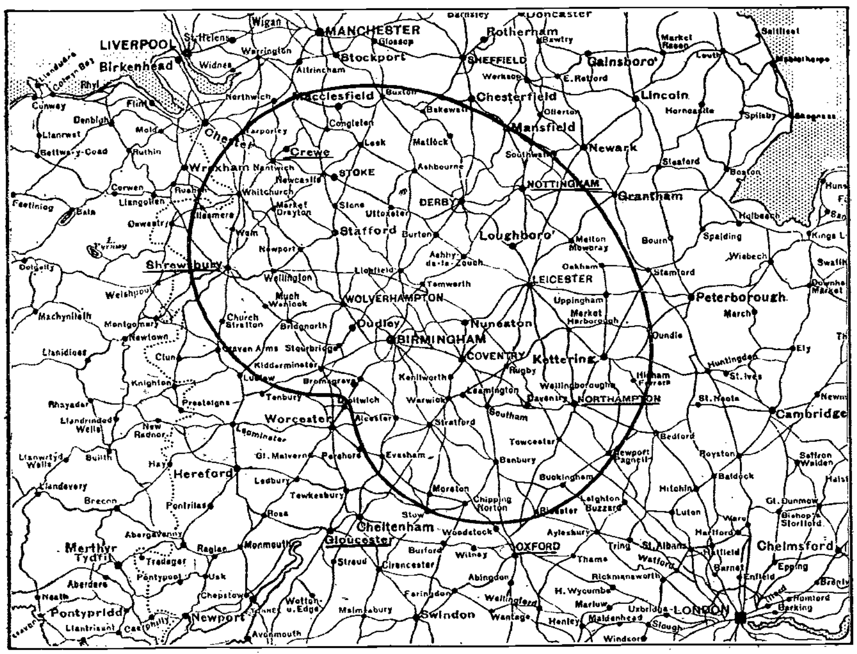
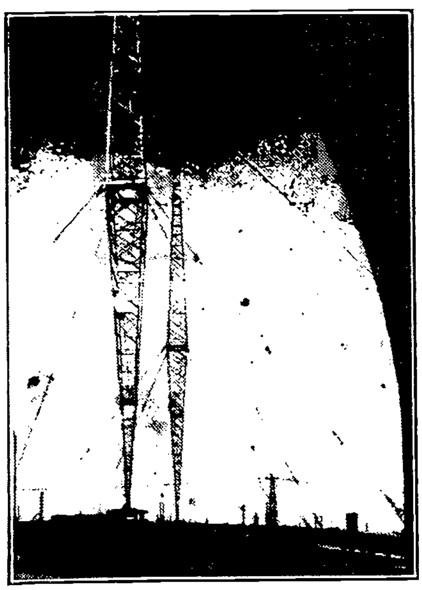


Fig. 3.—Designed service area of the B.B.C.'s Midland Regional transmitter.



Radiator and reflector masts at the Vienna station: an early example of directional broadcasting on medium waves.

Directional Broadcasting—

east direction. A cardioid polar diagram, as illustrated in Fig. 2a, was used at this station, but with omnidirectional aerial, radiating the same total power, were used. The combination of a directional aerial system and unequal attenuations in

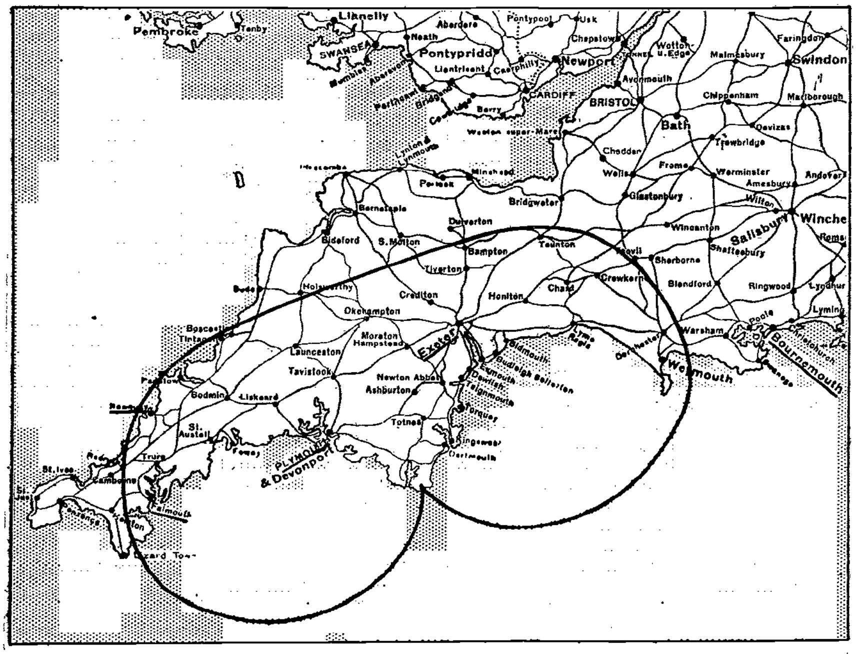


Fig. 4.—A good example of the modern tendency to reduce wasteful radiation by using a directional aerial was provided by the design of the Start Point station.

the relative amplitude adjusted to give a small amount of radiation in the direction AB; the line of aerials was chosen to give maximum increase of field strength in the direction of Nottingham.

Start Point

A more sharply directional polar diagram was aimed at for the newer Start Point transmitter, shown in Fig. 4. The service area in this case is southern Cornwall and Devon, and also a large part of the south coast. Advantage was taken of low attenuation over the sea by locating the transmitter on the coast line, on a headland which projects into the sea; in order further to increase the range along the coast, the directional aerial system shown in Fig. 2b was used, the line of aerials being arranged to give maximum increase in field strength in the desired direction. The amount of energy radiated out to sea was thus reduced considerably, whilst even in the least favoured direction, to the north, the field strength was as high as if an different directions thus gave an elongated polar diagram especially suitable for this service area. It is of interest to note that the field strengths from this transmitter in Plymouth, Falmouth and Portsmouth were roughly the same.

Even though the currents in the two aerials are equal, it is not necessarily true that the impedance and powers are the same. The working impedance of each aerial is dependent on the amplitude and phase of the current flowing in the other aerial. It is thus necessary to measure, in addition to the impedance of the separate aerials, the mutual impedance between them. The impedance and power in each aerial can thus be calculated, and impedance matching and phasing networks added to give the correct power and phase relationships. In the case of Fig. 2b, for instance, the power in aerial A is approximately two-thirds of the total power. The correct amplitude adjustment can be checked by means of meters, and the phase by means of a cathode-ray tube, or similar device, suitably coupled to the two aerials. A final check can then be made by means of local field strength measurements.

Book Review

Radio-Frequency Measurements by Bridge and Resonance Methods. By L. Hartshorn, D.Sc. Pp. 265+IV, with 99 figures. Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C.2. Price 21s.

THE thing that impresses one about this book is the sound and thorough way the author has done what he set out to do. There is an enormous literature on radio-frequency measurements—comparatively little of it in book form—and an attempt to cover the whole field in a book of reasonable size would have resulted in each aspect being too superficially treated to warn the reader of the many sources of error and indefiniteness. The author confines himself to the measurement of quantities such as impedance, resistance, capacity, phase, etc., excluding current, voltage and frequency; and deals with the two methods indicated in the title. Of these, the treatment of radio-frequency bridge methods is particularly valuable because of the absence of comprehensive information elsewhere; and resonance methods have been very usefully extended to include the transmission line "circuits" that are necessary to cope with the growingly important frequencies above 200 Mc/s.

The book is divided into three parts—principles, apparatus, and methods. In the first, the equations relating to impedance, resonance and screening are derived, for use later on. Thoroughness in getting down to basic principles is, however, not abandoned at the end of the first section but continues throughout. In this field, quick "ready-to-wear" rules are apt to lead the worker astray by not sufficiently exactly defining what it is that is being measured; but the present author, as befits a Principal Scientific Officer at the N.P.L., deals precisely and quantitively with all the minor complications, such as the inductance of variable condensers and leads, that are too often dismissed in general terms. Nevertheless, he is human enough to include the ARRL Radio Amateurs' Handbook among the thirteen books recommended, and to advise the modern "communication" receiver, rather than a special amplifier, as a bridge detector.

The volume is an authoritative and clear exposition of the subject.

M. G. S.

Series or Parallel?

ALTERNATIVE FEED CIRCUITS FOR AVC SYSTEMS

By W. T. COCKING, A.M.I.E.E.

The functioning and relative merits of the two available methods of feeding AVC voltages to the grids of controlled valves are discussed, and it is shown that the parallel method, though not widely used, has certain advantages for short-wave and all-wave receivers

IT is not always realised that, in the application of AVC bias to a controlled valve, alternative methods usually exist. Wherever alternative methods are available a designer necessarily has to choose between them, and it is consequently important for him to know the characteristics of each.

Probably the commonest AVC feed circuit is the series type shown in Fig. 1. The tuning coil L is not returned directly to the earth line but through a condenser C1, and the AVC line is connected to the junction of L and C1 through a resistance R1. This particular arrangement of series feed is necessary because the frame of the condenser C must be earthed in most cases. If it need not be earthed a modified form of the circuit, shown in Fig. 2, has certain advantages which will be dealt with later.

The first thing to notice about the circuit of Fig. 1 is that C1 is included within the tuned circuit. The condenser has a capacity C1, but it has also inevitably an internal inductance L1 and resistance R1; it is, in fact, on its own a series resonant circuit. The total inductance, capacity and resistance of the tuned circuit as a whole are thus no longer L, C and R, but become $L + L_1$, $CC_1/(C + C_1)$ and $R + R_1$.

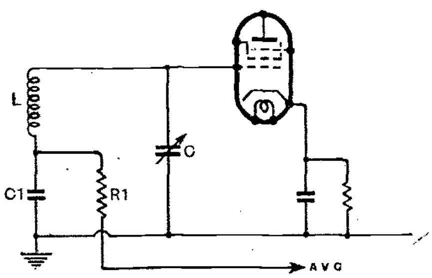


Fig. 1.—The series-feed circuit, as applied to the majority of receivers having a ganged tuning condenser with an earthed rotor.

The insertion of C1 thus affects the tuning and efficiency of the circuit.

First of all, let us consider the effect of the capacity of C1 alone. It comes in series with the tuning condenser C and so reduces the total maximum circuit capacity. This can be made as small as desired by the simple expedient of making C1 very large compared with the maximum capacity of C. For instance, if the latter has the common value of 0.0005 μF, and we are willing to sacrifice 10 μμF total capacity, we have $0.00049 = 0.0005\,C_1/(0.0005 + C_1)$ or $C_1 = 0.0245$ μF. In practice, a capacity of 0.1 μF is commonly used and this reduces a capacity of 0.0005 μF for the tuning condenser to an effective value of 0.0004975 μF; the reduction is 2.5 μμF.

Effect on Ganging

It is at once obvious that if there are several circuits with ganged tuning controls the accuracy of ganging may be affected even if C1 is large enough not to restrict the tuning range appreciably. A reduction of 10 kc/s or so in the tuning range may be unimportant in itself, but if one or two circuits are so restricted and others are not, the effect on sensitivity and selectivity of the ganging errors may be very serious.

It is important, therefore, to insert such condensers in all the tuned circuits which are ganged together, and the condensers must all have the same capacity. They are necessary for the maintenance of accurate ganging even if they are not required for AVC purposes. Thus, take the case of a superheterodyne with one RF stage. AVC will normally be applied to the RF valve, but not always to the frequency changer. Whether or not it is applied to this valve, however, its tuned grid circuit should include a condenser of the same value as that in the tuned grid circuit of the RF stage. The oscillator, too, should have the same capacity included within its tuned circuit, but this does not usually necessitate the use of an extra component, but merely an appropriate reduction in the value of the padding capacity.

The inclusion of C1 reduces the efficiency of the tuned circuit somewhat because of the losses in the condenser—it thus reduces selectivity and sensitivity in some degree. The importance of this depends upon the magnitude of the effective series resistance of the condenser in relation to the effective series resistance of the tuned circuit as a whole before the insertion of C1. It may be quite important when low-loss circuits are used, but in the average case of only moderately efficient components the loss introduced by C1 is not very serious.

On short and ultra-short waves where the coil inductance L is small

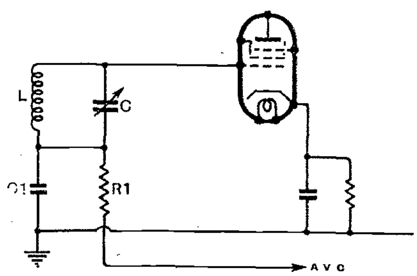


Fig. 2.—This series-feed circuit is practicable when the tuning condenser rotor may be isolated.

the inductance L1 of the condenser may be highly important. Its chief effect is likely to be in causing inaccurate ganging, and this can be

Series or Parallel?—

minimised by including identical condensers in all the circuits ganged together, just in the way that the inclusion of such condensers is advisable to prevent ganging errors due to capacity variations. In this case, however, it is not sufficient merely that the condensers should be of the same capacity; they should also be of the same make and type. Unless they are of the same construction it is improbable that their inductances will be even roughly of the same value.

These considerations do not apply to the circuit of Fig. 2, for here C1 is not a part of the tuned circuit LC. This circuit is nowadays usually adopted in IF amplifiers, and there is usually no objection to the use of different capacities for C1, or even different types of condensers, in the various stages. It is only with the arrangement of Fig. 1 that care must be taken.

As an alternative to the series-feed circuit the parallel-feed arrangement of Fig. 3 can be, and often is, used.

In this case the tuned circuit LC is complete in itself, and the valve is fed from it through the condenser C1, AVC bias being applied to it directly through R1.

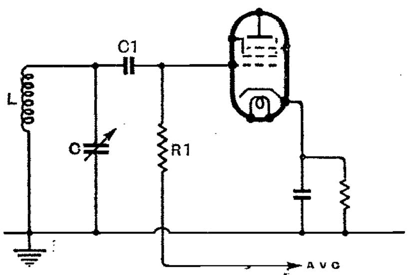


Fig. 3.—In the parallel system, controlling voltages are fed to the grid through a resistance R1; condenser C1 acts as a "stopper."

Provided that the reactance of C1 is small compared with the input impedance of the valve, the presence of C1 will have little or no effect on the tuning of LC. Consequently C1 need be inserted only in those circuits which need it for AVC purposes, and the condensers used in different circuits need not be of the same capacity nor of the same type.

On medium and long waves the input impedance of the valve is substantially the reactance of the grid-cathode capacity, so that it is only necessary for C1 to be large compared with this capacity. This rarely exceeds 10 $\mu\mu$F, so that C1 need not exceed 1,000 $\mu\mu$F for its effect to be negligible. Smaller values down to 100 $\mu\mu$F are often used.

The resistance R1 appears in shunt with LC when C1 is fairly large as indicated above. It consequently damps the tuned circuit and reduces sensitivity and selectivity. The extent to which this damping action is important depends upon the value of R1 in relation to the effective dynamic resistance of the tuned circuit.

The latter will rarely exceed 0.1 MΩ on the medium waveband and is likely to be considerably less on short waves. If R1 is made ten times as great—1 MΩ—the effective total dynamic resistance will be approximately 90,000 ohms, so that the drop in selectivity and stage gain will be about 10 per cent. If R1 were much higher, say 10 MΩ, the performance would be affected to a negligible degree, but there are reasons why this resistance cannot be more than a very few megohms.

Grid Resistance Limits

Valve makers often place a maximum limit of about 2 MΩ to the DC resistance included in the grid circuit of any one valve. There must be other resistances in the AVC circuit for filtering purposes which are common to more than one valve, and these count as though their value were multiplied by the number of valves to which they are common. Consequently, it is usually difficult to make R1 more than 1 MΩ and remain within the valve maker's limitation.

With good quality condensers it is probable that the losses introduced with the series circuit are lower than those caused by the resistances of the parallel circuit at moderate to low radio frequencies. Much depends on the components used, but the odds are that on medium and long waves the series circuit will be slightly the better of the two.

At high frequencies, however, the position is rather different. In the first place, the dynamic resistance of the tuned circuit is likely to be considerably lower, and in the second the valve itself has an appreciable input resistance. At really high frequencies this may be a few thousand ohms only, but over the usual short-wave bands it is generally to be measured in tens of thousands of ohms. The result is that a value of 1 MΩ for R1 in the parallel circuit is likely to increase the losses by a negligible amount.

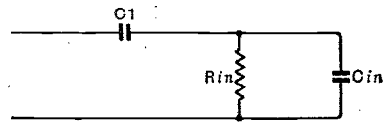


Fig. 4.—Explaining how the parallel-feed method may be used for impedance matching.

On the other hand, the resistance introduced by C1 in the series circuit will normally tend to increase with frequency, and so this circuit will have relatively higher losses on short waves than on medium and long. When the undesirable effects of inductance in C1 are also considered it can be seen that the advantage lies definitely with the parallel-feed system with a short-wave or all-wave receiver, but with the series-feed circuit for a set designed primarily for the medium and long wavebands.

There are, however, certain practical matters to take into account. In the parallel circuit, C1 is at a high radio-frequency potential, and must consequently be screened at least as carefully as the valve and its grid lead. The condenser, moreover, must have a low capacity to earth, otherwise the stray capacity across the tuned circuit will be excessive. With "top-grid" valves the disposition of this condenser and the resistance R1 is sometimes a nuisance. With the parallel-feed circuit, however, both condenser and resistance are at a low potential to earth and need little or no screening; neither is their capacity to earth important.

One point in connection with the parallel-feed circuit which deserves mention is the possibility of obtaining impedance matching between the valve and the tuned circuit in cases where the input resistance of the former is smaller than the dynamic resistance of the latter. As shown in Fig. 4, the input impedance of the

Series or Parallel ?—
valve can be represented by a capacity C*in* in parallel with a resistance R*in*. The impedance of the combination of the two with C1 is equivalent to a capacity and resistance in parallel, but the former is smaller and the latter of larger value than C*in* and R*in*. By a suitable choice of value for C1, R*in* can be matched to the tuned circuit and maximum efficiency is thus easily secured.

Provided that R*in* is much larger than the reactance of C*in* and C1 in parallel, the optimum value of C1 is $C/\left[\sqrt{\frac{R_D}{R_{in}}}-1\right]$ where R_D is the dynamic resistance of the tuned circuit. Thus, if the input resistance of the valve is one-quarter of the dynamic resistance of the tuned circuit, C1 should be about equal to C*in*. As C*in* is commonly 5-10 μμF, the value for C1 is much smaller than that often used.

Such small values will normally be required only on short waves where the valve input impedance is low. Before a detector or AVC rectifier, however, a small capacity may be advantageous even at low frequencies. Thus, suppose we have an IF circuit with a dynamic resistance of 0.2 MΩ and we are feeding an AVC diode from it through a capacity, the diode having an input resistance of 0.1 MΩ with a capacity of 5 μμF. Then for optimum efficiency the feed condenser should have a value of $5/[\sqrt{2}-1] = 5/0.414 = 12$ μμF.

Index for "The Wireless World"

OUR Publishers announce that the index for Volume XLVI of *The Wireless World* (November, 1939, to December, 1940) is now ready. Copies are obtainable for 7½d. each, post free, or, with cloth binding case, for 3s. 10d., post free. Our Publishers will bind readers' copies in cloth for 8s., plus 9d. for return postage of the completed volume.

Export Enquiry

THE firm of Meher Radio Company, Mehta Road, Bombay, India, requests us by telegram to invite British manufacturers of high-grade broadcast receivers to get into touch with them immediately with a view to arranging an all-India agency. Full particulars of products and prices should be sent.

In What Direction ?

A GRAPHICAL METHOD OF WORKING OUT THE BEARING OF A DISTANT TRANSMITTER

By T. S. E. THOMAS, B.Sc., Ph.D.

Many types of aerial, at any rate those used for short-wave reception, have marked directional properties, and it is an advantage when the best possible results are required from, say, the American Continent, to be able to set up the aerial on a bearing which will ensure the maximum "pick-up."

MOST radio aerials are directional, that is to say, the currents induced by a signal depend not only on the field strength but also on the direction of the waves. The directional property of the aerial is due partly to the layout of the aerial wires and

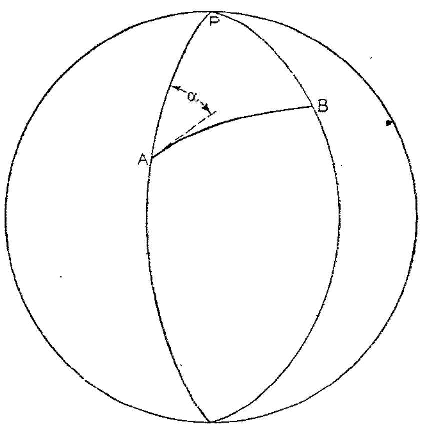


Fig. 1. Showing the true bearing of a station in relation to the Great Circle path of the wave from B to A.

partly to the screening effect of obstacles such as buildings. When consistently bad reception of certain stations is experienced it is useful to be able to ascertain whether this could be caused by the directional property of the aerial and, if so, how it can be remedied.

To find the direction of a distant station B at the observer's station A it is sufficient for short distances to join AB on the map with a straight line and measure the angle or bearing it makes with the North-South line or meridian at A. This procedure will not give a correct result when the other station is in, say, America or Australia, for the path of the waves is the "bee-line" along the earth's surface between A and B. This line (see Fig. 1) is called the Great Circle arc between A and B. The angle *a* which this line makes with the meridian at A could be found by measurements on a large globe, but the usual method is to use one of the formulæ of spherical trigonometry for which it is necessary to know the latitudes of A and B and the difference in their longitudes.

If only an approximate result, correct to the nearest degree or so, is required the arithmetic can be avoided by the use of a nomogram devised by Weir which is reproduced in Fig. 3. In order to understand the use of this nomogram it will first be necessary to dissect it into its component scales with the aid of the

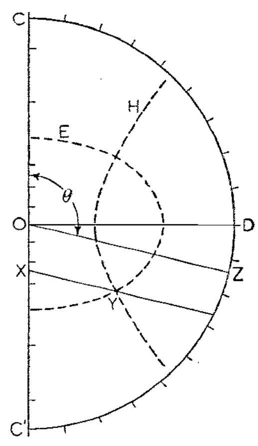


Fig. 2. Illustrating the method of using the nomogram shown in Fig. 3.

In What Direction?—

illustrative diagram in Fig. 2. On examination it will be found to consist of :—

1. A rectilinear scale COC′ with graduations corresponding to the observer's latitude.

2. A uniformly graduated circular scale CDC′ on which the bearing of B at A is measured.

3. A set of intersecting curves.

It will be seen that there are two types of curves : latitude curves such as E and longitude difference curves such as H. Each latitude curve corresponds to a definite value of the latitude of B, and each longitude difference curve to two values of the longitude difference between A and B. If we take the North and South latitude curves as distinct curves, then the intersection of a latitude curve and a longitude difference curve fixes a point Y on the nomogram. Curves for intermediate values can be sketched in when necessary.

Procedure

The rules for the use of the nomogram can now be set out as follows :

1. Find X the point on the latitude scale corresponding to the observer's latitude.

2. Find Y the point of intersection of the station latitude curve and the longitude difference curve

3. Join XY and through O the centre of the circular scale draw a line OZ meeting the scale at Z where the angle θ may be read off (the parallel line can be drawn with the aid of a ruler and set square).

4. If A and B are on the same side of the equator the Great Circle bearing a of B at A is equal to θ.

5. If A and B are on opposite sides of the equator then the bearing a of B at A is equal to 180° — θ.

It is important to note that the apparent reversal of the North and South latitude scales is not accidental.

The above set of rules may appear rather complicated, but if the working in the examples given below is repeated on the nomogram it will be found that the difficulties are not great.

Example 1.—At a receiving station n the Potteries Lat. 53° N. Long. 2° W. t is desired to find the bearing of a radio transmitter in California, Lat. 40° N., Long. 122° W.

In this case Long. Diff. is 122 — 2 = 120°.

The point X on the nomogram is the 53° division on the North Lat. scale. The point Y is located at the intersection of the 40° N. Lat. curve and the 120° Long. Diff. curve. A line OZ is now drawn through O parallel to XY and cuts the circular scale at the 51° graduation. Hence in this example the bearing is (Rule 4) 51° West of North.

Example 2.—At the same station in the Potteries the bearing of a transmitter in Australia at Lat. 30° S., Long. 148° E. is wanted.

In this case the Long. Diff. is 2 + 148 = 150°.

The point X is the same as above and the point Y is the intersection of the 30° S. Lat. curve with the 150° Long. Diff. curve. A line OZ is drawn through O parallel to XY and the circular scale reading is 17.5°. Since A and B are in this case on opposite sides of the equator the bearing is (Rule 5) 180 — 17.5 = 162.5° East of North.

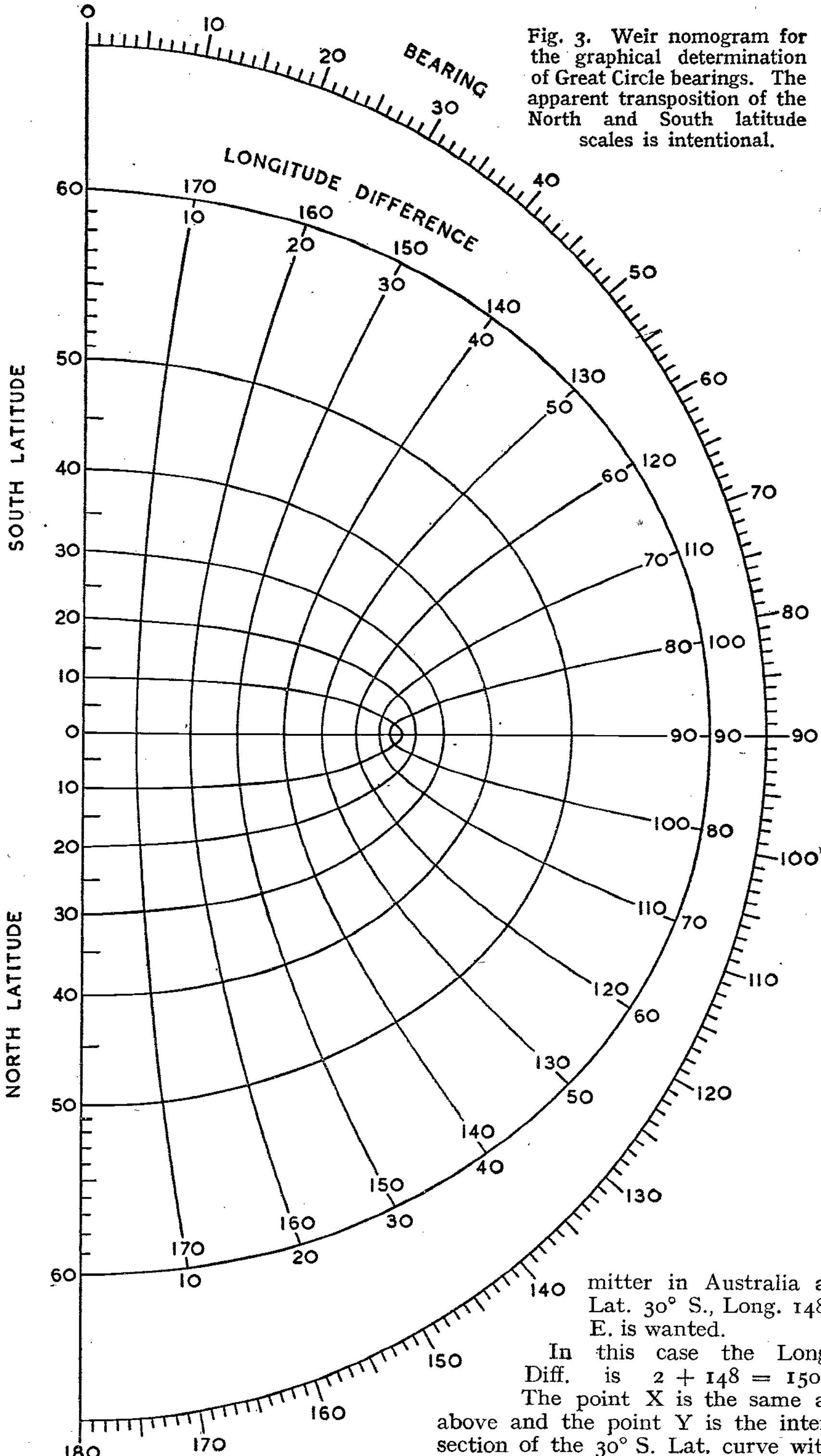


Fig. 3. Weir nomogram for the graphical determination of Great Circle bearings. The apparent transposition of the North and South latitude scales is intentional.

HT Battery Economy

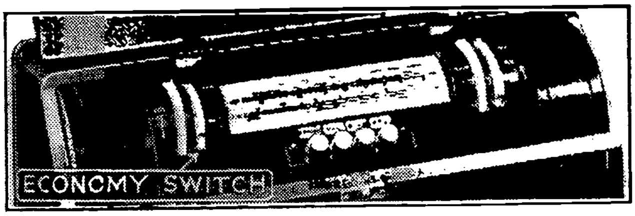
SOME WARTIME EXPEDIENTS

By "SERVICE"

BATTERY receiver users this winter will be well advised to make their HT batteries last as long as possible. Not only has the money-saving aspect to be considered, but supplies of battery ingredients must be conserved and battery distribution made as wide as possible. Stocks have accumulated during the summer months, but they are feeling the onslaught of the increased winter demand, and retailers may not soon be able to supply all types immediately upon demand. To be without radio these days is unpleasant to contemplate, so battery users should all do what they can to ease the manufacturing situation by economising in radio "consumable items" as much as possible.

Like many other forms of saving a great deal can be accomplished by voluntary economy. It should hardly be necessary to point out that the peacetime practice of leaving the set running for most of the day as a background to normal domestic activities should be discontinued.

Turning to the possibilities of effecting economies by technical means, a start can be made by ensuring that the aerial and earth system is the very best that can be provided. The reason why attention to these details will affect battery economy is that in the majority of modern battery receivers AVC is provided, and this means that the bigger the signal transferred from the aerial and earth system to the receiver, the greater will be the bias applied to the controlled valves by the AVC circuit. The increase in bias automatically reduces the anode current, and in the writer's experience a reduction of 1.5 mA can be effected. This may not sound a great deal, but, spread over a long period, it helps to increase the life of the battery appreciably.



The economy switch of the Marconiphone 895 is mounted on the control panel; in the H.M.V. 1404 it is at the back of the receiver.

A number of commercial receivers employ battery economising devices, and two typical examples of the simpler kind will serve to illustrate how various types of receivers may be dealt with.

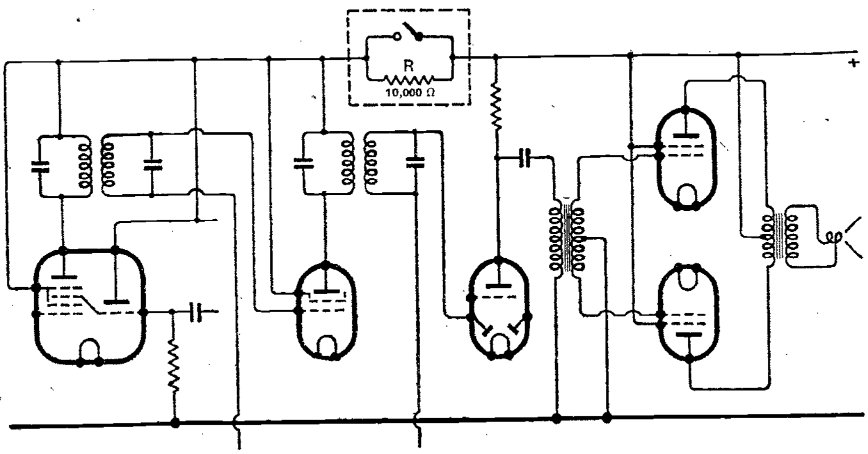


Fig. 1.—The battery economy device (shown within the dotted lines) of the Marconiphone 895 portable. It consists of a current-reducing resistance (with short-circuiting switch) in the common feed circuit of the frequency-changer and IF valves.

Fig. 1 represents the HT and valve anode circuits of the Marconiphone Model 895, 5-valve battery portable receiver. The economy switch is shown connected across the economising resistance R which has a value of 10,000 ohms. It will be noted that in this position the switch and resistance will only reduce the HT current taken by the mixer and IF valves. Even so the total HT current from the HT battery drops from 9mA to approximately 5 mA, which is a considerable saving in battery consumption over long periods.

In this particular receiver the output stage comprises two valves in push pull with a fixed bias. It is not practicable, therefore, to cut the HT down on these valves without also altering the bias, and the economy effected does not warrant any further complications, which would entail double switching.

The effect of this particular arrangement of battery economiser is to limit the sensitivity of the receiver but still to allow good local-station reception. The quality and power of reproduction of local stations is practically unaffected by the use of the economiser switch.

All Stages Affected

The second example is the His Master's Voice Model 1404, 4-valve battery superhet. Reference to Fig. 2 will show that in this case the economiser switch and resistance reduce the HT current taken by all stages of the receiver. The output stage is automatically biased, and, therefore, any reduction in the anode volts will bring about a corresponding decrease in the anode current with a consequent reduction in bias due to the smaller current flow-

HT Battery Economy—
ing through the automatic biasing resistance.

In this receiver the maximum HT current is 10 mA, but with the economiser resistance in circuit it

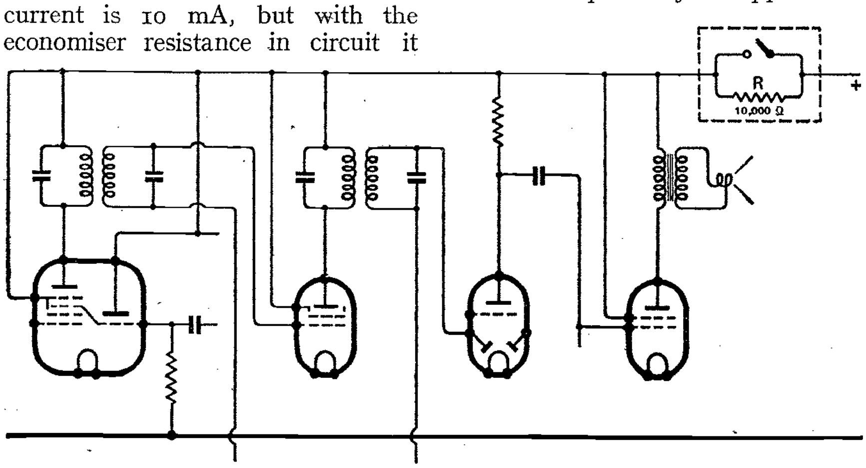


Fig 2.—In the H.M.V. 1404 superhet the economising resistance reduces the HT supply to all valves ; it may be short-circuited by means of a switch mounted at the back of the set.

drops to 5mA. As would be expected the overall performance of the receiver is inevitably affected when this method of battery economising is put into operation.

Economy by Over-biasing

Where a permanent reduction in HT battery consumption is tolerable straightforward output stages may have their bias values altered to bring about a reduction in anode current. For example, in one receiver brought to the notice of the writer a reduction of 2.5 mA was achieved by replacing a 330-ohm bias resistor by one of 560 ohms. The quality of reproduction was quite satisfactory if the volume control was used sympathetically so that the output stage was not overloaded. The maximum volume obtainable before distortion set in was adequate for a normal living room.

With any particular receiver a slightly different value of bias may be necessary to effect a satisfactory compromise between battery economy and volume of output. A variable resistance of about 1,000 ohms or so will prove useful in determining the exact value of bias resistance required, and can be either left in circuit when satisfactory results have been achieved or a fixed resistance of the desired value put in its place.

The fact that most receivers, after they have been modified for battery economy, will operate only at a lower volume of output before distortion sets in will probably be appreciated by neighbours, especially under war-time conditions of living. Readers of *The Wireless World* will be doing good work if they can persuade battery receiver users to apply the modifications described in this article.

There is one point to note when carrying out the modifications, and that is, instability due to the possible coupling of circuits by a common resistance in the HT feed. If, through insufficient decoupling in the receiver, this trouble shows itself, connect a low-voltage high-capacity electrolytic condenser across the added resistance. This will cure the fault.

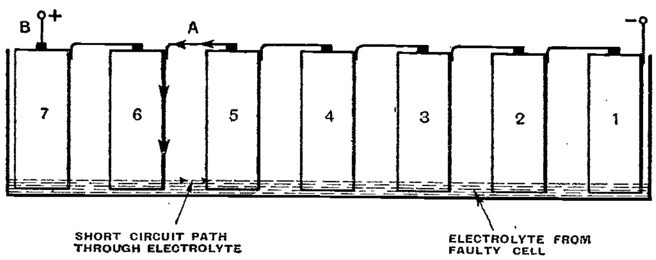
There is another way in which technical readers can help people who are coming into contact with battery receivers for the first time. There are many who have never previously owned a battery receiver, but who have bought them as stand-by sets in case of a major failure in the electricity supply service which will prevent them hearing important announcements from official sources. These people have often used their new receivers as a second instrument in the house, and are rather surprised at the apparent short life of the HT battery. Being used to operating a mains model most of the day they are inclined to use the battery receiver in a similar way.

Of course, an HT battery can be run down after only a very short life by leakage from a faulty cell. The electrolyte escaping from the cell will creep over the bottom of the battery and make a short-circuit path for all the cells except the last one, which is generally referred to as the positive cell.

This cell can never be discharged by internal short-circuits, whereas all the others can, as will be appreciated by a glance at the accompanying illustration. At A, cell 5 is shown discharging through the zinc of the cell and the electrolyte which has "crept" over all the bottom of the battery. At B, cell 7 (the positive cell) has no connection from its positive cell terminal, and therefore cannot discharge itself. By testing this cell, therefore, by means of a sharp prod which will penetrate the cardboard container of the battery and make contact with its zinc can and using this connection to take a quick voltage test across a 10-ohm load it can be ascertained whether the battery has been run down by internal or external conditions.

If the voltage of the cell is about 1.4V, then this indicates a faulty battery; but if the cell shows a much lower voltage, then it is proved that the whole battery of cells, including the positive cell, has been run down normally.

Showing how the positive end-cell of an HT battery remains unaffected by internal short-circuits. Mere dampness of the cardboard base of the container may cause trouble.



If all the above points are considered and the appropriate ones put into operation, a really worth-while saving in running costs and in the number of batteries used during the winter months will be effected.

Improving QPP Quality

By S. W. AMOS, B.Sc.

THE USE OF NEGATIVE FEEDBACK

IF good quality and a fair output are needed, the design of the output stage of a battery-driven receiver presents several problems not met with in mains-driven apparatus. The rival merits of a single triode and quiescent push-pull have been discussed at length in the columns of *The Wireless World* before, the chief factors to be considered being that whilst QPP gives large power output, the triode undoubtedly gives superior quality and is less prone to give distortion when the high-tension battery develops some internal resistance. It is also less particular about the aural effects of mismatching the valve impedance to the load impedance. For these reasons many people prefer triodes to the more complex quiescent systems.

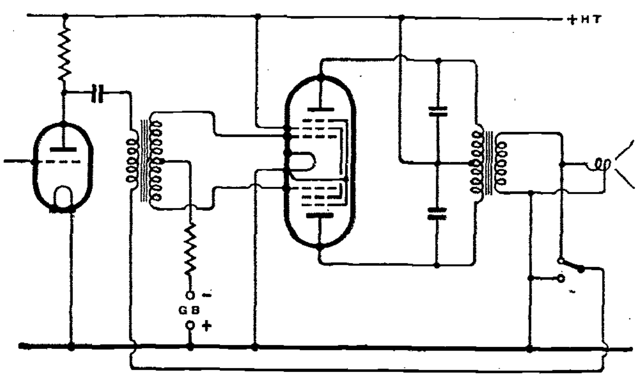


Fig. 1.—Application of negative feedback to a typical QPP amplifier.

Odd-number Harmonics

Distortion, in general, consists of spurious notes introduced by valves during the process of amplification. They have frequencies which are multiples of those forming the true signal. Even-number multiples, or harmonics, are automatically cancelled out in a well-designed push-pull stage, so that the output of a QPP valve should show little evidence of even harmonic distortion, if the two halves of the valve are well matched. Odd harmonics, however, are added in a push-pull stage, and as pentodes introduce more such distortion than triodes, and as odd harmonics are very noisy, these are undoubtedly the source of the objectionable shrillness or harshness characteristic of pentode outputs.

Any factor tending to reduce odd harmonic distortion in QPP quality, even at the expense of some amplification, is a very desirable thing, for the ideal battery output valve is one embodying the quality of a triode with the power output and economy in HT current of the quiescent system. Such a factor is inverse feedback.

Now inverse feedback cannot eliminate any distortion completely, but it can reduce it to such small dimensions that the ear, which is notoriously obliging in such matters, will overlook it entirely. We cannot hope, therefore, even with the aid of inverse feedback, to get from a QPP stage quality which is really identical with that given by a triode, though it might be possible to get results which are aurally indistinguishable.

Let us consider some methods of applying feedback, taking an average QPP valve, fully loaded. It delivers about one watt of audio-frequency power to the speaker, which, we will assume, has an impedance of 2 ohms.

The RMS voltage across the loud speaker is given by the formula:— $V=\sqrt{RW}$ in which V=RMS voltage, R=loudspeaker impedance and W=audio-frequency power. In this case, therefore, the RMS voltage is $\sqrt{2}$, and the peak voltage is hence 2, making the peak-to-peak voltage 4.

Applying Feedback

The average QPP valve requires a grid bias of the order of 9 volts, so that, when the valve is fully loaded, the peak grid-to-grid swing is 18 volts. This is supplied by a centre-tapped AF transformer having the rather high ratio of about 7:1. Hence the peak AC volts across the primary of the transformer is about 2.5. If, then, the EMF from the secondary side of the output transformer be applied to the primary of the intervalve transformer so that the two EMFs are in opposite phase, we shall achieve a measure of negative feedback. The primary of the transformer now has to supply 6.5 volts to give the same output which 2.5 volts formerly gave. This is

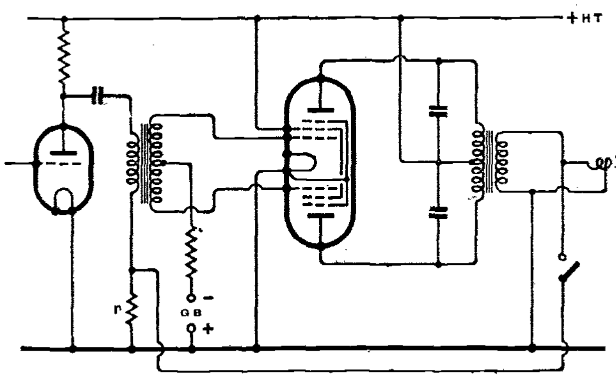


Fig. 2.—Another method of switching over from negative feedback to plain QPP amplification.

Improving QPP Quality—

therefore equivalent to a loss in volume of: $20 \text{ Log}_{10} \frac{6.5}{2.5} = 8$ decibels, which represents a noticeable, though not a serious, diminution of volume, but it is accompanied by a reduction of distortion and a straightening of the response curve. With such a small degree of feedback there is no point in making it variable; one either wants it all or none at all, so that a simple change-over switch can be included in the circuit to apply the feedback when it is needed. This is illustrated in Fig. 1. A simple on-off switch can also be employed instead as shown in Fig. 2. Here the value of the resistance r is somewhat critical, for it has to satisfy two conditions, namely:—(a) It must not be too great or it will behave as one half of a potentiometer, the primary of the transformer being the other half. Losses will therefore result. (b) On the other hand, it must not be too small, or else it will absorb appreciable power from the output transformer secondary, and thus also introduce losses.

In practice, therefore, as is so often needed in radio, a compromise is needed, and 50 ohms, with a 2-ohm speech coil, works well.

The scheme described above is very suitable for QPP stages, which immediately follow a leaky grid detector. Where there is an AF stage preceding the QPP valve, as in the majority of superhets, a more ambitious scheme can be used, for the feedback voltage can be applied to the grid of the penultimate amplifier. Supposing this valve, usually the triode section of a double-diode-triode, to amplify about 20 times—a reasonable amount—the peak volts at its grid will be: $\frac{2.5}{20} = 0.125$ volt. In this case, therefore, the loss in volume will be: $20 \text{ Log}_{10} \frac{4.125}{0.125} = 20 \text{ Log}_{10} 33 = 30$ decibels, a much more serious loss than before, and one which cannot be tolerated, except on the strongest signals. Such feedback as this, then, should be variable, and it can conveniently be arranged as illustrated in Fig. 3. The value of the potentiometer r is not critical; 10,000 ohms works well.

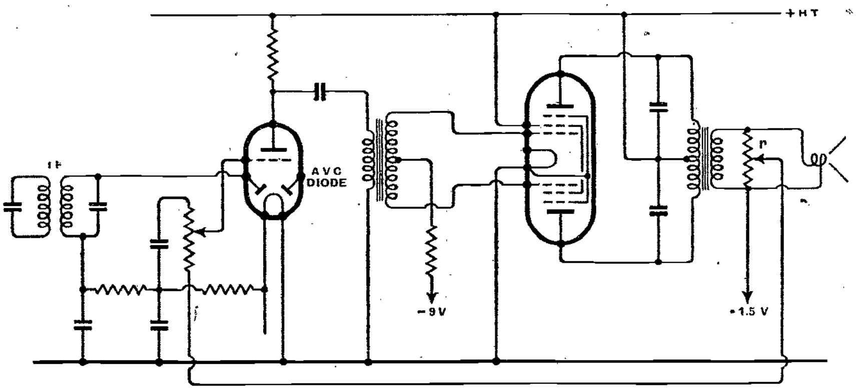


Fig. 3.—A more drastic negative feedback system, applicable to sets with an intermediate AF stage.

In using such an arrangement, the greatest possible feedback should be used, consistent with reasonable volume. In practice this simply means that the feedback potentiometer is used as a volume control, the true volume control remaining permanently at maximum.

When a fair degree of feedback is used, the quality obtained in practice approaches very closely that given by a triode. The objectionable "screechiness" of the pentode is quite eliminated. One's first impression, on listening to a QPP stage with feedback, is that there has been a distinct loss of "top," but if comparisons are made with a triode output it is realised that this loss is nothing more serious than a flattening-out of the response curve at the higher audio frequencies.

To simulate the conditions prevailing when a partially exhausted high-tension battery is in use, a 1,000-ohm resistor was included in the main HT positive lead of a QPP stage with variable feedback. With the feedback control in the position of zero feedback, there became evident a highly unpleasant form of distortion which can only be described as a grunt accompanying every burst of volume, and every note below a certain frequency. This horrible travesty of the original performance, with which some readers are no doubt only too familiar, is caused by the loss in HT volts across the resistor, which becomes serious whenever the anode current rises in sympathy with an orchestral crash or a bass note. By turning on the feedback it was observed that this distortion was reduced, although no elimination of it was possible. A large condenser of 4 mfds. capacity was connected between HT negative and the receiver end of the resistor, and this contributed something towards this reduction of the distortion.

Remembering the unfortunate fact that HT batteries can develop sufficient internal resistance to mar QPP quality before their useful life is over, it is possible to say that the addition of inverse feedback to the receiver will prolong the useful life of the cells, and this, combined with the reduction of third harmonic distortion and the straightening of the response curve, makes the addition of inverse feedback to QPP stages well worth while.

A Valuable Index

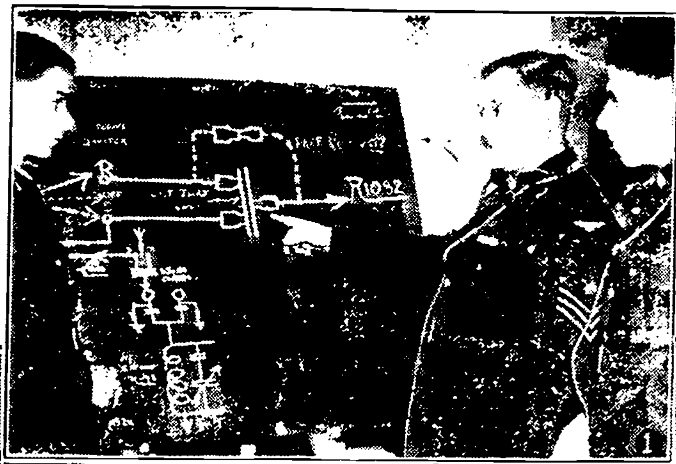
THROUGHOUT 1940 our sister journal, *The Wireless Engineer*, published abstracts from, and references to, more than 4,500 articles on wireless and allied subjects which have appeared in the journals of the world. The value of these abstracts is greatly enhanced by the publication of an index, occupying 43 pages, in the December issue of the journal. The type of index is unusual in that, instead of each title being alphabetically arranged, the keyword in the title is set in heavier type, and the title then appears alphabetically under this word in the index.

In addition to the above index and the index to articles published in *The Wireless Engineer* throughout the year, the December issue, which was on sale on the first of the month, contains articles on the circuit design of commutator inverters, the effect of screening cans on the effective inductance and resistance of coils, and phase focusing in velocity-modulated beams.

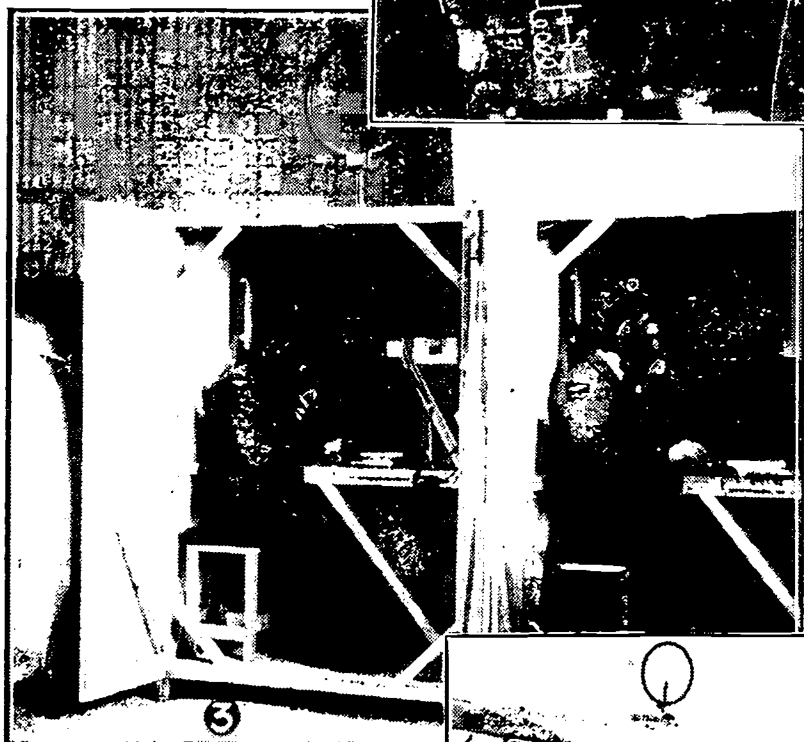
Copies of *The Wireless Engineer* are obtainable to order through newsagents or direct from our Publishers at Dorset House, Stamford Street, London, S.E.1, at 2s. 8d. post free.

Training R.A.F. Operators

AFTER the prospective R.A.F. wireless operator has attained the necessary standard of knowledge in general theory, he begins to undergo instruction in the actual circuit details of Service equipment (1). Direction-finding forms an important part of the operator's work; entrants are given the opportunity of practising on the ground (2) before being called upon to take bearings in the air. As beginners soon find out, sending and receiving at, say, the qualifying speed of 20 w.p.m. under ideal conditions in the class-room is vastly easier than in an aircraft. The transition is made more gradual by giving operating instruction in its later stages under conditions simulating those obtaining in flight (3). Sometimes the learner is accommodated during the "ground" stage in the fuselage of an obsolete aeroplane. In photograph No. 4, which shows a group returning from a training flight, the operators under instruction are approaching the stage where they will be ready for a short final course of operational training under Service conditions and then for the real thing.



GLIMPSES OF SOME OF THE LATER STAGES OF INSTRUCTION.



Automatic Meter Protection

DEVICE FOR SAFEGUARDING SMALL MOVING COIL INSTRUMENTS

By T. J. REHFISCH, B.Sc. (Eng.)

Methods of overload protection used in heavy electrical engineering are not easily applicable to meters with full scale deflections of less than a milliampere. The author reviews the alternatives available for instruments used in testing and laboratory work

METER manufacturers normally claim a considerable overload capacity for their products, depending on the rate of application and the actual type concerned. The usual rating is of the order of 100 per cent. for continuous, and many times this figure for temporary, overload currents. However, mechanical damage to the movement is bound to occur if the meter is abused frequently; even where the magnitude of a repeated overload is only small, the pointer will eventually fracture owing to fatigue.

This weakness can be prevented by arranging for the pointer of the meter not to travel beyond the stops or the ends of the scale under such constantly recurring conditions as an open or short circuit of the input and/or output terminals, as the particular case may be. Further, there sometimes exists some other critical but less frequent condition, such as, for instance, a maximum input voltage in the case of a valve voltmeter; this should lead to an overload not exceeding 50 to 100 per cent. for safe, continuous working.

The solution of any particular problem depends on the exact nature of these conditions and the meter used, while the scale shape may be affected, particularly where the protection is obtained by an addition to the instrument circuit proper.

There exist various methods of providing this protection; only a few of the basic ones will be described.

The simplest method of all is to place a resistor in series with the meter such that the maximum EMF in the meter branch divided by the total resistance in the branch is equal to the current for full-scale deflection of the meter. This arrangement is much used in insulation test sets and ohmmeters. Fig. 1 illustrates the law of a 1000-volt insulation test set fitted with a 50 μA meter. Curve A represents the scale law without a protecting resistor, the internal resistance of the instrument being regarded as negligible against 20 MΩ, while curve B applies to the same instrument protected by 20 MΩ. It will be noticed that the original range (curve A) of 500 to 20 MΩ has now been changed to 480 to 0 MΩ, i.e., the scale has been opened out somewhat; readings are affected by less than – 20 per cent. below 10 μA.

A meter can be protected by a device having a negative (resistance-current or voltage) characteristic. The multiplying power of such a shunt increases with load, i.e., it takes a progressively increasing share of the total or line current as the latter rises. Concrete examples are rectifiers (whether oxide or thermionic) worked at the bottom of their characteristic, and the new ceramic material "Metrosil" developed by Metropolitan Vickers.

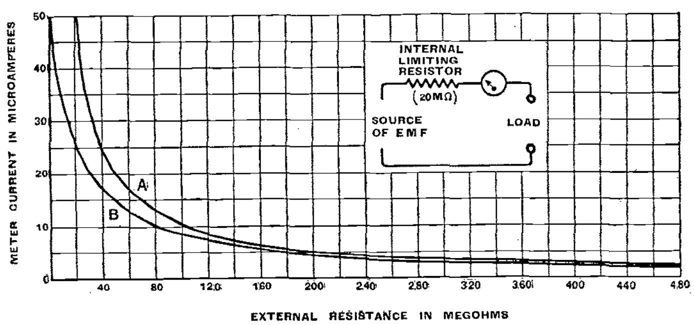


Fig. 1.—Curves showing effect of limiting resistance in an insulation test set; A, meter unprotected: B, with internal resistance of 20 MΩ.

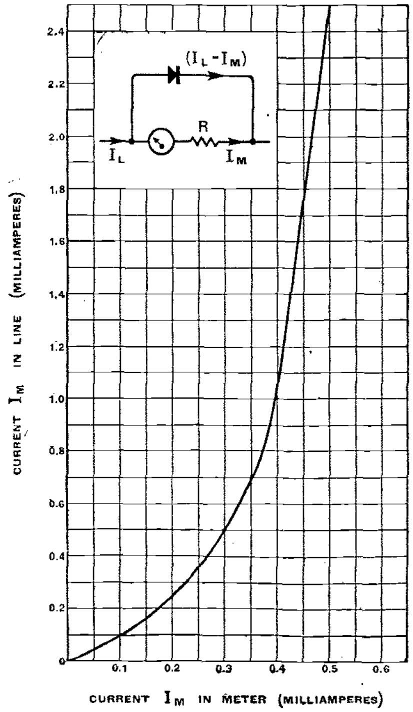


Fig. 2.—Law of meter protected by rectifier-type shunt. I_L (max.) = 2.5 mA, I_M (max.) = 0.5 mA, R = 400Ω.

As an example, consider a 0.5 mA. movement which is to be safeguarded against frequent maxima of line current amounting to 2.5 mA. The arrangement of Fig. 2 is a solution of this problem. The resistance R is adjusted until the full-scale deflection of the meter corresponds to 2.5 mA. in the line, i.e., the shunting rectifier—actually an inexpensive Westinghouse element type H1—then takes a current of 2.5 – 0.5 mA. = 2 mA, while for smaller values the shunting effect is less than $\frac{2.5}{0.5} = 5$.

Care must be taken to eliminate AC from the line, as rectification of this component by the "shunt" would result in erroneous readings.

Automatic Meter Protection—

It is well known that the anode current of a valve can only vary between the limits of zero (at "cut off") and some value corresponding to the flow of positive grid current, or saturation (complete emission) in the case of diodes. Thus, the valve circuit of Fig. 3 is a "backed off" meter or bridge circuit in which the standing anode current has been eliminated from the meter branch. For maximum sensitivity, expressed as the ratio "change in meter current divided by change in grid volts," experiment and theory indicate the condition R1 = R2 = R3 = impedance of the valve at its operating point. This maximum sensitivity is roughly equal to one-third of the normal valve slope.

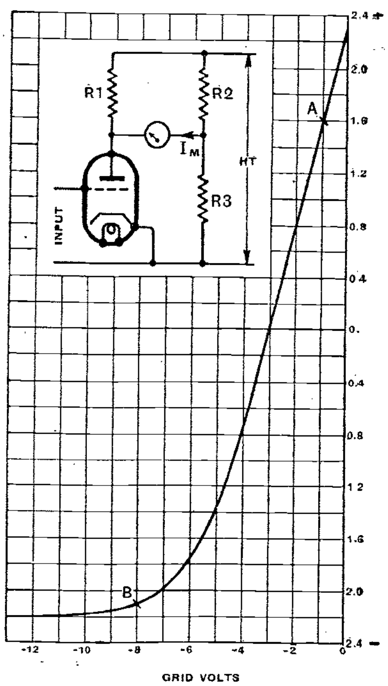


Fig. 3.—Illustrating the use of a valve as a current-limiting device. $R_1 = R_2 = R_3 = 15{,}000\Omega$. The curve is for an HL/41/DD valve with 250 volts HT.

The circuit of Fig. 3 may be used in a number of ways. When the input is a DC voltage, one would arrange for this to be negative only and work the valve from a point such as A; the maximum change in the meter current is then about 3.8 mA, and the current-voltage law linear over the major portion of the scale.

Where the input is alternating the valve is preferably used as a leaky grid rectifier. With the necessary filter in the anode circuit, the result is similar to that of the preceding case.

It is sometimes necessary to employ square-law detection, e.g., in the measurement of complex wave forms; or an open input circuit may be required. These requirements postulate anode bend rectification, and the valve would be worked at a point such as B (Fig. 3). Even then the DC voltage developed across the grid cannot pass zero far into the positive direction because of the flow of grid current within the valve, assuming a high DC impedance for the source. The total change of meter current will then be substantially the same as in the other two cases. However, as for small inputs, square-law rectification is less sensitive than its linear counterpart, a more delicate meter may have to be used in the anode bend detection circuit and protection will be less complete.

If any of these valve bridges are mains-operated a considerable overload current will pass through the meter when switching on, even where a slow-heating rectifier is used. To prevent this, R3 (Fig. 3) is replaced by a ballast valve of the same type as the control valve. This, incidentally, has the added advantage of reducing meter current fluctuations due to variations in the supply, particularly if the two cathodes use the same self-bias resistor; in the latter case, also, sensitivity is increased.

Further methods of restricting grid-voltage excursions are borrowed from wireless set technique, such as a diode limiter acting in a way similar to a noise suppressor, or a triode arranged as an AVC element.

Easily resettable "cut-outs" of a simple and rugged design are available for breaking currents from a few milliamps upwards. These consist of an iron-cored coil and a contact armature, the armature being pulled away from the contact stop and opening the circuit when the current exceeds a certain pre-set limit. To be of practical use the armature should be easily replaced against the stop, e.g., by a push-button.

Circuit breakers marketed for use with electric toy trains are very satisfactory for the small currents considered, and can be set over a wide range of "break-currents" by adjustments to the mechanical parts and the value of the shunt resistance

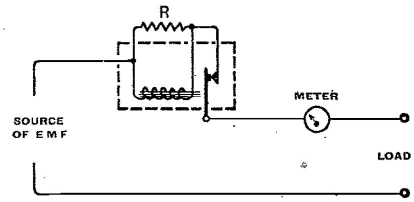


Fig. 4.—Basic circuit of electro-magnetic circuit-breaker for meter protection.

R (Fig. 4). When this is properly done, the value of the break-current is found to be constant for an indefinite period of time. R also serves the purpose of by-passing switching-on transients which would otherwise cause an unwanted break. To guard against this further, it is essential that the load should not be too capacitive. Any smoothing condensers must therefore be connected in the supply side of the circuit-breaker and should be sufficiently large to prevent ripple from causing chattering of the armature in the case of an AC mains-derived supply.

This review will have served its purpose if the reader will appreciate that there is scope for ingenuity in designing a self-protecting meter circuit. It is left to the judgment of the designer to choose, modify or combine any of the methods outlined above to suit his particular case. As the meter quite often represents the most costly component in the instrument, it is well worth the trouble to ensure that once fitted it may require no further attention.

Collins' Wireless Diary

In addition to the usual diary section and general information, this publication devotes some 100 pages to data and formulæ of wireless application; in this total is included log and anti-log tables, algebraic formulæ, etc.

In some cases the subjects are treated at considerable length; for example, in sections headed Capacity, Inductance, Wireless Installations, Oscillating Circuits, several pages are given to each topic. There is, in addition, much tabular data and a glossary of technical terms. *Collins' Wireless Diary* costs from 1s. 9d. to 8s. 6d., depending on the style of binding, and is published by William Collins, Sons and Company, Ltd., 144, Cathedral Street, Glasgow, C.4.

Current Topics

RECENT EVENTS IN THE WORLD OF WIRELESS

WAVELENGTH CHECKING CENTRE

Brussels Bureau Reopens at Geneva

THE task of checking and reporting on the wavelengths of European broadcasting stations, which has for many years been carried on at Brussels by the Union Internationale de Radiodiffusion, was abruptly terminated by the German invasion of the Low Countries on May 10th. M. Raymond Braillard, the director of the Brussels checking centre, was faced with the task of evacuating the apparatus as the military authorities signified their intention of doing so or destroying it.

We now learn from the Bulletin of the U.I.R. that the task of evacuation was successfully accomplished. On May 16th it was removed from Brussels and eventually, after many vicissitudes, it arrived safely at Geneva, the headquarters of the Union. Thanks to the great precautions taken during the journey, when it was under constant supervision, the equipment did not suffer in the slightest degree, and it was found possible to put it very speedily into service again. Some of the expert staff of the Brussels centre were able to resume their observations, and reports have been sent out to all members of the U.I.R. and to the various Administrations through the intermediary of the International Telecommunications Union at Berne.

Although the installation at Geneva is on a temporary basis only, it is interesting to learn that measurements are fully up to standard.

R.A.F. OPERATOR'S ENDURANCE

Blinded but Continued Operating

THE story of the safe return of a British bomber which was severely damaged over Germany is one of astounding persistence and courage. Fragments of an anti-aircraft shell hit the plane and touched off an outsize in flares. The observer and the wireless operator were both injured, and a ten-foot hole was torn in the fuselage.

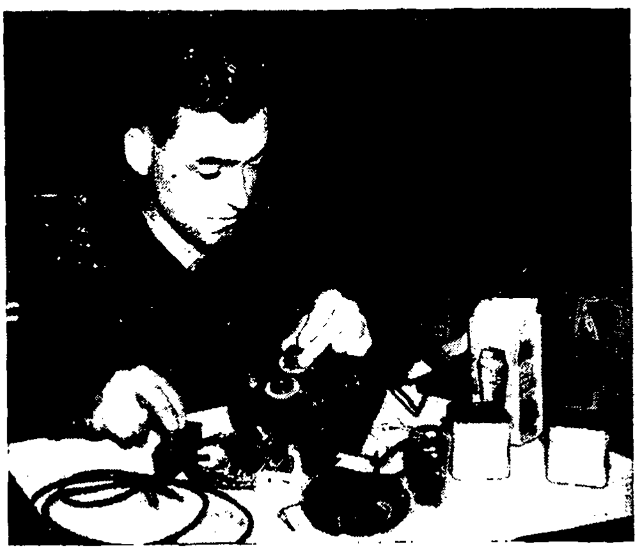
When giving the account of the flight the pilot said, "The explosions had hurled the control column out of my hands and the cabin filled with dense black smoke. Very soon the smoke cleared a little and I looked round and saw the wireless operator coming through the door with flames licking his flying suit. He was on fire himself. The bomb-aimer dashed up to him and beat the flames out with his hands. Then he disappeared down the fuselage again.

"Then the second pilot came forward and reported that the fire seemed to be under control. During this time, the wireless operator and I were alone in the cabin. He had collapsed on the floor and said, 'I'm going blind, sir.' His face was burned completely black, and it looked as though blood was streaming from his eyes. As soon as his burns had been attended to he explained the settings of the dials to the rear gunner, and when everything was ready he had his hand guided to the key. For forty minutes he stood like that, tapping out his message, but the aerial had been shot away, and nothing got through.

"It took us five hours to get home—there was an 80-mile wind against us. All those hours the wireless operator made no moan or complaint although he was suffering from the intense cold as well as from his burns.

"It was a crew to be proud of, not one of them showed even the slightest trace of fear or doubt about our ability to get through."

The captain of the aircraft, Pilot Officer G. L. Cheshire, and the wireless operator, Sgt. H. Davidson, have been decorated with the D.S.O. and the D.F.M. respectively for their gallantry.



ENEMY AGENTS' PORTABLE TRANSMITTER. This equipment was found in the possession of two spies who were executed in London on December 10th. The telegraphic transmitter, weighing about 1 lb., is housed in one case; in another are the dry batteries from which it is fed. The aerial, seen coiled up, is clearly intended to be erected on extemporised supports, such as trees, etc.

U.S.A.'s BIGGEST AND BEST

Wireless Equipment of the *America*

DETAILS of the extremely comprehensive wireless installation of the 35,000-ton *America*, the largest and fastest liner built in the United States, are published in the latest issue of the *RCA Review*. In addition to the four main transmitters, which cover long-, intermediate- and short-wave telegraphy and short-wave telephony, there is emergency equipment operated from a 12-volt accumulator battery, an auxiliary low-power radiotelephone for communicating with tugs and coastal stations in narrow waters, and two lifeboat sets.

Each of the main transmitters provides between five and ten crystal-controlled frequencies and in the case of the short-wave telegraphy set there is provision for extension up to a maximum of 30, with an aerial power of 1 kW. The elaborate aerial system fed by these transmitters comprises a main "flat top" aerial between the masts divided into two sections; the sections may be used separately or in parallel. For short-wave reception there are five dipoles mounted between the funnels and dimensioned for various frequencies between 4 and 22 Mc/s. Another aerial, in the form of a horizontal "V," may be used either for the emergency transmitter or for the main short-wave transmitter.

The main receiving equipment, operated from a neatly arranged "console," comprises three separate sets, designed for both headphone and loudspeaker reception and for switching time-signals to a speaker on the bridge. The radio-telephone receiver, with the switching arrangements for making connection to the public telephone booth, is separate. There is also an auto-alarm for maintaining a constant watch on 600 m. for distress signals. The direction-finder, which is installed on the bridge, has its main compass card driven from the ship's gyro repeater system.

AMATEUR TELEVISION

An American Move Criticised

THE fact that an effort is apparently being made in America to interest amateurs in television transmission in the 112-Mc/s band is deprecated by the Editor of the *T. & R. Bulletin*.

"We should be the last to criticise any move aimed at advancing the technique of television," he writes, "but we contend that the restricted amateur bands, as internationally agreed, are not the place for such experiments. Television must remain a selfish service—'eating up kilocycles'—until some new epoch-making method of transmission is evolved. For that reason we argue that those who wish to link up amateur television with amateur telephony should be given a separate part of the spectrum in which to out-jam one another! To permit television in the 112-Mc/s band is to restrict seriously all normal amateur telegraphy and telephony.

"It may perhaps be argued that television, being a new science (or is it an art?), should be given preference over the old-fashioned telephonic and telegraphic methods of communication, but somehow we think that very few of the ordinary hams of America will appreciate having to contend with even 120-line television transmissions within *their* bands."

It may be remembered that some years ago British amateurs were given an allocation just outside the 28-Mc/s band for television experiments, and it is suggested by the writer that if, after the war, this latest development "catches on" in Great Britain, our authorities would be well advised to place amateur television stations in a "world apart."

NEWS IN MORSE

FOR the convenience of readers who are anxious for opportunities of practising morse reception, we publish below the times (BST) of the transmissions of official British news bulletins in morse from the Post Office stations, GIA, 15.27 m; GAI2, 16.03 m; GIM, 23.13 m; GAY, 33.67 m; GIJ, 42.95 m; and GBR, 18.750 m.

00.30 GBR, GAY, GIM, GIJ
13.00 GBR, GAI2, GIA, GIM
17.02 GBR, GAI2, GIA, GIM
20.48 GBR, GAY, GIA, GIM

The transmitter GIA has its aerial directed towards South America.

N.B.C. TELEVISION NETWORK

Washington's First Station

THE capital of the United States is to have its first television station. The National Broadcasting Company has announced plans to establish a television centre in the Wardman Park Hotel, Washington, at a cost of approximately £50,000. This will be the N.B.C.'s second television station, and is expected to become the key tranmitter of a proposed network.

The new station, W3XNB, will operate with a power of 1 kW for both vision and sound.

The new site has all the advantages of a ready built studio building, for the hotel includes the Wardman Park Theatre, which seats 500.

It is proposed to link the new station with the existing station W2XBS in New York by means of a special automatic television relay system developed by R.C.A.

INDIAN SHORT-WAVE STATIONS

Overcoming Skip Distance

SINCE November 1st the short-wave stations of All-India Radio at Delhi, Bombay, Calcutta and Madras, which had previously been transmitting the evening programme in the 60-metre band, have been operating for the latter part of the evening in the 90-metre band.

This change became necessary due to the movement towards the period of minimum sunspot activity in the 11-year cycle. A.I.R. engineers state that during the winter of 1938-39 skip distance was scarcely in evidence even at the end of the evening transmissions in January, but that in January, 1940, it was making its presence felt.

During this winter a noticeable reduction in average ionisation levels is apparent, and therefore to avoid unsatisfactory reception within a radius of several hundred miles of the transmitter the change to the 90-metre band has been made.

AMERICA ON THE ALERT. One of the new F.C.C. monitoring cars equipped with apparatus for the location of illicit transmitters. Suspicious transmissions can be recorded on phonograph cylinders.

PIONEER'S RETIREMENT

MR. WALTER WITT BURNHAM, manager of the Radio Division of Ediswan, has now retired, and also relinquishes the chairmanships of the R.M.A. and B.R.V.M.A. Mr. Burnham, whose association with wireless dates back to the days before broadcasting, founded the firm of Burnham and Co., of Deptford, from which grew the original Burndept concern.

The chairmanship of the B.R.V.M.A. passes to Mr. G. A. Marriott, of the G.E.C. Osram Valve Department.

LIMITING RADIO SUPPLIES

AN amendment to the Limitation of Supplies Order recently announced by the President of the Board of Trade reduces the supplies of certain goods for the wireless industry in order that production may be devoted to an even greater extent to the war effort. During the six months from December 1st the quota for the home trade will be reduced to 25 per cent. of the sup-

Current Topics—

plies for the same period from December 1st, 1939. Although radiogramophones and accessories are scheduled, wireless receivers, sound amplifiers and loud speakers are excluded.

It is pointed out that there is no shortage but that the object of the Order is to conserve present stocks.

C.B.S. LONDON REPRESENTATIVE HONOURED

MR. EDWARD R. MURROW, chief of the European staff of the Columbia Broadcasting System, who is in charge of the London office, was elected by New York's Overseas Press Club as "the foreign correspondent who, during the first year of the second world war, has contributed the most, as a result of his work, toward the information of the American people and the formulation of American national policy in international relations." Mr. Murrow was presented with a typewriter.

Prior to his appointment to Europe in May, 1937, Mr. Murrow, who is 36, was C.B.S. director of talks. He recently returned to the U.S. on a short visit.

BLAST

THE effects on structures and material of blasts from the explosion of bombs are now well known in those localities that have suffered severe bombing air raids. In some of these areas radio shops have been damaged, and reports reveal that often glass-enveloped valves and other components in radio sets are unharmed, but almost always the equipment refuses to function because of ruined cones and speech-coils in the loud speakers. Presumably the nature of the blast wave is such that the effect is particularly destructive to present-day loud speakers. As an emergency protective measure for the speakers of broadcast sets, the placing of cushions against the front and back of the cabinet is suggested.

PA ENGINEERS' NATIONAL SERVICE

AT the annual general meeting of the Institute of Public Address Engineers, Mr. N. Partridge, the chairman, in presenting his annual report for the past year's working, said that the Institute's activity had increased, and its membership expanded. It was recalled that whilst many of the festive occasions with which PA had become associated had necessarily ceased, new applications had arisen.

Mr. Partridge recalled that when attempting to satisfy the demands for PA gear created by the "Music While You Work" campaign, a scarcity of record changers was revealed. When it was learned from the Ministry of Supply that, owing to manufacturers being engaged upon work of greater national importance, the shortage would continue, the Council of the Institute opened a register of second-hand gear. The invaluable aid rendered by PA vans towards minimising the disorganisation of food supplies resulting from the calamity which recently befell Coventry was voiced by the chairman.

FROM ALL QUARTERS

Obituary

WE regret to record the death at the age of 69 of Lord Tryon, who, until his elevation to the peerage in April, had been Postmaster-General since 1935.

List of Coast and Ship Stations

THE Bureau of the International Telecommunications Union, Berne, has announced that the thirteenth edition of the List of Coast and Ship Stations has been published. It can be obtained from the Bureau for 4.80 Swiss francs (including postage and packing).

Surplus Television Sets

IN reply to a question recently raised in the House of Commons, Mr. Harcourt Johnstone, Secretary for Overseas Trade, stated that surplus television receivers in this country cannot be exported to the United States as they incorporate certain American patents which British manufacturers are not permitted to exploit in the U.S.

FM Network

IT is expected that the new rules governing frequency-modulated broadcasting, recently announced by the Federal Communications Commission, will accelerate the introduction of this form of transmission in America. Mr. Paul A. de Mars, vice-president of the Yankee Network, speaking recently on "Some Observations on Frequency Modulation Broadcasting," said that within a year a new national network of FM stations should be under way.

Duplex Facsimile

FACSIMILE equipment providing for simultaneous transmission and reception of written messages by wireless or wire was recently demonstrated by Finch Telecommunications, Inc., at the company's works in Passaic, N.J. The apparatus, which, with its power supply unit, weighs less than 50 lb., measures approximately 15 x 14 x 13in. The advantage of this portable unit is that it can be used for visual communication between mobile points which hitherto have been confined to aural methods.

Inter-ship Radiotelephone Communication

IN order to relieve the congestion now existing on the present inter-ship frequency of 2,738 kc/s, the U.S. Federal Communications Commission has permitted the use of 2,638 kc/s for telephone communication between vessels. To avoid interference between the aeronautical and inter-ship communication services, which share the 2,634—2,642-kc/s band, the use of the newly allocated inter-ship frequency is banned on the inland waterways of the U.S., including the Great Lakes.

U.S.-Finland Radiotelegraphic Link

THE first direct radiotelegraphic circuit between the United States and Finland was opened by R.C.A. Communications, Inc., on October 16th. The terminal points are New York and Helsinki. It has, hitherto, been necessary to link the two countries via Stockholm, Sweden.

American Amateurs

THE fact that the Federal Communications Commission has gone to the trouble and expense of obtaining finger prints and details of citizenship of all American amateurs is taken by *QST* as an indication that there is no intention of shutting down their stations for reasons of national defence.

U.S. Foreign Language Censorship?

WHILST the Federal Communications Commission is powerless under existing law to censor programmes, it has sent a questionnaire to all stations requesting details of broadcasts in languages other than English in an endeavour to formulate a definite policy regarding foreign language transmissions from the United States.

The Voice of India

ALL-INDIA RADIO is to have a new 100-kW broadcasting station. A sum of £135,000 has been sanctioned by the Indian Legislature for the erection of the station, which is intended for transmissions to Europe, Africa, the Far East and the Middle East.

B.B.C.'s Red Cross Radio Competition

A NEW departure in B.B.C. programmes was introduced on December 7th and 11th, when a radio competition organised to raise money for the Red Cross Penny-a-week Fund was broadcast.

Canadian News

WHEN 73 of Canada's 86 medium-wave stations change their frequencies in accordance with the North American Regional Broadcasting Agreement on March 29th, many of them will have exchanged their frequency-control crystals with other stations. This exchange is being made to overcome the difficulty caused by the embargo placed on crystals by the United States, where most of the Canadian stations obtain them.

It may not generally be known that the Canadian Broadcasting Corporation has two mobile recording units in England. Each of these is manned by two engineers and there is a staff of four Canadian announcers.

The Canadian Broadcasting Corporation has a new 7.5-kW short-wave transmitter at Quebec with which it is proposed to radiate programmes to North and South America and Europe. The new transmitter, which, it is reported, will be ready for operation early in the New Year, is costing some £15,000.

The Montreal Light, Heat and Power Consolidated employs 38 wireless equipped service repair cars with which communication is maintained through the Company's headquarters short-wave station, CY5Y.

There appears to be no slackening in the demand for receivers in Montreal in spite of the additional receiving licence fee of $2.00 imposed on its citizens since July 1st. The general licence fee throughout the Dominion is $2.50.

NEWS IN ENGLISH FROM ABROAD

REGULAR SHORT-WAVE TRANSMISSIONS

Country : Station	Mc/s	Metres	Daily Bulletins (B.S.T.)
America			
WNBI (Bound Brook)	17.780	16.87	4.0‡, 6.0.
WCAB (Philadelphia) .	6.060	49.50	} 12.45 a.m.‡, 1.0 a.m.†.
WCAB	9.590	31.28	
WBOS (Millis)	9.570	31.35	11.45.
WCBX (Wayne) ..	17.830	16.83	2.0. 3.0†, 4.0†, 4.15§‡, 5.0*†, 7.0, 8.30†.
WGEO (Schenectady) .	9.530	31.48	8.30†, 9.55§‡, 11.25‡.
WGEA (Schenectady) .	15.330	19.57	1.0, 2.0‡, 6.0, 7.45, 9.55§‡.
WPIT (Pittsburgh) ..	15.210	19.72	6.0.
WRUL (Boston) ..	6.040	49.67	1.0 a.m.§.
WRUL	11.790	25.45	10.45.
WRUL	15.250	19.67	1.0 a.m., 10.45.
Australia			
VLQ (Sydney)	9.615	31.20	8.0 a.m.. 8.0.
VLQ5	9.680	30.99	1.30, 4.30, 10.30.
VLQ2	11.870	25.27	6.0.
VLQ7	11.880	25.25	8.0 a.m., 3.0, 8.0, 11.0.
VLQ8	17.800	16.85	7.0 a.m.
China			
XGOY (Chungking) ..	11.900	25.21	11.30 a.m., 12.10, 9.30, 10.30.
Finland			
OFD (Lahti)	6.120	49.02	} 8.55 a.m., 7.15, 10.15, 11.15.
OFD	9.500	31.58	
OFE	11.780	25.47	
OIE	15.190	19.75	
Hungary			
HAT4 (Budapest) ..	9.125	32.88	1.30 a.m.§.
HAT5	9.625	31.17	12.15 a.m.‡. 12.30 a.m.†.
HAS3	15.370	19.52	3.55†.
India			
VUD2/3 (Delhi) ..	9.590	31.28	9.0 a.m., 1.30, 4.50.
VUD4	11.830	25.36	9.0 a.m., 1.30, 4.50, 6.15.
VUD3	15.290	19.62	9.0 a.m.
Iran			
EQB (Teheran) ..	6.155	48.74	7.30.
Japan			
JZJ (Tokio)	11.800	25.42	9.5.
JZK	15.160	19.79	9.5.

Country : Station	Mc/s	Metres	Daily Bulletins (B.S.T.)
Manchukuo			
MTCY (Hsinking) ..	11.775	25.48	8.0 a.m., 10.5.
Nova Scotia			
CHNX (Halifax) ..	6.130	48.94	10.45.
Newfoundland			
VONG (St. John's) ..	5.970	50.25	11.15.
Rumania			
Bucharest	9.280	32.33	10.40‡.
Spain			
FET1 (Valladolid) ..	7.070	42.43	8.50.
EAJ7 (Madrid) ..	9.860	30.43	12.30 a.m.
Sweden			
SBO (Motala)	6.065	49.46	10.15.
Thailand			
HSP6 (Bangkok) ..	11.715	25.61	2.45.
Turkey			
TAP (Ankara)	9.465	31.70	8.15.
TAQ	15.195	19.74	1.15.
U.S.S.R.			
—— (Moscow) ..	7.545	39.76	10.30, 11.30.
RW96	9.520	31.51	7.30, 9.0, 10.30, 11.30.
RAL	9.600	31.25	1.0 a.m.
——	10.724	29.59	11.[illegible]
——	11.499	26.09	12.0 noon.
——	11.710	25.62	10.30.
——	11.830	25.36	7.33 a.m., 7.30, 11.30.
RNE	12.000	25.00	1.0 a.m., 9.0†, 10.30.
——	14.720	20.38	12.0 noon, 5.0.
RKI	15.040	19.95	1.0 a.m.
RW96	15.180	19.76	1.0 a.m., 7.33 a.m., 9.0,10.30.
——	15.715	19.09	12.0 noon.
——	18.540	16.18	12.0 noon.
Vatican City			
HVJ	6.190	48.47	8.15.
Yugoslavia			
YUA (Belgrade) ..	6.100	49.18	10.25.

It should be noted that at this time of the year changes of wavelength are frequently made and readers are, therefore, advised to try alternative wavelengths.

REGULAR LONG- AND MEDIUM-WAVE TRANSMISSIONS

Country : Station	kc/s	Metres	Daily Bulletins (B.S.T.)
Bulgaria			
Sofia	850	352.9	9.55 (Th. and Sat.).
Hungary			
Budapest	546	549.5	11.10.
Ireland			
Radio-Eireann ..	565	531	6.45‡, 10.5†, 10.10‡.
Latvia			
Madona	583	514.6	10.0 (Tu. and Fri.).
Kuldiga	1,104	271.7	10.0 (Tu. and Fri.).

Country : Station	kc/s	Metres	Daily Bulletins (B.S.T.)
Rumania			
Radio-Romania ..	160	1,875	10.40‡.
Bucharest	823	364.5	10.40‡.
Spain			
Radio-Coruna	968	309.9	1.10 a.m.
Sweden			
Motala	216	1,389	} 10.15.
Stockholm	704	426.1	
Goteborg	941	318.8	
Falun	1,086	276.2	
U.S.S.R.			
Moscow I.	172	1,744	11.30.

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

Short-wave Broadcasting Stations

ARRANGED IN ORDER OF FREQUENCY

Station	Call Sign	Mc/s	Metres	kW
49-Metre Band (6.000–6.200 Mc/s)				
Pretoria (South Africa)	ZRH	6.007	49.94	5
Pernambuco (Brazil)	PRA8	6.010	49.92	—
Boston (U.S.A.)	WRUL	6.040	49.67	20
British Oversea Service	GSA	6.050	49.59	10–50
Philadelphia (U.S.A.)	WCAB	6.060	49.50	10
Motala (Sweden)	SBO	6.065	49.46	12
Toronto (Canada)	CFRX	6.070	49.42	—
Lima (Peru)	OAX4Z	6.080	49.34	15
Vancouver (Canada)	CFKX	6.080	49.34	—
Nairobi (Kenya)	VQ7LO	6.083	49.31	1
Delhi (India)	VUD3	6.085	49.30	10
Toronto (Canada)	CRCX	6.090	49.26	—
Cape Town (South Africa)	ZRK	6.097	49.20	5
Belgrade (Yugoslavia)	YUA	6.100	49.18	10
British Oversea Service	GSL	6.110	49.10	10–50
Saigon (French Indo-China)	FZR	6.110	49.10	12
Lahti (Finland)	OFD	6.120	49.02	1
Hsinking (Manchukuo)	MTCY	6.125	48.98	20
Pittsburgh (U.S.A.)	WPIT	6.140	48.86	40
British Oversea Service	GRW	6.145	48.82	10–50
Winnipeg (Canada)	CJRO	6.150	48.78	2
Teheran (Iran)	EQB	6.155	48.74	14
Schwarzenburg (Switzerland)	—	6.165	48.66	25
Lima (Peru)	OAX4G	6.180	48.54	15
Schenectady (U.S.A.)	WGEA/O	6.190	48.47	25–100
Vatican City	HVJ	6.190	48.47	25
Athlone (Ireland)	—	6.190	48.47	—
Ica (Peru)	OAX1A	6.335	47.33	—
Radio Nations (Switzerland)	HBQ	6.675	44.94	20
Bandoeng (Dutch E. Ind.)	PMH	6.720	44.64	1.5
Valladolid (Spain)	FET1	7.070	42.43	—
41-Metre Band (7.200–7.300 Mc/s)				
Calcutta (India)	VUC2	7.210	41.61	10
British Oversea Service	GSW	7.230	41.49	10–50
Bombay (India)	VUB2	7.240	41.44	10
Tokio (Japan)	JVW	7.257	41.34	50
British Oversea Service	GSU	7.260	41.32	10–50
Lisbon (Portugal)	CSW8	7.260	41.32	10
Madras (India)	VUM2	7.270	41.27	10
Delhi (India)	VUD2	7.290	41.15	10
Moscow (U.S.S.R.)	—	7.545	39.76	20–100
Cairo (Egypt)	SUX	7.865	38.14	10
Moscow (U.S.S.R.)	—	9.010	33.30	20–100
Budapest (Hungary)	HAT4	9.125	32.88	5
Bucharest (Rumania)	—	9.280	32.33	—
Lima (Peru)	OAX4J	9.340	32.12	—
Radio Nations (Switzerland)	HBL	9.345	32.10	20
Ankara (Turkey)	TAP	9.465	31.70	20
St. John's (Newfoundland)	VONG	9.482	31.64	—
31-Metre Band (9.500–9.700 Mc/s)				
Chungking (China)	XGOY	9.500	31.58	35
Bangkok (Thailand)	HS8PJ	9.500	31.58	10
Lahti (Finland)	OFD	9.500	31.58	1
Mexico City	XEWW	9.503	31.57	10
Belgrade (Yugoslavia)	YUC	9.505	31.56	10
British Oversea Service	GSB	9.510	31.55	10–50
Moscow (U.S.S.R.)	RW96	9.520	31.51	20–100
Pretoria (South Africa)	ZRG	9.523	31.50	5
Hong Kong (China)	ZBW3	9.525	31.49	2.5
Schenectady (U.S.A.)	WGEO	9.530	31.48	100
Treasure Island (U.S.A.)	KGEI	9.530	31.48	20
Calcutta (India)	VUC2	9.530	31.48	10
Tokio (Japan)	JZI	9.535	31.46	50
Motala (Sweden)	SBU	9.535	31.46	12
Suva (Fiji)	VPD2	9.535	31.46	—
Vatican City	HVJ	9.550	31.41	25
Bombay (India)	VUB2	9.550	31.41	10
Pittsburgh (U.S.A.)	WPIT	9.570	31.35	40
Millis (U.S.A.)	WBOS	9.570	31.35	10
Madras (India)	VUM2	9.570	31.35	10
Montevdico (Uruguay)	CXA2	9.570	31.35	5
British Oversea Service	GSC	9.580	31.32	10–50
Melbourne (Australia)	VLR	9.580	31.32	2
Delhi (India)	VUD2/3	9.590	31.28	10
Philadelphia (U.S.A.)	WCAB	9.590	31.28	10
British Oversea Service	GRY	9.600	31.25	10–50
Moscow (U.S.S.R.)	RAL	9.600	31.25	20–100
Cape Town (South Africa)	ZRL	9.606	31.23	5
Panama City	HP5J	9.610	31.32	2.5
Sydney (Australia)	VLQ	9.615	31.20	—
Budapest (Hungary)	HAT5	9.625	31.17	5
Taihoku (Formosa)	JFO	9.636	31.13	—
Wayne (U.S.A.)	WCBX	9.650	31.09	10
Perth (Australia)	VLW2	9.650	31.09	—
Perth (Australia)	VLW4	9.655	31.04	—
Vatican City	HVJ	9.660	31.06	25
Buenos Aires (Argentine)	LRX	9.660	31.06	7
Manila (Philippine Islands)	KZRH	9.660	31.06	—
Treasure Island (U.S.A.)	KGEI	9.670	31.02	20
Teheran (Iran)	EQC	9.680	30.99	14
Mexico City	XEQQ	9.680	30.99	10
Sydney (Australia)	VLQ5	9.680	30.99	—
British Oversea Service	GRX	9.690	30.96	10–50
Buenos Aires (Argentine)	LRA1	9.690	30.96	10
Singapore (Malaya)	ZHP	9.700	30.93	2.5
Fort-de-France (F.W.I.)	—	9.705	30.92	—
Lisbon (Portugal)	CSW7	9.740	30.80	10
Athens (Greece)	SVJ	9.825	30.54	—
Madrid (Spain)	EAJ7	9.860	30.43	10
Rio de Janiero (Brazil)	PSH	10.220	29.35	—
Bandoeng (Java)	PMN	10.260	29.24	1.5
Sofia (Bulgaria)	—	10.310	29.10	—
Buenos Aires (Argentine)	LSX	10.350	28.99	12
Moscow (U.S.S.R.)	—	10.724	29.59	20–100
Lisbon (Portugal)	CSW6	11.040	27.17	10
Radio Nations (Switzerland)	HBO	11.402	26.31	20
Moscow (U.S.S.R.)	—	11.500	26.09	20–100
Canton (China)	XGOK	11.650	25.75	—
25-Metre Band (11.700–11.900 Mc/s)				
Motala (Sweden)	SBP	11.705	25.63	12
Panama City	HP5A	11.700	25.64	2.5
Moscow (U.S.S.R.)	—	11.710	25.62	20–100
Bangkok (Thailand)	HSP6	11.715	25.61	10
Winnipeg (Canada)	CJRX	11.720	25.60	2
Buenos Aires (Argentine)	LRA3	11.730	25.58	10
Vatican City	HVJ	11.740	25.55	25
British Oversea Service	GSD	11.750	25.53	10–50
Moscow (U.S.S.R.)	RNE	11.766	25.51	20–100
Hsinking (Manchukuo)	MTCY	11.775	25.48	20
Saigon (French Indo-China)	FZR	11.780	25.47	12
Lahti (Finland)	OFE	11.780	25.47	1
Boston (U.S.A.)	WRUL	11.790	25.45	20
Tokio (Japan)	JZJ	11.800	25.42	50
British Oversea Service	GSN	11.820	25.38	10–50
Moscow (U.S.S.R.)	—	11.830	25.36	20–100
Delhi (India)	VUD4	11.830	25.36	10
Wayne (U.S.A.)	WCBX	11.830	25.36	10
Perth (Australia)	VLW3	11.830	25.36	—
Lisbon (Portugal)	CSW5	11.840	25.34	10
Melbourne (Australia)	VLR3	11.850	25.32	2
Rio de Janiero (Brazil)	PRF5	11.855	25.30	—
British Oversea Service	GSE	11.860	25.29	10–50
Sydney (Australia)	VLQ2	11.870	25.27	—
Pittsburgh (U.S.A.)	WPIT	11.876	25.26	40
Sydney (Australia)	VLQ7	11.880	25.25	—
Chungking (China)	XGOY	11.900	25.21	35
Moscow (U.S.S.R.)	—	11.910	25.19	20–100
Rabat (Morocco)	—	11.940	25.13	—
Moscow (U.S.S.R.)	RNE	12.000	25.00	20–100
Shanghai (China)	FFZ	12.050	24.90	—
Quito (Ecuador)	HCJB	12.460	24.08	—
Moscow (U.S.S.R.)	RKI	14.717	20.38	20–100
Radio Nations (Switzerland)	HBJ	14.538	20.61	20
19-Metre Band (15.100–15.350 Mc/s)				
Moscow (U.S.S.R.)	RKI	15.040	19.95	20–100
Teheran (Iran)	EBP	15.100	19.87	14
Vatican City	HVJ	15.120	19.84	25
Boston (U.S.A.)	WRUL	15.130	19.83	20
British Oversea Service	GSF	15.140	19.82	10–50

Station	Call Sign	Mc/s	Metres	kW
Motala (Sweden)	SBT	15.155	19.80	12
Tokio (Japan)	JZK	15.160	19.79	50
Moscow (U.S.S.R.)	RW96	15.180	19.76	20–100
British Oversea Service	GSO	15.180	19.76	10–50
Lahti (Finland)	OIE	15.190	19.75	1
Ankara (Turkey)	TAQ	15.195	19.74	20
Chungking (China)	XGOX	15.200	19.74	35
Pittsburgh (U.S.A.)	WPIT	15.210	19.72	40
Lisbon (Portugal)	CSW4	15.215	19.72	10
Belgrade (Yugoslavia)	YUG	15.240	19.68	10
Boston (U.S.A.)	WRUL	15.250	19.67	20
British Oversea Service	GSI	15.260	19.66	10–50
Wayne (U.S.A.)	WCBX	15.270	19.65	10
Delhi (India)	VUD3	15.290	19.62	10
Buenos Aires (Argentine)	LRU	15.290	19.62	7
British Oversea Service	GSP	15.310	19.60	10–50
Sydney (Australia)	VLQ3	15.315	19.59	—
Schenectady (U.S.A.)	WGEA/O	15.330	19.57	25–100
Treasure Island (U.S.A.)	KGEI	15.330	19.57	20
Budapest (Hungary)	HAS3	15.370	19.52	5
Moscow (U.S.S.R.)	—	15.715	19.09	20–100
16-Metre Band (17.750–17.850 Mc/s)				
Pittsburgh (U.S.A.)	WPIT	17.780	16.87	40
Bound Brook (U.S.A.)	WNBI	17.780	16.87	25
British Oversea Service	GSG	17.790	16.86	10–50
Chungking (China)	XGOX	17.800	16.85	35
Sydney (Australia)	VLQ8	17.800	16.85	—
British Oversea Service	GSV	17.810	16.84	10–50
Wayne (U.S.A.)	WCBX	17.830	16.83	10
Tokio (Japan)	JLS2	17.845	16.81	50
Moscow (U.S.S.R.)	—	17.910	16.75	20–100
Radio Nations (Switzerland)	HBF	18.450	16.26	20
Moscow (U.S.S.R.)	—	18.540	16.18	20–100
Bangkok (Thailand)	HS6PJ	19.020	15.77	10
13-Metre Band (21.450–21.750 Mc/s)				
Boston (U.S.A.)	WRUL	21.460	14.00	20
British Oversea Service	GSH	21.470	13.97	10–50
Schenectady (U.S.A.)	WGEA	21.500	13.95	25
Philadelphia (U.S.A.)	WCAB	21.520	13.94	10
British Oversea Service	GSJ	21.530	13.93	10–50
Pittsburgh (U.S.A.)	WPIT	21.540	13.93	40
British Oversea Service	GST	21.550	13.92	10–50
Wayne (U.S.A.)	WCBX	21.570	13.91	10
Schenectady (U.S.A.)	WGEA/O	21.590	13.89	25–100
British Oversea Service	GRZ	21.640	13.86	10–50
11-Metre Band (25.600–26.600 Mc/s)				
Boston (U.S.A.)	WRUW	25.600	11.70	—
St. Louis (U.S.A.)	W9XPD	25.900	11.58	—
Cincinnati (U.S.A.)	W8XNU	25.950	11.56	—
South Bend (U.S.A.)	W9XH	26.050	11.52	—
Superior (U.S.A.)	W9XJL	26.100	11.49	—
Nashville (U.S.A.)	W4XA	26.150	11.47	—

Stations of which the names are "indented" are working outside the regular broadcasting bands.

Short-wave Receiving Conditions

PROSPECTS FOR JANUARY

(COMMUNICATED BY THE ENGINEERING DEPARTMENT OF CABLE AND WIRELESS, LTD.)

RECEPTION during the month of November was somewhat more erratic than of recent months, consecutive days of favourable conditions being relatively few in number.

Ionosphere storm conditions were reported to be in evidence on November 1st, 4th, 5th, 9th, 12th, 13th, 14th, and 20th to 30th inclusive (but excluding 24th and 27th).

The occurrence of a large group of storms between the 20th and 30th was not entirely unexpected; the probability of such was, in fact, referred to in the November issue of this journal, published on October 20th, as some readers may recollect.

Recovery to more normal conditions during the last day or two of the month, the possibility of which was suggested in that issue, did not, however, materialise.

A sudden ionosphere disturbance of the "Dellinger" type occurred on November 15th at 0835; its effects, which were observed for about forty minutes, were confined mainly to routes to the Eastward and Southward of this country. The last reported disturbance of this type occurred on August 15th at 1435. (This and other times given in this report are GMT on the 24-hour clock notation.)

Particulars of the broadcast bands which, it is considered, should prove most reliable during January under normal conditions of propagation at the times stated for five selected routes, are given below; these may serve as a guide when considering the possibilities of reception from places not too remote from those specified.

Attention is drawn to the fact that a number of factors, for example (a) transmitter power, (b) efficiency of aerials at both the transmitting and receiving end, and (c) ionosphere abnormalities, may often result in better reception being obtained on wavebands other than those quoted.

Montreal: Midt, 41 or 49 m; 0300, 49 m; 0700, 41 or 49 m; 1000, 31 or 41 m; 1200, 19 or 25 m; 1400, 16, 19 or 25 m; 1700, 25 or 31 m; 2000, 31 or 41 m.

Apart from the effects of ionosphere storms which may be detrimental to reception from time to time, particularly during the hours of darkness, difficulties may be experienced on occasions between 0700 and 1100. In general, the most favourable period for reception on this route is likely to be between 1400 and 1800.

Tokio: Midt, 31 or 41 m; 0700, 19 or 25 m; 0900, 16, 19 or 25 m; 1100, 19 or 25 m; 1300, 25 or 31 m; 1600, 31 or 41 m; 1800, 41 or 49 m; 2200, 49 m.

Little, if any, reception is to be anticipated over this route between 0100 and 0500, and such signals as may be audible for an hour or two prior and subsequent to this period are not expected to be of any great value except under the most favourable conditions.

Buenos Aires: Midt, 31 or 41 m; 0300, 31, 41 or 49 m; 0600, 41 or 49 m; 0900, 25 or 31 m; 1200, 16 or 19 m; 1500, 16 m; 1800, 16 or 19 m; 2100, 25 or 31 m.

During adverse conditions the periods 0700 to 1000 and 1800 to 2100 are likely to present the greatest difficulties.

Cairo: Midt, 41 or 49 m; 0300, 49 m; 0600, 25 or 31 m; 0900, 19 or 25 m; 1300, 19 m; 1600, 19 or 25 m; 1800, 25 or 31 m; 2100, 31 or 41 m.

Capetown: Midt, 31 or 41 m; 0300, 41 or 49 m; 0700, 25 or 31 m; 0900, 16 or 19 m; 1200, 16 m; 1500, 16 or 19 m; 1800, 25 or 31 m; 2100, 31 m.

In general, conditions on the Cairo and Cape Town routes should be favourable throughout the 24 hours, except, possibly, between 0400 and 0700.

With regard to reception during January, while there are no indications at the time of writing this report of a large number of consecutive days of "peak" conditions, it would seem probable that signals during the latter part of the second week and early part of the third week may prove to be

Short-wave Receiving Conditions—

subnormal compared, for example, with those during the first or last few days of the month.

Most readers are no doubt aware that the area and number of spots on the sun varies from day to day and that the annual means (called Wolf numbers) follow a roughly periodical variation, the period being about 11 years from one maximum (or minimum) to the next, the complete variation from minimum through maximum and back to minimum being termed the solar or sunspot cycle.

The last maximum occurred in 1937, the Wolf number for which was 114 as compared with 79 for the previous maximum, i.e., that of 1928.

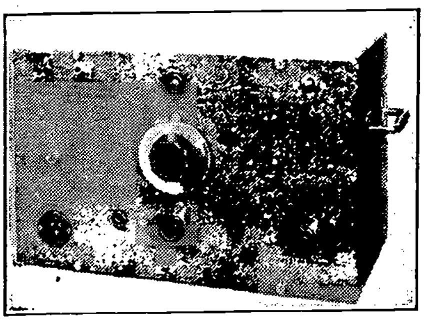
Since 1937 the numbers as shown in the brackets below have progressively decreased; for example, 1938 (109), 1939 (89).

With regard to the year 1940, although the Wolf number is unlikely to be published from Zurich before next March, it would seem from purely radio data that it will be about 60.

Salford Crystal Calibrator

STANDARD FREQUENCIES FOR LABORATORY AND PRODUCTION WORK

DESIGNED for the calibration of radio receivers this new product of Salford Electrical Instruments, Ltd., Silk Street, Salford, 3, Lancs, consists of a quartz crystal-controlled oscillator with a low temperature coefficient operating at either 100 kc/s, 1 Mc/s or 5 Mc/s. An auxiliary oscillator working at either 25 or 50 Mc/s can be set from the main oscillator, and by the use of harmonics, frequencies up to 300 Mc/s can be calibrated with an accuracy better than 0.1 per cent.



Portable crystal calibrator unit, Type BW200, made by Salford Electrical Instruments.

The unknown frequency is combined with the calibrated oscillation in a mixing stage, and the beat is observed by means of phones.

Letters to the Editor

THE EDITOR DOES NOT NECESSARILY ENDORSE THE OPINIONS OF HIS CORRESPONDENTS

High-Quality Gramophone Recordings

MAY I express my appreciation for the additional list of gramophone records given by Mr. G. R. Ginns in *The Wireless World* for December. Will others please help to expand this list of records which must pass an average test for (a) freedom from amplitude and frequency distortion, (b) reasonably low surface scratch, and (c) contrast and substantial quality. The type of record we leave to the individual's taste.

Without the help of readers it is a hit-or-miss business buying gramophone records for several reasons, such as the time wasted in wading through far too many bad recordings, or the absence of a faithful reproducer in the dealer's shop. Quite frankly I give up unless a particularly good recording is heard by broadcast or a friend's house, so for this reason an exchange of lists is most helpful.

"Schon Rosmarin." Liebesfreud. Col. FB 1410. Saxophone solos.

"Evensong." Solemn Melody. H.M.V. BD 670. Concert organ.

"Finlandia," Parts 1 and 2. H.M.V. BD 665. Concert organ.

"Plymouth Hoe," Parts 1 and 2. H.M.V. B 9036. Light Sym. Orch..

"God Save The King"; "Rule, Britannia!" H.M.V. B 8553. B.B.C. Sym. Orch.

HAMILTON H. TAIT.

Edinburgh, 10.

I WAS very pleased to see that this topic was revived by your correspondent G. R. Ginns in the December issue. Under present wartime conditions many readers of *The Wireless World* will no doubt have turned to the electric gramophone as their main "wireless" interest. The scope of this interest, although it does not involve a consideration of radio frequencies, is very great, for it includes all the aspects of audio frequency amplification, pick-up and loud-speaker design, tone control in the widest sense ("electrical cooking"), the mounting of speakers and the acoustics of rooms, the plotting of partial and overall response curves, and finally the whole subject of direct recording. *The Wireless World* has always catered excellently for its readers who are interested in these topics, and many like myself must have felt very grateful for the first-class articles by Mr. Voigt, Mr. Scroggie, and others. I feel sure that if even more of your columns were devoted to this subject, many readers would be greatly indebted to you.

The following short list is my selection of "high-quality" recordings:

Overture, "Carnival" (Dvorák); Talich and Czech Philharmonic Orchestra. H.M.V. C 2842.

Rhapsody, "Espana" (Chabrier); Sir Thomas Beecham and London Philharmonic Orchestra. Columbia LX 880. (There appears to be little volume compression in this recording.)

Variations on a Theme by Haydn (Brahms); Weingartner and London Philharmonic Orchestra. Columbia LX 744-745.

Incidental Music to "The Tempest" (Sibelius); Sir Thomas Beecham and London Philharmonic Orchestra. Part of the Sibelius Society Album, Vol. V, H.M.V.

Overture, "Die Fledermaus" (J. Strauss); Marek Weber and his Orchestra. H.M.V. C 2646. (There is possibly a little too much reverberation in this recording, though this very fact may make it appeal to many when it is reproduced in the average room.)

Ballet Music, "Coppelia" (Delibes); Walter Goehr and London Ballet Orchestra. Columbia DX 899.

Letter Scene and Waltz from "Rosenkavalier" (R. Strauss); Kipnis and Ruziczka (duet), with Berlin State Opera Orchestra. H.M.V. DB 1543.

Flower Song from "Carmen," and Your Tiny Hand is Frozen from "Bohème"; Webster Booth (tenor) and London Philharmonic Orchestra. H.M.V. C 3030.

Iago's Creed from "Otello" (Verdi); Denis Noble (baritone) with Orchestra. H.M.V. C 3153.

The best recorded speech I have heard is "The Birth of Radio," a Columbia record (Ref. No. R.O.67) presented with a commercial radiogram about five years ago.

C. H. EDLIN (B.Sc., A.Inst.P.)

Woolaton, Nottingham.

MY own best records have been in previous lists given by readers, but I have two which, although not perhaps of the highest quality, are certainly not bad. They are both violin solos with accompaniment, apparently a difficult subject for recording. Here they are:—

"Poem" and "Le Cygne," Wolfi. Col. DB 1058.

"Serenade" and "Song of Paradise," Campoli and Foort. H.M.V. BD 484.

Perhaps I should mention that I use a Cosmocord Series III crystal pick-up with a resistance-capacity correcting network to give an approximately level frequency response, followed by an amplifier resembling Mr. Scroggie's (*The Wireless World*, May 11th, 1939). E. F. GOOD.

Sheffield, 7.

MR. G. R. GINNS' letter interested me greatly, and I quite agree that it would be very helpful to know which are the best recordings. The trouble is that it is essential to know what sort of apparatus is being used by the critic before one is prepared to accept his opinion. Personally I use a Lowther straight set with a Voigt speaker and Voigt pick-up. Here is a list of really outstanding recordings:

"England, My England." H.M.V.
"Lullaby" (Scott), sung by Flagstad. H.M.V.
"Ecossaises," Brailowsky. H.M.V.
Handel's "Largo," Gigli. H.M.V.
"Don Juan," Strauss. H.M.V.
Walton's "Façade." H.M.V.
"Scenes from Shadow Play," 1 and 2. (Coward.) H.M.V.
"I Got Rhythm." Parlophone.
"If All the World Were Mine." H.M.V.
"Walt Disney Selections," Parts 1 and 2. Columbia.

It must be borne in mind that late prints of records are not as good as early prints—also that a record deteriorates very rapidly at the beginning of its playing career. In my opinion, after four or five playings a record is no longer anything like as good as when it was new, although it will not get any worse for another hundred or more playings.

MAURICE ELLINGER.
London, W.2.

GRAMOPHONE records seem to be the order of the day and I would like to take this opportunity of adding my voice to that of Mr. Ginns in a request for readers to send in lists of high quality recordings.

My selection is set out below:

"Frasquita Serenade" (organ), Parlophone F843.
Rachmaninoff's "Prelude in C Sharp Minor," H.M.V.DB3011.
"Nellie Dean" (Joe Daniels' Dance Band), Parlophone F1558.
The whole of the latest H.M.V. recording of "The Mikado" is good—i.e., DB4038-48 or auto-coupling 8105-15, but especially DB4039, "Wandering Minstrel"; 4040, "Our Great Mikado"; 4041, "Behold the Lord High Executioner" and "Comes a Train of Little Ladies."

Walsall. A. A. COTTERELL.

Book Review

How to Make Good Recordings. Pp. 127. Published by Audio Devices, Inc., 1600, Broadway, New York City, N.Y., U.S.A. Price (in U.S.A.): $1.25.

DIRECT disc recording by amateurs is rapidly growing in popularity as a hobby throughout America, and laymen with more enthusiasm than knowledge and experience seek enlightenment. To meet this demand the manufacturers of Audiodisc blanks and other recording products have prepared this beautifully printed new book to help the budding recordist.

Admittedly a limited exposition on a complex subject, this publication succeeds in collecting, under 100 sections indexed for quick reference, a great amount of hitherto scattered information which the novice would find invaluable and the more seasoned recordist will find useful for checking his routine procedure. The latter may also profit by a study of the chapter on common recording difficulties and their remedies.

In dealing with the various aspects of the work plentiful references to the relative Audio company's products are made and, although advice on choosing the best recorder is given, it is presumed that a complete apparatus will be acquired, as no circuits for amplifiers or details of matching technique, etc., are included.

The excellence of the many self-explanatory diagrams on such topics as microphone placing and the clarity of the illustrations depicting record cutting defects deserve special mention. A useful glossary of technical terms employed in the text concludes this recommended handbook.

D. W. A.

"Radio Designer's Handbook"

A COMPLETE REFERENCE MANUAL OF CIRCUITS AND FORMULAE

THOSE engaged in the design of receivers, whether from a professional or amateur point of view, will find in this new work every formula required for the evaluation of circuit constants and a wealth of information on modern receiver developments, including negative feed back, volume expansion, automatic frequency control, etc.

Explanatory matter is brief and to the point, and a good index enables the reader to reach the essential information required in the shortest possible time.

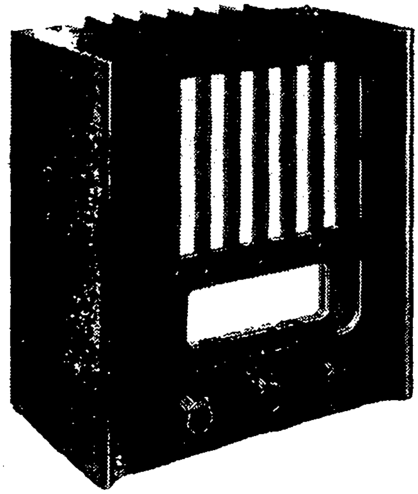
There are chapters on the design of tone controls, AVC circuits and frequency changers (including formulæ for oscillator tracking), and the treatment of audio amplifiers and output stages is unusually complete. Tests and measurements, including valve voltmeter design, have a chapter to themselves, and there is a section dealing with wireless mathematics.

The handbook is edited by F. Langford Smith, B.Sc., A.M.I.E.E., and is available from our Publishing Department, bound in cloth, priced 7s. 6d., or by post, 8s. 1d.

Test Report

Murphy Model AD94

A COMPACT AND EFFICIENT RECEIVER DESIGNED TO MEET WARTIME REQUIREMENTS. PRICE £9 10s.



IN designing this receiver, Murphy Radio have taken into account wartime changes in listening habits, the present and possible future restrictions on the supply of certain raw materials, and last, but by no means least, the necessity of keeping the price within reasonable limits. The result is a most attractive little receiver of good appearance and lively performance, which should safely carry the good name of the firm through the war period.

In these days, a long-wave range is more or less redundant, so the designers have concentrated on two waveranges only—short and medium —with a consequent saving in coils and switching complications. Other circuit economies have been made by omitting the tone control and also the external loud speaker switch, but the main components are of standard Murphy quality and no compromise with reliability and essential performance has been allowed.

The set bridges the gap between the so-called "midget" receiver and the full-sized table model, and combines the light weight and small size of the former with the better range, selectivity and quality of the latter.

The moulded bakelite cabinet is an innovation as far as Murphy sets are concerned, but the designers seem to be quite as successful as they have been with veneered woods in the past.

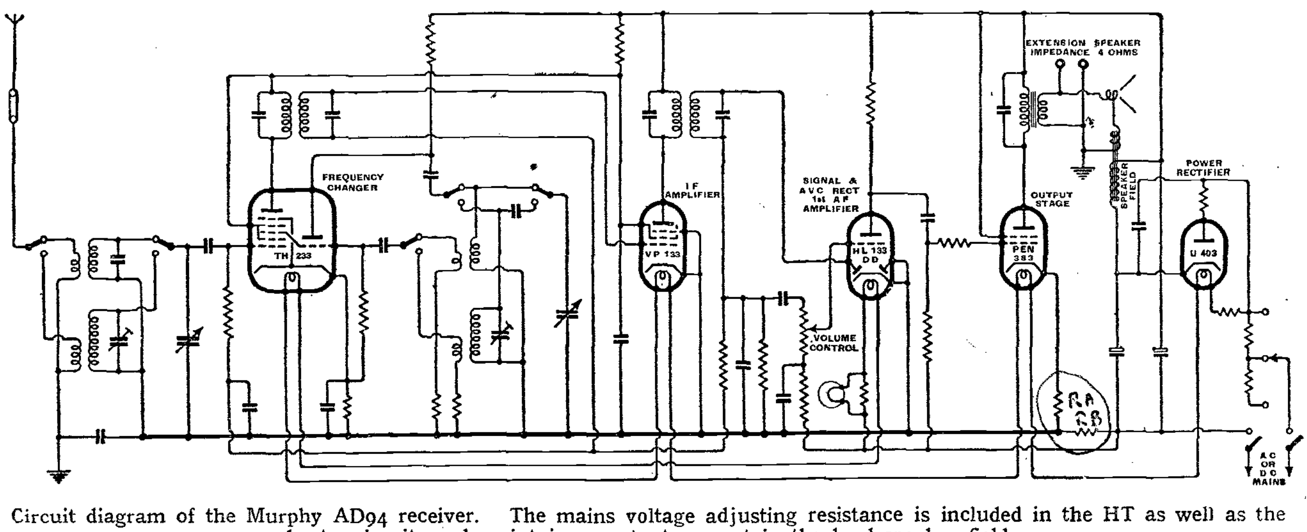
Circuit.—The valve sequence follows the usual arrangement in four-valve superheterodyne receivers. A triode-heptode is used for frequency changing, a variable-mu pentode for IF amplification, a diode-triode for signal and AVC rectification and first stage AF amplification, and a beam tetrode for power output.

Iron cored inductances are used throughout, and circuit alignment is carried out by adjusting the core positions. No variable padding condensers are provided, and correct tracking is effected by inductance variation at the low-frequency end and trimmer adjustment at the high-frequency end of each waveband. There are sockets for an aerial filter unit to reduce local station interference in situations where this is troublesome.

The simplest form of single diode rectifier circuit is employed, and the redundant diode is tied down to cathode. AVC is applied to both preceding valves. A measure of negative feedback is introduced by the economy of omitting the by-pass condenser on the bias resistance of the output valve. Bias for the first AF stage is taken from a tapping on the same resistance and is, of course, decoupled.

WAVERANGES		
Short ..	*16.7 to*	*50 metres*
Medium	*200 to*	*550 metres*

Performance.—The general liveliness and good signal-to-noise ratio on the short-wave band are remarkable in view of the fact that no RF stage is employed. There is a dead silent background between stations which serves to emphasise the clear



Circuit diagram of the Murphy AD94 receiver. The mains voltage adjusting resistance is included in the HT as well as the heater circuit, and maintains constant current in the loud speaker field.

Murphy Model AD94—

cut quality with which each successive station is received. Second-channel interference is not obtrusive on stations of moderate or low field strength, and the sensitivity over the whole range is remarkably uniform. The AD94 would be well worth buying as an auxiliary short-wave receiver to an existing standard medium- and long-wave set.

Selectivity on the medium-wave band is good, and when tuning through a station, the IF circuits sound sharp. The loud speaker has a good top response, and this removes any suggestion of dullness due to side-band cut when the station is accurately tuned. Quality of reproduction is in fact much superior to that of the average small set. There is enough low frequency response for the ear to be able to follow the double bass parts in a full orchestra without erring on the side of artificial resonance. So good is the response that one tends to ask for more volume than the set is capable of giving, and a wary hand must be kept on the volume control.

Constructional Features.—The new bakelite cabinet is a well thought-out design, from the point of view of both appearance and mechanical strength. The walls are for the most part little more than $\frac{1}{8}$in. thick, but the reinforcement provided by the ribbed exterior grille and the internal lugs for supporting the chassis gives strength and rigidity without adding unduly to the weight. Actually, the complete receiver turns the scales at only 13 lbs.

The chassis, which is coated with a durable blue enamel, is in the form of a channel section, which serves to strengthen still further the whole assembly. Components are laid out in the conventional Murphy fashion, with the main tuning condenser off-set. The chassis is only 4in. wide, and the electrolytic tuning condenser projects through a hole at the front, where it is clamped. One of the IF transformer cans is skewed slightly to give easy access to the cores for trimming.

In most Murphy DC/AC sets, a thermal delay is provided to protect the pilot lamp during the warming up period, but in this case an economy has been effected by using a lamp running at a lower temperature. This does not illuminate the whole dial, but gives a spot of light at the side to show when the mains are switched on.

From every point of view, the AD94 is a skilful compromise, and is just the right type of set to hold the "home front" until more liberal times.

Book Review

Getting Acquainted with Radio. By Alfred Morgan. Pp. 279+XI; 130 drawings and diagrams. Published by D. Appleton-Century Company, 34, Bedford Street, Strand, London, W.C.2. Price 12s. 6d.

GOOD books of the wireless-without-tears type are few and far between. Perhaps the subject does not readily lend itself to such treatment; be that as it may, many of the popular "simplified" expositions are likely to make the reader abandon wireless altogether—or, if he is really keen, to get down to first principles without waste of time.

Here is a book that is an exception to the general rule. The author seldom tries to simplify those things that cannot be simplified, but be finds so much to explain adequately that the type of reader for whom he is writing will gain a sufficient understanding of fundamentals on which to build a deeper knowledge by subsequent heavier reading.

In the opening chapter the pill of history is gilded under the heading of "Adventures in Space." Here, incidentally, the main initial contribution of Marconi—the addition of a radiating aerial-earth system to the Hertz oscillator—is ignored, but the slightly dramatised story of the beginnings of wireless is very readable. The author then proceeds to the explanatory part of his book, starting with wave propagation and proceeding to basic principles, valves, receivers, etc. The chapter headed "Taking the Mystery out of Tuning" should be especially helpful to many readers.

After the theory section come several chapters showing how the reader can put his knowledge into practice by building simple receivers and, as this book was originally published in America, where present restrictions do not apply, transmitters as well. The fact that American practice is exemplified does not greatly impair the value of the book to the reader in this country. H. F. S.

Random Radiations

By "DIALLIST"

FM Broadcast Service

BY now the regular frequency-modulation programmes originating in the Schenectady studios should be in full swing, for they were due to start on November 20th. The service is to be one of seven hours a day to begin with. It will consist of general entertainment programmes of the kind with which all DX listeners to America are familiar, with the one difference that more time than normal is to be given to news broadcasts. The transmitter is actually in the Helderberg Hills, a dozen or so miles from the city and the studios. FM does not lend itself, of course, to transmission over telephone lines, so the link will be a wireless one, using a very short wavelength. The frequency of W2XOY, the Helderberg station, is 43.2 megacycles. If anyone has an adaptor (a "translator" the Americans call it) enabling an amplitude-modulation receiver to deal with FM, he should be able to pick up these transmissions when conditions are favourable. I only wish that I had the chance of having a try for them: FM is claimed to be much less affected by atmospherics than AM and it would be vastly interesting to see how reception of W2XOY goes at times when AM stations are suffering severely from crackle.

A Combination Receiver

The American G.E.C. are, I note, bringing out a set which will receive either AM or FM transmissions, the change-over from one method to the other being made by the mere turning of a switch. A smart idea that, from many points of view. Few people, for instance, would want to buy a receiver that could be used on one station only, no matter how good its programmes were. Again, if FM is all that it's cracked up to be in the way of fine quality and freedom from atmospheric interference, such a receiver will be the best possible advertisement for the system, since it will enable the user to make direct comparisons without any trouble at all. If he finds that FM gives him better quality with fewer unwanted noises he's likely to become a convert without further ado. The Federal Communications Commission, by the way, has reserved 7 channels in the neighbourhood of 43 megacycles for frequency-modulation transmissions. One deduces that the F.C.C. regards FM as something promising and that W2XOY soon won't be the only station transmitting regularly by this method.

No Inter-station Interference?

It is claimed that FM does away with interference by one station with another. I read, in fact, that it is impossible for one station to jam another, for no two stations, even though both are working on exactly the same frequency, can be heard simultaneously. This is a big claim; but it is said to be amply supported by experimental results. For example, transmissions of different programmes on the same frequency were made from two experimental stations—call them A and B—in different parts of Schenectady. A car provided with a FM receiver was driven from the neighbourhood of A towards B. At the start A came in without a trace of B. Then, as the half-way mark was passed, A disappeared quite suddenly and there was B just as suddenly in its place. At the half-way line it was found, when the car was driven very slowly, the critical point, so to speak, was sharply marked. Here you were receiving A; a yard or so more and B's programme came from the loud speaker. Nowhere was there a duel between A and B, or even a background of one station on the other's programme. It was also found that with the car stationary near the mid-point a slight rotation in one direction or the other of the aerial would eliminate A and bring in B—or vice versa. Food for thought there; don't you agree?

Possibilities

Mind you, I've had no chance of getting any first-hand information about the results of FM, and nearly all that I've read about it has been written by folk responsible for its development or more or less closely connected with those that were. One knows only too well how enthusiasm for one's own products can blind the eyes to their shortcomings. But the accounts of results achieved by FM ring true, and I can't think that a concern like the American G.E.C. would spend a mint of money on developing it—with no immediate prospect of a return—if they hadn't convincing proof that it would live up to expectations. If it does there's a big future for it. One of the big problems of pre-war days was that of interference with broadcast reception. It's an important problem, for wireless has become an integral part of human life to-day. And it's going to be even more pressing after we've settled this spot of bother and got back to our normal lives again. Is FM going to show us how to eliminate the effects of interference, man-made and natural? Is it going to give us a means of avoiding the jamming, the heterodyning and the side-band splash that have so far defied all the efforts of those who do noble work in preparing wavelength "plans"—and still nobler and more strenuous work in persuading the many countries concerned to adopt them *and* to carry them out faithfully? If it does these things it will prove to be one of the most brilliant of radio inventions. If it doesn't it will, anyhow, have been a praiseworthy attempt to solve some of our greatest difficulties. And should it not furnish the complete answer to these problems, it may well point the way to something that does. Here's hoping, anyhow!

Sets for the Troops

BOTH the War Office and the Nuffield Fund are providing wireless receivers in large quantities for the troops in this country. But I'm sure that there are not a few units that could do with more than they receive from either of these sources. Having lived rough and more or less at the back of beyond myself since the war began I know how essential a wireless set is as a bringer of news and dispeller of boredom. If the papers come late the seven o'clock and eight o'clock bulletins appease the pangs of morning news hunger. We alternate between periods when we're so busy that we get little rest or sleep and others when time hangs heavy on our hands because there is next to nothing to do. During those slack periods we want wireless badly. Troops particularly likely to be glad of an extra receiver or two are anti-aircraft artillery and searchlight units. If you have an old one (it doesn't matter how old so long as it works: we're not unduly critical), you can probably find recipients who will welcome it. Should you not be in touch with such units the Welfare Officer (name and address at any post office) will tell you which would be glad of a present of this kind. You haven't an old set no longer in use? Then possibly you could rig up something from the contents of your junk box. Remember that a set that gets only the local station won't be sneezed at. Battery sets are always in demand; but many units have mains supplies of current, so that there are plenty of ready recipients of mains receivers. 'Tis a worthy cause. Will you do what you can?

Don't Waste Batteries

GOOD work, the strict control imposed on the prices of torch batteries. Last year, if you remember, there were some evil ramps and too often the only thing that limited the price asked was the amount that the customer was willing to pay. It was, I suppose, to be expected, for we were caught short of supplies—at any rate of supplies big enough to meet the demands of the black-out. But this year there has been plenty of time to make plans for the winter, and so far as one can see there's no difficulty about obtaining flashlamp refills. But don't be extravagant with your torch batteries just because there seem to be enough available. There *are* enough, if we're reasonably careful; but there won't be sufficient to go round if people waste them. I have a torch with both a sliding switch, which stays "on" once you've pushed the slide forward until you pull it back again, and a spring button which keeps the juice turned on only so long as you press it with your finger. I'm trying to remember never to use the slide, but always the button. And here's why—it's a tip that others may find useful. With the glass covered by the prescribed thickness of newspaper you may not notice that your torch is still on when you come into a lighted room after the darkness outside. I was caught that way the other day when using the slide; didn't, in fact, discover that the battery was doing useless work until it was all but run down. You can't do that sort of thing if you use the button only, for directly you put the torch down out it goes. And here's another tip that I've found a great economy. If you have a two-cell or a three-cell tubular torch, renew only *one* cell at a time. It's easy to find by substitution which is the worst of the old cells. Chuck it into the nearest battery salvage bin and put in the new one. Mark the old one (or ones) and when next your glim becomes dim you'll know where the discard is to be made. You'll find that the suggested combination of new and tired cells gives quite enough light and means much more economical working.

Book Received

Photograms of the Year, 1941. Edited by F. J. Mortimer, Hon. F.R.P.S., Editor of *The Amateur Photographer*. In spite of wartime difficulties, this well-known annual publication, which has just made its forty-sixth appearance, shows no falling-off in interest. Over 80 exhibition pictures, together with critical comments, are included. Among the various articles contained within its pages may be mentioned a review of the year's photographic work, both in this country and abroad. A directory of British Photographic Societies, nearly 500 in number, is also given. Published by Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1. Price 6s. (paper cover); 8s. (cloth bound), postage 7d.

Unbiased

By FREE GRID

Into the Future

IT is customary at this season to indulge in a few prophecies for the New Year. In these times more of us than ever before are gazing into our crystals instead of tickling them with cats whiskers, as naturally we all want to know what is in store for Adolf in the ensuing twelve months. I may say that I have been in consultation with the aged Eastern seer, to whom, as I told you a month or two back, I was able to be of great service on one occasion.

He rather disappointed me by merely prophesying the obvious for this year, namely, that in April *The Wireless World* would be celebrating its 30th birthday, and entering on its fourth decade of existence. However, I speedily found out that I had, through an oversight, omitted to send the necessary baksheesh, and when this omission had been remedied I got better results. He repeated even more emphatically than before that in 1941 we shall be using our television sets again.

Talking of television reminds me

Gazing into our crystals

that the Yanks have just decided to fall into line with certain other countries and adopt 441 lines as a television standard, so it looks as though we might eventually find ourselves in "splendid isolation" with our 405 lines, as we are with our antique monetary system, and a few other things like that. Now I hold no brief for 441 lines, and don't believe for a moment that definition is appreciably better than with our own 405 lines, but I do want to be able, when long-distance television comes, to use my domestic television set to pick up American and Continental programmes. My point is that if we are ever going to accept the 441 line standard, or any other figure, that may be internationally agreed upon, *now* is the time to make the change when television is in abeyance, and the minimum of trouble would be caused thereby.

If a change *is* going to be made, and it is left until after television is resumed, everybody will be clamouring for their sets to be adjusted overnight, so as not to miss a programme, and the makers' factories will be choked up with work, with the result that there will be general ill-feeling all round. If it were done now it could be carried out in a leisurely manner over a period of weeks. Therefore, if it *is* going to be done, better do it now or never at all.

A Serious Menace

I SUPPOSE that most of you have noticed the enormous increase in oscillation which has been taking place everywhere, but more especially in the London area, since the *blitzkrieg* began. On some evenings the noise has been truly dreadful, and it has at times been difficult to differentiate between the whistles emanating from the loud speaker and those due to falling bombs, and on several occasions diplomatic relations between Mrs. Free Grid and myself have been strained to breaking point, due to my dragging her unceremoniously under the table with me when a particularly realistic whistle came from the loud speaker.

It is, of course, quite obvious to me what is really happening. We hear many tales of mysterious light signals flashed to enemy aircraft by fifth columnists in our midst, but I long ago realised that Adolf was not quite so old-fashioned in his methods as that. A fifth columnist need run no risk of watchful warden or Home Guard seeing him flashing his torch; he can sit comfortably in his shelter posing as an innocent citizen, searching for the elusive B.B.C. with his old-fashioned swinging-coil set, for, after all, a nice wireless whistle on which an enemy plane can take a DF bearing is far better than any flashing light, and far less obtrusive.

A heavy hand fell upon my shoulder

In order to put my theories to the test I equipped myself with a very good portable DF outfit made up from a circuit published in *The Wireless World* Diary many years back, when wireless *was* wireless, and very speedily found that my worst suspicions were confirmed, namely, that the loudest and most persistent howls were emanating from houses adjoining important military targets. There was one particularly bad case in which a steady howl came from a row of modest suburban villas "situate," as the house agents say, hard by a locality which only the necessity of absolute secrecy prevents my revealing to you.

Having identified the actual house by means of careful work with my *Wireless World* Diary DF gear, I was investigating the matter further by peering through a chink in the black-out curtains when a heavy hand fell upon my shoulder, and I was confronted by a large limb of the law, or, to be exact, two limbs, in the shape of a very large policeman and a very small warden.

It is, I think, better not to dwell on the events of the next few hours; suffice to say that had it not been for the active intervention of the Editor, who is very well known to the police, things might have gone very ill with me indeed. The nightly howling on the ether still remains, and if any of you have neighbours who are more than ordinarily addicted to it, I will leave you to draw your own conclusions.

Apart from any question of fifth column activities, do not forget that when the enemy passes over an area from which a welter of whistles is emanating he is at once informed that he is over a town, and not over the countryside.

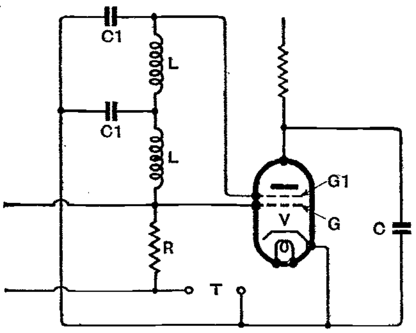
Recent Inventions

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

TIME-BASE CIRCUITS

THE frame and line synchronising signals are separated in a television receiver by applying them both to a "delay" circuit having a time constant which is greater than the "line" and less than the "frame" impulse.

The Figure shows a gas-filled valve V which generates a saw-toothed voltage when the condenser C is discharged. It is provided with two grids, one connected directly to the input and the other through a network of inductances L and capacities C1, forming a delay circuit.



Method of separating "line" and "frame" impulses.

Both sets of synchronising signals are applied to the terminals T. A short "line" impulse develops a voltage across the resistance R which is applied to the inner grid G, though its effect disappears before the same impulse can reach the second grid G1 through the delay circuit. Since the valve will only discharge when both grids are affected, the line impulses are thus cut out. The longer "frame" impulse, however, has time to get through to both of the grids, and so "trigger" the valve, to discharge the condenser C and generate a frame scanning-oscillation.

Murphy Radio, Ltd., and K. S. Davies. Application date December 14th, 1938. No. 522737.

o o o o

WIRED-WIRELESS SYSTEMS

WHEN a number of receivers are fed with different programmes from a common transmission line, it is desirable that each receiving set should present a high impedance to the line, so as to avoid disturbing the line voltage as the sets are switched into or out of circuit. The voltage is, however, not uniform along the line, being usually higher at points near the sending end. Also variations in voltage may arise owing to reflection at various branch points. Accordingly it is advantageous to be able to provide independent means for adjusting the signal strength at each receiver so as to make it substantially the same for each of the available carrier frequencies.

With this object in view, each receiver input is shunted by a fixed resistance in series with a variable resistance, which is also in series with a band-pass filter capable of passing the modulation frequencies from the line. The variable resistance can be adjusted up to a value ten times the fixed resistance, whilst the latter is sufficiently high to keep the response of the band-pass filter uniform over the whole band of signal frequencies.

P. P. Eckersley and R. E. H. Carpenter. Application date October 18th, 1938. No. 522889.

o o o o

VISUAL TUNING INDICATORS

THE fluorescent screen of a visual tuning indicator of the cathode-ray or "magic-eye" type is divided into, say, three segments, each producing a different colour under the impact of the electron stream. For each position of the wave-change switch of the set, a corresponding segment is automatically brought into circuit with the anode of the indicator tube, so that the tuning point of a long-wave station is shown, for instance, in red, whilst the medium and short-wave indications appear in other colours.

Vereingte Gluhlampen und Elektrizitats Akt. Convention date (Germany) May 28th, 1938. No. 519921.

o o o o

PUSH-BUTTON AND MANUAL TUNING

IN a motor-controlled push-button set, it is usual to provide for manual tuning as an alternative to automatic station selection. The invention consists in using the motor normally employed for automatic tuning, so that it also plays a useful part in manual tuning.

Suppose the tuning indicator-needle happens to be positioned towards the right-hand side of the station scale, and that it is desired to tune the set, by hand, to a station located towards the opposite end of the scale. The listener will then press the manual-control knob towards the left. This first brings the muting switch into action, so as to "silence" the set, and then brings the motor into gear to drive the needle towards the required end of the scale. When the needle has been brought close to the desired tuning-point in this way, the lateral pressure on the control knob is released. The muting switch then becomes inoperative, the motor drive is broken, and the tuning operation is completed by hand-control in the ordinary way.

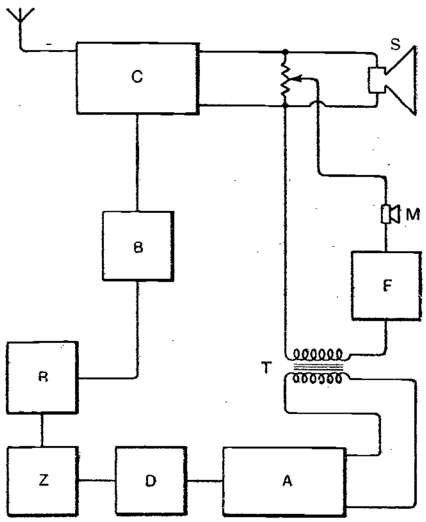
Kolster-Brandes, Ltd., and W. A. Beatty. Application date October 7th, 1938. No. 519905.

o o o o

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

WHEN THE AUDIENCE TALKS

WHEN the casual conversation of the audience in a cinema theatre threatens to drown out the speech from the film, it is possible to use the noise of such "chatter" to produce an automatic volume control voltage, which serves to boost-up the film dialogue. The present invention deals with the same problem in another, and possibly more effective, way, because matters are so arranged that any extraneous noise acts automatically to cut down the volume of the film speech or music, so that the audience is forced to be quiet if it wishes to hear what is coming from the stage. Similarly, the invention can be used to silence an ordinary wireless set when a conversation is started between people who have been listening to a broadcast programme.



Volume regulation by voice control

As shown, an auxiliary microphone M is "balanced" across the loud speaker S so that it is not affected by the normal output from the latter. Any extraneous noise, however, produces an unbalanced microphone current, which passes through a 200-400-cycle filter F and a transformer T to an auxiliary amplifier A. The output from A is rectified at D and passed through a time-delay circuit Z to operate a relay R This auto-

Recent Inventions—
matically applies a cut-off or volume-reducing bias to the main receiver C, through a special biasing network at B.

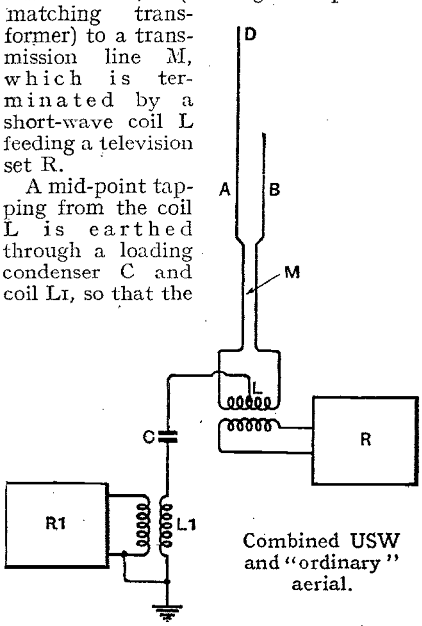
Kolster-Brandes, Ltd., and C. N. Smyth. Application date November 4th, 1938. No. 520915.

o o o o

"ALL-WAVE" AERIALS

THE Figure shows an aerial arrangement suitable for receiving both television and ordinary broadcast programmes. The upper dipole D, which is tuned to the television waves, is coupled through two suitably spaced conductors A, B (forming an impedance-matching transformer) to a transmission line M, which is terminated by a short-wave coil L feeding a television set R.

A mid-point tapping from the coil L is earthed through a loading condenser C and coil L1, so that the whole of the upper system acts as an aerial for the longer waves, which are fed to the receiver R1. Since the dipole aerial is "balanced" for the television waves, there will be very little "leakage" into the lower earthed lead, though a high-frequency choke may be inserted in series with the coil L1 if necessary.



Combined USW and "ordinary" aerial.

Kolster-Brandes, Ltd.; W. A. Beatty; and P. K. Chatterjea. Application date December 23rd, 1938. No. 523074.

o o o o

REMOTE VOLUME AND TONE CONTROL

IN order to control the output of a wireless set from a remote point through leads which do not carry power current, and which do not require shielding, a potentiometer resistance is shunted across the secondary winding of the loud speaker transformer. A variable tapping from this resistance is then connected in series with the cathode resistance of the distant amplifier, so as to apply negative reaction, and to give a control circuit of low impedance to the chassis of the set. A condenser for high-frequency discrimination is included in the feed-back connection, or any other required form of tone control may be incorporated.

The remote control may be used in addition to the ordinary volume control provided on the set. The latter then serves to determine the general level of volume suitable to the circumstances in which the set is being used, whilst the remote control allows a fine adjustment to be made to suit individual tastes, having regard to the particular type of music that is being reproduced.

Murphy Radio, Ltd.; D. N. Truscott; and G. D. Reynolds. Application date September 13th, 1938. No. 520128.

o o o o

AERIALS

A DIPOLE and reflector unit, as normally used for receiving television signals, is further adapted to receive ordinary broadcast signals. For television work, the dipole is assisted only by the re-radiation effect of the reflector, and is connected to the set by the usual coaxial or two-wire line.

For receiving the medium- or long-wave broadcast programmes, a separate screened down-lead is used. This is coupled through a matching transformer to the whole aerial unit, so that the capacity of the reflector, as well as that of the spacing bar between it and the dipole, both help to "load" the system, so that it can be tuned to the longer wavelengths.

Alternatively, the television dipole is directly connected to the reflector through a centre tapping on a coil having a high impedance to the television frequencies, and a low impedance to the longer waves. In this arrangement, the same down-lead is used for both types of programme.

Belling and Lee, Ltd., and F. R. W. Strafford. Application date September 24th, 1938. No. 520628.

o o o o

CAPACITY EFFECTS

IF a piece of metal foil is placed against a slab of agate or polished stone, and a voltage is applied across the surface of contact, the foil will adhere quite strongly to the stone. This phenomenon is known as the Johnsen Rahbek effect, and has already found various applications in wireless practice.

The effect is used in the present invention to convert a varying voltage into a corresponding variation of capacity. The polished surfaces of two pieces of agate are placed together, and two pieces of metal foil are cemented over the two outer surfaces. If a varying voltage is now applied across the two pieces of foil, it is found that the capacity between them changes with the voltage. The reason is obscure, but is believed to depend upon molecular changes in the thin dielectric film between the foil and the agate surface.

The arrangement can be used for applying automatic frequency control to a wireless receiver.

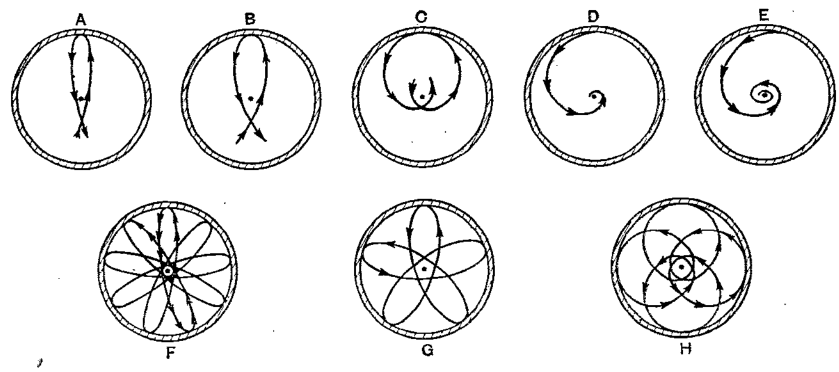
Marconi's Wireless Telegraph Co., Ltd.; N. M. Rust; J. D. Brailsford; and A. L. Oliver. Application date November 12th, 1938. No. 522476.

o o o o

MAGNETRON GENERATORS

A MAGNETRON valve consists of a single or "split" cylindrical anode enclosing a straight cathode, the space between the two electrodes being subjected to the action of an external magnetic field. The field controls the electrons emitted from the cathode, and forces them to follow a more or less curved path, as they move towards the anode. The frequency of the oscillation generated is thus determined by the curvature of the electron path, or, in other words, by the time taken for the electrons to travel from cathode to anode. In ordinary practice the applied magnetic field is of uniform intensity.

According to the invention, the magnetic flux is not kept uniform but is deliberately concentrated either near the anode or in the region of the cathode. This concentration is effected by placing elements of high magnetic permeability inside the tube near the electrodes in question. In the Figure, A, B, C, D, E represent different orbital paths which the electrons can be forced to take according as the magnetic control field is concentrated near the anode or near the cathode. F shows a cycle of nine electronic oscillations of the form shown in A, each rotating counter-clockwise; G represents a five-cycle sequence of the oscillations in B; whilst H shows, by contrast, the path taken by the electrons in a uniform magnetic field.



Electron orbits in a magnetron.

Marconi's Wireless Telegraph Co., Ltd. (assignees of E. G. Linder). Convention date (U.S.A.) December 30th, 1937. No. 523329.

Wireless World

CLASSIFIED ADVERTISEMENTS

THE CHARGE FOR ADVERTISEMENTS in these columns is
12 words or less, 3/- and 3d. for every additional word.

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

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

ADVERTISEMENTS for the February issue are accepted up to First Post on Thursday, January 9th, at the Head Offices of "The Wireless World," Dorset House, Stamford Street, London, S.E.1, 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.

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

Cheques and Postal Orders sent in payment for advertisements or deposits 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.

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

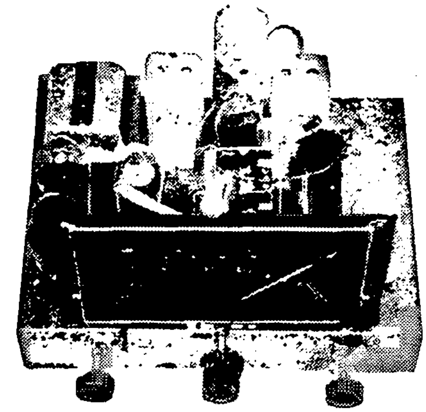
The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes. They also retain the right to refuse or withdraw advertisements at their discretion.

ARMSTRONG

A TIMELY SUGGESTION

Last month we told you how we were reluctantly compelled to refuse many orders owing to difficulty in obtaining raw material. The position, unfortunately remains the same.
However, the old adage that "every cloud has a silver lining" can happily be applied to owners of Armstrong Chassis, as all models, irrespective of age and type, were constructed with the best components obtainable. Although the original lively performance may have diminished somewhat after years of use, the skilled hands of our Service Department can restore its vitality to the same high standard as when it first left our works.
So if you think your Armstrong Chassis is not giving its original performance, we invite you to send it to us for examination, when we will send you a report and estimate for any necessary work. This does not put you under any obligation to us.
To readers who have a real need of a new wireless set, we have a few of our latest EXP48 Chassis so favourably reviewed in the October issue of "The Wireless World." Briefly, the specification is :—

SPECIAL OVERSEAS MODEL EXP48
8-v.4-BAND ALL-WAVE SUPERHET CHASSIS
(13-160m. continuous & normal Broadcast bands)
6 Watts Push-Pull Output.



When reviewing this Model "The Wireless World" said they considered us far-sighted in providing "a really good output stage for high quality reception from the B.B.C. programmes." "The sensitivity is sufficient to ensure reliable reception from every worthwhile station" and they experienced "no difficulty in picking up American stations." Further points were "the reproduction is excellent, bass response is unrestricted and the general balance is just right." "The price clearly does not exploit any tendency of rising costs of materials and labour."

Send for Illustrated Specification which fully describes this chassis with prices, etc.

Greetings

Despite the havoc of war we want to wish you, in all sincerity,

Every Happiness During The Coming Year

and to express our thanks for the loyal support and consideration you have shown during these difficult times.

ARMSTRONG MANUFACTURING CO.
WARLTERS RD., HOLLOWAY, LONDON, N.7, ENGLAND
'Phone: NORth 3213.

For the convenience of private advertisers, letters, other than circulars, etc., may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 1/- to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." All replies should be addressed to the Box number shown in the advertisement, c/o "The Wireless World," Dorset House, Stamford Street, London, S.E.1. *Remittances should not be sent through the post to Box Numbers.*

☛ DEPOSIT SYSTEM

Readers who hesitate to send money to advertisers in these columns may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt. Notes and Money Orders save time. Cheques should be made payable to Iliffe & Sons Ltd., and are acknowledged to seller when "cleared."

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. Details of any arrangement made between parties which does not concur with any of the above conditions must be advised to us when the deposit is made. For all transactions whether a sale is effected or not a commission of 1 per cent. is charged on and deducted from the amount deposited (minimum charge 2/-). All deposit matters are dealt with by Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

NEW RECEIVERS AND AMPLIFIERS

£12/10 Only, usual price £22.—*Wireless World* 2 R.F. Receiver with push-pull quality amplifier, 10 valves, including tone control stage, 8 watts triode output, ideal for quality reproduction from radio and gramophone; limited number.—Bakers Selhurst Radio, 75, Sussex Rd., South Croydon. [9344

RECEIVERS AND AMPLIFIERS
SECOND-HAND, CLEARANCE, SURPLUS, ETC.

BEETHOVEN Baby Portable, as new, complete with batteries and trickle charger; £4.—Hubble, 70, Aldermanbury, E.C.2. [9341

HOWARD, Model 460, super receiver, 10 valve, with frequency monitor and speaker, as new; £20.—Dawson, Jeweller, Halesworth. [9367

MIDWEST (English make) 1939 Model, 6-waveband, 9 valves, 10in. speaker, jack for phones, output 9 watts.—Box 2547, c/o *The Wireless World*. [9312

BANKRUPT Bargains.—Genuine offer; brand new 1939-40 fully guaranteed models, makers' sealed cartons, at 25 to 40% off present prices; also portables, midgets; send 1½d. stamp lists.—Radio Bargains, Dept. W.W., 261-3, Lichfield Rd., Aston, Birmingham, 6. [9362

Wanted

MURPHY A50 and Peak Preselector.—2, Cliff Rd. Gardens, Leeds, 6. [9324

McCLURE A.F.C.4 Feeder Unit or Similar, in perfect working order.—Hubble, 70, Aldermanbury, E.C.2. [9342

WANTED, Guthman, McMurdo double regenerative receiver; cash.—Lownds, The Cottage, Eakring, Notts. [9358

SOUND SALES Tri-channel Amp. (1939 or later), excluding 346 amplifier and speaker; also wanted Voigt corner horn (not home constructed), excluding speaker unit.—Write 113, Kingsfield Av., Harrow, Middx. [9329

PUBLIC ADDRESS

V

VORTEXION P.A. Equipment.

IMITATED, but unequalled.

WE Invite You to a Demonstration.

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.

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.

WE are Compelled Through Rising Costs to Increase our Prices by 10%.

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

SEE Our Display Advertisement on page 27 (Edit.).

VORTEXION, Ltd., 257, The Broadway, Wimbledon, S.W.19. 'Phone: Lib. 2814. [9232

Ode Partridge No. 3

PATRIOTS ALL

In October and December
Our Odes on "Think" and "How"
Appealed to *private* users
To reduce their buying now
Of Chokes and Mains Transformers,
So that every one we make
Could serve a better purpose
As there's such a lot at stake.

So many firms have written us
Expressing consternation
Thinking we included *them*
In our appeal for abnegation.
Of course it's just the opposite
And what we want the most
Is to help the Nation's effort
To lay the Axis ghost.

So do not think we're overwhelmed.
Our production's swift and sure,
We can cope with still more orders
And can always find a cure
Should "indigestion" threaten
Through quantities being vast,
And despite wartime conditions
Deliveries are still fast.

We know that private customers,
However hard it sounds,
Appreciate that our appeal
Was on Patriotic grounds.
Free men we are and will remain
But this would be reversed
Unless we all with one accord
Put the Nation's welfare first.

* * * *

Our Bard demands this extra space
For a sound and happy reason
To wish you all Good Luck, Good Cheer
And Compliments of the Season!

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

King's Bldgs., Dean Stanley St., LONDON—S.W.1
Telephone: VICtoria 5035.

HEAYBERD

Manufacturers of
RECTIFYING EQUIPMENT
for all purposes

Although our output is practically all for urgent war purposes we still issue our lists of transformers and rectifying equipment, which we shall be pleased to send to you on application, quoting Folio 6.

F. C. HEAYBERD & Co. LTD
10 FINSBURY STREET, LONDON, E.C.2
Telephone: MET 7516 (5 lines).

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?

WE are Compelled Through Rising Costs to Increase our Prices by 10%.

VORTEXION, Ltd., 257, The Broadway, Wimbledon, London, S.W.19. 'Phone: Lib. 2814. [9233

NEW LOUD-SPEAKERS

BAKERS Brand New Surplus Speaker Bargains.

EVERY Music Lover Interested in Realistic Reproduction should write for free descriptive leaflet now.

£5; usual price £10.—Brand new permanent magnet infinite baffle speaker, complete with beautifully finished cabinet in polished walnut.

£2/10; usual price £5.—Brand new super quality triple cone speaker, permanent magnet model; exceptional bargain; limited number.

£1/12/6; usual price £3/5.—Brand new permanent magnet infinite baffle extension speaker, in rexine covered cabinet, the ideal extension speaker.

SECURE One of These Exceptional Bargains Now.

BAKERS Triple Cone Conversions Will Immensely Improve Reproduction of Your Present Speaker. ("For a few shillings you have converted a speaker scheduled for the scrap heap into one worth pounds.—W. E. Darby, Grad. I.E.E.") Write for details.

BAKERS SELHURST RADIO, 75, Sussex Rd., Sth. Croydon. [9345

SECOND-HAND LOUD-SPEAKERS

GOODMAN'S Junior, 15-20 watt amplifier, PX25A's, new condition; offers.—"Woodlands," Gobowen, Oswestry. [9363

Wanted

HARTLEY-TURNER Loud Speakers, good condition; state price, type, energised or P.M.—Box 2553, c/o *The Wireless World*. [9351

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 12.—44, Holloway Head, Birmingham. [0531

"H.A.C." Short-wave Receivers, famous for over eight years; latest model one-valver now available; complete kit of precision components, accessories, full instructions, requiring no soldering; only 16/-, postage 6d.; illustrated catalogue free.—A. L. Bacchus, 109, Hartington Rd., S.W.8. [9322

Wanted

ROTARY Convertor for Short Waves, 100 D.C.-230 A.C., approx. 100w.—Apply "B," c/o Innes, Ltd., Cupar, Fife. [9327

CABINETS

A CABINET for Every Radio Purpose.

SURPLUS Cabinets (Undrilled) from Noted Make.

WE Have Hundreds in Stock (no Catalogues); send measurements of chassis, etc., and say what kind of cabinet required; stamp for reply.

INSPECTION Invited.

H. L. SMITH and Co., Ltd., 289, Edgware Rd., W.2. Tel.: Pad. 5891. [9331

DYNAMOS, MOTORS, ETC.

ALL Types of Rotary Converters, electric motors, battery chargers, petrol-electric generator sets, etc., in stock, new and second-hand.

A.C. D.C. Conversion Units for Operating D.C. Receivers from A.C. Mains. 100 watts output, £2/10; 150 watts output, £3/10.

WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0518

Wanted

WANTED, Rotary Converter, 50 volts D.C., converting to 230 volts, 50 cycles A.C., output 460 watts to 600 watts.—Captain Scott, Quedgeley Court, Gloucester. [9333

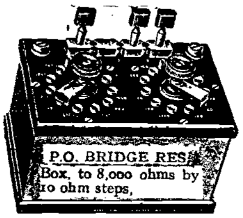
GRAMOPHONE MOTORS

Wanted

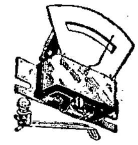
RECORD Changers, radiogram units, pick-ups, etc., new or second-hand; units also requiring repair also purchased; state condition and make.—Box 2557, c/o *The Wireless World*. [9361

• ELECTRADIX •

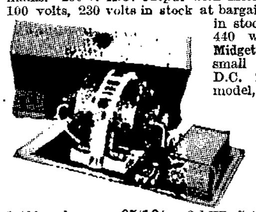
HIGH-GRADE UNIPIVOT INSTRUMENTS for Lab. Model K, 60-0-60 scale with thermo attachment. Two Type K ditto, mahogany case. Cambridge Induction Micrometer Unipivot, Model L, mirror scale 0-120, two shunts and vibrator, **£7/10/-.**
PORTABLE SUB-STANDARD MOVING COIL METERS, mirror scale, volt-ammeters. Weston & Nalder, 5¼in. Sector, table, **60/-**. G.E.C. 5-0.5 a., reads to 1/10 amp., in screened case, 7in. × 7in. × 3¼in., unused, **50/-**.
MIRROR GALVOS, Reflecting Beam, by Paul Gambrell, Sullivan and Tinsley, **£3/10/-**. Standard Res. Boxes and Univer. Shunts. 2¼in. panel Electrostatic Meters to 2,000 volts, **£2.** 8in. dial, 6,000 volts, **£4/10/-**. 12,000 volts Ev. Edg. Lab. type, **£5/10/-**, or pair for 2 phases, **£10.** X-Ray type, 60,000 volts, **£4/10/-**. Two Laboratory Table "Kelvin" Electrostatic Voltmeters, 100 to 600 volts, large scale, **70/-**.
AMMETERS. Weston Model 354. Central zero 1 to 15 amps., polar D.C., flush panel, 2½in. dial; Sale price **9/-**. Weston, 0 to 30 m/a., Mov. Coil Milliammeters, **25/-**. Hoyt CZ Mov. Coil Milliammeters, 25-0-25 m/a., **20/-**.



If you have Resistances to measure, Standard **RESISTANCE BOX** guaranteed to standard. 1,000 ohms, 4,300 ohms, 8,000 ohms, 12,400 ohms. Cheap.
ELLIOTT & E.E. No. 108, with moving-coil meter and graded Rheo., **37/6.** Silvertown horizontal Galvos. jewel pivots, **7/6.** Volt and Ammeters, in stock.
MEGGERS AND OHMMETERS. Evershed Bridge with decade res. box, 10,000 ohms. Meggers: 100 volts. 250 volts and small MEG, N.C.S. Ohmer, 500 volts to 20 megs. Ev. Edg. Metrohm, 250 volts .01 to 20 megs. Silvertown Portable Test Bridge Set. Cheap.
FOCOMETER. Lens Calibrator for testing focal length of Lens, with microscope stand, fine adjustment. Cost £30. **£5/10/-**.
MILLIAMMETERS. 8 m/a. back of panel illuminated. Skeleton type, 970 ohms D.C. with plain scale and 1in. needle, mica. Great bargain at **3/9** post free. Bulgin Midgets and Sifam, 1¾in., 10 m/a, **8/6.**



HIGH FREQ. Ammeters. Flat panel, 2½in. dial, Hot wire, 0-500 m/a, **7/6**; 0 to 1 amp., **10/-**; 0 to 2 amps., **12/6**; 0 to 2½ amps., **12/6.** 3in. dial ditto, 0-4 amps., **21/-**. Panel 4in. dial, 3 amps., **£1/10/-**; 7in. dial, 2 to 15 amps., **£1/15/-**.
D.C. CURRENT RECORDERS, Chart Recording Ammeters, wall type, 0 to 5 amps., moving coil. Shunts to 50 a. range. 12-hour drum clock, **£5/10/-**.
DIX-MIPANTA VEST POCKET TESTER. Moving-iron multi-range meter for A.C. or D.C. No projecting terminals. THREE ranges of volts: 0-7.5, 0-150, 0-300. In black bakelite case. 2½in. by 2¼in., **19/6.**
7in. OSCILLOGRAPH TUBES, Ediswan, **£3/10/-**.
OSCILLATORS. McLachlan Het. W/M, 20 to 5,000 metres, **£4.** Sullivan Screened Het. to 16,000 metres, **65/-**.
TESTERS FOR RADIO SERVICE. Inductance Bridge, Baldwin Henlog, 20 micro-H. to 20,000, **£5/10/-**. Induction Micrometer, Cambridge, Universal Model L, unipivot 0-120 meter shunts and A.C. gen., **£8/10/-**. Capacitor Analyser, Hunts, 1 mfd. to 70 mfds., 50 ohms to 2 meg. and power factor, cheap. Cap.-Res. Radiometers, .0001 mf. to 25 mfds., 20 ohms to 4 megs., **£9/10/-**. Cap.-Ohmmeter, range .0001 mf. to 10 mfds., .01 to 1 meg., need adjust.
SIG. GENS. AND OSCILLATORS. Radiolab Ev. Edgcumbe Modulated R.F. 3-piece Oscillator, 5 ranges 10/3,000 metres. Ditto, Type B, 175 to 3,000 metres, as new. Triumph Sig. Gen., 100 to 3,000kc. and 3 to 75 megacycles, **£7/10/-**. Chicago Oscillator, Webber, 20 kc. to 60 mc., as new, **£12.** Trimeasy Pye Oscillator, 12 to 3,000 metres, in 5 ranges. Ganging Oscillator, Cossor, 10 kc. to 20 mc., as new, **£11.**
VALVE ANALYSERS, Etc. Weston Selective, Model E665, D.C./A.C. volts 5/1,000 v., m/a ½ to 500 at 1,000 o.p.v., for 4.5, 7 and 9 pin valves, **£13** for a twenty-guinea set. Ev. Edgcumbe D.C. Multi, 5 m/a to 500 amps., 150 m/v to 600 volts, portable, **£8.** Emicol 3-meter Valve Tester, volts, m/a and ohms, valve bases, etc., needs repair, cheap. Met-Vick A.C. Watt-Hr. Meter, 250/500 v., 1 to 100 amps., 120 r.p.m., integrating, **60/-**. Huntington Texiloscope **35/-**.
SUPREME PORTABLE VALVE ANALYSER KIT, with 2-scale mov. coil meter, with rectifier for A.C., drilled and fitted panel in case, range switch, etc., **45/-**, makes an 8-guinea set.
D.C. to A.C. ROTARY CONVERTERS. For A.C. Radio on D.C. mains. 230 v. A.C. output with filter, in silence cabinet. 12 volts, 100 volts, 230 volts in stock at bargain prices, as illus. Other sizes



in stock: 50 watts, 180 watts and 440 watts, all in new condition. Midget A.C. Rotary Converters for small 50 cycle 230 v. output from D.C. 230 v. mains; 7 watt P.M. model, **27/6** only. Specially compact lightweight 15 watt D.C./A.C. 230 v. Cheap, **55/-**
D.C./D.C. PORTABLE MOTOR GENS., for H.T., 6 v. input 500 v. 25/30 m/a. output, **57/6.** 6 v. to 400 v. 75 m/a, **62/6.** 12 v. to 1,000 v. 75 m/a, **65/-**. 25 v. to 1,400 v. ½ amp., **£5/10/-**. 2 kWh Set, 200 v. D.C. coupled to 5,000 volt ½ amp. D.C. Gen., **£15.**
DYNAMO BARGAIN. 100 volts 1 amp. D.C. shunt, ball-B. "Croydon," 15 lb., 6in. × 5in., **12/6** carr. free.
INVERTERS. Crypto 440 watt M.G. input 230 v. 50 cycles to D.C. 220 v. 2 amps. Starter and Volt Regulator, **£8/15/-**. Smaller set, A.C. 220 v. to D.C. 100 v. 1 amp., **60/-**. Sets for Battery Charging. Big set for 200 cells and 8 car batteries on 230 v. A.C. complete **£15.** Cost double. 3½ kW. set for 500 cells, **£35.**
MOTOR GENERATORS. D.C./D.C. 220 v. D.C. to 24 v. 30 amps., **£9.** 220 v. to 16 v. 5 a., **£5.** Many other sizes in stock.

Send 2d. stamp for latest Bargains List "W."
Stamped envelope must be sent for all answers to enquiries.

ELECTRADIX RADIOS
218, Upper Thames Street, London, E.C.4
Telephone: Central 4611

No overheating with Solon *Electric* Soldering

Overheated irons need filing and retinning; a laborious or troublesome job—cut it out by using a SOLON. With Solon Electric Soldering, in 4 minutes, the bit gets to the correct heat and stays there!—just as long as you need it; 15 hours' use takes only 1 unit. No flame—no dirt. The constant heat, at the point, makes the solder run sweetly; sweats it right into the joint; gives you a strong neat job.

Made for following standard voltages :—200/220 230/250.

SOLON *Electric* **SOLDERING IRON**

Handyman model supplied complete with Resin-Cored Solder, Flex and Lamp Adaptor **9/4**

Solon Resin-Cored Solder **6D.** per reel.

W. T. HENLEY'S TELEGRAPH WORKS CO. LTD. (Dept. 24/E), Engineering Sales Dept., Milton Court, WESTCOTT, DORKING, SURREY.

Joining the R.A.F.?

If you intend to join any section of the Services in which a knowledge of the Morse Code is required you can become a skilled W/T Operator by taking a

CANDLER *CODE* COURSE

There are courses for beginners and also for those who desire to considerably increase their w.p.m. speeds.

In the "BOOK OF FACTS," which will be sent FREE on request, full information is given concerning the subjects covered by all Candler Courses.

There's no royal road to learning—but there IS a quick, sure way to genuine CODE skill. Thousands of Candler Trained Operators, including many in the Services, have proved the value of this truly remarkable system of Code instruction.

J. Clarricoats, Sec., Radio Society of Great Britain—says: "I regard the Candler System as being the most important system of its kind and already large numbers of Members of the Radio Society of Great Britain have intimated to me that they are studying the course of instruction with a view to preparing themselves for service in one branch or another of H.M. Forces."

Courses supplied on cash or monthly payment terms.

COUPON

Please send me a Free Copy of Candler "Book of Facts"

NAME ....

ADDRESS ....

....

Post in 1d. unsealed envelope to London Manager
CANDLER SYSTEM CO. (Room 55W.), 121, Kingsway, London, W.C.2.
Candler System Co., Asheville, North Carolina, U.S.A.

141

RECORDING EQUIPMENT

Wanted

V.G., Saja and other makes of recording equipment of studio standard required: highest price paid.—Box 2555, c/o *The Wireless World.* [9357

VALVES

METROPOLITAN RADIO SERVICE.—American Valves, in all types. trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000. [0436

ACCUMULATORS

50 Radio Accumulators at Half Price! Slightly used but in perfect condition; £6.—Box 2554, c/o *The Wireless World.* [9352

METERS, ETC.

Wanted

FERRANTI 2½in. Flush 1 m.a. Moving Coil Meter, or any other good make.—5, Bank Rd., Biggleswade, Beds. [9366

TEST EQUIPMENT

Wanted

EVERETT EDGCUMBE 1940 All Purpose Tester, No. 40.—71, Windsor Lane, Burnham, Bucks. [9337

REPAIRS AND SERVICE

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). [9227

EPOCH.—Diaphragms for all models, guaranteed 12 months, as supplied to G.P.O., Gaumont-British, etc.—"R.E.C.S.," Crown St., Reading. 'Phone: 2796, day or night. [9354

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. [8934

METROPOLITAN RADIO SERVICE.—Guaranteed repairs to American and British receivers; American valves, condensers, volume controls, linecord resistances, Majestic I.F. transformers, and rewinds, trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000. [0435

PATENTS FOR SALE

THE Proprietor of British Patent No. 290,642, relating to "Improvements in radio telephone signalling," is desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the invention either by the sale of the Patent Rights or by the grant of Licences on reasonable terms. Interested parties who desire further particulars should apply to Albert L. Mond and Thiemann, of 14-18, Holborn, London, E.C.1. [9325

THE Owner of British Patent No. 469,498, relating to "Improvements in or relating to Phonographs," is desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the invention either by the sale of the Patent Rights or by the grant of Licences on reasonable terms.—Interested parties who desire further particulars should apply to Albert L. Mond and Thiemann, of 14-18, Holborn, London, E.C.1. [9326

COMPONENTS

SECOND-HAND CLEARANCE, SURPLUS, ETC.,

PREMIER RADIO.

PLEASE See Our Displayed Advertisement on page 5. [0488

SOUTHERN RADIO'S Wireless Bargains.

ALL Goods Previously Advertised Still Available.

SOUTHERN RADIO, 46, Lisle St., London, W.C. Gerrard 6653. [9238

FERRANTI A.F.5C., definitely as new; 16/6, post free.—48, Albert Rd., Levenshulme. [9343

TROPHY Three, complete set coils, guaranteed perfect; £2/17/6.—Hobley, 109, Drive, Wellingborough. [9347

Masteradio —MALLORY

VIBRAPACKS

PERFECT PORTABLE POWER

British-made Vibrator Power Supply Units employing the WORLD-FAMOUS "MALLORY" VIBRATORS

OUTPUTS of up to 30 watts from either 6 volt or 12 volt battery supply.

EFFICIENCY as high as 70% including rectification.

LIFE. Masteradio-Mallory Vibrators mean longer life. Longer life means LOWEST COST PER HOUR ACTUAL USE.

DEPENDABILITY. In Masteradio-Mallory Vibrapacks the Vibrator is working under ideal conditions, thus ensuring utmost dependability.

Used by the War Office, Air Ministry, G.P.O.

Let our Technical Dept. solve your portable power problems. Write for details:

MASTERADIO Ltd.

(*Dept. W. W.*) Vibrant Works, RICKMANSWORTH ROAD, WATFORD, HERTS.

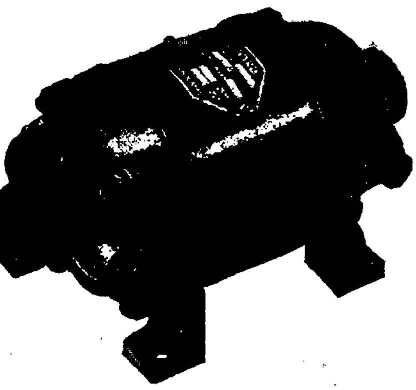
'Grams: Mastiola, Watford. 'Phone: Watford 9885.

GREENWOOD

•WARD•

AC/DC ROTARY CONVERTERS

for operating P.A. Amplifiers, Radio Receivers, etc.



WE ALSO MANUFACTURE

DC/DC ROTARY TRANSFORMERS, SMALL ALTERNATORS, SMALL DC 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, and are fully equipped for general small engineering work.

Full details of any of the above upon request. Export enquiries invited.

CHAS. F. WARD

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

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

RADIO CLEARANCE, Ltd.—Owing to bomb damage have taken new premises at 95, High Holborn, V.C.1, where all orders will be executed with our usual promptness.

ALL-WAVE Superhet Chassis, 5-valve A.C., latest Mullard valves, T.H.4B., V.P.4B., T.D.D.4, Pen.A.4, L.W. 4/350v. Ranges: short-wave, 16-48 metres; medium wave, 200-560 metres; long-wave, 800-,200 metres. Size of chassis, 14½in. long, 7½in. deep; height overall, 8½in. Controls: Tuning at side, volume on/off at side, wavechange, provision for pick-up. Complete with valves, £4/7/6 each.

SPECIAL Offer.—Ready in 7 days, 200 only, 5-valve A.C./D.C. sets, 3 wave-bands, complete in attractive cabinet, size 14in.×8in.×6in., ready to plug in; list price £8/8, our price £4/9/6 each.

2V. Output Pentode Valves, 5- or 4-pin, side terminal, unboxed; 2/11 each.

LISSEN 2V. Screen-grid Valves, S.G.2V.; 4/6 each.

LISSEN 2V. Battery Pentodes, 4-pin, side terminals, P.T.2A.; 4/11 each.

LISSEN Rectifier Valve U650; 2/11 each.

ULTRA Short and Short-wave Choke, Lissen Hi-Q., inductance 100 microhenries, boxed; list 2/- each, our price 1/- each.

ULTRA Short and Short-wave Double Wound Low-resistance Choke, Lissen Hi-Q., resistance less than 0.05 ohms, boxed; list 2/6 each, our price 1/3 each.

LOW-LOSS Ceramic Valve Holders, Lissen Hi-Q., baseboard and chassis 7-pin; 1/- each.

MANSBRIDGE Type Condensers, Lissen Hi-Q., 250 D.C. working, moulded cast with feet, 1 mfd.; d. each.

LOW-LOSS Short-wave Variable Condensers, Ceramic insulation, brass vanes, Lissen Hi-Q., minimum capacity, 5 microfarads, two types, boxed, with knobs, 60 mmfd., list 7/6 each, our price 3/- each; 20 mmfd., list 5/6, our price 2/6 each.

ROTARY Coil Units, Lissen Hi-Q., 4-band from 4.8-91 metres, can be selected by turn of knob, with circuit, boxed; list 15/6, our price 6/11 each.

PUSH-PULL Switches, Lissen 2 point, 4d. each; 3 point, 6d. each.

YAXLEY Type Switches, 4-pole, 3-way, 9d. each; Yaxley type switches, 4 bank, 2/6 each.

AMERICAN Line Cords, with fittings, 3/6 each; 3-way American line cords, 450 ohms resistance, /6 each.

ROLA P.M. Speakers, latest model, 7½in. cone, with power and pentode transformer, boxed; 15/- each.

MAGNAVOX 10in. Energised Speaker, field resistance 3,000 ohms, with transformer; 12/6 each.

CLOCK-FACED Dials, 5in.×3½in., with printed 3-wave scale and escutcheon; 2/6 each.

STRAIGHT Line 3 Waveband Dials; 1/11 each.

MAINS Transformers, G.E.C. American windings, 350-0-350v., 65 m.a., 6.3v., 2.5 amps., suitable or replacements in G.E.C. models; 6/6 each.

MAINS Transformers, Wearite, R.C.1 250-0-250v. 80 m.a., 4v. 2.5 amps., 4v. 4 amps., 9/11 each; R.C.2, 350-0-350v. 120 m.a., 4v. 2.5 amps., 4v. 4 amps., 2/6 each; R.C.3, 350-0-350v. 150 m.a., 4v. 2.5 amps., v. 2 amps., 4v. 5 amps., 15/- each; R.C.4, 500-0-500v. 50 m.a., 4v. 2 amps., 4v. 2 amps., 4v. 2.5 amps., v. 5.6 amps., 21/- each; R.C.5 100 watt auto transformer, 100-110v., 200-250v. reversible, 12/6 each; all above transformers 200-250v. tapped primaries; R.C.D. drop through type capped, 350-350v. 100 m.a., v. 2 amps., 6.3v. 5 amps., 10/6 each.

CHASSIS Mounting Valve Holders, American 4-5-6-7-pin, 4d. each; Octal, 6d. each; Loctal, 10d. each.

VALVE Holders, Celestion, 5- and 7-pin chassis type, 4d. each; baseboard type, 5-pin, 2d. each.

VOLUME Controls, Centralab, spindles, length 2½in., with switch, 100,000, 250,000, 500,000 and 1 meg., 2/11 each; Centralab 1 meg. volume controls, with switch, 1½in. spindle, 2/- each.

VOLUME Controls, C.T.S., wire wound, 5 watt, 500, 1,000 and 10,000 ohms; 2/6 each.

ROTHERMEL Junior Pick-up, Piezo electric model, with rest, brand new, boxed; 21/- each.

PRESS-BUTTON Units.—Size of unit, 6in.×6in.× 2in., complete with six press buttons and capacitors; 4/11 each.

2-WAY Push-button Switches, 1/6 each; 11-way push-button switches, 1/6 each; 6-way push-button switches, 1/- each.

SPEAKER Cabinets, suitable for 8in. speaker; 4/6 each.

(This advertisement continued in column three.)

GALPINS

ELECTRICAL STORES

75, LEE HIGH ROAD, LEWISHAM, LONDON, S.E.13

Telephone: LEE GREEN 5240

Terms: Cash with Order

ELECTRIC LIGHT CHECK METERS, small, late type, well-known makers, in good condition, electrically guaranteed for 200/250 volts 50 cy. 1 phase A.C. mains. 5 amp. type, **6/-**; 10 amp., **7/6**; 20 amp. **9/-** each. Post 1/- on all types.

"CRYPTO" SHUNT WOUND DYNAMO, 30 volts 10 amps., 1,900 r.p.m., in good condition, **65/-**, carriage forward.

"CROSSLEY" APPROX. 1 H.P. GAS ENGINE, tube ignition, in good condition, **65/-**, carriage forward.

D.C. ELECTRIC LIGHT CHECK METERS, 200/250 volts 5 and 10 amps., **4/6** each, post 1/- (in new condition).

PHILIPS HIGH VOLTAGE CONDENSERS. Infd. at 4,000 volt working, **5/6** each, carriage paid.

REGULATORS, STARTERS AND LARGE DIMMER RESISTANCES. Stud Switch-arm type. State wants.

SWITCHBOARD VOLT AND AMPMETERS MOVING COIL AND MOVING IRON. All first-class makers. Please state requirements.

TEN LINE CORDLESS TELEPHONE PORTABLE EXCHANGE BOARD, complete with calling generator in new condition, **£6/10/-**, carriage forward.

EX R.A.F. GLASS ACCUMULATOR TANKS, 5×5×8in., new and unused, **3/6** each, post 1/-.

EX R.A.F. SWITCH PANEL, with case (new), fitted 6 small knife switches, leads, cords and cleats, complete in wood case, **2/6** each, post 6d.

EX R.A.F. NEW NECO MOTOR BLOWER, 100 volt motor, shunt wound, 1,800 r.p.m., ball bearing, fitted to Cyclone fan, 4½in. inlet 5in. outlet, massive aluminium casing 11in. dia., new and unused, **55/-** each, carriage 4/-.

SMALL ELECTRIC ROTARY CONVERTOR, 110 volts D.C. input, 10 volts at 30 amps. output. Useful for garage charging, **55/-**, carriage forward.

D.C. MOTOR BLOWERS, 2in. inlet and outlet. Aluminium body, laminated field, ideal for dug-out ventilation. 100 volt, **25/-**.

X-RAY TUBES by well-known makers, 7in. bulb Tungsten Targets, **15/-** each, carriage forward.

HIGH-VOLTAGE TRANSFORMERS useful for all test work, or television. Input 200/240 volts, output 5,000 and 7,000 volts, **6/6** each, post 1/-.

VOLTAGE CHANGING TRANSFORMERS (Auto Wound), 100/110 to 200/240 v., or vice versa, fully guaranteed, 1,000 watts, **60/-**; 2,500 watts, **110/-**.

DUG-OUT LAMPS, Ex R.A.F., solid brass construction, glass dome, complete with 12-volt bulb (any bulb can be fitted), wall fitting, **3/-** each, post 6d.; Ditto, wing type, as new, **2/6**, post 6d.

DUG-OUT LAMPS, Ex R.A.F., porthole type, or can be bracket fitted, glass dome, three colour fitting, white, red or green, solid brass construction, 6in. dia., complete with bulb; any size bulb can be fitted. Price **5/-**, post 6d.

1 kW. TRANSFORMER, 100 v. input at 100 cycles, output 10,000 volts centre tapped, price **30/-**, carriage forward.

EX R.A.F. AUTOMATIC CHARGING CUT OUTS AND VOLTAGE REGULATORS, to suit any dynamo up to 20 volts at 15 amps., fully adjustable, wiring instructions, complete in metal case. Price **3/6**, post 9d.

DOUGLAS ENGINE, 2¾ h.p., special air cooling, twin, on alli bedplate, portable, complete with petrol tanks and in perfect working order, suitable for pumping, lighting, etc., price **£10.**

B.T.H. LIGHTWEIGHT HEADPHONES, 4,000 ohms, headbands damaged, phones guaranteed, **5/-** per pair. Post free.

DYNAMOS, all shunt wound and fully guaranteed, 50/75 v.–15 a., **£6/10/-**; 50/75 v.–25 a., **£8/10/-**; 50-volt–30 a., **£8/10/-**. All carriage forward.

8-10 WATT AMPLIFIER for public address work, 110/240v. mains, Mo values, using 2 P × 4's in push-pull, **35/-** each, carriage 2/-.

LARGE D.C. CIRCUIT BREAKER, as new, 4-pole, 100 amps., price **£5**, carriage forward.

SWITCHBOARD, lightweight, suitable for portable set, fitted a pair of meters, Everett Edgcumbe, flush fitting, 3½in. dia., reading 0–150 v. and 0–50 a., moving coil, 5 double-pole knife switches, etc., **£5**, carriage forward.

25-VOLT D.C. MOTOR, maker "Crompton," ½ h.p., ball bearing, in perfect order, **£3**, carriage forward.

DITTO, on iron bedplate, but fitted with large reduction gear and rope drum, **£5**, carriage forward.

110-VOLT D.C. MOTOR, totally enclosed, rated at 8 amps., ball bearing, in new condition, make good slow-speed dynamo, **£2/5/-**, carriage forward.

MANGIN REFLECTING MIRRORS for spotlight work, price **5/-**, post 6d.

CROMPTON MILLIAMPMETER, 8in. dia., 7½in. scale, moving coil reading 0–15 m/a, as new, **£3/10/-**.

BAKER 20-WATT MOVING-COIL SPEAKER, complete with metal rectifier and universal transformer, **£2/10/-**, carriage forward.

GUNMETAL PULLEYS, 7in. diameter, to take 1in. dia. rope, complete with rope guard and hook, **7/6** each, post 1/-.

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

(This advertisement continued from first column.)

SET Cabinets, various sizes; callers only, 4/- each.

RESISTANCES, ½ watt, ¼-½ and 1 meg. only; 1/6 dozen.

DROPPING Resistances, for all purposes, total resistance 535 ohms., 5 taps in steps of 50 ohms., standard for Pye, Lissen, Ever-Ready, etc.; 3/- each.

PUSH-BACK Connecting Wire; 1d. per yard.

10FT. Coils Connecting Wire, glazed; 4d. each.

DUAL Capacitators, 300×600; 4d. each.

I.F. Transformers, 465 k.c. in 1¼in. cans; 2/6 each.

COIL Kit, for superhet circuit, including 2-gang straight condenser, aerial coil assembly, oscillator coil assembly and 2 465 k.c. I.F. transformers, with circuit diagram; 8/11 each.

PILOT Lamps, 6.3, 0.3 amp.; 6d. each.

PLESSEY Single Gang 0.0005 Variable Condensers; 1/11 each.

T.C.C. 8 mfd. 150v. Tubular Electrolytics; 1/6 each.

T.C.C. 16×8 mfd. 350v. Wkg. Tubular Electrolytics; 2/6 each.

B.I. Wire-end Bias Electrolytics, 50 mfd., 12v.; 1/6 each.

TUBULARS, wire-end, non-inductive paper condensers, all sizes up to 0.1; 5d. each, 4/9 per dozen.

B.I. 8×8 mfd., 440v. working, cardboard electrolytics, 3/6 each; ditto, 16×8 mfd., 4/6 each; ditto, 8 mfd. tubulars, 2/- each; ditto, 4 mfd. tubulars, 1/9 each; ditto, 2 mfd. tubulars, 1/3 each; ditto, 8 mfd. cans., 2/11 each.

HUNTS Cardboard Wire-end 8 mfd.×8 mfd.×8 mfd., 450v. wkg., 2 negatives; 3/11 each.

CONDENSERS.—0.0005 twin, 1/3 each; triple, 1/9 each.

LISSEN Mica Condensers, our assortment; 2/- dozen.

RAYTHEON Valves, first grade, largest stockists, all types stocked, including glass series, glass octal series, metal series, bantam series, single-ended metal series and resistance tubes; all at most competitive prices; send for lists.

AL Orders Must Include Sufficient Postage to Cover. Hours of business: Week-days 9-4, Saturdays 9-1 p.m. Please write your name and address in block Letters. We cannot undertake to answer enquiries unless full postage included (2½d.).

RADIO CLEARANCE, Ltd., 95, High Holborn, London, W.C.1. [9368

COMPONENTS at Scrap Prices; state needs.—A.A. Agency, Bridge of Allan, Scotland. [9360

VAUXHALL.—Rola 8in. P.M. speakers, 14/9; 8in. energised 1,500 ohm, 12/6, with transformers.

VAUXHALL.—Ironcored tuning coils on base, terminals, switch, 3-gang bandpass, 19/6; volume controls, 2/3, with switch 3/-.

VAUXHALL.—Electrolytic condensers, 8 mfd. 500v. 2/-, 8 8 mfd. 500v. 3/6; Niclet 3½-1 L.F. transformers, 5/9.

VAUXHALL UTILITIES, 163a, Strand, London, W.C.2. Postage extra orders under 3/-; 1d. stamp for list. [9356

L.T. Metal Rectifiers, 12v. 1 ampere, with circuit, 4/6; transformers for same, 10/6; crystal microphones, famous maker, a beautiful mike, £2/12/6; tubes, firsts, sealed boxes, 75, 42, 80, 4/3.—Champion, 42, Howitt Rd., London, N.W.3. [9365

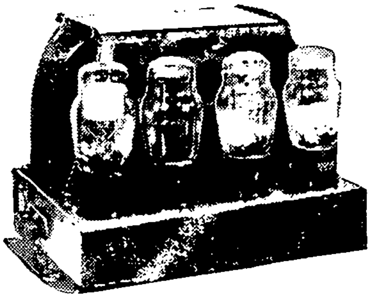
HAYNES 2 H.F. Tuner, 1937 model, recently re-valved, 130/-; mains transformers, Partridge, 350-120, new, 21/-; Rich and Burdy 350.0 .350 120 m.a., 4v. 2.5a. 4v. 6a, 4v. 1a, 4v. 1a, 35/-; chokes, Sound Sales, 10H. 118 ohms, 270 ma. 10/-; Varley 20H 500 ohms. 100ma, 6/6; Varley 14-28H 260 ohms, 115 ma, 17/6; Ferranti speaker, M.I. P.M., 37/6.—Williamson, 30, Malvern Avenue, Flixton, Lancs. [9364

COULPHONE Radio, New Longton, Preston.—Prompt personal attention. All goods brand new. Tungsram valves; guaranteed American valves, 5/9; Octal, 6/9; Cosmocord crystal pickups, 22/6; Rola G12 2,500 ohms, with transformer, 57/6; 10in. Rola P.M., with transformer, 22/6; 8in. Rola P.M., 15/6; Goodmans 8in. P.M. Universal transformer, 16/6; Plessey 8+8 mfd. aluminium can, 525 volt, 3/3; Airmaster 8-valve 4-waveband, push-pull chassis, with speaker, £10/10. Stamp for 1941 list just printed. [9339

A NEW YEAR'S OPPORTUNITY !

For Gramophone or Microphone use in the Home, Office or Factory,

This Modern Streamlined 5-watt, 4-Valve A.C. AMPLIFIER CHASSIS is an outstanding bargain.



Two Triodes in output stage. HI-GAIN Screened Grid L.F. stage. Designed for energised M.C.Speaker may be adapted for P.M. Speaker by using field replacement choke. Limited supplies only of this unrepeatable offer. Price, including valves .... **£3 . 5 . 0**
Energised Speaker to suit, 15/-.

MICROPHONES : Heavy duty, double button type. Chromium-plated case. Gold-plated electrodes. High output. Good Quality. With mounting clips and springs, **£1.15.0.** Transformers for same, 7/6.

COMPLETE MOTOR-DRIVE TUNING ASSEMBLY. Including 2-gang ·0005 condenser, tuning motor with muting switch and homing commutator and station selector. With 8-Button push-button switch, **25/-.** Full details supplied.

SMALL REVERSIBLE A.C. MOTORS (as used for motor tuning). 25-30 volts A.C. Built-in reduction gear spindle. Speed about 60 r.p.m. A first-class job with hundreds of applications, **6/6.**

AUDAK PICK-UP HEAD. High resistance coil, **6/6.**

AUDAK CUTTING HEADS (Heavy duty). 3-5 ohm coil. High quality instrument, **17/6.**

B.T.H. CAPACITATOR GRAMOPHONE MOTORS, with 5-inch Turntable, 100-250 volts, **22/6**; an unusual Bargain !

SINGLE EARPIECES, with flexible metal sheathing, chrome plated, **2/6.**

B.T.H. HEAVY DUTY RECORDING MOTORS. 79 r.p.m. capacitator type, 220 volts A.C., 50 cycles. Weight 7 lbs. Without Turntable, **£2.2.0.**

ELECTRO-MAGNETIC COUNTERS. Useful for innumerable purposes, **5/6.**

LONDON CENTRAL RADIO STORES
23, LISLE STREET, LONDON, W.C.2
'Phone: GERrard 2969.

CABINETS

for

RADIO AND RADIO INSTRUMENTS

In Wood, Metal, Rexine, etc.

Details of Radio Cases for the Home will be forwarded on receipt of 2½d. in stamps.

LOCKWOOD & CO. (Dept. W.)
65, LOWLANDS ROAD, HARROW, MIDDLESEX
'Phone : BYRON 1818

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

G. A. RYALL, "Arnehurst," Marsh Lane, Taplow, Bucks (late Ryalls Radio of London), offers radio goods, all new, unless otherwise stated. Post free. Minimum orders 1/3, please.

ROLA 10in. 2,000 ohm Energised Speakers, pentode transformers, with over 11 yards 3-way rubber cable with 5-pin plug, with 4-prong winder, in portable rexine carrying case, leather handle, brown finish, nickel plated corners. Note, speaker aperture is 8in. only, made for Pathe cine outfit, in original wrappings, size 16½ square, 7½in. deep; 17/9 each.

SPEAKER Only, as above, 9/6; cable and plug only, as above, 2/9; case with cable holder, as above, 7/9.

AMPLIFIER Chassis Complete, ex the Pathescope cine outfit, contains the two mains transformers as below, two Hunts 8 mf. 500v. Mansbridge 2×1 mf., pair low voltage cathode condensers, group board with resistances as below. Toggle switch, T.C.C. 0.01, two Erie resistances, 5-pin socket for speaker, fully wired, with mains leads and double adaptor, flat pancake-type chassis (SG as LF valve, pentode output, rectifier), gram. input socket, three valve holders, less valves; 18/6 the lot, carriage paid.

MAINS Transformers, made by Standard Telephones for Pathe amplifier, input 110-250v. A.C., outputs 350-0-350v. 120 ma.. 4v. 2½ amp., 4v. 4-5a., special heavy primary, used as 250w. Auto trans. for other items below; can be used as 300w. auto transformer, drop through type size, 5¾×4⅜×2in. deep; 10/9 each, used, as new.

A.C. Induction Motors, fitted with fan-cooling, 1,500 revs. one-tenth horse power, 110v., for use with above transformer, supplied 8 mf. paper block condenser, as used motors fitted 4-pin plug; 14/9, used, as new.

A.C. Transformer, input 110v., for use with above transformer, secondaries 10v. and 20v. at 5 amps and 8 amps; 4/9.

SIX-WAY Group Boards, with insulation sheet, for mounting, complete with 6 resistances, 1,200 ½w., 500 1w., 4,700 2w., 1,200 1w., 10,000 3w., 100,000 ½w.; 1/6 each.

R.C.C. Units on Small Paxolin Panel, comprise T.C.C. 0.01 mica condenser, 0.15 non-inductive tubular, 2 meg and 4 meg, ½-watt resistances; two for 1/6.

CELESTION Speakers, 600 ohm field with push-pull transformer, with 5-pin plug, 10in. cone, 9/6; Celestion 700 ohm speakers, with pentode transformers, heavy magnet type, 10/6; all above have 10in. cones.

CELESTION 10in. Speakers, less transformers, with 4-pin Octal plug, fields 1,500 ohms, special curved (exponential type) cones, good bass response; 7/9 each; all have normal speech coils about 2 ohms.

MAGNAVOX 152 Speakers, less transformers, 2,250, 5,000 ohm, 7/9 each; Magnavox 1,000 ohm special type with ringed cone, less transformer, 8/9 each; the above are mostly rated to handle 8 watts, all are new oddments purchased from Messrs. Celestion.

NOTE.—All above speakers are energised types, and not permanent magnet, of which we have none to offer at present, and are not suitable for use as extension speakers, unless suitably energised.

BLOCKS Containing Two Large Capacity Mansbridge Condensers, low voltage for cathode bypass, inverted chassis type; 1/6 each.

AMERICAN Valves, sets three, 2-volt American bases, 1A4 VM/HFP, 1B4 HFP, 2101 ½-watt output Pentode; 6/6 the set of three; suit Philco sets.

SPECIAL Offer Europa Valves, AC/L, for power grid detector, and first stages amplifier, impedance 7,000 ohms, 2/3 each; AC/HP 5-pin with earth pin at side for metal screening, a fine SG detector or HF valve, 2/3 each; both are 4-volt lamp valves with British bases.

SPECIAL Note.—We are now confining our business to mail orders, and shall be able to give prompt attention from a quiet situation.—G. A. Ryall, "Arnehurst," Marsh Lane, Taplow, Bucks. [9353

Wanted

EDDYSTONE COMPONENTS WANTED.

ANY Quantity of New Eddystone Components; send full details with price required.—Box 2552, c/o *The Wireless World*. [9346

WE Buy Used Radio Receivers, chassis, amplifiers, test meters, converters, speakers, etc., radio and electrical accessories; spot cash paid.—'Phone Ger. 4447. [9296

ALL-POWER TRANSFORMERS LTD.

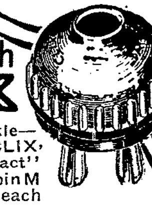
specialise in the manufacture of Mains Transformers and Chokes of every type and size. Supplied in quantities or singly. Write for quotation.

We take this opportunity of wishing all readers

The Compliments of The Season

8a Gladstone Road, Wimbledon, S.W.19
'Phone : LIBerty 3303

Connect with **CLIX**



Cut the crackle—Connect with CLIX, the "perfect contact" plug, 5-amp., 2-pin M type. **4½d.** each
also 2-5 and 15 amp. 2- and 3-pin B.S.S.

CLIX

British Mechanical Productions Ltd.
1, Church Road, Leatherhead, Surrey.

ACOUSTICAL AMPLIFIERS

IF YOU WANT

- **30 watts Quality Output**
- **from A.C. Mains or 12-v. Car Battery**
- **for Mobile Patrol,**
- **Music for your workers or**
- **for A.R.P. purposes**

OUR MODEL C25 will fill your need.

Write for full Specification and Circuit.

The ACOUSTICAL MANUFACTURING CO.
Electro-Acoustic Engineers,
201-205, Lever Street, City Road, London, E.C.1.
CLErkenwell 5821

MAINS TRANSFORMERS

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. Colindale 7131

• SPOT CASH •

For Musical Merchandise, Microphones Radio-Grams, Gramophones, Records, etc.

Complete Retailers' Stocks bought, size or distance no object.

Write stating full particulars :—
RENOS, 64, OXFORD ST., MANCHESTER

ELEMENTARY AIRCRAFT WIRELESS

by

J. A. McGILLIVRAY.

Specially produced for prospective R.A.F. wireless operators.

Price 3/- Post free.

Obtainable from

Scottish Aviation Limited, Prestwick Aerodrome, Ayrshire.

THE INSTITUTE OF WIRELESS TECHNOLOGY

(Founded in 1925. Incorporated 1932)

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

BOOKS on WIRELESS

Write for complete list to
ILIFFE & SONS LTD.
Dorset House, Stamford St., London, S.E.1 w.w.

FOR THE RADIO SERVICE MAN, DEALER AND OWNER

The man who enrolls for an I. C. S. Radio Course learns radio thoroughly, completely, practically. When he earns his diploma, he will KNOW radio. We are not content merely to teach the principles of radio, we want to show our students how to apply that training in practical, every-day, radio service work. We train them to be *successful!*

INTERNATIONAL CORRESPONDENCE SCHOOLS

Dept. 38, International Buildings, Kingsway, London, W.C.2.
Please explain fully about your Instruction in the subject marked X.

Complete Radio Engineering
Radio Service Engineers
Elementary Radio **Television**

If you wish to pass a Radio examination, indicate it below.

Inst. of Wireless Technology
P.M.G. Certificate for Wireless Operators
Provisional Certificate in Radio Telephony and Telegraphy for Aircraft
City and Guilds Telecommunications

Name..Age......
Address ....
....

(Use penny stamp on unsealed envelope.)

TUITION

RADIO Training.—P.M.G. exams. and I.E.E. Diploma; prospectus free.—Technical College, Hull. [0611

MORSE Code Courses.—"Book of Facts," free.—Candler System Co. (Room 55 WO), 121, Kingsway, London, W.C.2. [9074

WIRELESS Officers.—Short courses of training for young men for marine and air services.—Marine School, South Shields. [9166

PRACTICAL Postal Courses, radio television, test equipment design, trade-test coaching for R.A.F. post, I.P.R.E. and I.W.T. exams.; booklet free.—Secretary, I.P.R.E., Bush House, Walton Av., Henley-on-Thames. [9328

RADIO Engineering, Television and Wireless Telegraphy; comprehensive postal courses of instruction.—Apply British School of Telegraphy, Ltd., 179, Clapham Rd., London, S.W.9 (Estd. 1906). Also instruction at school in wireless for H.M. Merchant Navy and R.A.F. [9249

SITUATIONS VACANT

AIR MINISTRY.

CIVILIAN W/T OPERATORS Required.—Temporary appointments with possibility of permanent appointment after the conclusion of hostilities. Ages 21-45 at date of application. Candidates should preferably possess the 1st Class Postmaster-General's Certificate or the Air Operator's Certificate in Wireless Telegraphy and have had experience in radiotelephony, direction finding and maintenance work.

SALARY 75/- per week for the first two years, thereafter rising by annual increments for approved service to a maximum of 125/- per week. A temporary war bonus of 5/- per week will also be paid.

NORMAL Hours of Duty are 45 per Week Exclusive of Meal Times, day and night, or 180 in periods of four weeks.

ARRANGEMENTS Will be Made for Suitable Candidates to be Interviewed at Renfrew, Manchester, London or Bristol.

APPLY by Postcard for Application Form to the Under-Secretary of State, Air Ministry (S.1.e.), Julian Road, Bristol, 9, stating at which of the above towns interview is desired. [9332

WANTED, by old-established Central London firm, a first-class service engineer; must be thoroughly conversant with all makes and preferably able to repair spring motors.—Box 2549, c/o *The Wireless World*. [9334

WANTED.—Civilian Morse and Procedure Instructors (male) at R.A.F. Signals Schools. £4/12/6 weekly, rising annually by 2/6 to £5/2/6. Ability to send and receive morse at 25 w.p.m. essential. Experience of teaching and lecturing an advantage. Minimum age 30.

APPLY, in writing, Air Ministry (S.5D.), W.C.2, with particulars of experience, age, etc. Third class fares repaid to candidates required to attend Selection Boards. [9348

WANTED.—Civilian Wireless Instructors (male) at R.A.F. Signals Schools. £5/2/6 weekly, rising annually by 2/6 to £5/10. Sound knowledge of electrical principles and their application to radio and low power electrical engineering essential. Test for candidates will include giving lecture on any subject they choose involving principles of modern radio. Lecturing sequence and style most important. Minimum age 30.

APPLY, in writing, Air Ministry (S.5D.), W.C.2, with particulars of experience, age, etc. Third class fares repaid to candidates required to attend Selection Boards. [9349

CHIEF Inspector Required, to control and direct the effort of electrical and mechanical inspection units located in several factories situated in and around N.E. London; applicants must have had experience in a similar position, be thoroughly familiar with the procedure of Government Inspection Departments, particularly as applied to the manufacture of precision, electro-mechanical products, possess a comprehensive knowledge of radio, electrical and mechanical engineering technology, and be capable of obtaining the maximum efforts from a large staff.—Write, with full details of age, education, training and subsequent experience, to Box 2550, c/o *The Wireless World*. [9338

SITUATION WANTED

ELECTRICAL Instrument Tester, 20 years' experience, testing and calibration of precision electrical instruments, requires situation.—Box 2556, c/o *The Wireless World*. [9359

MORSE EQUIPMENT

FULL Range of Transmitting Keys, practice sets and other equipment for Morse training.—Webb's Radio, 14, Soho St., London, W.1. 'Phone: Gerrard 2089. [9350

TAX-FREE STOCKS ARE DWINDLING FAST!

New supplies will be 25% higher.

ORDER FREE OF TAX ***NOW!***

L.R.S. EASY TERMS ON REQUEST.

RADIO RECEIVERS, &c.

	£	s.	d.
COSSOR 31— Battery 4-valve all-wave Superhet ...	8	2	0
VIDOR all-dry ARP receiver 320	7	7	0
EVER READY all-dry Superhet	8	0	0
ULTRA Model 70	9	19	6
Part carr. 2/- extra on receivers.			
HEAYBERD MODEL A 0-5 Battery Charger, Westinghouse 2-12 v. at 2 a. ...	5	0	0
AVO Universal AC/DC Test Meter... ...	6	10	0
AVOMINOR Test Meter	2	15	0
VORTEXION AMPLIFIERS (see their advt. page 27 Editorial). Now available from us on Easy Terms. Write for quotation!			
LOUDSPEAKER UNITS—			
Sound Sales 11in. PM	5	10	0
Magnavox 8in. mains energ.	1	10	0
Rola 10in. mains energ.	1	10	0
Celestion 10in. PM	1	12	6
Celestion 8in. PM	1	10	0
Sound Sales 12in. mains energ. Super Auditorium	11	11	0
Energising Unit for above	6	0	0
W.B. LOUDSPEAKER UNITS (Junior)...	1	15	6

Post and Packing Charges: 8in. Units, 1/6. Larger Sizes, 3/-. S.S. Auditorium, 5/- for case.

DOMESTIC ELECTRICAL GOODS

	£	s.	d.
MORPHY RICHARDS IRONS, Auto-control Safety Model, post 1/-	1	5	0
MORPHY RICHARDS FIRES—			
Tubular Major, 1 kW	1	7	6
Tubular Twin Beam, 1 or 2 kW ...	1	16	0
Cray Twin Beam, ¾ or 1½ kW	1	1	0
Senior Twin Beam, 1 or 2 kW	1	7	6
ORMOND HAIR DRYER	1	12	6
State voltage and include 1/- carr. with order.			
STUART-TURNER AC/DC CENTRIFUGAL PUMPS—			
No. 10, 100 gals. per hour	4	10	0
No. 11, Pumps 280 gals. per hour ...	5	12	0
Foot valve and strainer **12/6** and **15/-** extra (when water has to be lifted over 15ft.). First-class construction. Ideal for A.R.P. Shelters.			
LIONEL ELECTRIC TRAIN SETS. High-grade Goods or Passenger sets	4	4	0

CLOCKS, WATCHES, &c.

	£	s.	d.
WESTMINSTER CHIMES CLOCKS— With high-grade movements, 8-day, guaranteed Walnut cases	3	0	0
TRIPLE CHIMES CLOCKS— A few only are available at	3	12	6
Postage 1/- extra.			
GENTS' HIGH-GRADE 15-JEWEL Chrome WATCHES, Swiss movement (wrist) ...	1	15	0
GENTS' FLAT POCKET DRESS WATCHES, Chrome, same quality movement	1	15	0
LADIES' HIGH-GRADE 15-JEWEL Swiss Movement WRIST WATCHES, Chrome...	1	15	0
LADIES' MINIATURE, same movement as above quality, Chrome	2	7	6
A few Gents' and Ladies' watches in 9-ct. gold also available.			
(Write for complete watch and clock list.)			
VICEROY NON-ELECTRIC SHAVERS (made by Rolls Razors, Ltd.). A welcome present for the Services ...	2	10	0
REMINGTON RAND AC ELECTRIC SHAVERS	2	15	0
REJUVENATE YOUR SHAVEMASTER by fitting a new 475 Comb and Cutter. Post free, **9/6** per set.			

Send 2½d. stamp for illustrated price lists of any item. Terms: Cash with order or C.O.D.

LONDON RADIO SUPPLY CO.

Established 1925.
All communications to evacuation address—
"WINDEN," ARDINGLY ROAD, BALCOMBE, SUSSEX

TECHNICAL TRAINING

GREAT Possibilities Exist for Technically Qualified Engineers, key men in wartime and afterwards. Through the home-study courses of The T.I.G.B. take a recognised engineering qualification such as A.M.I.Mech.E. A.M.I.E.E., A.M.I.R.E., A.F.R.Ae.S., A.M.I.Chem.E., C. and G., etc., in which examinations the T.I.G.B. students have gained 25 FIRST PLACES and Hundreds of Passes. Write to-day for "The Engineer's Guide to Success"—Free—containing the world's widest choice of engineering courses covering all branches, including Aeronautical, Mechanical, Electrical, Wireless, Chemical, etc.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN, 82, Temple Bar House, London, E.C.4. [9335

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

BUSINESSES AND 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, 17/6 per annum, post free.—Send your trade card for specimen copy to Dorset House, Stamford St., London, S.E.1. [0614

VACUUM CLEANERS

HOOVER, model 700, £12/12; also Electrolux, latest model X1, £6/6; Goblin, £4/4; Tellus, £5/5; all rebuilt, guaranteed 1 year.—"R.E.C.S." Crown St., Reading. 'Phone: 2796. [9355

BOOKS, INSTRUCTIONS, ETC.

AMATEUR Radio Handbook—Second Edition Now on Sale, 328 pages. Price 4/2.—Radio Society of Great Britain, 16, Ashridge Gardens, London, N.13. [9252

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, post 6d. Limited supply on linen, 10/6, post 6d. 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 St., London, W.1. 'Phone: Gerrard 2089. [8767

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, and is read by all the leading manufacturers and traders. Trade only, 17/6 per annum, post free. Published at Dorset House, Stamford St., London, S.E.1. [0615

"FOUNDATIONS of Wireless." By A. L. M. Sowerby, M.Sc. Second Edition. An elementary textbook of receivers. Deals fully with the construction of wireless sets, valves, and the process of detection. Price 5/- net. By post 5/6, from Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

"RADIO Interference Suppression." By Gordon W. Ingram, B.Sc. A book for servicing experts and wireless enthusiasts providing immediate and practical analysis of causes of interference which is sub-divided into groups for easy reference. Price 5/- net. By post 5/4, from Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

VALVES—American and British types—large stocks carried.

Send Trade-card (and 2½d. stamp) for Price-lists and Comparative Charts, to:

LEONARD HEYS, 36, Henry Street, Blackpool, Lancs. (Established 1922.)

TRIX SOUND EQUIPMENT

RELIABLE AMPLIFICATION

The TRIX ELECTRICAL COMPANY LTD. 65, Bolsover St., London, W.1. Euston 5471

Second Edition—

RADIO DATA CHARTS

A SERIES OF ABACS

providing most of the essential Data required in Receiver Design.

By R. T. BEATTY, M.A., B.E., D.Sc.

"Radio Data Charts" provide designers of wireless apparatus with a ready and convenient means of solving problems without having recourse to complicated formulæ and mathematics.

By the use of the new "Radio Data Charts" such abstruse problems as the design of tuning coils are solved almost as easily as the simple application of Ohm's Law.

4/6 net — By post 4/10

From leading booksellers or direct from the publishers.

ILIFFE & SONS LTD., Dorset House, Stamford St., London, S.E.1

W.W.93

BOOKS, INSTRUCTIONS, ETC.

"WIRELESS Direction Finding." By R. Keen, B.Eng. (Hons.), Sheffield, A.M.I.E.E. Third Edition. Covers the latest developments, including medium- and short-wave Adcock systems and deals with Beacon Transmitters, Aircraft Approach and Blind Landing processes. There are also detailed descriptions of Commercial Shore, Ship and Aircraft Installation. Price 25/- net. By post 25/9, from Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

"RADIO Laboratory Handbook." By M. G. Scroggie, B.Sc., A.M.I.E.E. The only practical handbook on the subject. Gives the serious wireless worker complete information about laboratory equipment, the necessary instruments and correct methods of operation. Price 8/6 net. By post 9/1, from Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

"RADIO Data Charts." By R. T. Beatty, M.A., B.E., D.Sc. Second edition. A series of Abacs providing most of the essential data required in receiver design and enabling problems to be solved without having recourse to complicated mathematical formulæ. Price 4/6 net. By post 4/11, from Iliffe and Sons Ltd., Dorset House, Stamford St., London, S.E.1.

"HANDBOOK of Technical Instruction for Wireless Telegraphists." By H. M. Dowsett, M.I.E.E., F.Inst.P., M.Inst.R.E. Sixth Edition. A standard handbook for wireless operators containing a complete theoretical course for students anxious to qualify for the Postmaster-General's Certificate of Proficiency. Price 21/- net. By post 21/9, from Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

"TELEVISION Receiving Equipment." By W. T. Cocking, A.M.I.E.E. A new handbook containing information for everyone interested in cathode-ray receiving equipment. The complete vision and sound receiver is described and the treatment throughout is substantially non-mathematical. Price 7/6 net. By post 8/-, from Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

"WIRELESS Servicing Manual." By W. T. Cocking, A.M.I.E.E. Fifth Edition. Deals with the principles and practice of the repair and adjustment of wireless receivers, and contains appendix of detailed information. Price 5/- net. By post 5/6, from Iliffe and Sons Ltd, Dorset House, Stamford Street, London, S.E.1.

Wanted

WANTED, Newnes' Complete Wireless, four volumes. Box 2551, c/o *The Wireless World*. [9340

CLASSIFIED ADVERTISEMENTS intended for the FEBRUARY ISSUE can be accepted up to Thursday, January 9th

The Carrington Manufacturing Co.

Wish all their friends the Compliments of the Season

CAMCO *for* CABINETS

The Carrington Mfg. Co., Ltd., Camco Works, South Croydon

SIXTH EDITION —Revised and Enlarged

HANDBOOK of TECHNICAL INSTRUCTION for WIRELESS TELEGRAPHISTS

By H. M. DOWSETT, M.I.E.E., F.Inst.P., M.Inst.R.E.

Provides a complete theoretical course for students wishing to qualify for the Postmaster-General's Certificate of proficiency. Chapters deal with Echo Sounding Apparatus, Short-Wave Marine Transmission and Reception, Marine Telephony and Band Repeaters—all recent developments which concern the sea-going operator. All sets in general use (Marconi, Siemens, Radio Communication) are also described.

PRICE **21/-** net. By post 21/9

Foreign postage 22/-

Obtainable from all leading booksellers or direct from the publishers

ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1

W.W.100

RADIO DESIGNER'S HANDBOOK

A Comprehensive Manual for Radio Engineers and Experimenters.

Edited by F. Langford Smith, B.Sc., A.M.I.E.E.

This handbook is a complete collection of all the principal formulæ involved in the design of receivers and components. The eight sections of the book deal with Audio Frequencies; Radio Frequencies; Rectification; Filtering and Hum; Receiver Components; Tests and Measurements; Valve Characteristics; General Theory; Sundry Data.

Full explanations are given of the way the principles are applied and each chapter gives a list of works dealing with the particular subject.

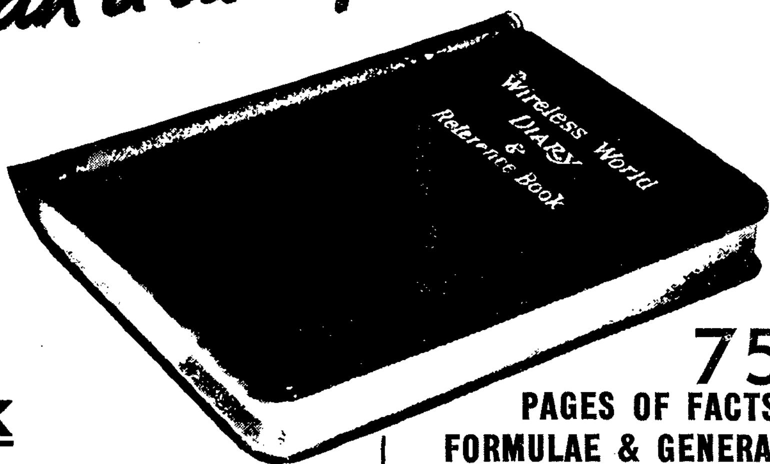
Size $8\frac{3}{4} \times 5\frac{3}{4}$ inches, 352 pages with numerous diagrams and charts. Cloth boards.

Price 7/6 net. By post 8/1

ILIFFE & SONS LTD., DORSET HOUSE, STAMFORD ST., LONDON, S.E.1

It's more than a diary!

NOW ON SALE



The Wireless World DIARY & REFERENCE BOOK for 1941

European Broadcasting Stations.
Short-wave Stations.
Base Connections British and American Valves.
Circuit Diagrams of Receivers, Amplifiers, Whistle Suppressors, Tone Controls and AVC Systems.
Data for Winding Coils.
Prevention of Mains Interference.
Morse and "Q" Codes.
International Call Sign Allocations.

Size $3\frac{1}{2}$ by $4\frac{1}{2}$ inches, 192 pages. Bound leather cloth, back loop with pencil.

PRICE 2/- net
Purchase Tax extra

By post, including purchase tax, 2/7

From bookstalls and stationers or direct from the Publishers

75 PAGES OF FACTS, FORMULAE & GENERAL INFORMATION ——

that is difficult to memorise but . . . .

ESSENTIAL TO PROFESSIONAL AND AMATEUR!

LIFFE & SONS LTD., DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1

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: 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.

Obtain the best from your records by using

The "VOIGT" MOVING COIL PICK-UP

Many favourable comments have been received from those who obtained delivery of early models.

Provisional Price : **£6 - 0 - 0.**

Delivery 12 weeks.

Output approx. 50 m.v.

Reproducing point stiffness, 1½ gms./thou.

VOIGT PATENTS LTD.

VOIGT PATENTS LIMITED

THE COURTS, SILVERDALE, LONDON, S.E.26. Tel. : SYDenham 6666

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

THE NEW ERSKINE McMURDO 15-17 RECEIVER

Chassis price complete with valves and speaker - - **50** gns.

15 valves (including four duplex valves).
R.F. stage on all bands.
POLYSTYRENE COIL FORMERS.
SILVER-PLATED COPPER TUBE COILS.
10-2,000 metres coverage.
Variable selectivity.
Distortionless negative feedback detector.
15 watts push-pull output with negative feedback.
15" loudspeaker.
Beat frequency oscillator.
Inter-station noise suppression.

We are confident that the amazing performance of this new receiver will astonish even the most experienced enthusiast.

May we send you details now.

ERSKINE LABORATORIES LTD.

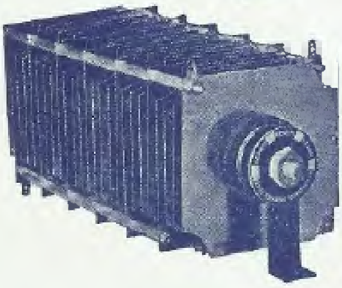
PROSPECT WORKS, NORTH STREET, SCALBY, SCARBOROUGH.

Tel. : Scalby 83.

L.T. BATTERY CHARGING

L.T. 7, 8 & 9.

L.T. 4 & 5.



L.T. 10 & 11.

There is a complete range of Westinghouse Metal Rectifiers for L.T. battery charging, with outputs ranging from ½ to 4 amps. In all cases a transformer and regulating resistance are necessary; control of the current may be by either tapped transformer or tapped resistance.

Full details are given in "The All Metal Way." Use the coupon and get your copy NOW.

WESTINGHOUSE METAL RECTIFIERS

COUPON

WESTINGHOUSE BRAKE & SIGNAL CO., LTD.,
Pew Hill House, Chippenham, Wilts.

I enclose 3d. in stamps. Please send me a copy of "The All Metal Way."

Name..

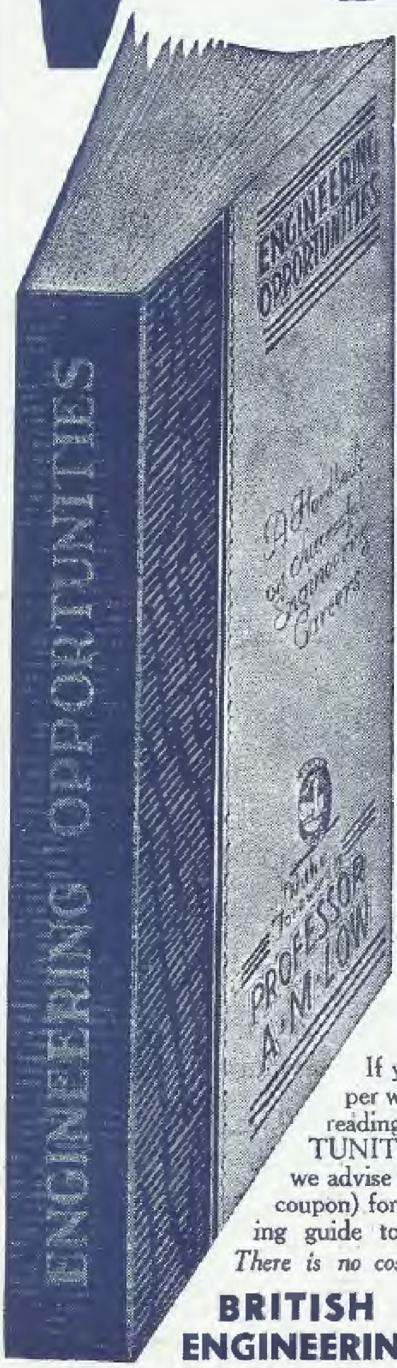
Address..

....

W.W. 141.

FREE!

THIS IMPORTANT GUIDE TO SUCCESSFUL ENGINEERING CAREERS



After months of intensive effort and research we are pleased to announce that the new edition of our handbook, "ENGINEERING OPPORTUNITIES," is now out of the publishers' hands and ready for *free distribution.* Containing 208 pages of practical guidance, this book is, beyond argument, the finest and most complete handbook on Successful Engineering Careers ever compiled. It is a book that should be on the bookshelf of every person interested in engineering whatever his age, position or experience.

The Handbook contains, among other intensely interesting matter, details of **B.Sc., 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., A.M.I.P.E., CIVIL SERVICE,** and other important Engineering Examinations; outlines courses in all branches of **CIVIL, MECHANICAL, ELECTRICAL. AUTOMOBILE, RADIO, TELEVISION, AERONAUTICAL and PRODUCTION ENGINEERING, DRAUGHTSMANSHIP, TRACING, BUILDING, GOVERNMENT EMPLOYMENT,** etc., and explains the unique advantages of our Employment Department.

Brighten your future by Studying through the Black-Outs

WE DEFINITELY GUARANTEE "NO PASS—NO FEE"

If you are earning less than £10 per week you cannot *afford* to miss reading "ENGINEERING OPPORTUNITIES." In your own interests, we advise you to **write** (or forward the coupon) for your copy of this enlightening guide to well-paid posts — NOW. *There is no cost or obligation of any kind.*

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

Principal: Professor A. M. Low

387, SHAKESPEARE HOUSE,
17, 18 & 19, STRATFORD PLACE, LONDON, W.1

- - - - - - TEAR OFF HERE - - - - - -

FREE COUPON

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY,
387, Shakespeare House, 17-19, Stratford Place, W.1

Please forward **Free** of cost or obligation of any kind, your 208-page Handbook "**ENGINEERING OPPORTUNITIES.**"

NAME ....

ADDRESS ....

....