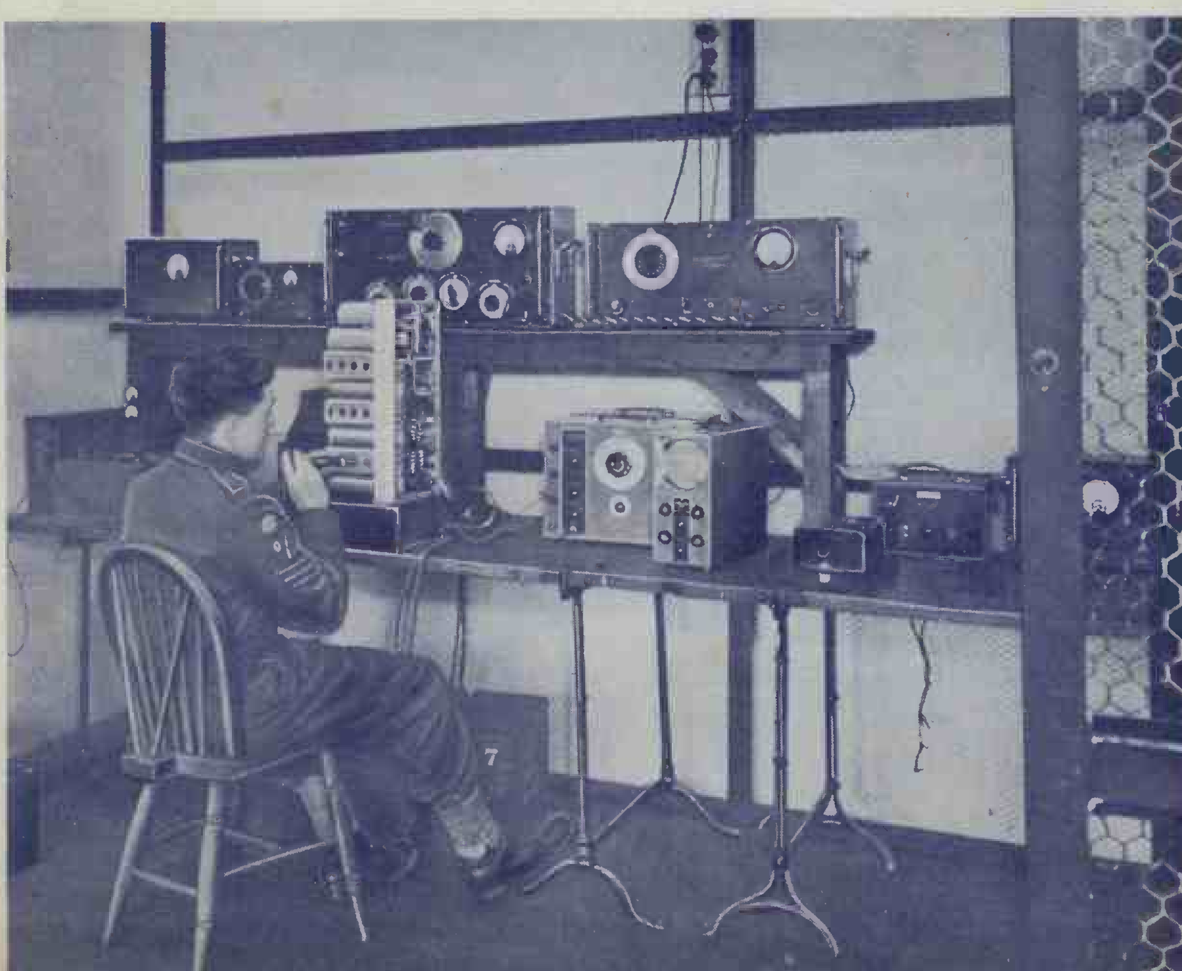
PROBLEMS OF SELECTIVITY

MONTHLY
ONE SHILLING

The Wireless World

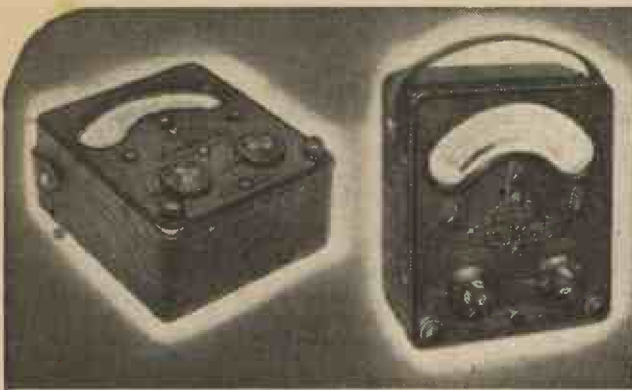
COVERING EVERY WIRELESS INTEREST

MARCH, 1941



WIRELESS IN THE R.A.O.C.

No. 1065 Vol. XLVII No. 3



46-range Model 7 Universal AvoMeter

40-range Model 40 Universal AvoMeter

"Avo" Valve Tester with Universal Panel

PRECISION METERS
that Master every Testing Problem

The world-wide use of "AVO" Instruments is striking testimony to their outstanding versatility, precision and reliability. In every sphere of electrical test work—laboratory, shop or out on a job—they are appreciated for their dependable accuracy, which is often used as a standard by which other instruments are judged. There is an "AVO" Instrument for every essential electrical test.

OTHER "AVO" INSTRUMENTS (not illustrated).

High Resistance AvoMinor.
"Avo" Low Resistance Ohmmeter.
The Avodapter
The "Avo" Bonding Meter
The "Avo" MilliOhmmeter
9-pin AvoCoupler

AVO

Regd. Trade Mark

ELECTRICAL MEASURING INSTRUMENTS

BRITISH MADE

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

Sole Proprietors and Manufacturers:—

THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT Co., Ltd., Winder House, Douglas St., London, S.W.1

'Phone: Victoria 3404-7.

All-Wave "Avo" Oscillator

"Avo" Test Bridge

Universal AvoMinor

D.C. AvoMinor

PREMIER RADIO

PREMIER SMOOTHING CHOKES

Type	Current	Henrys	Res	Prices
C 40/500	40 MA	20-34 H	500 ohms	5/3
C 60/180	60 MA	8 H	180 ohms	5/3
C 60/400	60 MA	25-34 H	400 ohms	7/6
C 60/500	60 MA	18-30 H	500 ohms	5/3
C 100/400	100 MA	20-34 H	400 ohms	9/6
C 150/185	150 MA	20-34 H	185 ohms	13/6
C 200/145	200 MA	20-34 H	145 ohms	15/9
C 250/120	250 MA	25 H	120 ohms	17/6
C 60/2500	60 Speaker Field Replacement		2500 ohms	7/6

PREMIER PICK-UPS

Heads (will fit any tone-arm) 7/6
Premier Pick-up with Volume Control 2,000 ohms 12/6
Premier de Luxe, 6,000 ohms 17/6

ANOTHER SPECIAL OFFER

Rothermel Brush Piezo Crystal Pick-ups. New Junior P.U. with arm, 24/6. Standard, S.8 Model with arm, 34/9. P.U. head only, De Luxe Model, 24/6.

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
Bell Transformers, 3-5-8 volts ... 5/6

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/-.

Potentiometers, all resistances, 2/4 each; with switch, 3/3.
Ceramic Valve Holders, chassis mounting, 4 or 5 pin, 7d. each. 7 pin, 11d. each.
Valve Screens, for American type valves. Small size, 1/2. Medium size, 1/2.

"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

BATTERY VERSION KIT also available £3 8 0

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

MOVING COIL SPEAKERS

All complete with transformer. Rola 6½ in., 15/-; 8 in. P.M.s, 17/6; 10 in. P.M.s, 22/6.

ENERGISED MODELS

Plessey 8in., 175 ohm field, 7/6; G.12 energised, or 2,500 field, 63/-. 10 in. B.T.H. 1,600 ohm field, less transformer, 11/6. Magnavox 154, 2,000 ohms Universal transformer, 15/-.

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.
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, 9 in. ring, 7/6 each. Adjustable Floor Stand, 8 in. ring, Chrome finish, 26/6.

REPLACEMENT VALVES for ALL SETS

Europa Mains Valves. 4 v. A.C. 5-pin 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, 11/5; A.C./Pens. I.H., 10/6; A.C./P.X.4, 9/-; Oct. Freq. Changers, 9/6; Double Diode Triodes, 9/9; 3½-watt D.H. Triode, 12/-. 350 v. F.W. Rect., 10/8; 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, 9/- each. D.D. Pens., 10/3.

Write for latest lists.

Cardboard Electrolytic Conds. 4 MFD, 8 MFD, 1/9; 8×8, 3/6; 4×4, 2/8; 8×4, 3/3; 4×4×1 3/9; 4×4×4, 4/3; 16×8, 4/-; 16×16, 5/-.

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).

Masteradio

VIBRATORPACKS

(British equivalents of American Types)

Proven for long life and reliability under war conditions (in all services, on land, sea and in the air).

Efficiency as high as 70% including rectification.

Size only $5\frac{3}{8}'' \times 4\frac{1}{2}'' \times 5\frac{3}{8}''$ high and weighing only 6 lbs. approx.

Outputs of up to 30 watts from 6 or 12 volts Battery. (Special Vibratorpacks up to 60 watts.)

Also 150 watts A.C. from 110 or 220 volts D.C. supply using MASTERADIO INVERTORS.

Let our Technical Staff solve your Portable Power problems.

Write for details :—

THE PORTABLE POWER SUPPLY FOR RADIO TRANSMITTERS AND RECEIVERS.

PUBLIC ADDRESS SYSTEMS.

SCIENTIFIC APPARATUS.

EMERGENCY POWER SUPPLY SYSTEMS.

Used by :
The WAR OFFICE
The AIR MINISTRY
The POST OFFICE
and POLICE FORCES.

A SELECTION FROM THE FULL RANGE OF STANDARD VIBRATORPACKS

TYPE	OPERATING VOLTS	CONSUMPTION AMPS.	OUTPUT VOLTS D.C. UNSMOOTHED	OUTPUT M.A.	TYPE OF RECTIFIER
6A300	6.	7	300	100	Sync. Vibrator
6B300	6	7	300	100	OZ 4 Valve
12A300	12	3.5	300	100	Sync. Vibrator
12B300	12	3.5	300	100	OZ 4 Valve
VP551	6	6/7	300–275–250–225	100	OZ 4 Valve
VP552	6	6/7	do.	100	Sync. Vibrator
VPG554	12	3/3.5	do.	100	OZ 4 Valve
VPG552	12	3/3.5	do.	100	Sync. Vibrator
VP553	6	4/5	200–175–150–125	100	OZ 4 Valve
VPG553	12	2/2.5	do.	100	OZ 4 Valve

Greenwood

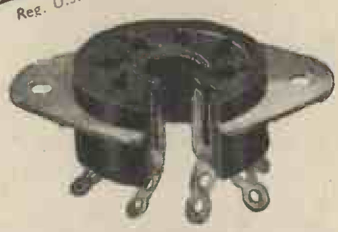
Masteradio LTD.

VIBRANT WORKS, WATFORD, Herts.

'Grams : MASTIOLA. 'Phone : WATFORD 9885/9890.

AMPHENOL

Reg. U.S. Pat. Off.



BRITISH MADE

● CONSIDER the FOLLOWING FACTS !

STRENGTH ! EFFICIENCY !

- Exclusive Celestion-Amphenol Moulded-in Plates ensure maximum strength, rigidity and a high degree of efficiency.
- The sturdy plates keyed into the body cannot rattle loose.

UNIFORM CONTACT ! INSULATION !

- Celestion - Amphenol Contacts pressed from specially treated phosphor bronze are engineered to ensure uniform contact on all prongs.
- There will be no "fatigue" even after constant use.
- Exceptional insulation is assured by the special properties of the moulding powder.

CELESTION-AMPHENOL VALVEHOLDERS

All standard British and American types available.

CELESTION LIMITED

Engineers

KINGSTON - UPON - THAMES, SURREY

Telephone : KINgston 5656-7-8.

JOHN McCLURE, LTD.

Owing to the increasing difficulties of production for civil requirements during war time we fear we have in the past had to keep some customers waiting a long time for delivery of orders.

We very much regret the necessity for this delay and ask all customers to rest assured that we are doing our best to give them service.

At the same time we regret that we cannot accept any further orders for any chassis complete with valves, but shall be pleased to continue supplying units completely tested and aligned *less* valves.

An allowance will be made in prices as follows :

Standard Feeder unit . . .	£1 0 0
Feeders with Push-Pull Output	£1 4 0
Standard Amplifiers . . .	£1 10 0

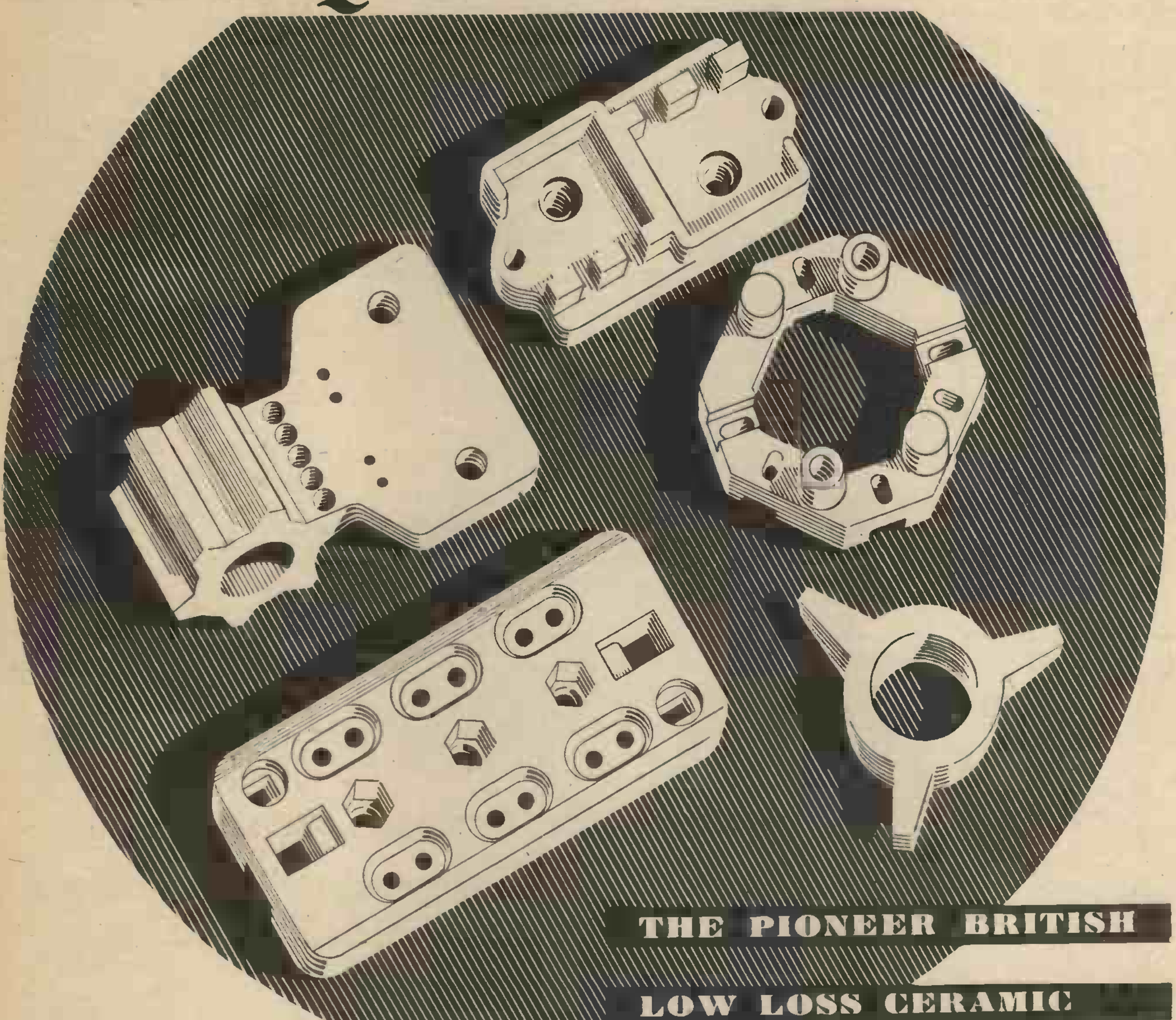
Will any customers with outstanding orders please note that quicker delivery can be given if valves are not supplied.

JOHN McCLURE, LTD.

CROXSONS' WORKS, HIGH WYCOMBE, BUCKS

Telephone : High Wycombe 1290-1

FREQUENTITE



THE outstanding properties of Frequentite—Low Loss and High Mechanical Strength—led to a demand which even before the war severely taxed our productive capacity. The needs of the fighting services have inevitably led to restriction in supplies for general industry, *but we can now meet all requirements promptly.*

Extensions to our plant, the employment of specialised new equipment, and progressive improvements in our manufacturing technique made during the past seven years, now enable manufacturers to obtain bulk supplies of the most intricate designs. Please write for Catalogue No. SP.10.

STEATITE & PORCELAIN PRODUCTS LTD.

Head Office and Works: STOURPORT-ON-SEVERN, WORCS.
Telephone: Stourport 111. Telegrams: Steatain, Stourport.

SP2

11A

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. 1065 Vol. XLVII. No. 3

MARCH, 1941

Contents

THE *disappearing* TRICK . . .

ENORMOUS quantities of tubular condensers, of all kinds of specifications, are now being used in apparatus for the Services—of which we, of course, make our share. Only a very few are left over for ordinary commercial work, and if we are to make any broadcast receivers at all, we must economise in them.

We have made several circuit changes in the various receivers so as to save "tubulars," and one typical change, which saves two condensers, is illustrated in the diagrams above.

Fig. 1 shows the A.V.C. and cathode bias systems of a standard type of A.C. superhet using separate cathode bias circuits in the ordinary way.

Fig. 2 shows the A.V.C. and bias system of the new scheme. The resistances R_1 and R_2 are connected between the negative side of the H.T. supply and the chassis, and the cathode of V_3 is connected to their junction. It will be seen that under "no-signal" conditions the A.V.C. line has the same potential to chassis as the cathode of V_3, and will therefore be negative to chassis by the voltage-drop across R_1. This negative bias is decoupled by the usual A.V.C. decoupling and fed on to the grids of V_1 and V_2, making the cathode bias unnecessary. The earthy end of the volume control is returned to the negative side of R_2, and the voltage across R_2 provides the bias voltage for V_3.

The anode current of V_4 passes through R_1 and R_2, and it is therefore necessary to arrange the 50 μF condensers C_1 and C_2 so that the audio-frequency voltage built up across R_1 and R_2 from the audio-frequency components of V_4 anode current shall be a minimum and so produce a negligible amount of feed-back into the grid and cathode circuit of V_3.

The student of design will realise that while, with normal cathode bias systems (as in Fig. 1), the valves are to a large extent "self-regulating," with the new scheme, the bias is fixed by the total anode current of the receiver, and in consequence there will be wider variations in valve gain from set to set. Apart from this, however, the change involves no loss in performance or reliability—and it certainly enables us to avoid using components which have an even more vital job to do elsewhere.

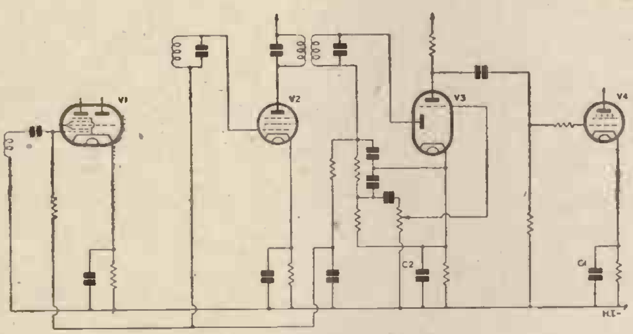


FIG. 1. The Typical Cathode Bias System

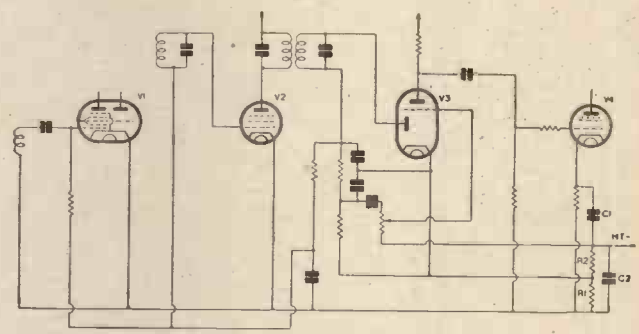


FIG. 2. The New Method described here

The
Wireless World

COVERING EVERY WIRELESS INTEREST

ESTABLISHED 1911

Vol. XLVII. No. 1065 | MARCH, 1941 | Price One Shilling

Broadcast Receivers of the Future

Progress Along Less Stereotyped Lines

MUCH ingenuity has been displayed by broadcast receiver designers in the past in producing more or less elegant variations of basic circuit arrangements—notably of the four-valve-plus-rectifier superhet. No doubt records have shown that the introduction of a new model, or perhaps more accurately a new variation, had a tonic effect on the flagging curve of sales, but we believe that even before the war radical changes were overdue. A more exacting type of set buyer, with clear-cut ideas as to what he wanted, was coming forward. Here we are thinking not only of typical readers of this journal, but also of those more critical members of the general public who took their broadcasting seriously.

An analysis of about 1,000 circuit diagrams representative of commercial broadcast receiver design over the period 1929-1939 has led the authors of a recent paper[1] presented before the I.E.E. to the following conclusion: "Design has been influenced to a great extent by the fact that the sales market consisted of a large majority of purchasers of first receivers. This has rather tended to over-emphasise the accessory circuit (which can be made a good selling point) at the expense of basic design and the potential user's needs. With market saturation approaching, replacements must become a larger and larger proportion of the total sales, and this should give the designer an opportunity of producing receivers calculated to fulfil the more exacting requirements of the user."

It is evident that there will always be a demand for the simpler mass-produced set, but the authors (all Marconi engineers) are right in envisaging an increase in the number of buyers who will only be satisfied by sets with a specialised performance in one direction or another. The demand for high-quality reproduction and for long-range sets of the communication type has been in evidence for some time.

The present hiatus in the production of broadcast sets and the diversion of designing talent to fresh fields may well produce for the post-war revival something radically better than "cold cabbage warmed up." Certainly the time is opportune to take stock of progress up to the present, and to make plans ahead.

What form will the broadcast set of the future take? The answer will depend to a large extent on the nature of the transmitters and the wavelengths on which they work. Selectivity, for example, is almost as much as quality of transmission as of reception, and is of such importance that we feel justified in dealing with that aspect of the subject alone at some length elsewhere in this issue.

"Cooked" Transmission Technique

There is also room for closer collaboration between transmitter and receiver designers if better quality of reproduction is to be obtained. The introduction of "pre-emphasis" for high notes in the transmitter and a reciprocal "de-emphasis" following the same law in all receivers would help to reduce background noise, while complementary degrees of compression and expansion would add greatly to the realism of a transmission such as that of the full orchestra, which covers a wider volume range than can be handled by present-day transmitters without encroaching on background noise at minimum or overloading at maximum.

Far from having reached a state of finality in design, we may reasonably look for a flood of new ideas and a major advance in broadcasting technique when social and economic life is once more stabilised. The perceptible slowing up of progress in fundamental design immediately prior to the war was the result of reaching limitations imposed by the present system. Ultra-short-wave broadcasting in this country and frequency modulation in America were symptomatic of the need for breaking fresh ground. The foundations of real progress will depend upon the realisation that broadcasting must be viewed as a complete communication system and not as a chain of separate units engrossed in their own special problems.

[1] Broadcast Receivers: A Review, by N. M. Rust, O. E. Keall, J. P. Ramsay, M.A. and K. R. Sturley, Ph.D.

Selectivity

Selectivity is not determined exclusively by the circuit properties of a receiver. Harmonic distortion in the transmitter can have a significant effect, particularly in relation to sideband splash. The geographical and frequency distribution of stations are equally important.

THE overall selectivity curves of a receiver, while helpful to the designer in checking calculations, are not by themselves a criterion of the performance which the set will give under listening conditions. To be in a position to estimate the degree of encroachment of unwanted transmissions on a desired programme, one must know not only the frequency distribution and relative field strengths of the transmissions at the place where the receiver is installed but also the nature of the sideband spectrum radiated by the interfering station.

These points are brought out very clearly in a paper recently presented before the Institution of Electrical Engineers.[1] The "state of the ether" on the medium-wave band in the London area under normal conditions is graphically illustrated by a graded field strength chart reproduced in Fig. 1. This gives some idea of the formidable task which the receiver is called upon to perform, but does not tell us the exact nature of the interference which will be met with between stations in individual cases. Neither is this question answered by an inspection of the selectivity response curves of the receiver itself.

The authors found that the R.M.A. and I.R.E. two-signal selectivity tests using an interfering

[1] "Broadcast Receivers": A Review by N. M. Rust, O. E. Keall, J. F. Ramsey, M.A., and K. R. Sturley, Ph.D.

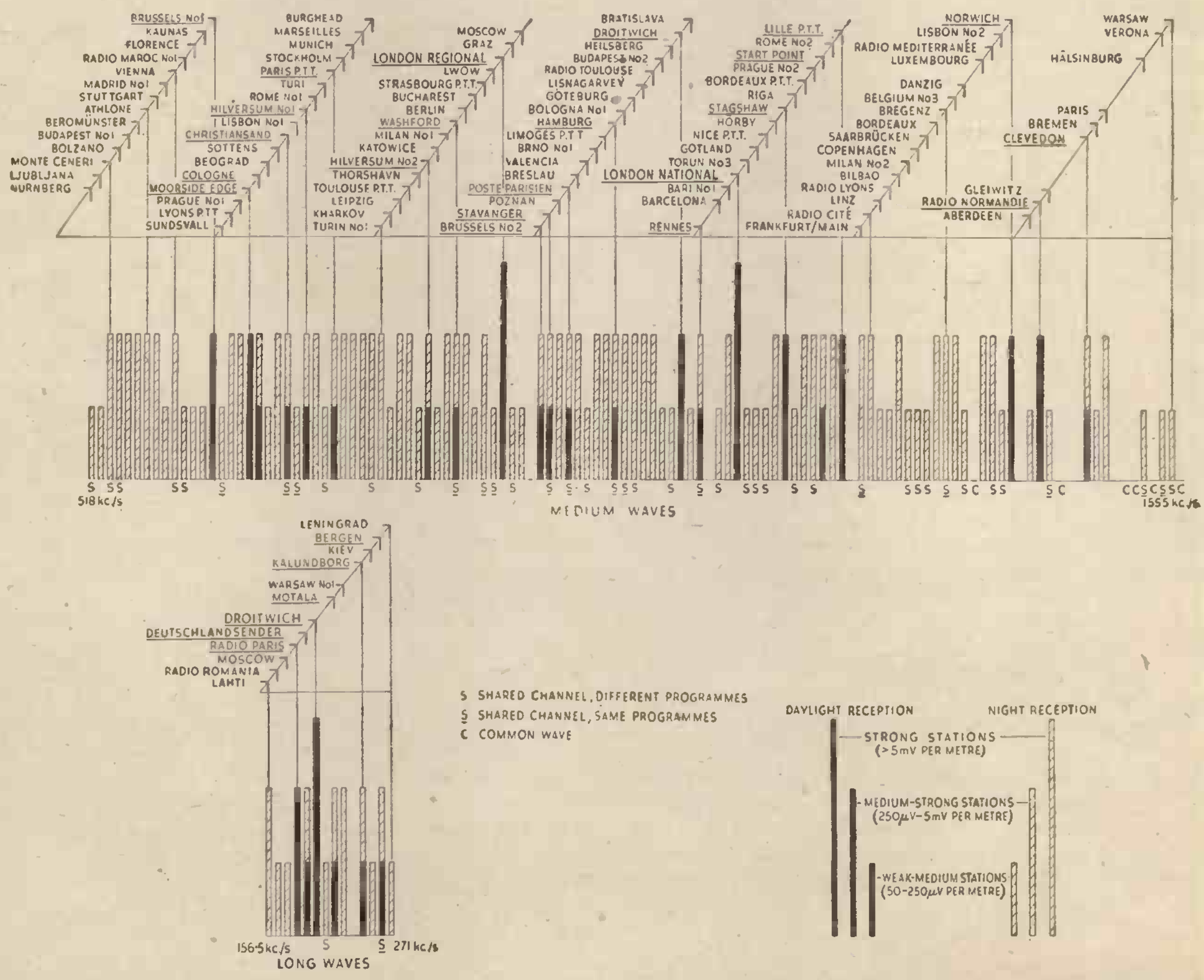


Fig. 1.—Graded field strength chart of medium-wave stations in London. The frequency distribution is in accordance with the Montreux Plan.

A Survey of the Problem as it Affects the Whole Broadcasting System

modulation frequency of 400 c/s gave little indication of receiver service under listening conditions, and it was decided to make investigations of "interference protection" on a wider basis. Accordingly tests were made under four separate headings:

(1) Two-signal interference measurements using an interfering carrier modulated over a range of 0 to 20 kc/s.

(2) Measurement of the interference output frequencies.

(3) Cathode-ray tube examination of the interference output.

(4) Listening test.

The receiver employed had a linear frequency response up to 5 kc/s, and the distortion was 1.9 per cent. (including the signal generator) for an output of 1 watt. The distortion in the AF stages was less than 1 per cent., and a two-tone test gave a residue of 2.5 per cent.

Sideband Interference

First, the receiver was adjusted to give an output of 1 watt at certain values of desired carrier, modulated 30 per cent. at 400 c/s. Then the interfering carrier (derived from a signal generator with 1.25 per cent. distortion at 30 per cent. modulation) was switched on, and modulated continuously from 0 to 20 kc/s, measurements of the interfering modulation being taken at the receiver output.

The results are shown in Fig. 2 (a) for carrier spacings of 15 kc/s and 18 kc/s and desired and undesired carrier strengths of 100 and 10,000 μV respectively. The dips in the curves represent positions at which zero beat tones are observed. These occur when the interfering modulation frequency is a sub-harmonic of the carrier spacing.

It will be observed that the interference increases with the modulation frequency, and near to the wanted carrier would be higher under working conditions than is shown by the curves. This is due to the action of AVC, which is able to operate on the steady modulation products derived from the test interference, but would not respond to the transient high-frequency side bands resulting from the average programme.

Most of these sidebands are harmonics of the modulation frequency in the transmitter, and the interference is particularly serious when the normal pass-band of the receiver is entered. The distortion present in the signal generator used for the tests (1.25 per cent.) is comparable with that of high-grade broadcast stations where 1 per cent. for 30 per cent., and 4 per cent. for 90 per cent. modulation is regarded as acceptable. Nevertheless, the interference produced can be serious even with 3- or 4-channel separation, and it will be seen from the results given in the table that the harmonic sidebands of a 10,000 μV undesired station may equal the fundamental sidebands of a desired 100 μV carrier.

Carrier (μV)	10^2	10^3	10^4	10^5	10^6
Fundamental sideband ...	15	150	1,500	15,000	150,000
2nd harmonic sideband ...	0.15	1.5	15	150	1,500
3rd harmonic sideband ...	0.15	1.5	15	150	1,500

Harmonics in the transmitter may originate at audio frequency in the modulator or sub-modulator, or at radio frequency in the RF stages, and may be restricted by a low-pass filter in the AF stages or a band-pass filter between the RF power stage and the aerial. Filters of the latter type are difficult to design for use in transmitters, but to test the efficacy of both types of filter the test signal generator was fitted with a low-pass filter between the AF oscillator and the modulator, having a normal cut-off at 5 kc/s and an attenuation of 80 db. above 7.5 kc/s; also an elementary RF band-pass filter of ±7.5 kc/s pass range attenuating frequencies outside ±15 kc/s by 20 db. The results obtained are shown in Fig. 2.

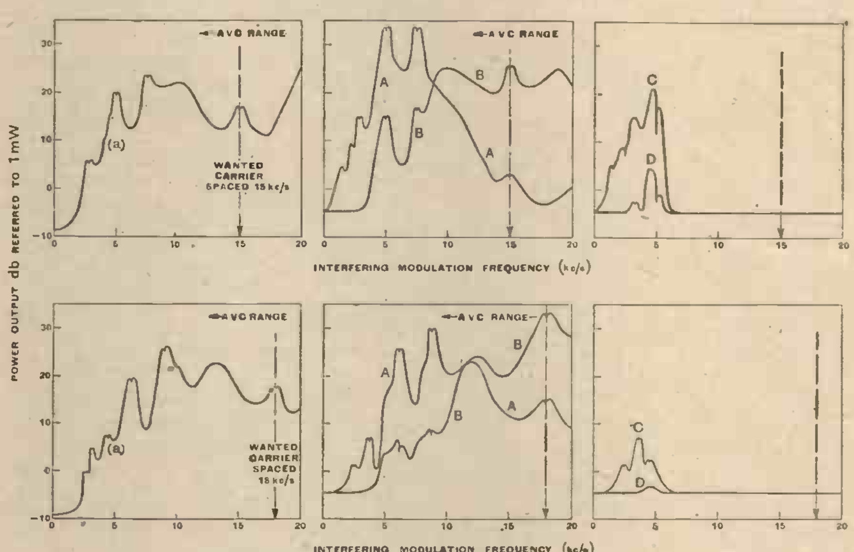


Fig. 2.—Curves (a): Magnitude of sideband interference resulting from 10,000 μV undesired signal spaced 15 kc/s and 18 kc/s from 100 μV wanted carrier. Curves: A, no filters in unwanted "transmitter"; B, RF filter only; C, AF filter only; D, RF and AF filters both in circuit.

The frequency composition of the interference output was then analysed in tabular form, and charts were prepared which indicate the degree of interference likely to be experienced under service conditions. In preparing these charts the relative strength of the different frequency components of the orchestra were taken into account. The dotted line in the top left-hand corner of Fig. 3 shows the general decrease in

Selectivity—

amplitude with frequency, and the average slope has been fixed by the straight line which represents the fundamental sidebands present in the transmitter when a 75-instrument orchestra is playing at "maximum" level. Similar curves

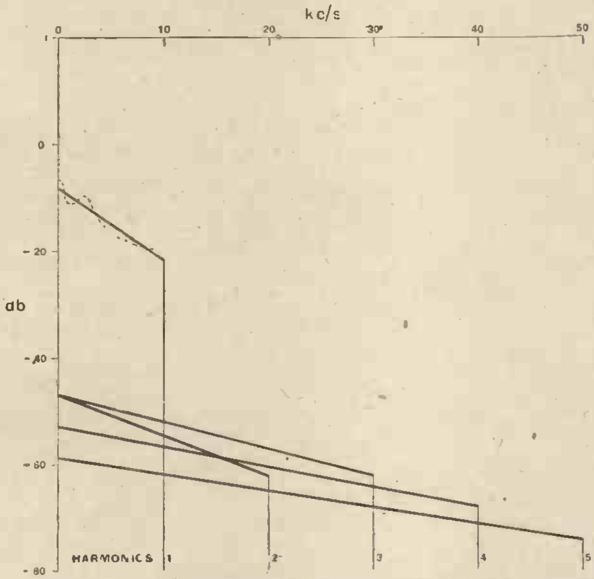


Fig. 3.—Average distribution of fundamental and harmonic sidebands in one half of the spectrum radiated from a transmitter modulated 100 per cent. by a 75-instrument orchestra playing at "maximum" level. Sideband levels are referred to the carrier.

were prepared for "most probable" orchestral level and "average conversational" level. The horizontal scale at the top shows frequency difference from the unwanted carrier, and, on the vertical scale, sideband levels are referred to the carrier, 100 per cent. modulation being assumed.

A chart representing an average receiver is shown in Fig. 4. This is to the same scale as the transmitter chart of Fig. 3 and shows a response range of ±5 kc/s. The downward sloping lines give the sideband frequency distributions corresponding to 50 per cent. and 10 per cent. modulation, and the noise level is arbitrarily fixed at 30 db below 30 per cent. modulation level.

The receiver chart should be drawn on transparent material, and when placed over the transmitter chart the degree of probable interference can be visualised. Thus in the left-hand dotted position in Fig. 5 the station separation is 9 kc/s, and the carrier levels are equal. Interference is almost entirely due to the fundamental sidebands of the unwanted transmitter, which produce an equivalent modulation of between 30 and 60 per cent. In the other position, where 18 kc/s spacing is assumed and the wanted carrier is

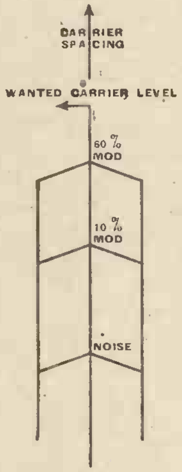


Fig. 4.—Chart of average receiver characteristics drawn to same scale as Fig. 3. An acceptance band width of ±5 kc/s is assumed. This diagram should be drawn on transparent material.

30 db below the unwanted carrier, interference is due to harmonic sidebands and is equivalent to modulation of about 10 per cent. This interference occurs, in the second example chosen, only when the fundamental modulating frequencies are developed in the region of 6.5 to 10 kc/s for second harmonic and 4 to 8, 3 to 6, and 2.5 to 5 kc/s for third, fourth and fifth harmonics respectively. It is for this reason that programmes predominating in low tones (the organ, for instance) give comparatively little sideband splash.

From further tests the writers conclude that unnecessary harmonic sidebands can give a transmitter an effective modulation range of 30 to 50 kc/s, and that the interference from this source can cause first order effects which are independent of cross modulation and distortion in the receiver itself.

Listening tests with the interfering carrier modulated by a speech amplifier confirmed that sibilants as represented by the word "street" caused greater interference than the long vowels in "radio."

Depth of Modulation

Some interesting results were obtained from cathode ray observations of the modulation depths at the detector. "The RF signal was applied to one pair of plates and the AF signal to the other pair, resulting in a trapezoidal shape during modulation. London Regional showed an average modulation of 20-50 per cent., but 80 per cent. was frequent and 100 per cent. not uncommon.

"High modulation occurred on sustained vowels and explosive sounds; modulation on sibilants rarely exceeded 50 per cent. Radio Normandie gave average modulation depths of 50-100 per cent.

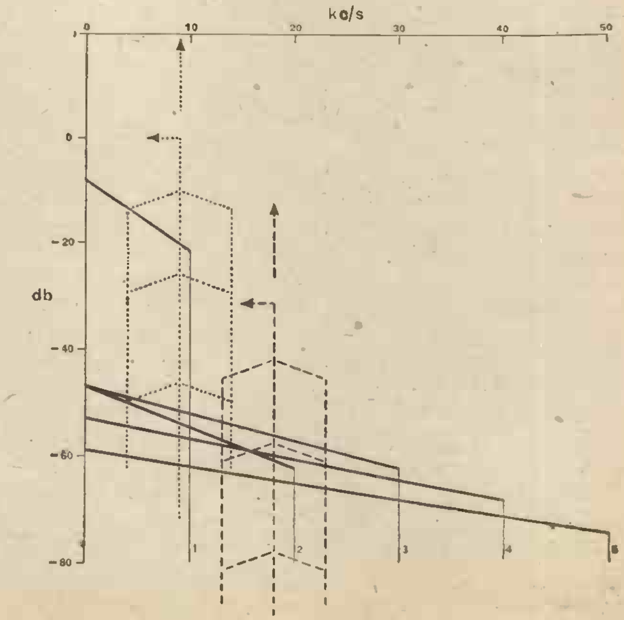


Fig. 5.—Illustrating the use of Figs. 3 and 4 in predicting the nature and magnitude of interference.

"The transient nature of sideband interference was clearly shown by tuning the receiver to a locally applied carrier of about 100 μV adjacent to London Regional. The interference modulation was on occasion equivalent to 500 per cent., and these high levels produced a harsh and raucous output."

Referring back to the state of affairs depicted in Fig. 1, the prevalence of interference is not remarkable in view of the considerations put forward by the authors. They suggest that a solution may be found in the reallocation of wavelengths and the method of "group allocation" put forward as far back as 1928,[1] and frequently advocated in this journal receives their support. If instead of 12 separate channels each of 9 kc/s nominal width the spectrum of 108 kc/s allowed to Great Britain under the Montreux Plan were divided into two bands, one near the high frequency and the other near the low frequency end of the medium-wave band, 5 kc/s single sideband transmission could be used for speech and 20 kc/s double sideband for programmes calling for a high degree of fidelity. Any required combination could be made in each band between the limits of 21 speech and two high-fidelity channels. The authors conclude that "for a given total frequency spectrum allotted to a country, group allocation permits the most economical programme-frequency distribution and goes far towards the elimination of station interference if the conditions for transmitter and receiver design cited above are fulfilled. Immediate general acceptance of the principle is unlikely owing to the special technical problems involved, but future developments along these lines are possible."

Receiver Design

So much for the wider aspects of the selectivity problem. On the detailed improvement of selectivity in receiver circuits the paper has many useful suggestions to offer.

The section dealing with distribution of selectivity throughout the receiving chain is best quoted in full.

"An important point in receiver design (particularly for the superheterodyne) is the degree of selectivity required of each stage. Let Fig. 6 represent a group of adjacent transmissions applied to the input of receivers of differing selectivity (the detectors are assumed linear). If one receiver has a pass range E-F the detector produces audio-frequency components not only of the desired and undesired transmissions, but also components due to combination of the sidebands and unwanted carriers between themselves.

"In a homodyne receiver (one into which an artificial carrier identical in frequency and phase with the original is introduced) this intermodulation is reduced, being actually inversely proportional to the amplitude of the artificial carrier. When the latter is large the intermodulation products are negligible, and the output comprises only the beat tones between individual frequencies in the spectrum E-F and this carrier. If the audio-frequency range be now restricted so as to exclude all frequencies produced by combination between the carrier and frequencies outside A-B the result is the same as if the pass-band before the detector were reduced to A-B, i.e., selectivity can be controlled in the audio-frequency stages.

"Thus in the homodyne receiver AF selectivity may be employed in addition to RF selectivity, which need not be of a high order. In this, as in other systems, undesired fundamental and harmonic sidebands, which overlap into the region A-B, cause interference, and this interference can only be removed by further reduction of A-B so as to exclude the undesired sidebands. With the normal receiver restriction of the audio-frequency pass range is, owing to intermodulation products, not so effective as a means of controlling selectivity, and adequate selectivity before the detector is essential.

"If it can be assumed that all amplifier stages preceding the detector have linear characteristics, the overall selectivity curve determines the resultant interference, and the selectivity distribution over individual stages is not important. For RF stages having non-linear amplifying characteristics it is essential to obtain the maximum possible selectivity between the aerial and the first RF valve, since the ratio of interference to desired signal is greatest here.

"In the superheterodyne receiver the frequency changer becomes the important position, for the IF amplifier usually has a narrow pass-band.

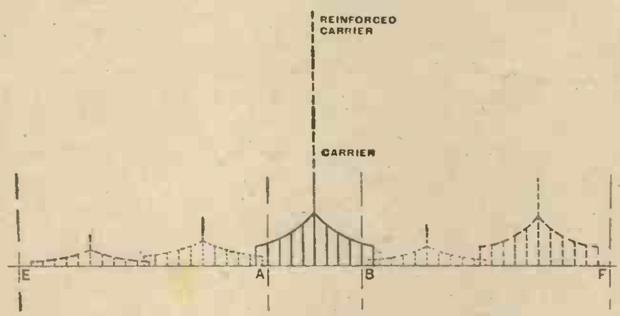


Fig. 8.—Illustrating the problems of selectivity confronting receivers of different types.

A pass-range of E-F before a frequency changer of linear characteristics (by linear it is implied that the modulated IF output is directly proportional to the modulated input) followed by an IF amplifier of pass range A-B gives the same interference output as the homodyne receiver with an RF pass range of E-F and an AF pass range of A-B. Practical types of frequency changers rarely possess the ideal characteristic and intermodulation occurs. In order to reduce interference it is therefore essential to have adequate selectivity before the stage producing modulation products, viz., the detector in the straight receiver and the frequency changer in the superheterodyne.

"With non-linear characteristics for the RF valves preceding the frequency changer, interference is a minimum when the selectivity between the aerial and the first RF valve is a maximum. An important rule can therefore be stated with regard to selectivity distribution: circuits preceding non-linear stages determine the interference output to a much greater extent than succeed-

[1] "Allocation of European Broadcast Wavelengths," by S. Lemoine, *The Wireless Engineer*, July, 1928.

Selectivity—
ing circuits, and it is therefore imperative that the selectivity of the former should be adequate. A frequency changer and detector are necessarily non-linear devices, but

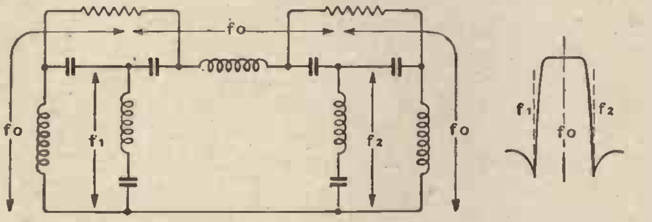


Fig. 7.—Band-pass circuit including rejection circuits designed to improve selectivity outside the pass-band. The side dips are usually located 9 kc/s from the mid-frequency.

an RF amplifier is only non-linear when distorting."

Band-Pass Filters

Dealing with band-pass circuits, the authors emphasise that the shape of the response curve is quite as important as the band width. Simple tuned coupled filters tend to give considerable variations in the pass-band if the attenuation outside the band is to be adequate. A filter designed to overcome this difficulty is outlined in Fig. 7. Here rejection circuits are included to produce dips, usually located at 9 kc/s from the mid-frequency, and thus to suppress heterodyne whistles as well as increasing the sharpness of the cut-off.

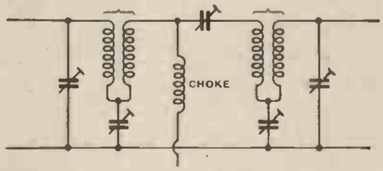
Unfortunately, in circuits of this type high attenuation at the dip frequency is obtained at the expense of performance outside these frequencies, and better results are obtained by a combination of the filter with an over-coupled band-pass transformer. A practical circuit of this type which is easy to adjust is shown in Fig. 8. The choke does not enter into the filter circuit, but is necessary to supply HT voltage to the anode of the preceding valve.

The authors are of opinion that "design technique is ahead of present-day requirements when the limitations imposed by the transmission of unnecessary harmonic side-bands is considered. As an experimental check on this statement four receivers were constructed with the following features:—

(a) Homodyne.
(b) Four tuned RF stages.
(c) Superheterodyne with aperiodic RF input and an IF of 1,600 kc/s (single span), incorporating a special frequency changer to reduce non-linear effects to a minimum.
(d) Superheterodyne with highly selective RF and IF stages.

"Comparative tests showed that the major cause of interference was sideband splash, which masked receiver non-linear effects and resulted in approximately similar performance from all receivers, which had approximately the same audio response range. The only noticeable difference was that the quality of the homodyne receiver was superior to that of the others, whilst the tuned RF receiver had a low noise-level.

"Interference protection must therefore be considered as a characteristic of the whole communication network, involving transmitter as well as receiver selectivity, and such factors as wavelength allocation. A solution to the problem requires international agreement on transmitter sideband restriction and wavelength allocation."



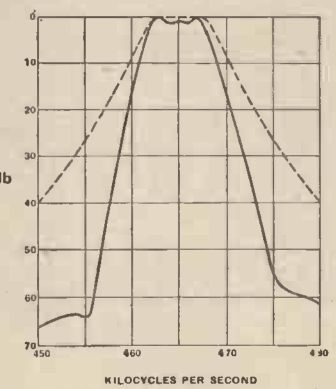


Fig. 8.—Modification of the circuit of Fig. 7 with (full line) response characteristic compared with two ordinary transformer-coupled IF stages (dotted line).

Taylor Model 81A Universal Meter

THIS instrument fully justifies its name, for in addition to direct measurements of voltage current and resistance it may be used for capacity and inductance in conjunction with a separate adaptor (Model 311), and will also show changes of AC volts in terms of decibels.

The basis is a 0 to 250 micro-amp meter with a rectifier for AC measurements, an internal battery for resistance and a series of shunts and multipliers selected by rotary switches, giving over 50 ranges.

Six concentric scales are marked on the meter dial, the outer one (resistance) being 3½in. long, and the inner (decibels), 1½in. The shortness of the lower scales is to some extent offset by the fineness of the pointer.

We checked the instrument against laboratory sub-standard meters and found agreement within the reading error at full deflection and scale errors not greater than 3 per cent. at intermediate points. To compensate for the rectifier characteristics at low inputs, a separate calibration is provided for AC volts from 0 to 2.5. This range was found to be accurate within the reading error over its whole length. The meter movement had a perfectly dead beat action with no overswing.

Readings of standard resistance values agreed to within 5 per cent. or less after allowance had been made for the resistance of the external leads.

All the range selector switches worked positively and did not cause any variation of reading when moved slightly to test their contact resistance. The makers have wisely excluded the 10 amp range from the switching and provided separate input plugs for this range. Shrouded plugs are also available for the 1,000 volt range.

The instrument is provided with three test leads, two with crocodile clips and one with an insulated test prod. A press-button switch is used for meter protection. This may be depressed permanently by rotating through a right angle.

The workmanship is of a high standard throughout, and the polished bakelite case is provided with a carrying strap and rubber feet on two sides. The price is £13 13s., and the makers are Taylor Electrical Instruments, Ltd., 419/422 Montrose Avenue, Slough, Bucks.

A more sensitive instrument (Model 81c) with many additional ranges is available at £18-18s.

Wireless in the R.A.O.C.

Testing and Repairing Equipment: The Training of Personnel

By MAJOR W. T. COCKING,
A.M.I.E.E., O.M.E. (Wireless), R.A.O.C.

Practical work in a wireless mechanics' training school.

The maintenance of communications is a vital necessity in modern warfare, and in the case of the Army it is the Royal Army Ordnance Corps which is responsible for all major repairs to wireless equipment. In this article the wireless work of the R.A.O.C. is described both in its main function of effecting repairs and in its secondary activity of training the necessary personnel.

THE Royal Army Ordnance Corps is associated in the minds of most people with guns and ammunition, and there are many who do not realise that these essentials of modern warfare form but a part of its activities. To-day the word "ordnance" really means munitions of war, and as these now include almost anything, so the scope of the R.A.O.C. is indeed wide.

The Corps is concerned with the supply and maintenance of equipment of all kinds, and is divided into two sections; there is the stores side, concerned with the supply of everything from a tank to a gas mask, and there is the engineering side, which looks after repairs and maintenance. On both sides wireless is of considerable importance, partly because it is so widely used in the modern army and partly because it demands specialist personnel. On the one hand the R.A.O.C. supplies wireless equipment of all kinds to those units, such as the Royal Corps of Signals, which operate it in the field, and on the other hand it carries out the more serious of the repairs which are inevitably necessary from time to time.

It should be understood that in addition to purely wireless apparatus, allied equipment is dealt with by the same departments. Thus, a wireless repair workshop does not confine itself only to wireless sets, but handles field telephones and other equipment of similar nature.

For obvious reasons little can be said about the equipment, and it is sufficient to point out that the wireless apparatus includes transmitters and receivers ranging from the older well-tried designs to the complex systems evolved by modern technique.

Skilled personnel is clearly necessary for the repair and overhaul of such apparatus, and the main work is done in permanent workshops, which are well equipped with testing apparatus. The standard of workmanship demanded for repairs and the precision required in making the various adjustments are far higher than are commonly met with in broadcast practice. One result of this is that the test equipment provided is more like that found in a design laboratory than that usually adopted in a servicing department.

Every piece of wireless and telephone apparatus has a rigid performance specification, and after repair each piece of gear is tested to make sure that it is within the specified limits. The result is that repaired apparatus is as good as new.

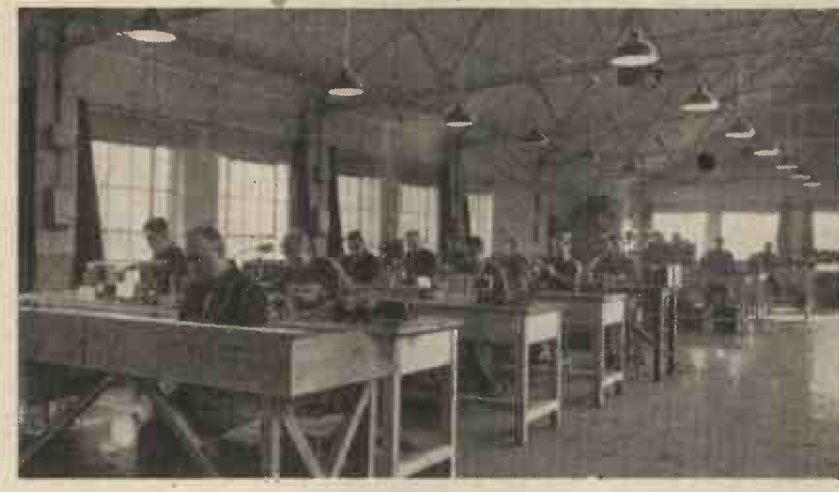
An Ordnance Wireless Workshop, such as the one shown in the photographs which accompany this article, consists of a modern steamheated building, the central body of which is equipped as a repair workshop. Here it is that the actual mechanical part of the repairs is carried out and that the lathes, drilling machines, engraving machines, etc., are fitted. Around the central workshop are grouped test rooms, painting and brazing rooms, cloakrooms, offices, and the store. In this last are held spare parts for the repair of sets.

The test rooms are each individually screened. A single screen is not considered sufficient and the screening built into the walls, floor and roof is supplemented by a screening cage inside the room itself. A set is thus tested inside a double screen which effectively removes any outside interference. Between sets in adjoining rooms there are no fewer than four layers of screening, since each is within a double screen. The result is that transmitters and receivers can be tested in adjoining rooms without any trace of interference. Components, audio-frequency amplifiers and telephones do not need such elaborate screening, of course. The testing of such apparatus is consequently done with only single screens and sometimes without any screening.

The apparatus installed in a test room naturally depends upon the particular use to which that room is put, but in a typical case it consists of a standard signal generator, output meter, dummy aerials, a "wobbly" oscillator and cathode-ray oscilloscope

Wireless in the R.A.O.C.—
for ganging, a beat-frequency audio oscillator, and a crystal calibrator or wavemeter.

On arrival in the workshop for repair a wireless set is first given a visual inspection to ascertain its mechanical condition. The controls are all tried and any mechanical defects are first put right.



In a wireless repair workshop. This is where the mechanical part of repairing wireless apparatus is done ; the shop is well equipped for such work, and is well lighted, warm and airy.

When in mechanically good condition the set is passed to a test room, where it is checked for electrical faults and adjusted. It then passes to the "Out Inspector," who checks it to ensure that its performance is up to standard. The set is tested on "Receive" for sensitivity, selectivity, image interference (in the case of superheterodynes), frequency calibration, A.V.C., etc., and on "Send" for output, modulation, frequency calibration again and so on.

The limits are quite close and no set can get through the tests unless it is in really first-class condition. With such precision methods the chance of a fault escaping detection is negligible and it is frequently possible to catch a defect in the process of development. In its early stages, for instance, a fault may cause no symptoms beyond a small reduction in sensitivity, which would not be noticeable in normal operation, or even with the usual somewhat rough and ready tests used in broadcast set repair.

When such an effect is noted during the Army test procedure, however, its cause is sought and remedied. In this way many major breakdowns in operation have undoubtedly been prevented.

A high standard of accuracy of calibration is necessary for Army sets, and the workshop must thus have means of measuring frequency accurately. Following the usual practice, sets and wavemeters are calibrated from shop standards, which are frequently checked by a primary standard having an accuracy rather better than 1 part in 10^5.

All work is not done in a fixed workshop such as has been described, and mobile workshops are also employed. A mobile workshop consists of a lorry fitted out in a manner very similar to that of a test room. The lorry is completely screened and just as fully equipped as one of the test rooms of a main workshop. Similar types of test apparatus are fitted and a high standard of accuracy in measurement is obtained.

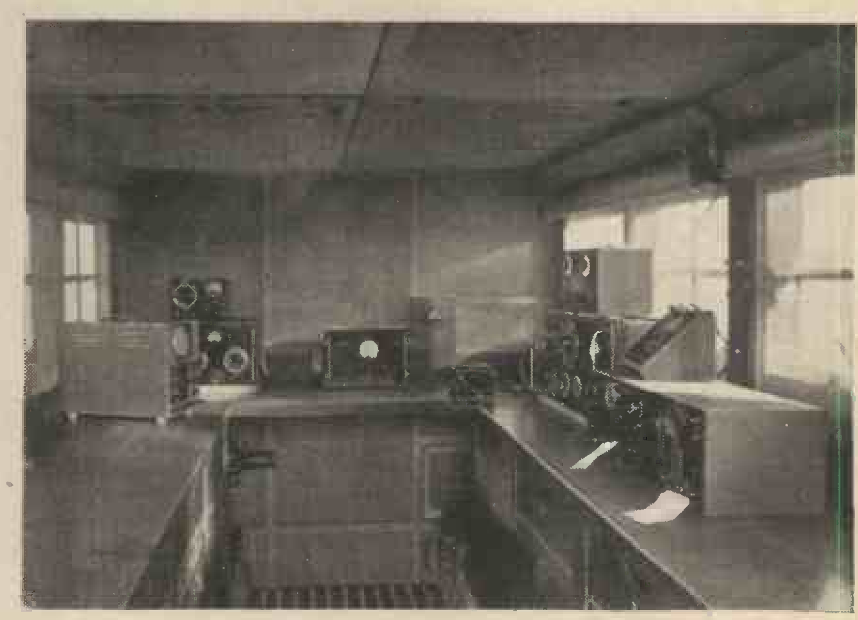
Travelling Workshops

The lorry is equipped for minor mechanical repairs and carries a stock of spare parts, so that if necessary quite a lot can be done in the way of repairs. It is usually more economical of time and labour for repairs to be done at a main workshop, however, and the mobile test room is used largely to determine the condition of sets in the hands of units.

The test apparatus carried is largely AC operated, and wherever possible the lorry is connected to an AC supply. Everything can be worked from batteries, however, and the lorry can function as an independent unit far away from any supply mains.

All this test equipment would be of no use without the right men to operate it. In the main workshops both civilians and military are employed and in wartime the latter usually predominate. The workshop is in charge of an officer who is a wireless specialist. Under him come Warrant Officers and N.C.O.s, who are usually Armament Artificers (Wireless), tradesmen and, if there are civilians employed, a civilian foreman.

R.A.O.C. personnel are grouped



A mobile test room mounted on a six-wheel lorry chassis. Some of the test apparatus with which it is equipped can be seen on the benches. Lockers and drawers under the benches contain other apparatus, tools and spare parts.

Wireless in the R.A.O.C.—
according to their trade, and it is usual to have a number of storemen and clerks, who usually range from privates to a corporal or a sergeant, while those employed on wireless repairs are wireless mechanics.

There are three grades of wireless mechanic and the rank is usually that of private, although corporals and sergeants are to be found, and lance-corporals are not uncommon. Men are graded by means of a trade test and receive tradesmen's rates of pay according to their grading.

The lowest grade, Class III, is normally employed on bench work in carrying out the mechanical repairs to apparatus. The next grade, Class II, is often similarly employed, but normally on work demanding a higher standard of skill. This grade may also be used on fault-finding and set testing, if particularly able.

The highest grade, Class I, usually does only the most-skilled bench work and is generally occupied with set testing. In most cases, however, set testing and fault-finding are carried out by Staff Sergeants, who are Armament Artificers specialising in wireless. The Warrant Officer, who is also an Armament Artificer (Wireless), may be a Sergeant-Major (Class I) or a Quartermaster-Sergeant (Class II). In the normal course of events his duties are as much administrative as technical and he will probably only carry out any work on a wireless set himself when any special difficulty crops up. He will, for instance, investigate a fault which has eluded his subordinates.

General view in a training school. In this part of the building students work with apparatus, handling testing and measuring instruments as well as wireless sets.

Officers' Duties

The officer in charge of the workshop is a wireless specialist and is frequently an Ordnance Mechanical Engineer (O.M.E., for short), 4th Class, with rank of lieutenant. In some cases he is an O.M.E. 3rd Class or even 2nd Class, with rank of Captain or Major respectively.

His duties include the administration of the workshop, making arrangements with other units for the repair and inspection of their equipment, giving advice and assistance on technical matters to any who need it, the investigation and report of defects which could be remedied by a change of design, and so on. In addition, he is the final court of appeal to his subordinates in any technical difficulty and must always be prepared to undertake fault-finding and set testing himself.

For all ranks the work is of an interesting kind and is performed under good conditions. Workshops are necessarily dry and warm, but even in mobile test lorries steps are taken to alleviate the worst of the vagaries of the climate.

In addition to the repair and maintenance of wireless and telephone equipment, the R.A.O.C. carries on the training of wireless personnel. Training, indeed, forms an exceedingly important branch of its activities.

Anyone with an adequate knowledge of wireless, or who is considered to be able to acquire an adequate knowledge after training, can join the R.A.O.C. After the usual preliminary military training, he is given a trade test to determine the extent of his wireless knowledge. If he does sufficiently well in this test he is, after a short course on Army apparatus, classified Wireless Mechanic, Class III or Class II, according to his ability, and he receives the appropriate higher rate of pay.

Should he fail in the test, but show sufficient knowledge to make it likely that he would reach the standard of Wireless Mechanic Class III after training, he will be listed as a Wireless Mechanic (unclassified). He will then go on a course of instruction lasting some five months. After this he will be trade tested again and he should now qualify at Class III standard. He will then be posted to a workshop or other unit, where he will be employed at his trade.

After he has gained experience and acquired new knowledge in the course of his work he can be again trade tested and graded Class II if his ability justifies it. Theoretically, after gaining still more experience he can reach Class I standard, but in wartime he is liable to miss this rung of the ladder and go straight on to the next step.

Any man who at any time passes his trade test as Class II or Class I can be recommended by his commanding officer for Armament Artificer (Wireless). He may be a new recruit fresh from his initial military training or he may be an old-stager. That makes no difference; all that is necessary is that he should have the proper qualifications.

The technical requirement is more than a mere pass in the trade test for Wireless Mechanic Class II; he should have a knowledge of wireless theory of the order of that necessary for Class I, but he need not have the experience of Army equipment which is demanded for this grade. In addition to the technical knowledge, he must have the character and personality necessary for the rank of Staff Sergeant. When qualified he will have charge of other men and, in emergency, may have to control a workshop. His job is thus a responsible one, and technical qualifications alone do not fit a man for it.

Prospects of Promotion

On being recommended for an Armament Artificer (Wireless) a man goes on a special technical course lasting about three months. At the end there is an examination. If he passes this and his conduct has been such as to confirm the earlier recommendation he becomes a Staff Sergeant with effect from the date of his entry on the

Wireless in the R.A.O.C.—
course. He is then posted to a workshop or other unit for duty.

Should he fail to reach Armament Artificer standard he remains a Wireless Mechanic, but although he may be promoted to corporal or sergeant, promotion to higher rank in wartime is not very likely until he has taken the Armament Artificer's course again and passed the final examination.

At the present time there is ample scope for the right type of man in the R.A.O.C., and no one with the necessary qualifications or the ability to learn can complain of lack of opportunity. If a man enters the Army with the technical knowledge needed to take the Armament Artificer's course, he can be a Staff Sergeant within about five months.

Promotion to higher rank is necessarily slower and depends largely upon ability and experience, but the opportunity is there. There is, too, always the possibility of promotion to commissioned rank. Suitable men or N.C.O.s are picked out and sent to an Officer Cadet Training Unit and afterwards commissioned.

Qualifications for Commissions

Suitable men are still needed as officers and can be enlisted straight from civil life. The technical requirements are a thorough knowledge of wireless theory and practice, and an applicant should have had some recognised training or apprenticeship. If he possesses a degree or its equivalent he is normally commissioned as a Lieutenant O.M.E., 4th Class, but otherwise as a 2nd Lieutenant.

After passing through an O.C.T.U. he is commissioned and then goes on a five months' technical course on which his wireless theory is brushed up and he becomes familiar with the Army wireless and telephone equipment. There are various examinations during the course and if he passes these successfully he is posted for duty as an O.M.E. (Wireless).

For all ranks both training and subsequent work are of an interesting nature and appeal particularly to those who have been engaged on wireless work in their civilian life. Not only is it in the national interest that all wireless men entering the Army should be engaged on technical work, for they require less training than the non-technical, but it is in their own interests. For the duration of the war they will still be engaged at their normal work, even if under somewhat different conditions, with the result that when peace comes again they will be in an ideal position for the resumption of their civilian activities. They will be technically up-to-date and the possessors of a large amount of practical experience. Many who return to their old jobs will be far more efficient than they were before the war!

In conclusion, a few words about technical training methods may be of interest. The Wireless Mechanic starts his training with a 16 weeks' course at one of the technical training centres. During this time he is taught how to use and look after tools—a part of the course which includes filing, drilling, tapping and soldering—elementary wireless theory, and simple fault-finding. Throughout the course every effort is made to link theory with practice.

When he has successfully passed the examination at the end of this basic course, he goes to another training school for a period of some six weeks, where he is initiated into the mysteries of Army equipment. Here he sees and handles the Army wireless sets and telephones and becomes familiar with their construction. A final test follows the course, and he is ready for duty as a Wireless Mechanic.

The training of Armament Artificers and O.M.E.s is carried out at the Military College of Science. Both have courses of a similar nature, but the one for the O.M.E.s is the longer of the two. On this course wireless theory is just dealt with, but the instruction is not so much designed to teach theory in the first place as to brush up what has been previously learnt. It is assumed that the O.M.E. has a good knowledge of theory to start with and this part of the course is in the nature of recapitulation.

After this preliminary run through wireless theory, the O.M.E. goes on to Army equipment. The training here is naturally of a much more advanced nature than is necessary in the case of a Wireless Mechanic. Not only is the construction of a set dealt with, but all features of its design and operation are thoroughly treated. At the end of the course the O.M.E. should be thoroughly familiar with all sets and telephones and know exactly how any part of them functions.

This photograph shows a lecture in one of the classrooms of a training school. As can be seen from the blackboards, the subject of the lecture is modulation depth.

A Comprehensive Summary

As may be expected in the present circumstances the Abstracts and References section of our sister journal, *The Wireless Engineer*, is not as large as in pre-war days. It is, however, a very comprehensive summary of the articles on wireless and allied subjects recently published in the world's technical journals, which include those in enemy as well as allied and neutral countries.

In the February issue, which has been on sale since the first of the month, the section contains abstracts from and references to some 350 articles. Abstracts from those journals which are not readily obtainable are given at considerable length. Copies 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.

Propagation of Short Waves

II.—Choosing the Best Wavelength

By D. W. HEIGHTMAN

In Part 1 the author gave a simplified explanation of how short waves travel over great distances; he now concludes by showing how the listener's choice of the best wavelength is dependent on such factors as season, time, and direction and distance of the transmitter

IN considering reception from (or transmission to) any part of the world we have to bear in mind the fact that the signal travels in a straight line, in the horizontal plane, between the transmitter and the receiver, i.e., over the "great circle" distance. Unless one has previously studied the matter it is often found that one has quite wrong ideas as to the true directions of many of the more distant parts of the world. It comes as a surprise, for instance, to many people to learn that the true direction of New Zealand from this country is north-east. Fig. 1 gives approximately the correct directions and distances from London of some of the well-known broadcasting centres in various parts of the world. A globe or great circle map such as that published by *The Wireless World* are useful to have by one for reference in this connection.

Certain of the more distant countries such as New Zealand and Australia can be communicated with both ways round the world. In the case of these two countries signals may come in from north-easterly directions or from south-westerly directions. The direction adopted depends on the most suitable distribution of daylight over the signal path at the desired time of communication. This matter, of course, becomes important when directional aerials are used.

Reverting to the main topic, from Part I it was seen that, in short-wave reception or transmission, we have to arrange the frequency and aerial directivity to suit (a) existing conditions in the ionosphere and (b) the distance and direction over which it is desired to communicate. Because (a) varies from hour to hour, particularly from day to night, with the season of the year, with the sunspot cycle of eleven years and occasionally due to the irregular nature of the sun's radiation, it is not possible to formulate exact rules to suit all communication requirements. Nevertheless, it is now possible to forecast, with reasonable accuracy, optimum frequencies for any particular distance, direction and time, assuming that no ionosphere disturbance takes place and that average conditions prevail.

The accompanying table represents an attempt to provide data in fairly convenient form on the optimum frequencies for use in this country at various times and seasons. The optimum frequencies represent values about 15 per cent. less than the maximum usable frequency.

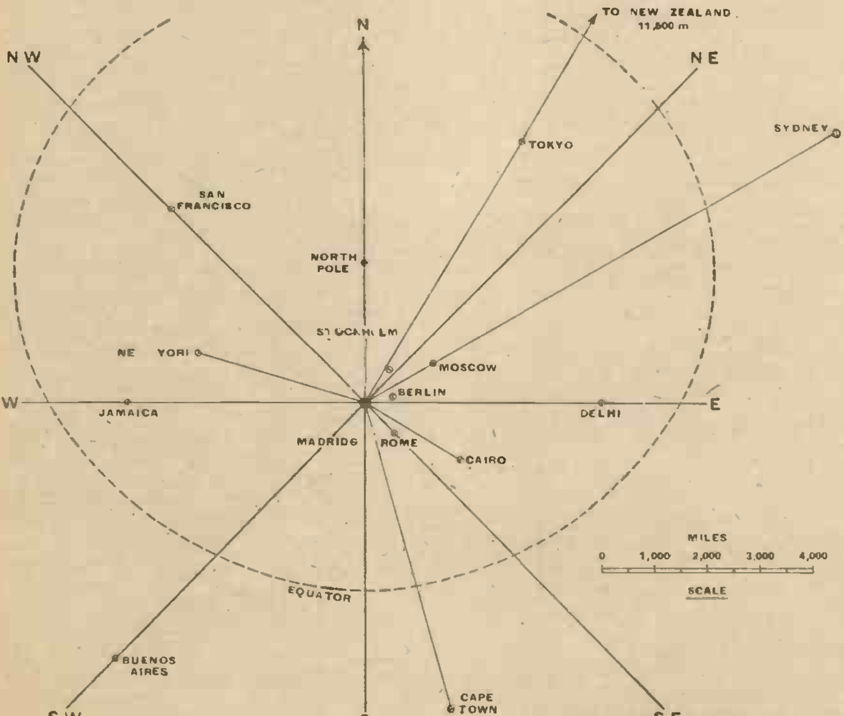


Fig. 1.—Diagram showing approximately the true direction and distance from London of some of the world's broadcasting centres.

Sunlight and Darkness

For long-distance reception in this country there are three main directions to be considered independently, i.e., easterly, particularly between east and north-east; southerly, which includes all directions south of east or west and westerly, particularly between west and north-west. These divisions are necessary because of the different distribution of sunlight or darkness over the different signal paths. Southerly directions present more reliable conditions due to the more even distribution of sunlight north-south than east-west (also due to the fact that the signal paths are far removed from the earth's polar regions).

Propagation of Short Waves—

Over easterly or westerly paths part of the signal route may be in sunlight and the remainder in darkness, so that at one end of the route we may have a high optimum frequency and at the other a low frequency. To cover the whole route a frequency between these two extremes has to be used. Under some conditions no communication over such a route is possible because the low frequency signal necessary at one end is rapidly attenuated on reaching the daylight end of the circuit.

The seasonal variation in ionosphere conditions is allowed for in the table by the division of the year into winter, equinoxial and summer months. The figures given represent average values for this year (1941), which is a little more than half-way between sunspot maximum and sunspot minimum years. At the sunspot minimum, expected to occur about 1943, the optimum frequencies will be about 85 per cent. of the values given, while at the next sunspot maximum, due about 1947-8, the optimum frequencies will be approximately half as much again as the values given. For example, in the winter afternoons of 1947 we can expect the optimum frequency over distances of 3,000 miles or so to the westward (U.S.A., etc.) to be about 30 Mc/s instead of 20 Mc/s, as at present, while, in the next year or two, this value will probably drop to about 17 Mc/s. Intermediate years will, of course, give intermediate values which will be fairly easy to arrive at, if we remember that sunspot maximum values are nearly twice those at the sunspot minimum and that the average sunspot cycle is eleven years.

Interpreting the Data

In using the table of optimum frequencies it can be assumed that the values given under "E" and "W" will be reasonably accurate for directions between east and north-east and west and north-west respectively. Directions between south-east and east and south-west and west will generally have values intermediate between those given for "S" and "E" and "S" and "W" respectively. The figures given under "S" will be reasonably accurate for directions between south-east and south-west, it being remembered that, while the SE direction will "open up" earlier in the day, the SW direction will continue "open" when, with the approach of night, the SE route has closed for the higher frequencies. Distances and times not given in the table will, of course, require interpolation of values intermediate between the two nearest values given.

Since the earth, at any particular time, is only affected by radiation from the central zone of the sun, there is a tendency for good, poor or disturbed conditions to re-occur at approximately 27-day intervals. This period is, of course, the time required for one rotation of the sun. The rule only holds good, however, if no alterations have taken place on the sun during its rotation.

Due to the fact that signals generally travel over several constantly varying paths in their passage through the ionosphere, considerable trouble is experienced with fading, the received signal being the result of the additive or neutralising effects of the several waves actually arriving at the receiving aerial. It has been found, for instance, that transatlantic signals arrive over three or four main paths at vertical angles of between 10 deg. and 30 deg. A wave travelling over a slightly shorter path will arrive at the receiving aerial a fraction of a second sooner than a wave which has followed a rather longer path. Hence the waves will be out of phase and interfere with one another. In the worst case, seldom met in practice, the waves will be of equal strength but opposite phase, thus cancelling each other so that no signal appears at the receiver input.

Overcoming Fading

Beyond using a well-designed AVC system and an aerial giving the best possible pick-up, there is little that the ordinary listener can do to combat fading. In elaborate systems, for commercial use, etc., there is available the diversity method where two or more aerials, spaced some distance apart (ten wavelengths or more) are used. The outputs of the two aerials are combined in a dual receiver, and, as a signal will seldom be zero at the two aerials at the same time, it is possible to maintain a more level output. In the complicated MUSA system used by the G.P.O. the aerials and receiver are arranged so that a very sharp vertical directivity is obtained. In this way reception can be concentrated on one main signal path, thus largely cutting out the other interfering waves arriving at different angles.

Time	Distance and Bearing														
	500 miles			1,000 miles			3,000 miles			5,000 miles			10,000 miles		
	E	S	W	E	S	W	E	S	W	E	S	W	E	S	W
Nov., Dec., Jan., Feb.															
07.00	8	7	4	12	11	5	14	14	6.5	15	15	7	—	—	11
10.00	13	13	10	17	18	12	20	21	10	16	22	9	—	—	14
14.00	12	12	12	14	18	17	16	21	20	12	22	16	16	—	—
18.00	6	7	8	7	10	12	10	14	16	9	16	16	12	—	—
22.00	4	5	5	5	8	7	6	10	10	7	12	11	9.5	—	—
Mar., Apr., Sept., Oct.															
06.00	11	9	7	14	11	8	16	13	10	16	14	10	—	—	12
10.00	13	14	10	16	18	12	18	22	12	18	22	12	17	—	12
14.00	12	15	10	16	18	16	18	22	18	15	23	16	14	—	—
18.00	10	12	13	12	16	16	13	20	18	12	17	17	11	—	—
22.00	6	9	8	9	11	10	10	12	12	10	12	13	—	—	14
May, June, July, Aug.															
06.00	11	10	8	14	12	9	16	13	12	17	13	12	—	—	12
10.00	12	12	11	16	16	14	17	18	16	16	16	14	—	—	14
14.00	12	12	12	16	16	16	16	18	17	16	19	17	14	—	14
18.00	12	12	12	14	16	16	15	19	17	13	17	17	12	—	—
22.00	7	9	9	10	11	12	12	14	14	14	14	15	12	—	—

Table of optimum frequencies for 1941, under average undisturbed conditions. The figures represent frequencies in megacycles and the columns E, S, W, east, south and west directions respectively. Times are all GMT. See text for full explanation of the table.

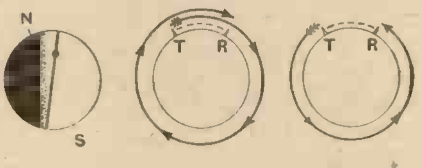
Propagation of Short Waves—

A form of fading, known as selective fading, also causes distortion of telephony signals. A modulated (telephony) carrier wave actually consists of the main carrier frequency plus extra side frequencies (side bands). (E.g., suppose a single pure 5,000-cycle note is being transmitted on a 15-Mc/s carrier; we shall then have radiated frequencies of 14,995, 15,000, and 15,005 kc/s.) These side bands can fade independently of the main carrier and also, since they are of slightly different frequency, travel over paths of slightly different length, resulting in their arrival at the receiver in a different phase relationship to the main carrier to that at which they left the transmitter, and in this way causing distortion. Little can be done to combat this form of fading, which may cause severe distortion

Echo Effects

While a signal generally reaches the receiver by the shortest route from the transmitter, it can, under certain conditions, also travel in the opposite direction round the world. As the round-the-world signal has a considerably longer distance to travel it arrives at the receiver a fraction of a second after the short-path signal, thus causing echo effects. The time delay for a signal which has travelled completely round the world is of the order of one-seventh of a second. Occasionally signals are observed which have travelled round the world two or more times. Suitable conditions for echo signals occur when the distribution of ionisation is fairly uniform over the whole round-the world path. These conditions are satisfied over different paths according to the time of day and season of the year. For instance, in the winter mornings a signal can leave this country in a north-easterly direction, travelling over northern Russia, where it is midday, Siberia, Japan, and thence to the South Pacific, where it is summer midnight, and returning over South America and the Atlantic, where dawn has already broken. Stations located in countries around this round-the-world path will all exhibit echo effects to a greater or less degree.

Over round-the-world paths such as this are avoided the extreme variations in optimum frequency, from complete darkness to broad daylight, obtained over east or west paths. During the winter in the northern hemisphere the South Pole is illuminated throughout the 24



(a) (b) (c)

Fig. 2.—Explaining the production of round-the-world echo signals. (a) Lighting conditions on a winter morning, showing echo path. The lighter shaded part represents twilight zone. (b) A forward round-the-world echo path and (c) a backward echo path. Actually the signals would not have a circular path as shown, but would travel round the world in several reflections between layer and earth. Dotted line represents direct signal between transmitter and receiver.

hours, so that, even though it be midnight in the southern hemisphere, a signal route passing fairly near to the South Pole will only have to pass through a twilight zone and no complete darkness. (See Fig. 2.) Similarly, in the northern summer the North Pole is illuminated throughout the 24 hours and in the early summer mornings the echo path then is to the north-west, via North America, and back via South Africa. Several other round-the-world echo paths exist for various times and seasons, but the above examples should serve to illustrate the requirements for such a route.

Only signals of optimum or higher than optimum frequency show marked echo effects. The lower frequency signals are reflected at shorter distances and attenuated before they complete the world circuit.

In addition to the more important forms of propagation we have considered here it will be found that frequently signals, especially from powerful transmitters, are receivable within the skip distance. These signals are due to a variety of causes, some known and others at present being investigated, but as they are generally unreliable and of low intensity they need not be considered in detail here.

The British Journal Photographic Almanac, 1941. The new edition of this well-known photographic annual contains a photogravure supplement and a number of articles of interest to the serious photographer, as well as a large amount of technical data and reviews of new photographic accessories. Published by Henry Greenwood and Co., Ltd., 24, Wellington Street, London, W.C. Price 2s. 6d.

Economies in Receiver Manufacture

By "SERVICE"

Conserving Supplies of Materials

BROADCAST receiver manufacturers are finding it more and more difficult to maintain the pre-war elaboration of their designs, and many changes are to be found in the sets which are now, or will shortly be, marketed.

Many readers of *The Wireless World*, especially those who are service engineers, use manufacturer's service manuals giving technical information concerning their receivers with circuit diagrams, valve current and voltage tables and lists of components. The data provided in these publications is generally very accurate, but future issues of these manuals dealing with wartime productions may have to be regarded more as guides rather than

Many economies in material have been skilfully introduced into the Murphy AD94, an AC/DC superhet which covers short- and medium-wave bands; long waves, at present, more or less redundant, are omitted.

authoritative sources of information as to what will be found in the receivers. If manufacturers cannot maintain their stocks of a certain part used in the receiver during the assembly of the instrument they will have to switch over to a suitable substitute, and even then supplies of the substitute may give out before full production has been completed, necessitating a further change.

Thus, for any particular component given in the spare parts list there may be three different types, any one of which may be found in the receiver under examination. Similarly, if a component part becomes faulty beyond repair, and a replacement has to be ordered, quite a different looking accessory may arrive from the manufacturer and the service engineer may have to use his initiative as to the best way of incorporating it in the receiver. Manufacturers will, naturally, try to keep their customers informed of such changes, and parts which are sent out as substitutes will probably be accompanied by special instructions stating how they can be used in place of the original part.

Sacrificing Appearance

Another aspect is the condition in which spare parts may be delivered. Manufacturers are having to conserve their material to the utmost, and with the reduced sales cost of production must be kept as low as possible. Many parts that are returned for replacement will have to be repaired, but it is quite likely that they will not acquire the finish and brand new appearance given to them in normal times. If the component is technically sound it must be accepted as being a standard replacement.

With regard to the influence of the war on the type of receiver which will be manufactured for the duration, cabinet work will be the most obvious evidence of the difficulties with which set makers are grappling. The lack of proper wood from which cabinets may be economically mass produced has forced a number of manufacturers to go over to bakelite cabinets for home markets. (Timber for cabinets of export receivers is available under Government permits to manufacturers.) This has made quite a change in their standard of reproduction due to the different acoustic properties of plastic material. This is accentuated by the very small loud speaker units which are being produced for reasons of economy. It is not that the quality is poor, but it is probably below the very high standard for which some of the larger manufacturers were renowned.

Shortage of timber will certainly affect radio-gramophone production as so much more is used in these large instruments than in table models. Where manufacturers are able to obtain a certain amount of timber it is quite likely that they will use it all on their radio-gramophones and employ bakelite for table receivers. Even so, the production of anything like normal quantities of radio-gramophones will be quite out of the question, and it is probable that a simple record player housed, perhaps, in a bakelite cabinet will be offered to those who desire to have record reproduction in the home.

Smaller Motors

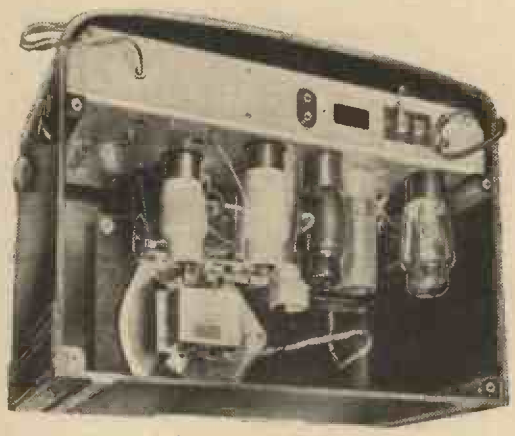
The subject of radio-gramophones brings up the question of motors. These components incorporate a fair amount of iron and copper and designers are searching for methods by which this can be reduced. They will undoubtedly bring out smaller types if at all possible, at least for radio-gramophones if not for automatic record player mechanisms which require a more power-

Economies in Receiver Manufacture—
ful driving unit. For straightforward turntable driving quite small, high-speed motors are effective, and with suitable gearing power units such as are used for tuning and wavechange motors in the more elaborate type of receiver may be found to have sufficient torque for driving the turntable at a constant speed.

Bakelite Chassis

Economy in metal will mostly be manifested in the design of the chassis itself, and a major saving is effected if a metal chassis can be dispensed with and a bakelite one substituted. The employment of a bakelite or wood framework as a foundation for the chassis is being seriously contemplated by some manufacturers.

A general trend towards the simplification of wartime receivers will help in this direction, because the circuits will be straightforward, with quite average sensitivity, and should allow of the very minimum of screening. With a carefully considered layout it is possible to dispense with screening for such items as IF transformers and provide merely a thin bent screen, chiefly to shield the transformer from adjacent wiring and components, instead of totally enclosing it, as is usual, in a screening can.



Another wartime receiver is the H.M.V. Model 911 in which many innovations have been daringly introduced. The inverted tray-like chassis, fixed to the bakelite cabinet by only two screws, simplified servicing and saves metal.

Resistance capacity coupling in the AF circuit will save another small transformer, while the use of metallised valves will do away with valve screening cans.

Tons of valuable aluminium have gone into the making of tubular electrolytic condensers in the past, and it is quite likely that this familiar component will be supplied only in cardboard containers in the future.

Some manufacturers are considering the production of a receiver which will remain their standard "line" for the duration of the war, in order that they may have as wide a market as possible with the minimum of design and layout expense. It will, most likely, take the form of an AC/DC receiver, which has a great advantage over an AC model where economy of metal is concerned, as it has no mains transformer. By employing a line cord for the mains voltage-dropping resistance the heat from this necessary component can be kept outside the cabinet, which can thus be of smaller dimensions. As to the smoothing circuits, the majority of mains supplies in this country are of good quality and do not need the high order of smoothing facilities incorporated in most receivers to give a low hum level. Smoothing circuits may be quite satisfactorily cut down by using smaller chokes (or loud-speaker field coils) and condensers, the argument being that the receiver is a wartime standard article which will give good results on standard mains under standard conditions of aerial and earth. Any particular set of adverse conditions must be dealt with individually, and extra smoothing incorporated at an appropriate charge.

As an example of wartime receiver production, one well-known manufacturer has brought out a model in which several of the above-mentioned economies have been effected. The new Murphy AD94 is the first receiver manufactured by Murphy's to have a bakelite cabinet, and its designers have, with great intrepidity, eliminated the long-wave range and confined the receiver to the reception of short and medium waves. There is not much of interest on the long-wave band in these times, and the saving in coils and switching is well worth while. Such items as the tone control and extra loud-speaker switches have been deleted, and there is no IF filter in the aerial circuit.

It is to be expected that other manufacturers will follow this lead, and service engineers will at least have some reason to be thankful for conditions which have produced a more simple receiver for them to get used to in these difficult times.

The Wireless Industry

TWO very informative instruction manuals have recently been issued by A. C. Cossor, Ltd., Highbury Grove, London, N.5. They deal with the Model 3389 AC impedance bridge and the Model 3339 double-beam oscillograph. In addition to operating instructions for the particular instruments concerned, there is much useful general information on measurement technique in a number of applications. The price of these manuals (one copy being supplied with the instrument free) is 1s. 6d. for the Model 3389 and 2s. 6d. for the Model 3339.

Varley Dry Accumulators, Ltd., By-Pass Road, Barking, Essex, have prepared a list of the principal portable receivers indicating the type of dry accumulator which is applicable in each case.

The Tin Research Institute, Fraser Road, Greenford, Middlesex, have prepared a comprehensive technical booklet (Publication No. 102) on "Hot Tinning," and the processes involved in the hot dipping of ferrous and non-ferrous articles. The scope of the work is wide and covers all classes of manufactured articles.

The new address of Stratton and Co., Ltd. (Eddystone), is Lapworth Court, Old Warwick Road, Lapworth, Warwickshire.

A treatise on flexible remote controls has been issued by The S.S. White Co., of Great Britain, Ltd., St. Pancras Way, Camden Town, London, N.W.1. Manufacturers of special receivers will find all the technical information on the mechanical properties and application procedure which may be required in adapting controls of this type to their needs.

Cossor Model 74 — A Correction

Will readers kindly note that the Cossor Model 74 reviewed in our last issue was incorrectly described in the title as Model 74A.

Test Report

Bush Model PB73

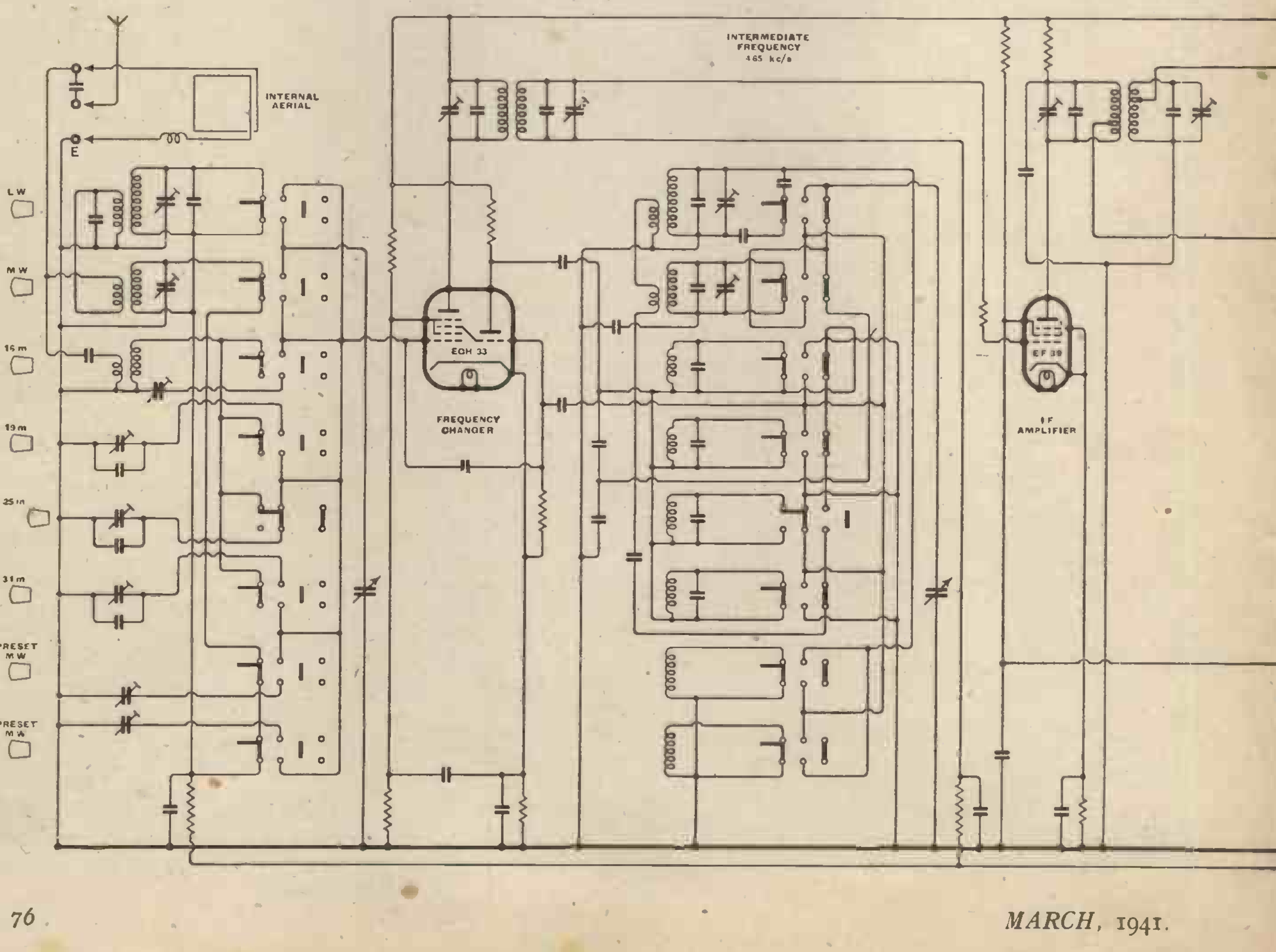
AC Superhet with Bandspread Tuning on Short Waves (Four Valves + Rectifier).

THE last Bush receiver to be reviewed in this journal was the PB63 (February, 1940 issue), in which permeability-tuned push-button circuits were provided for six stations—two on long and four on medium wavelengths. Since that time the public interest in long waves and, to a certain extent in medium waves, has diminished, and the demand is for a set which will give, in addition to the Home and Forces programmes, a good performance on short waves with the maximum possible ease of handling.

The PB73 fits neatly into this scheme of things. Two push-buttons are retained for pre-setting to any station lying between 325 and 550 metres on the medium-wave band, and four are used to select the short-wave broadcast bands on which the most interesting transmissions are to be found.

Each of these bands is expanded to the full depth of the tuning scale, and there is ample room for the calibration and naming of individual stations on adjacent channels. Continuous tuning is retained over the medium- and long-wave ranges, and the remaining two push-buttons are used to switch-in these bands.

Circuit.—A single-tuned circuit precedes the frequency changer. On medium and long waves it is tuned by the main gang condenser, but on



short waves it is pre-set by trimming capacities to the mid-point of each band, the aerial damping being sufficient to ensure wide-enough coverage. The aerial section of the push-button switch also includes contacts for the separate scale lamps used on each waverange, but these have been omitted to simplify the circuit.

A frame aerial consisting of a few turns in series with a small RF choke is mounted horizontally on the underside of the roof of the cabinet. It terminates in plugs which fit into the normal aerial and earth sockets.

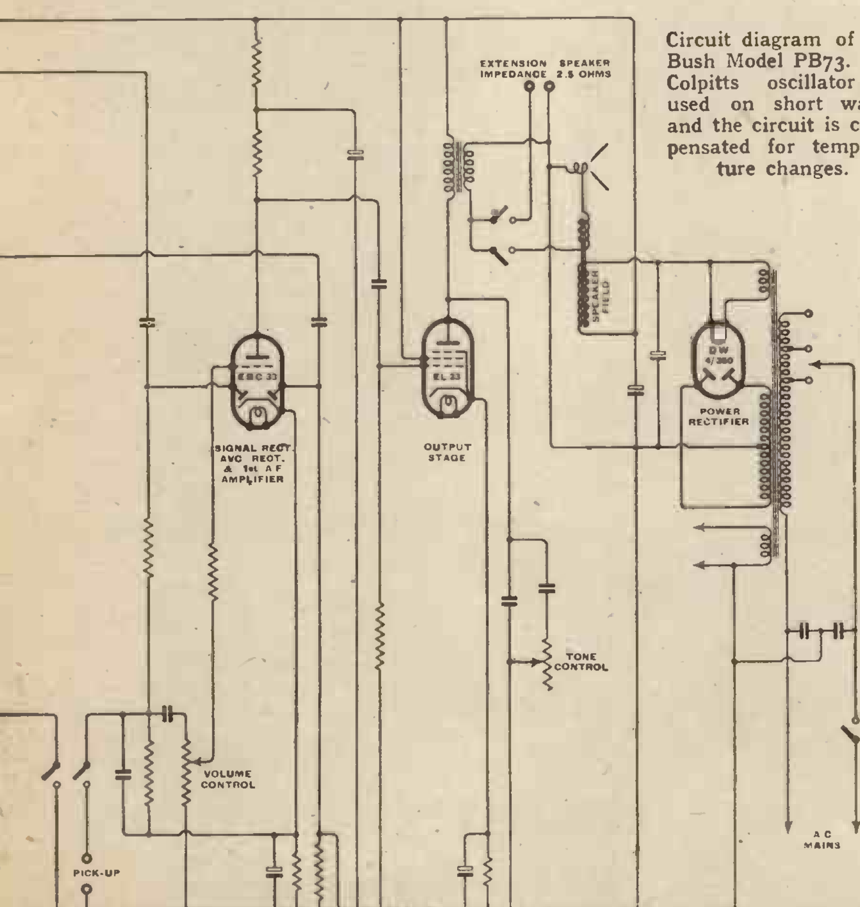
The frequency changer is a triode hexode, and on medium and long waves the oscillator section makes use of a parallel-fed reaction circuit. When the medium-wave pre-set station buttons are depressed, the tuning condenser is disconnected and the circuit is tuned by switching an inductance in parallel with the main oscillator coil.

On short waves the oscillator is changed over to the Colpitts type of circuit, and the series capacities are given values suited to the requirements of band spreading. One of the padding condensers has a negative temperature coefficient to compensate for frequency drift during the warming-up period.

The intermediate amplifier makes use of iron-cored coupling transformers, but the adjustment is by means of small trimmers in parallel with the main silvered-mica tuning condensers. Both primary and secondary circuits in the output transformer are tapped down for the AVC and signal diode circuits.

AVC is delayed and is applied to the frequency changer, and IF stage on medium and long waves, but only on the IF on the short-wave bands.

Resistance coupling follows the triode section of the detector stage, and tone control is applied in the anode circuit of the pentode output valve. A centre-tapped capacity filter is connected across the mains input to the set.



Circuit diagram of the Bush Model PB73. A Colpitts oscillator is used on short waves and the circuit is compensated for temperature changes.

WAVERANGES

16-metre	.. *16.45*	-	*17.2 metres*
19-metre	.. *19.15*	-	*20.1 metres*
25-metre	.. *24.85*	-	*25.8 metres*
31-metre	.. *30.25*	-	*31.85 metres*
Medium	.. *198*	-	*565 metres*
Long	.. *850*	-	*2,000 metres*

Price, £16 11s. 9d.
(Including Purchase Tax)

Performance. —The sensitivity on all four short-wave bands is amply sufficient to make the most of any signal above the prevailing noise level, and American stations can be received with ease. Thanks to the bandspread circuits, the tuning is as free from effort as it is on the medium waveband, and the accuracy of station calibrations is sufficiently close to eliminate any ambiguity as to the identity of adjacent stations.

Reception on the medium- and long-wave ranges is unusually clear and free from self-generated whistles. The background noise between stations is low, and there is no trace of mains-borne interference. Selectivity is everything that is should be, and there can be no doubt that the radio performance in general is sufficiently advanced to meet not only immediate conditions but those which may be expected to prevail immediately after the war.

The quality of reproduction is good, and the normal setting of the tone control with maximum high-note response gives a good balance of tone at average volume levels. When the volume is tuned up to maximum, there appears to be some increase in the proportion of high frequencies, and the tone control can then be used with advantage to restore the balance.

Constructional Features.—The chassis is deep, and accommodates the gang condenser below the main deck, where it is kept free from dust. It is mounted on the right of the coil assembly, which can be removed as a single unit together with the push-button switch rack. The scale frame is of substantial construction, and the design is well thought out, from the point of view of even illumination over each scale.

Makers.—Bush Radio, Ltd., Power Road, Chiswick, London, W.4.

THE WORLD OF WIRELESS

THE RADIO INDUSTRY

R.M.A. Activities in 1940

THE busiest year in the history of the Radio Manufacturers' Association was reviewed at its annual general meeting held on January 24th, at which the chair was taken by Mr. M. M. Macqueen in the absence of the president, Lord Hirst. The report of the Executive Council, in which considerable space is devoted to reviewing the position regarding the supply of raw materials and export, reveals the importance of these two aspects of the Association's work in the present emergency. Mr. Macqueen recalled that the wireless industry was beaten by only a few days by the motor industry in approaching the Board of Trade on the question of the supply of raw materials.

Space will not permit more than a few extracts from the report, which ran into many thousands of words.

Export.—During the year 120,000 receivers were built for export. It is planned to produce approximately 230,000 receivers during 1941, and specifications are being prepared for a cheap two-valve local-station receiver to be marketed in India at a landed cost of £4.

Television and FM.—It having become clear that there was no prospect of the reinstatement of a public television service until after the war, the R.M.A. have during the year explored methods of continuing television research and development both by the Government and the industry, and have discussed with the B.B.C. the question of continuing television and frequency modulation research.

Imported Apparatus. — Following representations by the Association to the Board of Trade and the Treasury, importations of radio apparatus and parts have been prohibited except under a Board of Trade licence.

Substitute Materials.—When it was realised that aluminium would cease to be available for condenser vanes, it was proposed that sheet zinc be adopted, with brass as an alternative.

FM STATIONS

New System of Call Signs

THE U.S. Federal Communications Commission has adopted a system of call signs for frequency-modulated transmitters which indicate the frequency employed and the geographical position of the transmitter.

The first letter in the call will be K or W, indicating West or East respectively. This will be followed by a number between 42 and 50, which will indicate the second and third figures of the frequency in kilocycles. The first figure of the frequency is always four, as FM frequency allocations range from 42,000 to 50,000 kc/s, with 200 kc/s separation. The call ends with a letter or letters which denote the city in which the transmitter is located. To identify educational stations E will be used.

The reason for employing K and W to indicate West or East is that they are two of the three international prefix letters assigned to the U.S.A. The third is N, which is reserved for the U.S. Navy and coastguards.

EXPORT BATTERY RECEIVER

Modern tendencies in the design of British battery-fed receivers intended exclusively for the export market are exemplified in the Ultra Model 350, in which a 6-volt accumulator is the sole source of power. HT supply is obtained through a vibratory converter. Wavelength coverage is 13.5 to 150 metres, and 200 to 550 metres, spread over four ranges. The five valves (plus rectifier) employed are of the 6-volt indirectly-heated type.

PAN-AMERICAN NETWORK

C.B.S. Enterprise

A FUNDAMENTALLY new scheme in oversea broadcasting is announced by the Columbia Broadcasting System following a seven weeks' tour of investigation by Mr. William S. Paley, president, to determine what C.B.S. could do to further the U.S.A.'s "good neighbour policy" with Central and South America.

Having proved conclusively that the short-wave transmission of N. American programmes through Latin America was not sufficient, since most listeners in those countries tune to their local stations just as they do in the U.S., a C.B.S. Latin-American network was formed. This network, which will cover eighteen of the twenty South American Republics (Haiti and Honduras are not yet included), will consist of 39 medium- and 25 short-wave stations. The short-wave transmissions are intended to serve the interior.

This network will be made possible by the opening of two new 50-kW short-wave transmitters WCBX and WCRC. The transmissions, which will be radiated from an aerial system consisting of eight directional arrays, will be picked up on special receiving equipment at each group of stations and rebroadcast.

The Latin-American stations have agreed to rebroadcast the C.B.S. programmes for at least one hour a day. The arrangement is reciprocal and the C.B.S. has, therefore, undertaken to rebroadcast programmes originating in the Latin-American countries.

WHITHER AMATEUR RADIO?

"THIS war, like the last, is giving a tremendous stimulous to technical advances in radio communication," writes the editor of the official journal of the Canadian Operators' Association. He foresees an overwhelming rush into amateur radio after the war of men who have become proficient in radio communication while on active service.

The possibility that some commercial interests may seize the opportunity of claiming amateur frequencies for their "supposedly more valuable services" is stressed by the writer. "The most cogent argument in our favour," he says, "will be the record of services that we have been able to render through our training as radio amateurs. . . . Canadian amateurs will take the place that they should occupy in Empire and world communication, and the British Empire Radio Union will exist in fact as well as in name."

BRIT. I.R.E. AND I.W.T.

Plans for Combining Forces

FUSION between the Institute of Wireless Technology and the British Institution of Radio Engineers was, in principle, agreed upon at a joint meeting of the two societies held on January 18th. Certain technical and legal matters outstanding are to be settled by a Committee on which both bodies are represented, and it is expected that the fusion will be completed by March 31st.

According to a statement issued jointly, the objects of the two institutions being similar, fusion should strengthen the work of each body in fulfilling its purpose.

The offices of the combined body are at Duke Street House, Duke Street, London, W.1.

MURPHY SERVICE TRAINING PLAN

THE task of maintaining some nine and a half million domestic receivers with a trained personnel seriously depleted by the calls from the services is the tough proposition facing dealers' service departments in 1941.

Having tried with little success to conduct a short training course for juniors last year, and realising that in the present emergency the chief drawback to standard correspondence courses for servicemen is that they take many months to complete, Murphy Radio is negotiating to conduct, at a reasonable price, a condensed course concentrating on the essential theory required in practical servicing.

VALVE PROGRESS

MR. W. J. PICKEN, the new chairman of the I.E.E. Wireless Section, in his inaugural address, recorded the growth of the section from 529 members in 1930 to 1,133. His address was on the history of the development of the transmitting valve. The advantages of air cooling were stressed, and Mr. Picken said, "The highest power cooled-anode valves will soon be available for cooling either by means of water or by means of forced air." Remarking that the evolution of the transmitting valve is often influenced by that of the receiving valve, Mr. Picken said, it is to be hoped that it will not be forced to follow the receiving valve as it goes merrily along adding electrode to electrode.

RECONDITIONED RECEIVERS

Purchase Tax Position

A RECENT announcement by H.M. Customs and Excise defines the position of second-hand or reconditioned receivers. No tax is chargeable on such sets where transactions are between retailers and their customers. Where a retail branch of a registered firm of manufacturers "acquires a set from a customer, reconditions it to an extent not involving manufacture, and resells it retail," no liability for tax is involved.

Any chargeable parts or materials used in the reconditioning will normally have been taxed at an earlier stage.

NAZI WIRELESS TRICKS ?

A.R.R.L Warns U.S. Amateurs

THE following message, intercepted by a reader, has been passed on to us. It was received from W4PB on about 14.32 Mc/s on January 19th. "D" is, of course, the international prefix for German stations.

QST de W4PB=N1918; W4PBck76; official ARRL message; West Hartford, Conn.; January 13, 1941=To All Radio Amateurs=W2KYT advises that a phoney station on 7,090 kc/s signing K4KP is D4TKP stop he believes that HR1AT is also another D station stop separate advices indicate a 14-Mc/s station signing K4ARR to be D4ARR stop the League cautions all United States amateurs to be wary of calling or working any stations that may turn out to be in foreign lands because of certainty of FCC difficulty from any violations of order number 72.

WAR is the significant call sign of the United States War Department's Net Control Station. By recently exchanging messages with W1AW, the headquarters station of the American Radio Relay League, WAR inaugurated a schedule for contacts with amateurs on 4,025 and 13,320 kc/s at specific periods. It is hoped that the scheme will "foster closer relations between the Signal Corps and the radio amateur for mutual benefit."

NEWS FROM GREECE

NEWS of the war in Albania and the situation in the Balkans can be heard each evening in an English bulletin broadcast from Athens. It is radiated by the courtesy of Cable and Wireless from the company's transmitter on a frequency of 9.935 Mc/s (30.196 metres) beamed on Great Britain.

The transmission, which is from 8.40 to 9 p.m. B.S.T., opens with the Greek National Anthem, which is followed by the British National Anthem. The news begins at 8.45.

B.B.C. OVERSEA TRANSMISSIONS

FURTHER developments in the B.B.C. Oversea Service were introduced on February 16th, and the service will be still further extended early in March. There are now in effect six oversea services from this country operating for a total of 54¼ hours a day. In September, 1939, only nine foreign language transmissions were radiated by the B.B.C.; now 32 are used. The power of the transmitters, too, has been greatly increased.

The service is now split up as follows:—

1.—World Service in English, 21 hours daily, for evening reception in four areas: Pacific, Eastern, African and North American.

2. Second World Service, 2 hours daily. Broadcasts daily in Hindustani and Afrikaans, weekly in Burmese and Maltese, and occasionally other tongues, such as Malay. There are also regular broadcasts in English for Indian listeners.

3. Main European Service, 20 hours daily, carrying broadcasts in German, French, Italian, Dutch and Flemish and the languages of Central Europe.

4. Second European Service, 5 hours daily, for broadcasts to Spain and Portugal, the Scandinavian countries and the Balkans.

5. Latin-American Service, 4 hours daily, for broadcasts in Spanish and Portuguese to South America.

6. Near East Service, 2½ hours daily, for broadcasts in Arabic, Persian and Turkish.

FROM ALL QUARTERS

America's Receiver Output

AMERICAN radio manufacturers produced eleven million receivers during 1940, which was two millions more than in the preceding year. The Institute of Radio Engineers announces that 52 per cent. of the year's total were table models and 21 per cent. car radio receivers. An increase in the popularity of console radiograms, which account for 7 per cent., is noted. According to our U.S. contemporary, *Radio To-day*, there are one thousand and sixty-four radio manufacturers in the States.

A Unique Verification Card

A NEW ZEALAND correspondent of our contemporary, *The Australasian Radio World*, has received a novel verification from station KGIR on a sheet of copper. The station, which operates on 1340 kc/s but will soon change to 1370 kc/s, is situated in Butte, Montana, U.S.A., which is the centre of the largest copper mining district in the world. A minute copper buffalo was also received.

B.B.C. Short-wave News

BROADCASTS of News in English in the European and World Services of the B.B.C. take place at the times (B.S.T.) given below. In the majority of cases transmission is made on all the short-wave bands appropriate for the time of day, though a smaller number of channels is used for the European bulletins, the times of which are marked with an asterisk. 7.15 a.m., 9 a.m., 12 noon, 2 p.m., 2.30 p.m.*, 5 p.m., 7 p.m., 9.45 p.m., 11 p.m.*, 11.45 p.m., midnight*, 1 a.m., 2.45 a.m., 5.30 a.m.

Receivers for Friendly Germans

THE Home Secretary has decided that Germans and Austrians in this country who are regarded by the authorities as reliable, are now to be exempt from the restriction imposed some months ago prohibiting the possession of receivers by enemy aliens.

Jamming: Official Statement

IT was stated in the House of Commons that the jamming of the B.B.C. Forces programme on 373 metres is of Italian origin and is aimed at the B.B.C.'s transmissions in foreign languages, which are radiated on this wavelength at certain times during the evening. We do our best to counteract it by jamming enemy transmissions within such limits as our resources impose on us.

Obituary

WE regret to record the deaths of Dr. Miles Walker, F.R.S., and Mr. D. P. Dunne.

Dr. Walker, who from 1912 to 1932 was professor of electrical engineering at Manchester University, and later Professor Emeritus, died on January 22nd, after an operation, at the age of 73. Prior to accepting the chair at Manchester, he was for some years designer of alternating current machinery to the British Westinghouse Company, the predecessors of Metropolitan Vickers.

Mr. D. P. Dunne who died on January 31st, at the age of 65, was for a number of years managing director of the Chloride Electrical Storage Company. He joined the company as secretary in 1902.

R.S.G.B. Progress

IN spite of—or is it because of—the war, the Radio Society of Great Britain made remarkable progress during 1940. No fewer than 300 new members entered the Society. It is interesting to note that over 50 per cent. of the new members are in the Services.

Indian Made Receivers

A COMPANY with a capital of one million rupees has been floated in Bombay for the manufacture of receivers. With the exception of the valves, the receivers will be entirely Indian made. At first receivers with a range of only 75 to 100 miles, for local reception, will be produced.

90,000,000

ACCORDING to the figures obtained by the U.I.R., there were, at the end of 1939, nearly ninety million receivers in use throughout the world. To this total Europe and North America each contribute approximately 40,000,000.

Reactions

"CROWD emotions are rare in broadcasting, but individual reactions are often intense. A misspelling in a newspaper passes without comment, but a mispronunciation on the wireless is sometimes taken as a personal affront," said Mr. F. W. Ogilvie, director general of the B.B.C., at the Manchester Luncheon Club.

Higher and Higher

AMERICA'S tallest mast, 878ft. high, has been made taller by the addition of a four-element turnstile array for FM transmissions. The station, WSM, has been granted a 20-kW FM licence for an area covering 16,000 square miles.

American Servicemen for England?

THE suggestion has been put forward by a correspondent of *The Wireless and Electrical Trader* that American radio engineers might be invited to work in this country during the war to assist dealers who are finding it difficult to carry on as a result of the shortage of servicemen. Some of the obstacles pointed out by *The Trader* are: whether American engineers would be allowed to work in this country; their willingness to do so and whether dealers would be in a position to pay the comparatively high rates of pay commanded by American radio engineers in their own country.

Halcyon Days

MR. A. D. GAY (G6NF), in his presidential address before the Radio Society of Great Britain, referred to the halcyon days of amateur transmitting when wavelengths *descended* to 45 metres. "The process of calibration in those days was," he said, "to adjust one's transmitter and call test. If no reply was received that day, the same performance was repeated the next day, slightly changing the tuning, and so on until you effected contact with some other lonely soul who was striving to establish communication!" Mr. Gay has for the last ten years been calibration manager to the Society.

W/O Trainees for R.A.F.

BOYS having taken the course at civil wireless schools licensed by the G.P.O. and municipal technical colleges will in future be accepted, if suitable, by the Royal Air Force as wireless operators from the age of 17½. A reimbursement for tuition fees up to £25 can be claimed by the entrant.

"Wireless World" Bound Volumes

OUR publishers advise us that copies of Volume XLVI of *The Wireless World* are available bound complete at a cost of 23s., including postage. Copies of the index to the volume (November 1939, to December, 1940) are still obtainable at 7½d. each, post free, or with binding case for 3s. 10d., post free. Readers' copies will be bound for 8s. plus 9d. for return postage of the completed volume.

Cossor's Chairman

MR. T. A. MACAULEY chairman of A. C. Cossor, has tendered his resignation on account of the demands on his time by national work. He has nominated Sir Louis Sterling to succeed him. At the Board's request Mr. Macauley has consented to act as vice-chairman and chairman of the finance committee.

Royal Signals Comforts

WITH the expansion of the army the demands upon the Royal Signals Comforts Fund have greatly increased. The latest request is for over-mitts for despatch riders, which the organisers are in a position to have made by voluntary workers but have not the necessary materials. We have, therefore, been asked to appeal for old mackintoshes and pieces of thick woollen material and fur, which should be sent to 801, Hood House, Dolphin Square, London, S.W.1. It is gratifying to learn that 16,534 woollen garments were despatched to Signal Units from the inauguration of the fund in November, 1939, to December 1st, 1940.

R.C.A.

In his annual statement, Mr. David Sarnoff, president of the Radio Corporation of America, stated that in 1941 national defence will continue to be "the number one programme of the laboratories and manufacturing plants." He announced that a demonstration of large-screen television in a New York theatre would be undertaken early this year.

"Radio's Moving Day"

This is the title given to a little booklet issued by the R.C.A. to 100,000 servicemen and dealers to assist them in adjusting the push-button controls on 10,000,000 domestic receivers when 777 of America's 862 medium-wave stations change their frequencies on March 29th, in accordance with the North American Regional Broadcasting Agreement.

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.
WBOS (Millis)	9.570	31.35	11.45.
WCBX (Wayne) ..	9.650	31.09	9.55‡, Midt.‡.
WCBX	11.830	25.36	7.30‡.
WCBX	17.830	16.83	2.0, 3.0, 5.0†, 5.30‡
WGEO (Schenectady) .	9.530	31.48	8.30†, 10.55§‡, 11.25‡.
WGEA (Schenectady) .	15.330	19.57	1.0, 2.0‡, 6.0, 7.45.
WPIT (Pittsburgh) ..	15.210	19.72	6.0.
WRUL (Boston) ..	11.790	25.45	8.15§‡, 9.30 ‡.
WRUL	15.350	19.55	8.15§‡, 9.30 ‡.
Australia			
VLQ (Sydney)	9.615	31.20	8.0 a.m., 8.0.
VLQ5	9.680	30.99	1.30, 4.30, 7.15, 10.30.
VLQ2	11.870	25.27	12.45, 6.0, 7.15.
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			
XRVC (Chungking) ..	7.508	39.96	11.30 a.m., 12.10, 9.30, 10.30.
Finland			
OFD (Lahti)	6.120	49.02	12.15 a.m., 8.40 a.m., 7.15, 10.15.
OFD	9.500	31.58	12.15 a.m., 7.15, 10.15.
OFE	11.780	25.47	12.15 a.m., 8.40 a.m., 7.15, 10.15.
OIE	15.190	19.75	12.15 a.m., 7.15, 10.15.
Greece			
Athens	9.935	30.19	8.45.
India			
VUD3 (Delhi) ..	9.590	31.28	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			
JVW (Tokio)	7.257	41.34	9.0.
JZI	9.535	31.46	9.0.

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.
Portugal			
CSW7 (Lisbon) ..	9.740	30.80	8.30, 10.30
Rumania			
Bucharest	9.280	32.33	10.15.
Sweden			
SBO (Motala)	6.065	49.46	10.20.
Thailand			
HSP5 (Bangkok) ..	11.715	25.61	2.0.
HS6PJ	19.420	15.77	2.0 (Mon.).
Turkey			
TAP (Ankara)	9.465	31.70	7.15.
TAQ	15.195	19.74	12.15.
U.S.S.R.			
—— (Moscow) ..	7.545	39.76	10.30, 11.0.
RW96	9.520	31.51	7.30, 9.0, 10.30, 11.0.
RAL	9.600	31.25	1.0 a.m.
——	10.724	29.59	11.30.
——	11.499	26.09	12.0 noon.
——	11.710	25.62	10.30.
——	11.830	25.36	7.33 a.m., 7.30, 11.0.
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. The times of the transmission of news in English in the B.B.C. Short-wave Service are given on the opposite page.

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.).
Egypt			
Cairo	1,348	222.6	6.50, 10.10.
Ireland			
Radio-Eireann ..	565	531	6.45‡, 10.5†, 10.10‡.

Country : Station	kc/s	Metres	Daily Bulletins (B.S.T.)
Portugal			
Lisbon	629	476.9	8.30, 10.30.
Rumania			
Radio-Romania ..	160	1,875	10.15.
Bucharest	823	364.5	10.15.
U.S.S.R.			
Moscow 1	172	1,744	11.0.

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

Ganging with the Beat Oscillator

Substitute for a Signal Generator

By E. L. THOMAS, B.Sc., A.C.G.I.

It is shown that by combining part of the output of the frequency changer oscillator of a superheterodyne receiver with that of the beat oscillator, or a fixed intermediate frequency oscillator, it is possible to obtain a test signal which can be used instead of a signal generator to gang and track the radio frequency circuits of the receiver. This test signal possesses certain advantages over that from a signal generator, since it is always automatically in tune, and overcomes the effects of "pulling" at the frequency changer. A practical circuit is described which is suitable either for a portable unit to be used in place of a signal generator, or as part of the circuit of a communications receiver.

THE beat oscillator (BO) of a superheterodyne receiver consists essentially of a circuit which can be made to oscillate at approximately the intermediate frequency (IF) of the receiver. The output of this oscillator is electrically coupled to the detector circuits. If the receiver is accurately tuned to a steady unmodulated carrier, then the beat note which is heard in the phones or speaker has a frequency equal to the difference between the BO frequency and the IF. It is usual to provide a control to vary the BO frequency by a few kc/s on either side of the IF, so that when CW signals are being received the pitch of the note may be suitably adjusted.

In order to consider how the test signal may be obtained we will consider a superheterodyne receiver with

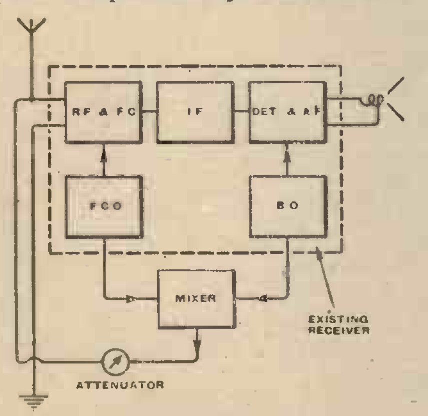


Fig. 1.—Block diagram showing the additions necessary to obtain a test signal from an existing receiver.

an IF denoted by f, and tuned to a signal having a frequency f_s. The frequency changer oscillator (FCO) of the receiver will normally be operating at a frequency f_o, where $f_o = f_s + f_i$. If now some of the FCO output is mixed with that of an oscillator working at IF, then the resultant will contain the following frequencies: f_o, f_i, $f_o + f_i$, and $f_o - f_i$. $f_o + f_i$ can be rewritten as $(f_s + f_i) + f_i$, or $f_s + 2f_i$, which is the second-channel frequency. $f_o - f_i$ can be rewritten as $(f_s + f_i) - f_i$, or f_s, which is the frequency to which the receiver is tuned. This means that, no matter to what frequency the receiver is tuned, it is always possible to obtain automatically a signal which is exactly in tune. If this signal can be controlled and applied to the receiver input, it can be used to gang and track the RF circuits in the same way as the output of a signal generator of conventional type. It is shown below that there are certain advantages to be obtained by using this self-generated test signal in preference to that from an external source, particularly at high frequencies. All that is needed, then, is an IF oscillator, which can be the BO of the receiver, a mixing device, and an attenuator.

Unwanted Frequencies

Of the four frequencies which appear in the output from the mixer, only the component of frequency f_s is actually required. If the other three components are allowed to pass through the receiver, overloading or a spurious reading of the output meter may be produced, and it will then be impossible to trim the receiver circuits accurately. The possible effects of these unwanted components are therefore considered in turn. (1) f_o: At low frequencies, where the percentage difference between f_o and f_s is large, this component will be considerably attenuated by the RF circuits of the receiver. At high frequencies, however, where the percentage difference is small, it may reach the FC valve at an appreciable level, but it appears in practice that it is unlikely to cause any trouble. (2) $f_s + 2f_i$: This component will be attenuated by the RF circuits in the same way as an external signal of second-channel frequency. (3) f_i: The IF component will also be attenuated by the RF circuits, but the attenuation will increase with the frequency to which the receiver is tuned. When this component reaches the IF circuits it will be amplified in the same way as a genuine signal, and if it is strong enough it may cause the IF valves to overload. This component can be used for lining up the IF circuits if necessary.

A receiver of the communications type is always provided with a BO for CW reception, and if this is set to zero beat it can be used as the IF oscillator. Fig. 1 shows in schematic form how the system can be applied

Ganging With the Beat Oscillator—

to such a receiver. The only additions to the original circuit are the mixer and the attenuator.

The mixer valve can be of any type which is normally used in the FC stage of a receiver, but the circuit must be arranged so that the proportion of wanted component at the anode of the valve is as high as possible. This condition is realised when the output from the IF oscillator or BO is fed on to the grid of the oscillator section, and the FC oscillator connected to what is normally the signal grid. The wanted output can be controlled by adjusting the input from the IF and FC oscillators, or by applying bias to the valve.

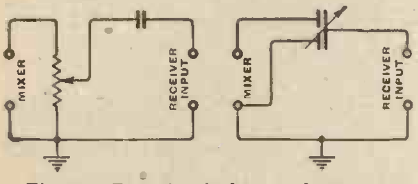


Fig. 2.—Two simple forms of attenuator which can be used to control the amount of test signal injected into the receiver.

A filter must be inserted between the mixer and the receiver input in order to attenuate the IF component. The filter need only be of simple form, and a single circuit tuned to the IF is usually sufficient.

The attenuator controls the amount of the test signal which is fed into the aerial circuits of the receiver. The ideal type would be a proper resistance attenuator, but for a limited range of control a variable resistor or a differential condenser is fairly satisfactory (see Fig. 2).

Need for Modulation

If the receiver is provided with a tuning indicator which operates from the detector or AVC circuits, then the test signal need not be modulated. If, however, the receiver is to be ganged with the aid of an audio output meter, then the test signal must be modulated at an audio frequency. The most convenient place to introduce this modulation is in the mixer.

This system can be applied to the alignment of a receiver in two ways —either as a small portable unit which can be used with any receiver, in the same way as a signal generator, or it can be incorporated as a part of the receiver BO. Suitable circuits will now be described.

Fig. 3 shows a practical circuit which is suitable for a portable unit. Excluding a power unit or batteries, all the components can be assembled in a box not larger than 6in. × 4in. × 4in. There are only three controls: the attenuator, a switch to select either RF or IF output, and a modulation on-off switch.

A triode heptode is used as a combined mixer and IF oscillator, the triode section acting as a tuned grid oscillator in conjunction with the circuit L1C1. The signal grid of the valve is connected through a small blocking condenser to a flexible lead, which in use is clipped on to a point on the FCO circuit of the receiver under test. The output from the anode of the valve is taken via a resistance attenuator to an output lead, or to terminals. A filter circuit, L2C2, tuned to the same frequency as L1C1, is inserted between the valve and the attenuator when using the RF output, but it can be switched out of circuit when an IF signal is required. Both the RF and IF outputs can be modulated by an AF oscillator which is connected to the signal grid of the heptode. This oscillator consists simply of a small pilot type neon lamp (with the internal ballast resistance removed), the resistance, R2, and the condenser, C3. The values of R2 and C3 are chosen to give a suitable modulation frequency. The modulation is controlled by a switch, S.

If the circuit is only to be used with receivers which are provided with beat oscillators, then the IF oscillator is unnecessary, and that part of the circuit to the right of the dotted line in Fig. 3 can be dispensed with. The point "a" should then be connected to the "hot" end of the BO tuned circuit.

Built-in Test Set

The same circuit can be incorporated in a communications receiver, if the output is suitably switched, to serve as BO, and also to provide RF and IF test signals. A suitable arrangement is shown in Fig. 4. When the circuit is used as a BO, a variable condenser should be connected in parallel with C, to control the pitch of the beat note.

The point on the FCO circuit to which the connection "b" should be made will probably have to be determined by experiment. In the original circuit sufficient coupling was obtained by connecting to the *earthed* side of the FCO gang condenser section.

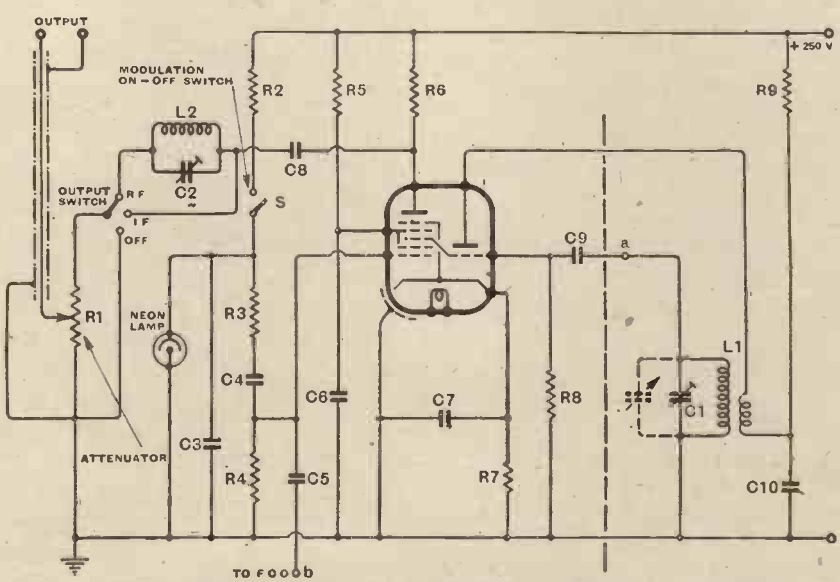


Fig. 3.—The mixer circuit shown in this diagram is suitable for a portable unit. Component values are: R1, 100Ω var.; R2, 2 MΩ; R3, 2 MΩ; R4, 25,000Ω; R5, R6, 10,000Ω; R7, 300Ω; R8, 30,000Ω; R9, 25,000Ω; C3, C4, 0.001μF; C5, 50μμF; C6, C7, 0.1μF; C8, 0.01μF; C9, 0.0001μF; C10, 0.1μF. Valve: Mazda TH41.

Ganging With the Beat Oscillator—

The procedure to be adopted in lining up a receiver by means of a circuit such as that described above is as follows: Throw the switch to the frequency of the test signal is directly determined by that of the FCO, it will alter by exactly the right amount to compensate for the pulling.

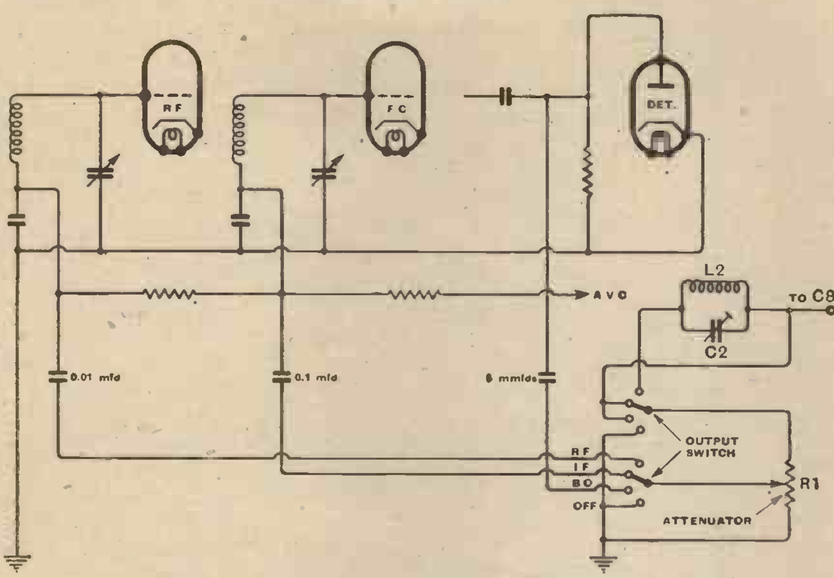


Fig. 4.—If the mixer is incorporated in a receiver, it can be arranged to act as a BO in addition to providing test signals. This diagram shows how the output circuit of Fig. 3 can be modified, and suggests a method of injecting the test signals into the receiver.

"IF" and turn the BO control to the zero beat position. Then set the attenuator to give a suitable input to the receiver, and adjust each of the IF transformer trimmers in turn for maximum output. Next, throw the switch to "RF," and the RF circuits can be tracked and ganged in exactly the same way as with a conventional signal generator, but without the trouble of having to reset the generator dial for each frequency. The ganging can be checked continuously throughout each waverange by simply setting the receiver tuning to any frequency and adjusting the appropriate trimmers.

Freedom from "Pulling"

One great advantage of the system is the apparent absence of "pulling" of the FCO, which is usually troublesome at frequencies above about 10 mc/s. The reason for this is that as the signal grid circuit of the FC valve is trimmed through resonance, it slightly alters the frequency of the FCO circuit, making the correct setting of the trimmer very difficult to determine. But since

If the circuit is built into a receiver as in Fig. 4, it can be used in the normal way as a BO for CW reception by throwing the switch to "BO."

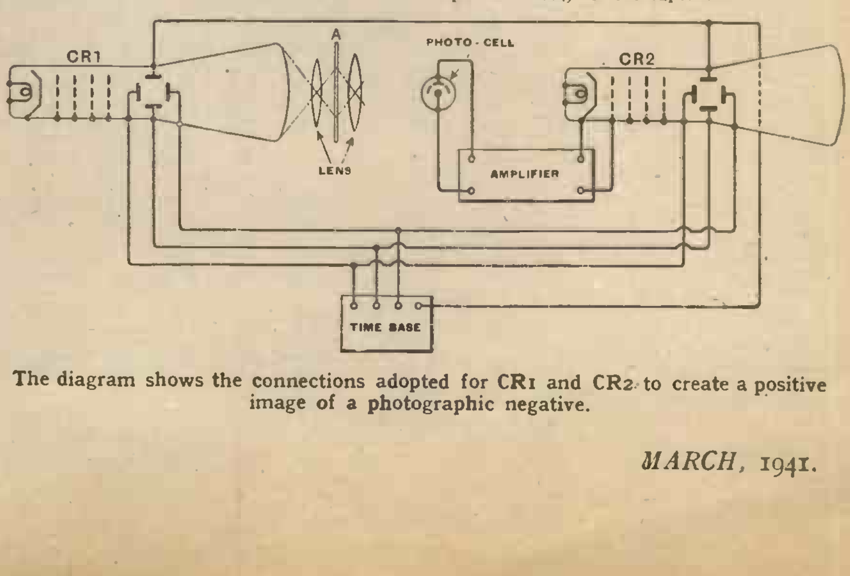
Viewing Photographic Negatives

THE cathode-ray tube is continually being put to new uses, and the possibility of using it to create a positive image of a photographic negative has been invented by M. P. Rubert. It is often difficult for the inexperienced to judge the quality of a negative, and where many are handled a method whereby it can be instantaneously viewed as a positive is not without its advantages.

The illustration shows the basic arrangement. Two cathode-ray tubes, CR1 and CR2, are set up, and have their deflecting plates paralleled and connected to the double time-base. Their other electrodes, except their grids, can be run from a common HT supply.

A bright raster is produced on the screen of CR1 and focused by the lens through the photographic negative A on to the photo-cell. This cell feeds into an amplifier, the output of which is applied to the grid of the tube CR2.

The negative is scanned by CR1, and the picture is reconstructed on the screen of CR2, where it can be a negative or positive according to the phase of the amplifier output. Synchronism is inherent, and any desired number of frames and scanning lines. As the picture is a "still," there is no reason why fluorescent screens of long persistence should not be used; the requirements are obviously less exacting in this respect than in a television receiver or ordinary oscilloscope.



The diagram shows the connections adopted for CR1 and CR2 to create a positive image of a photographic negative.

Club News

Ashton-under-Lyne and District Amateur Radio Society

Headquarters.—Beaconsfield Club, Stalybridge Road, Ashton-under-Lyne, Lancs.

Meetings.—Wednesdays and Fridays at 7.30 p.m.

Hon. Sec.—Mr. K. Gooding, 7, Broadbent Avenue, Ashton-under-Lyne, Lancs.

The Society's activities have been resumed in new club rooms. More classes are being held in which use is made of headphones and a valve oscillator in a two-way system. The club's receiver is being converted from AC to DC.

Messrs. W. P. Green and J. Cropper are to continue their series of lectures on the principles and design of the superhet.

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	—
Vancouver (Canada)	CFKX	6.080	49.34	—
Lima (Peru)	OAX4Z	6.082	49.32	15
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	6.116	49.05	12
Lahti (Finland)	OFD	6.120	49.02	10
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	—
Santa Clara (Cuba)	WOHI	6.450	46.50	5
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	—
Athens (Greece)	—	7.075	42.39	—
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	6
Bucharest (Rumania)	—	9.280	32.33	2
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	10
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
Lima (Peru)	OAX4T	9.562	31.38	15
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
Montevdieo (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	—
Buenos Aires (Argentina)	CXA14	9.640	31.12	7.5
Wayne (U.S.A.)	WCBX	9.650	31.09	10
Perth (Australia)	VLW2	9.650	31.09	—
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	—
Perth (Australia(	VLW4	9.665	31.04	—
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	—
Guatemala City	TGWA	9.685	30.98	10
British Oversea Service	GRX	9.690	30.96	10–50
Buenos Aires (Argentina)	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	—
Aranjuez (Spain)	EAQ	9.860	30.43	30
Cairo (Egypt)	—	10.055	29.83	10
Leopoldville (Belg. Congo)	—	10.140	29.59	—
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 (Argentina)	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)				
Panama City	HP5A	11.700	25.64	2
Motala (Sweden)	SBP	11.705	25.63	12
Moscow (U.S.S.R.)	—	11.710	25.62	20–100
Bangkok (Thailand)	HSP5	11.715	25.61	10
Winnipeg (Canada)	CJRX	11.720	25.60	2
Buenos Aires (Argentina)	LRA3	11.730	25.58	10
Vatican City	HVJ	11.740	25.55	25
British Oversea Service	GSD	11.750	25.53	10–50
Guatemala City	TGWA	11.760	25.51	10
Moscow (U.S.S.R.)	RNE	11.766	25.50	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	10
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
Buenos Aires (Argentina)	CXA8	11.820	25.38	5
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	—
Brazzaville (Fr. Eq. Africa)	—	11.950	25.10	—
Moscow (U.S.S.R.)	RNE	12.000	25.00	20–100
Shanghai (China)	FFZ	12.050	24.90	—

Station	Call Sign	Mc/s	Metres	kW
Quito (Ecuador)	HCJB	12.460	24.08	—
Radio Nations (Switzerland)	HBJ	14.538	20.61	20
Bandoeng (Dutch E. Ind.)	PMH	14.630	20.51	1.5
Moscow (U.S.S.R.)	RKI	14.717	20.38	20–100
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
Motala (Sweden)	SBT	15.155	19.80	12
Tokio (Japan)	JZK	15.160	19.79	50
Guatemala City	TGWA	15.170	19.78	10
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	10
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 (Argentina)	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
Boston (U.S.A.)	WRUL	15.350	19.55	20

Station	Call Sign	Mc/s	Metres	kW
Budapest (Hungary)	HAS	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
Lahti (Finland)	OIH	17.800	16.85	10
Guatemala City	TGWA	17.800	16.85	10
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
Athlone (Ireland)	—	17.840	16.82	—
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
Leopoldville (Belg. Congo)	—	20.040	14.97	—
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

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

Short-wave Receiving Conditions

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

SHORT-WAVE receiving conditions were moderately good during the first week of January, but afterwards were variable throughout most of the remaining days of the month.

Ionosphere storms were in evidence from January 16th to 28th inclusive (but excluding the 21st and 22nd).

These disturbances were more extensive and developed a few days later than was anticipated at the time of preparation of the report for the January issue of *The Wireless World* (see page 21); however, the absence of an extended period of "peak" conditions and of storms at the opening and closing of the month was substantially as implied in that report.

Only one sudden ionosphere disturbance of the "Dellinger" type was in evidence during the month; this occurred at approximately 1005 on January 24th and affected simultaneously a number of routes to the east and south of this country.

There has been a general decrease in frequency of occurrence of this phenomenon (in January, 1940, for example, nine such disturbances were reported), a fact which may be attributed to the present general decline in solar activity.

Particulars of the broadcast bands which it is considered should prove most reliable during March 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, as, for example, transmitter power, efficiency of aerials at both the transmitting and receiving end, and ionosphere abnormalities, may often result in better reception being obtained on wavebands other than those quoted. All times given in this report are GMT on the 24-hour clock notation.

Melbourne: 0600, 16 or 19 m Eastward (via Calcutta) and 25 or 31 m Westward (via Pacific); 0900, 19 m. Eastward and 25 m. Westward; 1200, 19 m Eastward; 1500, 19 or 25 m Eastward; 1800, 25 or 31 m Eastward; 2000, 31 m Eastward and 19 m Westward; 2200, 19 m Westward.

Difficulties of reception are to be anticipated between 2300 and 0500.

Montreal: Midt, 25, 31 or 41 m; 0400, 31, 41 or 49 m; 0800, 25 or 31 m; 1100, 19 or 25 m; 1400, 16 or 19 m; 1800, 19 or 25 m; 2100, 25 or 31 m.

Reception may be difficult, even under normal propagation conditions, for one or two hours centred on 0900. The most favourable period for this route is expected to occur between 1300 and 1900. It is probable that on occasions the 13-metre band may be usable for short periods around 1400.

Bombay: 0100, 31, 41 or 49 m; 0500, 19 or 25 m; 0800, 16 m; 1100, 16 or 19 m; 1500, 19 or 25 m; 1800, 25 or 31 m; 2200, 31 or 41 m.

Cape Town: Midt, 31 or 41 m; 0300, 41 or 49 m; 0500, 25 or 31 m; 0800, 16 or 19 m; 1000, 16 m; 1500, 16 or 19 m; 2000, 19 or 25 m.

Cairo: Midt, 31 or 41 m; 0300, 41 or 49 m; 0500, 31 or 41 m; 0700, 19 or 25 m; 1000, 19 m; 1500, 19 or 25 m; 1800, 25 m; 2100, 25 or 31 m.

In general, conditions in respect of the last three routes referred to above should be favourable throughout the greater part of the 24 hours.

With regard to reception during March it is not unusual at this period of the year for both the frequency and intensity of ionosphere storms to be relatively high.

At the time of writing this report the trend of conditions suggests the possibility of such disturbances increasing about the middle of March, and of a subsequent recovery during the fourth week of the month.

UNBIASED

By FREE GRID

Science and the War

Ships of the desert.

IT is a far cry—however far that may be—from the desert warfare of the last great conflict to that of the present one—and in no respect is the contrast more marked than in the methods of transport and attack. In those far-off days the camel with its self-contained fuel supply held the position occupied to-day by tanks, armoured cars and motor lorries.

Even then, however, wireless played a leading part, and many of you may recollect my publishing the accompanying photograph of myself fitting some of these ships of the desert with the very latest in wireless equipment, complete with earthing plate, securely embedded by the army veterinary corps in the water in the camel's hump.

Most of the brass-hats and other high dignitaries of the scientific departments of the Admiralty, War Office and Air Ministry are diligent, if furtive, readers of *The Wireless World*, and no doubt many of them read some time ago of my idea of using a mixture of hydrogen and oxygen instead of petrol as a fuel for my car, because the exhaust is, of course, water, and if directed at the ground will short-circuit the tyres and so form an ideal car-radio earth.

Apparently as a result of reading about this idea of mine, it occurred to a very august personage at the War Office that if hydrogen were used instead of oil as the motive power of tanks, it would solve a good many transport problems, for, unlike oil, it is lighter than air, and so the more cans of it you load on to a transport wagon the lighter does the wagon become. The more that is loaded on to it, therefore, the more it is capable of taking; in fact, it would be a sort of first-cousin to perpetual motion were it not for the fact that eventually the lorry becomes so light that it tends to take to the air.

Even now, however, you have probably not grasped what is the greatest of all advantages of using hydrogen as a fuel for driving tanks across the desert. It is simply that, since the exhaust is water, there is an unlimited supply of fluid for cooling not only the engines but the gun barrels also. It is not even necessary to provide a radiator to enable the same water to be used continuously, as fresh water is available in unlimited quantities. Finally, of course, the exhaust is used as drinking water for the troops.

Man-Power Problem Solved

I SUPPOSE that many of you, like myself, spend a good deal of time in fire-watching these days, even if it is only the sitting-room fire. Personally speaking, I volunteered for the job a long time ago, as I could see plainly that compulsion was in the offing. I have for the most part been watching over some repulsive-looking bungaloid growths erected in the horrible pseudo-Tudor style so beloved of builders of the baser type, and I am sorry to say that, so far, not a single fire bomb has fallen among them.

Doubtless, this is because enemy airmen, if they really can see in the dark, as some people allege, are unable to believe that these repellent doss-houses are intended for human habitation.

If a fire bomb did fall among them I should be sorely tempted to fill my stirrup pump from my petrol tank, and only the fact that the stuff is rationed prevents my doing so. However, the real reason why I am bringing this subject up is that I wish to draw your attention to a piece of bureaucratic stupidity akin to that which in the last war caused sun helmets to be served out to the troops stationed in the Manchester area.

I had not been on duty many days before I realised what a colossal amount of man-power was being wasted, 99 per cent. of which could be saved by the use of well-known wireless principles. I speedily set to work, therefore, to construct a number of completely self-contained flea-power ultra-short-wave transmitters, complete with photocells, my idea being to place one of these in the room of each bungalow on the estate as well as at various vantage points in the roadway. My plan was to tune each transmitter to a slightly different wavelength so that it would operate the appropriate receiving circuit at the local A.R.P. post, and so indicate exactly where the bomb had fallen. This would have enabled the number of watchers to be reduced to one.

I was fully prepared to deal with intelligent technical doubts and queries concerning my scheme, but not the plethora of pettifogging objections which I actually received, including such a flimsy and typically bureaucratic excuse that no appropriate forms existed which could be filled up in order to transmit the idea to the proper authorities. Needless to say, to the official mind, the filling up of a form is an absolutely indispensable preliminary to all of life's activities, including that of being born, for which I understand a permit is now necessary from the Ministry of Supply, as a high Government official has discovered that the stork is a bird of definitely German origin.

Fire watching.

I cannot help feeling, however, that the real reason for the rejection of my idea is that, owing to the drastic saving of man-power it would bring about, my scheme would seriously endanger the position of many petty jacks-in-office "dressed in a little brief authority," to whom the war has been such a Heaven-sent opportunity.

UHF Oscillator Stability

Points in the Design of Superhet Receivers for 40 Mc/s

THE vogue for push-button tuning has taught designers a good deal about oscillator drift on medium and long waves, and many of the expedients which have been employed to overcome this trouble are applicable to the short and ultra short wavelengths.

It is well known that a rise in temperature causes an increase of both inductance and capacity in ordinary circuits with a consequent lowering of frequency. Humidity also tends to reduce the frequency as the dielectric constant of air (in condensers and between wiring) increase as the water vapour content rises.

Certain ceramic materials have a zero temperature coefficient and some a negative coefficient, and by including condensers with these dielectrics as part of the total tuning capacity, exact compensation for temperature changes can be made as far as capacity is concerned. The inductance temperature coefficient can also be neutralised at one frequency and be made negligible over a small band of frequencies, such as the television range, if it is reasonably small to start with.

Inductance Stabilisation

Methods of reducing the positive temperature coefficient and a number of other useful hints on UHF oscillator design in general, are given in a paper recently published by S. W. Seeley and E I. Anderson.[1] It is pointed out that the increase in inductance is due chiefly to expansion of the wire and a consequent increase in the size of the coil. By using wire drawn from "Invar" or "Nilvar," a 36-64 nickel-iron alloy having a very small coefficient of expansion, coils can be constructed with an inductance change of less than one part in a million per degree Centrigrade.

"Nilvar" wire is hard and difficult to wind, but if ceramic formers of a low coefficient of expansion are employed it is not difficult to wind mechanically stable coils. The real snag is the high electrical resistance of the wire which gives a Q of only 10 compared with 180 for similar coils wound with copper. Fortunately, this drawback is easily remedied by coating the wire with copper and this does not alter its mechanical properties. A coating 0.0025in. thick on 0.058in. diameter Nilvar wire gave a Q equal to solid copper, and a temperature coefficient of inductance so small as to be difficult to measure—considerably lower than 1×10^{-6} per degree C.

When circuits have been stabilised, changes in the operating conditions of the associated valve become the predominant factor. The input capacity, for instance, may increase by as much as 0.04 $\mu\mu$F during the warming up period, and in a 40 Mc/s oscillator with a total tuning capacity of 40 $\mu\mu$F a drift of as much as 20 kc/s may be experienced. This can be reduced by increasing the total tuning capacity and reducing inductance, but at ultra-high frequencies there is a limit to the amount by which the L/C ratio can be reduced without prejudicing the strength and stability of oscillation.

One way of circumventing these difficulties is to tap the grid down the coil, but this necessitates extra contacts if waverange switching is required. Another method is to operate the oscillator at a sub-multiple frequency, when the input capacity variation can be swamped by a much larger total tuning capacity. The disadvantage of this method is that the mixer grid will be sensitive to signals at approximately 0.5 and 1.5 times the desired signal frequency. These are at wider intervals than normal image frequencies, but reasonably good pre-selection is nevertheless essential in the RF stage. Against this may be set the fact that the oscillator frequency is less affected by the tuning of the RF circuits. Also, less of the oscillator voltage appears on the signal grid through stray couplings.

The conversion gain does not necessarily suffer with half-frequency injection, and in pentagrid mixers is nearly equal to normal frequency operation if an adequate oscillator voltage is applied.

Typical Circuit

The circuit of an oscillator-mixer stage exemplifying the various principles involved is shown in Fig. 1. It will be seen that the oscillator functions at quarter frequency and the injection is at half frequency, the harmonic being selected by a tuned transformer in the oscillator anode circuit with a band width covering 20-21 Mc/s.

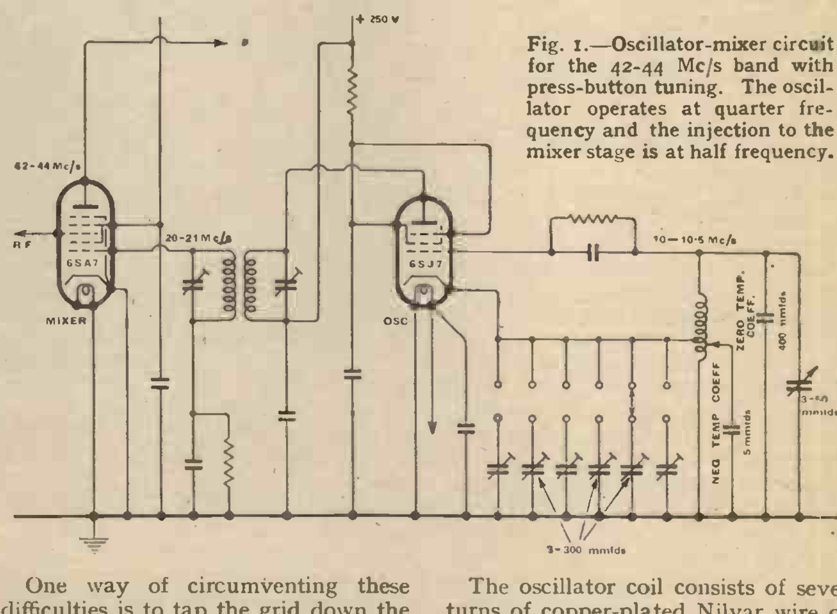


Fig. 1.—Oscillator-mixer circuit for the 42-44 Mc/s band with press-button tuning. The oscillator operates at quarter frequency and the injection to the mixer stage is at half frequency.

The oscillator coil consists of seven turns of copper-plated Nilvar wire on a ¾in. former, the winding length being approximately 1 inch. The cathode tap is 3 turns from the earth end of the coil. With the major portion of tuning capacity in the form of a zero temperature coefficient fixed condenser, the contribution of the

[1] *R.C.A. Review*, July, 1940.

UHF Oscillator Stability—

tuned circuit to the drift is negligible and the responsibility for the observed frequency deviation is shared by the valve and the push-button selector switch. This was included for experimental purposes and was of the con-

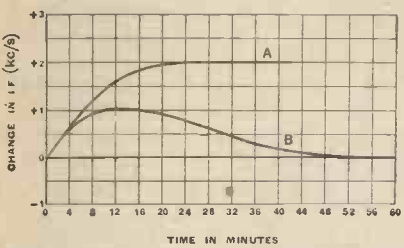


Fig. 2.—Frequency drift of the circuit shown in Fig. 1. Curve A uncompensated, curve B compensated by negative temperature coefficient condenser. The positive change in IF is due to the oscillator being on the low frequency side of the signal.

ventional type with phenolic insulation. Ceramic insulation is preferable, but until switches of this type are made the drift can be reduced by connecting the band selector switches across a part of the tuned circuit. Thus if it is across half the coil, the effect of the capacity change is reduced to a quarter of its original value, which may be as much as 0.2 $\mu\mu$F for a 30° C. temperature change with phenolic insulation.

Fig. 2(A) shows the frequency drift of the circuit with valve and switch variations uncompensated. Curve B was taken with sufficient negative temperature coefficient capacity included to compensate the drift after an hour's working. It will be seen that the maximum deviation is only temporary and is half the permanent uncompensated value.

Zero time is taken from 45 seconds after switch on, and the long period for final stabilisation is accounted for by the difference in the time required for various components to reach equilibrium. The valve itself takes about 15 minutes, and were it not for the other components a much better curve could be obtained by providing the compensating condenser with a local heater in order that its effect might keep pace with the changes in the valve. The ideal arrangement would be to have two compensating condensers with separate heaters, one to follow the valve and the other to look after the drift in components which heat more slowly.

The authors give some useful hints on laboratory technique in work of this kind. In the initial stages of an investigation when first order effects are being sought in individual components a hair-dryer provides a convenient method of applying local heat. A fan of 12 to 16 inches diameter will return the chassis to room temperature in a few minutes.

As work proceeds it is necessary to work with the chassis in its cabinet as the frequency changes are so small that compensation would be useless if made with the chassis in the open. It is also extremely difficult to find a sufficiently stable oscillator as a frequency standard and even crystal controlled oscillators are not sufficiently accurate unless the crystal is mounted in a thermostatically controlled oven. The authors used the standard frequency transmissions on 5 and 10 Mc/s from WWV (Bureau of Standards, Washington, D.C.).

BOOKS RECEIVED

Murder and Mercy. By Reginald Cartwright. A great deal has been written during the past few months about the campaigns in Finland, Norway and France, much of it in the nature of personal experiences and eye-witness accounts by people on the spot. The present account, written by an American citizen attached to an ambulance unit, presents the whole subject in such a very readable and refreshing manner, however, that this book is lifted high out of the category of "yet another book of war experiences," and we make no excuse for drawing attention to it. The despatches contained in this little volume first appeared in *The Autocar* and are now published in book form at the special request of readers.

The whole of the profits from this book are to be handed over to the Red Cross Fund Price 1s. 6d. net.

The Autocar Handbook, 14th edition. By the Technical Staff of *The Autocar*. The new edition of this motorists' vademecum has been brought completely up to date and is full of information both for the owner-driver and those who are in any way connected with wartime transport. In addition to the technical information contained in it there is a comprehensive survey of wartime motoring law. Price 3s. By post, 3s. 5d.

Flight Handbook, 2nd edition. By W. O. Manning, F.R.Ae.S., and the Technical Staff of *Flight*. Interest in aircraft and flying has, for obvious reasons, now become very general, and this book is equally suitable for satisfying the desire for information possessed by the average man-in-the-street and for providing a useful groundwork of knowledge for the youth who is contemplating entering the R.A.F. It assumes no prior knowledge, and deals in simple language with the whole question of "how it works," the function of each part of a modern machine being clearly explained. Price 4s. By post, 4s. 5d.

All the above books are obtainable from our Publishers, Dorset House, Stamford Street, London, S.E.1.

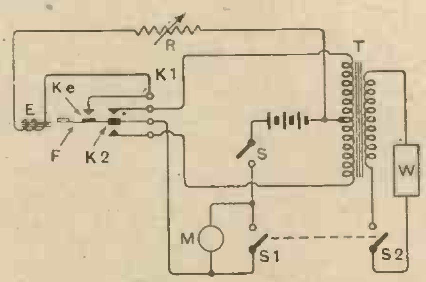
Vibratory HT Generators

Compensating for Wear of Contacts

IT is fairly safe, to assume that the vibratory HT generator, if only for its cheapness as compared with other methods of "stepping-up" DC voltages, will continue to be popular. A growing application is in battery-driven broadcast receivers for export, in which the sole source of current supply is a 6-volt accumulator, HT being supplied through a vibrator. Although there have been no spectacular innovations of late, work on vibratory generators has been going on steadily since their inception, and an interesting development was introduced in the laboratories of the German Telefunken Company shortly before the war.

As the efficiency of vibratory HT generators is largely dependent on the ratio of closing to opening time of the working contacts, it will be appreciated that, when these become burnt, the contact gaps widen, the efficiency of the unit falling after about 1,000 hours' use by from 80 per cent. to 50-70 per cent.

Telefunken engineers found that this disadvantage could be overcome, in the type of unit which is energised through a separate circuit (instead of through the operating contacts), by increasing the energising current to the magnet coil to increase the amplitude of the reed, thus increasing the closing time of the contacts and largely restoring the efficiency of the device.



By means of the rheostat R, energising current is increased to compensate for wear of the vibrator contacts

The accompanying diagram shows how this can be done. The positive side of the LT battery is connected through main switch S and switch S1 to the reed F, which is energised by the magnet coil E and vibrates between contacts K1 and K2 connected across the primary of the transformer T. The centre tap of the primary goes to LT negative. The load W can be disconnected from the transformer secondary by switch S2.

One end of the magnet coil E goes to the energising contact K*e*, the other end going to LT negative via the adjustable resistance R.

The coil E is so proportioned that, when the unit is new, it exerts sufficient influence on the reed for maximum efficiency even with resistance R set at a high value. Later, when the working contacts become burnt, the resistance can be reduced to increase the energising current through the coil, thus increasing the reed amplitude, and, therefore, the closing time of the contacts.

A meter M in parallel with switch S1 is used for checking the excitation of the magnet coil.

Switches S1 and S2 are mechanically coupled, and may be controlled by a push-button so arranged that, when it is pressed, the meter is in circuit, and the load is disconnected from the transformer secondary. The resistance R is adjusted with the push-button depressed, the operation of the converter being restored automatically when it is released.

If desired, a portable meter may be used with a plug and socket arrangement so designed that switches S1 and S2 are opened by inserting the meter plug.

The resistance R can be shunted across the magnet coil, instead of having it in series. Alternatively, it can be dispensed with by having a number of tappings on the magnet coil, provision being made for connecting any of these tappings to the DC supply as required.

LETTERS to the EDITOR

The Editor Does Not Necessarily Endorse the Opinions of His Correspondents

Colour Television

I FEEL that the article on Baird Colour Television in your February issue was over-enthusiastic; perhaps unwittingly so. This criticism, since I have seen no actual demonstration, is based on the fact that the system is reported to be of the two-colour variety.

Your contributor says: "Mr. Baird . . . uses only two colours, red and blue-green, since he has discovered that this combination gives, with the type of photo-electric cell used, *the same results as would be obtained with three separate filters.*" (My italics.) Now, this last statement definitely cannot be correct. Only if the colour of the light-spot itself were capable of change could such a result be obtained (by the use of wide-cut filters). With a light-spot of fixed characteristics only a limited analysis and synthesis can be carried out with two complementary filters.

Exactly the same problem is encountered in colour-film work, and anyone interested in colour-television would do well to read Klein's "Colour Cinematography." Of particular interest in the present case is Major Klein's comparative table of Colours of Original against Colours Reproduced by a two-colour process. This shows that not only are nearly all colours distorted, but that the yellows and violets are completely absent, as no combination of blue-green and red-orange can give these colours.

I would suggest several reasons why your contributor overlooked these flaws. (1) Although necessarily inaccurate, the process probably gives a pleasing coloured picture—so did the earlier Technicolour and Multicolour two-colour processes. (2) The subjects televised would appear to have been chosen to minimise these faults. Note that the girl's hair was *red*—the only hair colour reasonably reproduced—blonde hair would have appeared a pale greyish-orange. (3) There is a psychological tendency for the eye to overlook these defects (a mixture of simultaneous contrast and wishful thinking)—see Klein.

But though the eye tends to overlook these defects, there is no basis for accepting them. The ear is an equally accommodating instrument, and yet

Letters to the Editor—

we strive for high quality in radio because, although it is possible to get a good semblance of speech and music from a limited frequency response, the makeshift can always be recognised as unnatural. The same is true of two-colour systems; though we may not know what is wrong, we feel that the result is untrue to the original.

F. C. ARNAUD,
Sub-Lieut. (E) R.N.V.R.

[Our contributor writes: It must be admitted that Mr. Arnaud is correct in his statement that a truer colour rendering is obtained with a three-colour process than with a two-colour system. The net result, however, is of such a standard that deficiencies in colour rendering are overlooked.

Mr. Baird, in his earlier work, used three filters, but latterly employed the two-filter process, the use of which enabled greater detail to be transmitted within the available waveband, any inferiority in colour rendering being more than compensated for by the increased definition. The aim was to get the best final result within the waveband available.

While dealing with the subject of the Baird Colour System, I should like to point out that the system of scanning employed was demonstrated by Mr. Baird eighteen months ago (*The Wireless World*, August 17th, 1939), the receiver employing a cathode-ray tube in conjunction with a revolving colour disc. A year later a similar scanning system, using a CR tube and colour disc receiver, was shown in the U.S.A. and greeted as a new discovery.—ED., W.W.]

The Future of Amateur Radio

MY attention has been drawn to an article by "Navigator" which appeared in the February, 1941, issue of your journal.

The author of this article has completely ignored the existence of a national organisation—namely, the Incorporated Radio Society of Great Britain, which has for nearly 27 years maintained the most cordial relations with the G.P.O. and other Government authorities on behalf of the organised radio amateurs of Great Britain.

These relations have been maintained since the outbreak of hostilities, and, as a matter of interest, various questions concerning the future of amateur radio (including the re-issuing of licences after the war) were discussed as recently as last December.

Many of the plans suggested by your contributor have been considered in the past by the Council of the R.S.G.B. Frequently such plans have been brought forward by our Provincial District Representatives as an expression of local feeling or opinion.

It is incorrect to suggest that the status of amateur radio immediately preceding the war was "none too high." The Society has concrete evidence that the movement was held in high esteem in spite of "indiscretions" by a very small minority. We would remind your contributor that the R.S.G.B. was closely associated with the organisation of the Royal Naval Wireless Auxiliary Reserve and the Royal Air Force Civilian Wireless Reserve.

Since the commencement of the war the Society has received many expressions of appreciation from the fighting services for the way in which radio amateurs are helping the war effort.

Had your contributor read the annual reports of the Society, which are published in *The T. and R. Bulletin*, he would have seen that they have covered many of the points raised by him. He would also have realised that there has always been in existence a virile organisation which has worked to uphold the interests of all British radio amateurs.

A. D. GAY,
President, Incorporated Radio Society of Great Britain.

AFTER "Navigator's" excellent opening gun, perhaps the following comments would be of interest.

The main menace to amateur existence will be removed when those governments which oppose personal freedom have been subjugated, but a secondary menace will remain. Various interests will probably reopen their barrage against us.

It has been proved to the Services that the amateur operator has skill and initiative far above the average. We can hope for the support of the Services. What we do *not* want is a "committee—given full powers to advise [*sic*] the G.P.O." What we *do* want is a group of competent people of standing who are prepared to fight hard for the amateur. We have for far too long accepted the rôle of foundling, existing by charity. Britannia, not the G.P.O., rules the waves. We are free citizens of a free land, paying taxes for the support of that land (and the G.P.O.). Let us hope that the rigours of war will cause the orphan to grow and lose his foundling outlook.

As "Navigator" says, the public

Letters to the Editor—

and the Press have viewed the amateurs with suspicion. True!—and the amateur's own fault. On several occasions scurrilous anti-amateur paragraphs have appeared in the Press. No one hit back; no attempt has been made to "sell" the amateur. It would be well even now if the Press could be furnished with particulars of the amateur's part in this war.

It is reasonable that the amateur should not do Traffic Handling to the detriment of the country's income. When we have victory it is certain that the Empire stations will be on the air before the European ones. It is certain that—as the troops go home—there will be many more Empire stations on the air. In that interim period contact by amateur radio would tend to cement friendships formed under arms and act as another bond of Empire solidarity. Might not third-party messages of a purely "greeting" nature be allowed?

Finally, let us give up the pious "experimental" hypocrisy. Let us be respected as pursuing a fascinating and difficult hobby and let us insist on the same recognition and consideration—through a strong and efficient organisation—as any other group of common interest.

One thing is clear—the terms of our existence will depend on our own courage and forcefulness. The old "pre-Munich" attitude will leave us as badly off as before. G2"WAS."

AS a pre-war transmitting amateur I found the article by "Navigator" in your February issue very interesting.

Many of his suggestions for post-war amateur radio are indeed excellent, especially the proposal to introduce a stricter licensing test in order to obtain a radiating permit.

Perhaps the following ideas of mine will be of interest:—

(1) Artificial aerial licences to be issued as before. Much experimental work can be done at this stage.

(2) No "intermediate" stage necessary before full radiating licence, but all holders of the latter should pass a morse test at 18 w.p.m., and a reasonable exam. in radio theory and practice.

(3) Initial power (input) of transmitters to be 15 watts, rigidly adhered to.

(4) Use of telephony to be restricted to the 1.7-Mc/s, 3.5-Mc/s, 28-Mc/s and 56-Mc/s bands.

(5) New licence holders to use CW only for first three months. Permission to be obtained from G.P.O. to use telephony after the first three months of operation.

I agree with "Navigator" that there is little use for Traffic Handling in this country, and that our stations should remain experimental. Finally, let us hope that we do not lose too many of our precious kilocycles, and that the best use be made of what we retain.

R. L. PLUCK (ex G4AY).
Tunbridge Wells.

HAVING read the article by "Navigator" on the above subject, I am in agreement with almost everything he says. However, as the question of Traffic Handling has been raised, I feel I would like to make a few observations on this subject.

Traffic Handling as it exists in the U.S.A. would not be tolerated by the British Post Office, neither do I think it would be popular here, but I am of the opinion that after the war the Post Office would do well to consider allowing messages to be sent provided they were from one amateur to another, and concerned with purely amateur topics. An illustration will make this clear. A in London wishes to make a schedule with B in Birmingham at, say, 2230. A works C (a Birmingham station not far from B) during the afternoon. A originates a message which C handles. This procedure would save much needless calling (and hence unnecessary interference), and would be of great use to members of genuine experimental groups like the R.E.S. of the Radio Society of Great Britain.

CHAS. BRYANT.
G3SB; R.E.S; R.S.G.B.
Minehead, Somerset.

British and German Quality Recordings

REFERRING to the letter from Mr. D. W. Aldous in your February number. may I refer to the opinion expressed that German recording is best?

The German Telefunken recording, as probably Mr. Aldous is aware, is for the most part recorded in one concert hall in Berlin. The English recordings selected by Mr. Aldous as outstanding were all recorded in concert halls having somewhat similar reverberation characteristics to the German hall.

Thus it appears that it is not so much German recording; but recordings in certain types of concert halls which are liked so much.

The Horn Concerto (Mozart), B.B.C. Symphony Orchestra, H.M.V. DB. 3973/4, and the Capriccio Italien (Tchaikowsky), H.M.V. DB.3956/7, were both recorded in the Colston Hall, Bristol; while the Lost Chord (Sullivan), Webster Booth, H.M.V. C.3130 and Columbia LX.880, Espana London Philharmonic Orchestra, were both recorded in the Kingsway Hall, London.

It would be interesting to hear opinions of the following made in different halls:—

B.B.C. Symphony Orchestra and Toscanini—Invitation to the Waltz, H.M.V. DB.3542. Large Queen's Hall, London.

Madam Butterfly (Puccini), H.M.V. DB.3859/74. Gigli and Company. Opera House, Rome.

Die Walkure (Wagner), Berlin State Opera House Orchestra, H.M.V. DB.3719/28. Beethoven-saal, Berlin.

Variation on a Theme of Mozart, H.M.V. DB.4480/3. Opera House, Dresden.

Symphony in G. Major (Haydn), Vienna Philharmonic Orchestra (Walter), H.M.V. DB.3421/3. The Concert House, Vienna.

Concerto in D. Minor (Dvorak), Czech. Philharmonic Orchestra. H.M.V. DB.3288/92. German Club Hall, Prague.

It would also be interesting to hear why Mr. Aldous regards the German Telefunken series as the criterion for high quality recording while stating in the same letter that the Columbia LX.880—Espana—London Philharmonic Orchestra, is but one of a number of English records which equal the best Telefunken. Given two sets of recordings of equal merit, why select the German?

WM. T. PURSER,
Technical Recording Manager,
The Gramophone Company, Ltd.
London.

Test Gear Wanted

SOME time back you appealed to readers to assist in a scheme for handing over unwanted radio gear for the entertainment of members of H.M. Forces in outlying districts.

In this connection, I am writing on behalf of the radio mechanics stationed at this experimental station who have, with the approval and assistance of our C.O., formed a wireless club, and need components, etc., to make test gear for our laboratory. I am wondering if among your readers there are any with a surplus of useable but perhaps out-of-date and unwanted components which they would be willing to contribute to what is, you will agree, a worthy cause.

With some assistance from other *Wireless World* readers in this direction, we could equip our laboratory with the necessary gear to make experimental work of many kinds possible to our members. We are all keen amateurs who joined the service

Letters to the Editor—

as Radio Mechanics as appealed for through *The Wireless World*, and would find it a great asset to be able to pursue our hobby during our leisure hours in camp.

D. McDONALD.
(Leading Aircraftman, R.A.F.)

[Apparatus addressed care of this office will be forwarded.—ED.]

Bomb Blast Damage

AS a service engineer to a "radio hire service" in this heavily bombed locality, my experience of damage to broadcast receivers has been fairly comprehensive, and may be of interest to others.

I have found that, with one exception, receivers installed on the ground floor have had the cones "sucked out" instead of "blown in," whereas in upstairs rooms the effect has been just the reverse. In all cases the receivers themselves (including the valves) have resisted the blast.

In one particular instance, a chair was blown into the cabinet, severely damaging the front, but even here the speaker was the only damaged component.

E. M. SPARKS.

Bristol.

RANDOM RADIATIONS

By "DIALLIST"

The Modern Dry Cell

LIKE me, you may have been struck by the remarkably good lasting powers of the dry cell of to-day, whether it forms part of an HTB or of a flashlamp refill. Our manufacturers have certainly learnt a thing or two about dry cells in the past few years, and even under war conditions they are producing batteries whose performances are infinitely better than those of the 1920's and the early 1930's. Just how bad some of the dry batteries of those days were it's difficult to realise now. In lab. tests I used to take the "cut-off" EMF as 0.8 volt per cell, regarding a battery as finished when the voltmeter gave such a reading. I can remember standard-capacity HTB's which gave out in less than a week when run for 3 hours a day under a nominal load of 10 milliamperes. By nominal load I mean that the tests were made through fixed resistances of 150 ohms per cell. Hence if the initial EMF was 1.5 volts per cell, the current was 10 milliamps. As the EMF fell the current of course fell with it, so that by the time 0.8 volt per cell was reached it was only 5.33 milliamps. From the wireless point of view the test is a fair one, since the total HT current falls as the HTB ages. Also few sets can show much in the way of performance when the HTB is down to below 0.8 volt per cell.

Depolarising Does It

The improvement in dry cells is probably due very largely to research into the action of the depolariser. That action has really two aspects, which may be termed the working and the resting. If a cell is wanted for brief, rather heavy loads with long intervals between the periods of use, the depolariser does not need to have any very rapid action; during the few seconds in which it is at work there is not time for the accumulation of hydrogen bubbles round the central carbon rod to raise the internal resistance to a figure that will prevent the delivery of the needed current. An accumulation does occur, but the slow-acting depolariser has plenty of time to deal with it in the long rest period that follows. One of the chief uses of the dry cell in its early days was for working electric bells, and here you have just those short working periods followed by long rests. Again, the first small dry cells made were intended for supplying current to flashlamp bulbs. And in those days flashlamps *were* flashlamps; one switched them on only for a second or two at a time. The coming of the wireless set called for quite different work on the part of the dry cell used as part of its HTB: the cell was asked to deliver small currents for long periods on end. Old hands will remember that we used to make our HTB's of flashlamp refills, soldered in series, and that, even under the very small loads imposed by the sets of those days, they didn't last long. A quick-acting depolariser, with a long, useful life, was needed. It forms part of the dry cell of to-day, and that is one of the secrets of its far better performance.

Useful Bits and Pieces

THOUGH I clear out my workshop and lab. junk from time to time, I must confess that I still

Random Radiations—
have drawers full of tobacco and cigarette tins containing small parts such as we used to buy when Lisle Street was in its radio heyday, and we made many of our own receiving set components. I have never had the heart to give these away. There was always a feeling that they would come in useful, and I must say that it has been justified. Often I've been able to make a repair because I had something that would just fit in, and do the job. The other day the contents of my tins of bits and pieces found a new and unexpected usefulness. Certain gunnery problems demanded for their rapid solution the use of pivoted radial arms moving over scales. We made the scales and the arms easily enough, but what about the pivots and the bearings for them to work in? Nothing was available for the purpose; but I was just going home for a short leave, and it struck me that I might find something in those tins. Sure enough I did. For the pivot pins I selected a handful of the studs with which we used to make multi-point switches. These have small cylindrical heads and 4 BA shanks about an inch long. And the bearings? I had plenty of small metal bushes; but none was of the necessary wobble-free fit. Then I found some small single plugs and sockets. The plugs were of no use as pivots for various reasons, but the shanks of my studs were a beautiful fit for the sockets. Better still, the latter were threaded 0 BA on the outside and had thin hexagon tops. They could therefore be screwed into the wood on which the scales were mounted and driven home almost flush. My pivots and their bearings, contrived from old wireless small parts, have proved completely successful, and my feeling that these apparently useless things might one day come in handy has been amply justified.

The Cheering Short Waves

IF ever you're feeling a bit down in the dumps, just switch on your set, turn to the short-wave range, and twiddle knobs until you find a United States station sending out its war commentary. It's one of the most cheering experiences I know. Our American—I was going to say friends but they are more than that—kinsmen show in every sentence of such a broadcast how wholeheartedly they are with us, and how determined they are that no effort shall be spared to give us the supplies, the munitions, and the ships that we need. At such moments one realises not only the fullness of their support, but also what a grand thing it is to be able, by means of the radio receiver, to tune in the cheering words of a speaker thousands of miles away on the other side of the world. I like, too, to hear their replies to correspondents in this and other countries. They show how fully Americans appreciate what we are doing. I don't often waste time on the bombast and the clumsy distortions of facts put out by Rome and Berlin. But occasionally one can get a good laugh out of them. Haw-Haw gave us one the other night when in one sentence he foretold our coming extinction at the hands of his fellow Huns, and almost in the next warned British workers that after the war the British capitalist (who would presumably be liquidated or in a concentration camp, if the first prophecy came true) would still be up to his old evil tricks!

USW

NOT long ago the Signals people installed an ultra-short-wave radio set for my use, and you can imagine what a joy it has been to give it even the limited employment for which it is intended. I wish it could have been handed over to me for more general work, for it would be bliss to see whether or not USW DX is what it was in the days before the war. But beggars can't be choosers, and I'm jolly glad to have it, even if I mustn't use it for discovering if the old remembered transmitters are still at work or not. One supposes that American police chiefs still call all cars and that "hams" in far parts of the world still conduct long and earnest conversations in the jargon of their kind—I'm sure that there are fascinating fish to be caught, could I but cast the USW net. Well, I must possess my soul in patience and solace myself with dreams of the wonderful forward steps made by the transmitters "below ten" that I shall find once I can turn the knobs of my own ultra-short-wave receiver again.

All-day Wireless

WE'RE queer folk with our wireless; and none of us is queerer than Thomas Atkins of the present day. In the hut which serves my crowd as an officers' mess I have to ensure that things are as quiet as possible during the mornings up to lunch time, for there are always two or three of us then trying to sleep off the effects of a whole night spent on duty. The cooks and batmen have a wireless set in the kitchen, which, unfortunately, is in the same corridor as the sleeping quarters. I've impressed upon them the importance of keeping (a) the volume control reasonably near the minimum end of its travel, and (b) their door shut during the mornings. They're grand chaps and in other ways they look after us splendidly; BUT they seem unable to live without wireless as a background—no matter what is coming through—from the moment broadcasting starts in the morning until they go to bed at night. Believe it or not, I've gone into the kitchen and found the loud (the *very* loud) speaker delivering the news in Dutch! They begin by keeping the volume humanely low. Then they start chattering amongst themselves. Someone can't hear well enough. He gives the VC knob a tweak. The volume from the loud speaker increases. The human talkers raise their voices in order to make themselves heard. The would-be listener again adjusts the volume control. In self-defence the talkers talk more loudly. And presently there builds up a babel of noise that permeates the hut and wakes every sleeper. It's done quite unconsciously. The talkers talk against the wireless, and anyone who wants to listen to the broadcast programme finds the loud speaker's output drowned. Naturally he assumes that the sound level is low and turns up the wick. And so it goes on.

Taylor Universal Meter

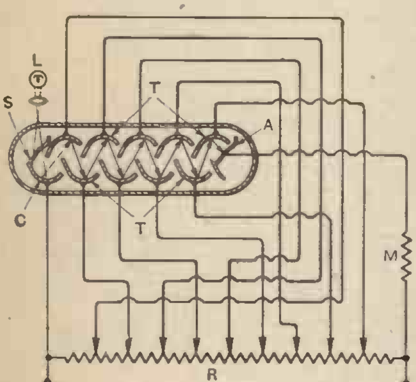
In addition to a wide range of DC, AC and resistance measurements, the Taylor Model 81A meter, which is reviewed elsewhere in this issue, gives readings of capacity and inductance when used with an external adaptor unit.

Recent Inventions

A Monthly Selection of the More Interesting Radio Developments

ELECTRON MULTIPLIERS

THE Figure shows an electron multiplier in which the various target electrodes are so arranged and shaped that the passage of the main discharge stream through the tube is controlled from one target to the next, without the use of any auxiliary electron lens or magnetic focusing. The electrode assembly includes a photo-electric cathode C at one end and a collecting anode A at the other end of the tube. Between them are a series of approximately L-shaped "target" electrodes T which are arranged in upper and lower lines so as to form displaced "mirror images" of each other. These are



Improved electron multiplier design.

biased with progressively increasing voltages tapped off, as shown, from a common potentiometer R.

In operation, light from a lamp L shines through a transparent extension S on to the photo-electric cathode C. The secondary electrons so produced are directed upwards and strike against the first of the upper-line targets T. Thereafter, owing to the shape of the targets, the main discharge stream follows the path shown by the arrowed line, until the amplified current is finally drawn off from the anode A into the load resistance M.

Any positive ions that may be produced by the impact of the electrons will tend to flow against the main stream. They are collected and removed by the longer limbs of each of the targets, which helps to ensure a strictly linear relation between input and output.

Marconi's Wireless Telegraph Co., Ltd. (assignees of J. A. Rajchman and E. W. Pike). Convention date (U.S.A.) October 30th, 1937. No. 520117.

○ ○ ○ ○

FLUORESCENT SCREENS

HIGH picture-definition depends upon sharpness of outline which, in turn, calls for a clear contrast between adjacent picture-elements, as formed on the fluorescent screen. Also good half-tone reproduction requires a wide range of half-tone values or, in other words, an adequate contrast range. In practice both these qualities may be obscured by various factors, such as the curvature of the fluorescent screen, undesired reflection from the glass walls of the CR tube, and particularly by the effect known as "halation."

According to the invention, the light-sensitive material of the fluorescent screen is deposited on a transparent glass plate by means of a transparent cement or "binder" such as boron trioxide. The fluorescent material is in the form of small particles which stand out from the surface of the binder in such a way that most of their area does not make contact with it. This helps to reduce the part of the fluorescent light that normally suffers total internal reflection, and so serves to prevent undesirable halation effects.

Marconi's Wireless Telegraph Co., Ltd. (Assignees of R. R. Law.) Convention date (U.S.A.) December 31st, 1937. No. 523359.

○ ○ ○ ○

TELEVISION RECEIVERS

INSTEAD of being fixed, the focusing coil of a cathode ray tube is mounted on a gimbal bearing, which is fixed, in turn, to a rubber bush or support carried on the glass neck of the tube. The gimbal bearing allows the coil to be moved slightly in the lateral direction, or to be rotated or "tilted," sufficiently to ensure that the "raster" or scanning field is correctly centred on the fluorescent screen of the tube. Once the correct adjustment has been found, the coil is firmly clamped in position.

D. Jackson. Application date January 3rd, 1939. No. 523439.

○ ○ ○ ○

SECONDARY-EMISSION ELECTRODES

TO provide a copious supply of secondary electrons, under bombardment, for instance in an electron multiplier, the "target" electrodes are usually coated with a film of silver oxide and caesium. Such films are, however, liable to fall off in sensitivity under the action of the heat produced by the impact of the primary electrons; they are also adversely affected by any molecules of oxide that may be liberated from an oxide-coated filament.

According to the invention, both these defects can be avoided by replacing the caesium by beryllium, which is first deposited *in vacuo* on a foundation plate of nickel and then subjected to heat treatment. When so prepared the sensitive layer will emit from four to five secondary electrons for each primary electron that strikes against it.

The British Thomson-Houston Co., Ltd. Convention date (Germany) January 18th, 1938. No. 523982.

ULTRA-SHORT-WAVE SIGNALLING

IT is known that ultra-short-wave signals can be received at distances in excess of the so-called "optical" range, though in general such reception will fluctuate considerably in strength. At the same time it is desirable, for the sake of economy, to be able to "service" as great an area as possible from a single transmitter so as to minimise the number of relay stations required, say, to distribute a television programme over a given area.

Field-strength fluctuation is mainly due to variations in the intensity or height of the ionosphere or Heaviside layer—a factor which can to some extent be offset by a suitable choice of either the working wavelength or of the vertical angle at which it is radiated, or of both.

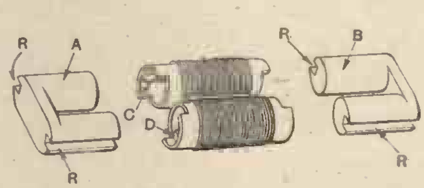
The invention is concerned with a system in which the transmitter radiates a "test" wave on a frequency which differs from that used for the signal proper. At the distant receiver a comparison is made between the "test wave" and the signal wave, and an automatic indication is given as to which wave comes in best from time to time. The personnel at the transmitter is thus kept informed how to vary the operative wavelength—or its vertical angle of radiation—so as to ensure the best possible working conditions.

Kolster-Brandes, Ltd., and W. A. Beatty. Application date January 6th, 1939. No. 523604.

○ ○ ○ ○

PERMEABILITY TUNING

A VARIABLE permeability unit, for tuning the RF circuits of a wide-band amplifier, is designed to possess a high initial ratio of inductance to resistance, and to maintain the same degree of selectivity over the whole tuning range.



Coil design for constant selectivity.

As shown in the Figure, the coil is wound in binocular form, the magnetic core being made in two parts, one fixed and one movable. The "fixed" part of the core consists of two flanges C, D secured to the inside of each former, whilst the movable part consists of two end-pieces A, B, both of these being recessed at R so as to slide over the fixed flanges.

The fixed magnetic flanges C, D ensure a high initial inductance-to-resistance ratio for the coil, which is maintained

Recent Inventions—
as the outer members A, B are closed in to increase the flux as the tuning point is moved up the wavelength scale. The device is stated to combine constant selectivity with uniform gain, as the dynamic resistance remains practically the same for all adjustments.

Johnson Laboratories Incorporated (assignees of W. A. Schaper). Convention date (U.S.A.) November 26th, 1937. No. 521862.

o o o o

MANIPULATING AN ELECTRON STREAM

THE electron stream flowing through a discharge tube is subjected to an oscillating electric field which has the effect of varying the velocity of the individual electrons so as to bunch or group them together at definitely spaced points along the length of the stream. In this condition the stream is passed through a second oscillating electric field, where an interchange of energy takes place.

The process is applied to the generation or amplification of waves having a frequency of the order of a thousand million cycles a second. More particularly it is stated to overcome the difficulties associated with "active-grid" losses when discharge tubes are used for handling oscillations of so high a frequency that the "transit time" of the working electrons is comparable with the time cycle of the oscillations being amplified or generated.

The periodic bunching of the electron may be likened to a "stationary wave" system set up along the stream. Since the latter is moving bodily, the arrangement simulates an alternating current from which energy can be absorbed at a frequency corresponding to that of the stationary wave system.

The Board of Trustees of the Leland Stanford Junior University of California (Assignees of R. H. Varian). Convention date (U.S.A.), October 11th, 1937. No. 523712.

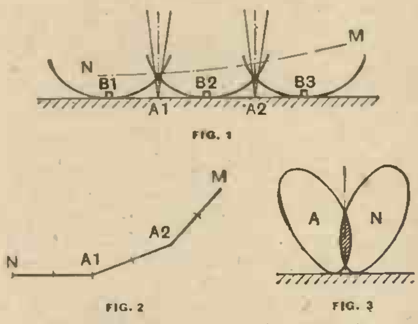
o o o o

AIRCRAFT NAVIGATION SYSTEMS

A NUMBER of short-wave radio transmitters B1, B2, B3, Fig. 1, are arranged along a route to be flown, so that in combination with marker beacons A1, A2, they can be used to guide a 'plane along an "erratic" course MN, such as is shown in Fig. 2, say for the purpose of avoiding some obstacle that may lie in the direct path from one point to another.

Each of the transmitters radiates two "overlapping" beams, Fig. 3, one of which is modulated, say, with the Morse signal A and the other with the Morse signal N. The dots and dashes merge together into a single continuous note only along the zone shown shaded in Fig. 3. If the pilot departs from this central zone, the signals break up and are heard in their distinctive Morse sequence The shaded zone in Fig. 3 marks out the course MN in Figs. 1 and 2.

At points near the limits of reception from each of the transformers, a short-wave "marker" beacon A1, A2 radiates a beam directed vertically upwards. Each marker transmits a distinctive signal so that as the 'plane flies over the pilot knows his precise location along the line of route. If desired, each of the transmitters may also radiate distinctive "complementary" signals, such



Radio marker system for aircraft

as A and N, or T and E, or F and L, so as to give the pilot additional evidence of his position at any given time.

Standard Telephones and Cables, Ltd. (Assignees of Le Matériel Téléphonique Soc. Anon.) Convention date (France) March 12th, 1938. No. 526318.

o o o o

ELECTRONIC AMPLIFIERS

THE flow of electrons through an evacuated tube can be controlled by the static field from a grid, or the stream can first be focused, or concentrated into a beam, and then deflected to one side or other so that it either hits or misses the output anode. As a refinement of the latter process, the concentration of the beam can be varied in its passage through the tube so that more or less of it will pass through an apertured electrode on the way to the output electrode.

According to the present invention, a number of concentrating electrodes are placed along the path of the electron stream, and control voltages are applied to them so as to vary the stream concentration and thus force more or less of the electrons to strike against a target electrode which is coated with a substance having a high coefficient of secondary emission. In this way the amplification is made to depend upon the number of primary electrons which impact against the specially coated part of the target or output electrode.

Telefunken Ges. für drahtlose Telegraphie m.b.h. Convention date (Germany) January 28th, 1938. No. 524417.

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.

AUTOMATIC FREQUENCY-CONTROL

IF a voltage is applied between certain semi-conducting substances, placed in close contact with each other, it is known that a marked adhesion occurs between them. This so-called Johnsen-Rahbeck effect is believed to be due to the molecular attraction that is brought into being between too close-set surfaces by an applied voltage. Since any decrease in the space between two dielectrics necessarily affects their condenser value, the phenomenon in question offers the possibility of using a change of voltage to produce a corresponding change of capacity.

According to the invention, the Johnsen-Rahbeck effect is utilised to apply automatic frequency control to a wireless receiver. A condenser is made by applying a thin film of collodion to a finely polished plate of aluminium, over which a thin foil of metal is placed. The condenser is then placed in shunt with the main tuning condenser of the local oscillator of a superhet set. A discriminator circuit of known type is used to derive a voltage representative of the initial error in tuning, and this voltage is applied to the Johnsen-Rahbeck combination so as to alter its effective capacity to the degree necessary to apply the required tuning correction.

Marconi's Wireless Telegraph Co., Ltd.; N. M. Rust; J. D. Brailsford; A. L. Oliver; and J. F. Ramsay. Application date, November 12th, 1938. No. 524073.

o o o o

VISUAL SIGNALS

THE signals used in telewriting or in picture telegraphy are recorded in permanent or semi-permanent form on a special crystalline screen, which takes the place of the ordinary fluorescent screen of a cathode-ray tube. The picture is formed by scanning the special screen with a beam of ultra-short-wave light, or with X-rays, the effect of which is to cover the normally transparent screen with small "opaque centres," following the track of the scanning beam. An image is produced because the degree of opacity varies with the intensity of the scanning beam. Once the picture has been formed it can be photographed direct from the screen, or projected as an image on to a separate screen outside the cathode-ray tube. When desired, the picture image can be removed by rescanning the crystalline screen, or by the application of heat or an electric field.

The screen is made of crystals of an alkali halide, such as sodium chloride or sodium iodide, the theory being that the short-wave scanning beam injects electrons into the existing crystal lattice, which thus form "opaque centres" of permanent or semi-permanent duration.

Scophony, Ltd., and A. H. Rosenthal. Application date, June 24th, 1939. No. 524230.

ELECTRADIX RADIOS

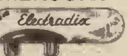
The ROLLS-ROYCE of BUZZERS is the CAMBRIDGE - TOWNSEND

TINY AND SHRILL

Perfect for Wavemeters, ideal for signals. High note model "T" Diaphragm blade. Platinum Contacts. The smallest Buzzer possible. **10/-**

15-DAY TIME SWITCHES.—Venner 1 amp., 5 amps., 100 amps., 200 amps. From 21/-.

MERCURY SWITCHES



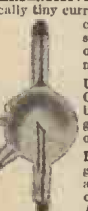
SWITCHES operate 5 or 10 amps. 250 volts, from a pocket cell indefinitely, hermetically sealed and absolutely gas tight, 30/-.

For switching anything by hand or automatically.

SWITCHES. — Aerial-Earth D.P.C.O., 3/6. Stud Box Switch, 8-way on panel by R.I., for meter ranges, etc., 7/6. Larger type G.P., with 10-way studs, 5/6.

YAXLEY & REX WAVECHANGE D.P., 3-way roll contact, 1/3. Bulgin 3-point wavechange, 9d. Tunewell S.P. on-off, 8d. 20-way panel Stud Switches, contact arms and ring for fitting 300-ohm ½ amp., 20-tap resistance, 10/6. 7-way Stud Switches on 2¼in. panel, with plug sockets, 1/9. 10-way D.P. ebonite, mounted, 8 amps., 5/6. 12-way D.P., 5 amps., 4/-. G.E.C. 10 amp. D.P. linked, 3/-.

SUPERSENSITIVE MOVING COIL RELAYS.—These work on really tiny currents from photo-cells, etc., and a small rectifier can be used for A.C. For panel use, the small 2in. flush Lesdix meter type W1 works on 50 micro amps. Handles 150 mills. on main contact, 55/-.



UNUSED X-RAY VACUUM TUBES.—New Government Hospital Surplus. 7in. dia. bulb. Big solid Tungsten Electrodes. Emission guaranteed. COST £5. SALE, 15/-. Callers only.

LIGHT AND RAY CELLS.—Electrocell, Self-generating, 25/- ; Raycraft outfit with relay and amplifier kit, 55/-. Photo-Cells for sound on Film and Ray work, R.C.A., 25/-. Beck, Angle Prisms, mounted in carrier, 5/6.

THERMOMETERS.—Panel 2½in. dial. 5ft. ether tube for distant indicating, reading 0 to 100 deg. Cent., 7/6.

FOURNIER THERMOMETERS by Cambridge Instrument Co., 4in. dial. 10-110 deg. Cent. Fitted adjustable electric contacts, 45/-. 12in. right angle Immersion Thermom. to 150 Cent., 3/6.

ALUMINIUM FOIL, 12in. by 12in., 9d. sheet.

HOME RECORDERS.—Electrical Home Recording requires Tracking Gear for Grooving, Traverse, etc., 25/-.

CUTTER needles, sapphire, 3/6. Real Diamond, 7/6. Rotary Needle Sharpeners, 1/6. Wood Needles, round or triangle, 1/- doz.

SMALL RHEOS.—Back of panel, one hole, front knob, Rotary Igranic 10 watts, 40 ohms, 2½ amps., 2/6 ; 6 ohms, 1.7 amps., 2/6 ; 10 ohms, 1 amp., 2/- ; 20 ohms, ½ amp., 2/- ; 30 ohms, .3 amp., 1/6 ; 30,000 ohms Reg. Volume Controls for Gramos. or Mikes. Resistors, on mica, 8 ohms, 1½ amps., 9d.

POTENTIOMETERS, Igranic Indigraph 300 ohms, list 5/-, sale 1/-. 30,000 ohms, 1/6.
Combined high and low rheos, 2/-.

TEST SET KIT BARGAIN.

Unfinished Supreme Valve Testers, 10in. × 8in. Teak case, hinged lid, panel with terminals, plug and sockets and M.C. Everett Edg. flush meter m/a volts and ohms. Multi Range Switch, 600 ohms res., etc. Ev. Edg. Meter M.C. two scales.

CELL TESTERS.—Megger 3-0-3 moving coil. Aluminium bodies, 17/6.

ELLIOTT BATTERY LOAD TESTERS.—Government Model 108. Moving Coil Ammeter and graded rheo., 37/6.

230 Volts A.C. 2½ kW. RECTIFIER EQUIPMENT, with 5 kW. transformer and Philips valve, D.C. output, 230 volts 10 amps., £15.

TEST PANEL, with 4 meters for full-range works testing. Ranges 5 m.a. to 12 amps. D.C. or A.C., with rectifier and transformer, 5 volts to 500 volts, 7in. dial meter on steel panel, 27in. × 30in., £12.

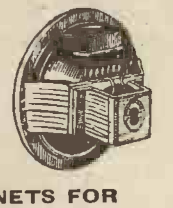
4-RANGE A.C. WORKS AMMETER, by Elliott, for 5, 25, 100 and 400 amps., with selector switch, £6 10/-.

DISTRIBUTION BOARDS.—Polished Hardwood, glass door, clip fuses, D.P., four of 12-way, one 8-way, two 6-way, six 5-way : all at 2/- per way.

HOT WIRE METERS for Radio or Low-Frequency, ½ amp., 2½in. dial, front panel, 100 m/a. to ½ amp., 10/-. 200 m/a. to 1½ amp., 7/6. 500 m/a. to 2 amps., 7/6. To 2½ amps., 15/-. High voltage model in square ebonite case, 1½ amps., 10/-. Special Sullivan Meters with cut-out switch, 15/-. High grade magnet damped H.W. Meters, 100 to 500 m/a., 4in. dial, Marconi type, 25/-. 200 m/a. to 1½ amps., J. & P., brass case, 27/6. 2 amp. and 3 amp. ditto, 32/6. 6in. and 8in. H.W. meters to 10 amps., 20 amps. and 50 amps., 40/-.

METER MOVEMENTS.—Full size, moving coil, P.M. for adapting home-made multi-range testers. For 3in. or 4in. dials, 5/-. Post 1/-.

MAINS ENERGISED SPEAKERS.—6in. Rola, 1,200 ohms, with speech transformer, 7/6. Magnavox, 6in. type, 12/6.



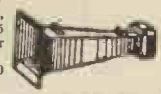
A.C. MAINS SPEAKERS, WITH RECTIFIERS.—Jensen, 220 volt, 7in. cone and transformer, 25/- ; 7in. cone, 20/- ; 100 volt, A.C., 8in. cone with transformer, 21/-.

BATTERY ENERGISED SPEAKERS.—K.B., 6 volt, 8in. cone, 8/6.

SHEFFIELD MAGNETS FOR MOVING COIL SPEAKERS.

Powerful New Steel. Four-claw 4½ lbs. 10 watt M.C. Speaker. Permanent Magnets at manufacturers' price. A great opportunity for **5/-**

P.A. HORN SPEAKERS.—Emerson Tone Correct Horn and Slings, as illus. New Perm. Mag. M.C., 15 watts without distortion, 24in. Flare, 40in. long, £6/8/-.



TANNOY AND MARCONIPHONE. P.M. Short Horn Model P.A., 12-15 watts, as new. 30in. High Power P.M. Speakers with Aluminium Horn for van top; handles 30/40 watts, £9.

MAINS P.A. AMPLIFIERS.—For pure sound amplification and Recording. Complete and cased, not naked chassis. Special Bargain, professional portable 5-6 watt Amplifier, A.C. or D.C. in covered cabinet with handle, 20 lb. weight only. Ideal for singer, entertainer or gramo., only £8. Small preamplifier. Philips 2-watt A.C. mains, in steel case, only £4/10/-. 10-watt steel cased Amplifier, quite new £8/15/-.

All these are complete with valves ready for use.

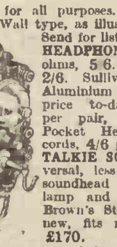
Set by Ardente, fine job, 20 watts pure output, A.C. mains, £16. Complete with valves.

250 NEON LAMPS.—Standard size letter neon bulb with holder, 220/240 v., 2/6.

Medical Shock Coils, 5/6 and 7/6. 300 Ignition Coils. 6 or 12 volts, 3/6.

DIAL TUNING.—10-point Finger Switch Dials, as illus., used on G.P.O. Automatic Telephones. These have spring drive, governor, clutch and contacts inside. Price 2/6.

TELEPHONES for all purposes. House, Office, Garage and Field Sports. Wall type, as illustrated. Table models cheap, Send for lists.



HEADPHONES. — Lightweight, 2,000 ohms, 5/6. Single high res. earpieces, 2/6. Sullivan 120 ohm W.D. model. Aluminium body and headbands. Maker's price to-day, 15/-. Our price, 4/9 per pair, cords extra. 6d. postage. Pocket Headphones, all leather and cords, 4/6 pair.

TALKIE SOUNDHEADS.—Brown's Universal, less optical, independent driven soundhead flex shaft, head amplifier lamp and P.C. Sale £8. Soundhead Brown's Standard with head amplifier, new, fits most projectors, £10. Cost £170.

Cinephone Soundhead with P.C. and meter, £7. B.T.P. Soundhead with Osram P.C., new condition. Beck optical. £8/10/-. Mihaly Soundhead, £3/10/-.

A 2 m.a. TABLE RELAY for radio work. Compact vertical type, enclosed. Screened 3,000 ohm coils. Platinum contacts. Single pole change-over, ½ amp. contacts. Wood base. Metal case. Size 2½in. diam., 3½in. high. Price only 8/-.

G.P.O. glass top B. Relays are twice the size, massive platinum contacts, 15/-. Some chipped, 10/-. A few without contacts, 5/-. 6d. postage.

SOLO VARIABLE AIR CONDENSERS for Wavemeters and Single Circuit Tuning, logarithmic blades, .0005 mfd., new, Type F, 2/6.

TEKADE, bakelite dielectric Tuning or Reaction variable, .0005 mfd., 1/6.

CAMERASCOPES True-Twin, 2 lens viewers, folds flat, 1/3.

CHARGE METERS.—Weston Model 354. Central zero 1 to 15 amps. D.C., pol. mag. dead beat. Flush panel, 2½in. dial. Sale price, 9/6.

NEW PANELS.—Paxolin or Ebonite. 12in. × 12in., 3/-. 18in. × 18in., 5/6. Ebonite quarter-inch Panels, 24in. × 24in. for 8/6. Carr. Fwd.

SCREENALL for lining Cabinets, anti-interference screen, flexible, fireproof thin asbestos faced aluminium foil back and front. Any length cut in 24in. width, 1/- per 2 square feet.

DYNAMO BARGAINS

110-volts, .8 amp. D.C. ball bearing, semi-enclosed. 1,850 revs., 15lb. 6in. × 5in., cheap, **10/6**

DYNAMOS. — Double Current, Govt., cost £15. Two commutators, D.C., 6/8v., 3/5 ams. and H.T. 400/600 v.. 100 mm., 5½in. dia., 12in. long, 17 lbs., 4,000 revs., ball bearings, 25/-. We have some surplus soiled sets, 15/-.

MOTOR DRIVES.—Morse ½ h.p. Silent Chains, new, 29in. long. with large and small 1½in. sprockets, ratio 4 to 1, for motor drive, projector, 8/6.

GEARS.—Skew drive Gear Boxes for Cine. or Boat. ½ or ¼ h.p., 10/-. Ditto on C.I Pedestal, with flywheel, 15/-. Small 2 to 1 Gear Boxes, 4/6.

100 DRILL STANDS.—Massive machined steel drill stands. Wolf type, with rise and fall handle and counter weight, height 32in., weight 102 lb. Sale price 10/-. Carr. forward.

ELECTRIC GOVERNORS, Centrifugal control, 1,500 r.p.m., contacts, brushes, slip rings for autospeed regulation, 7/6.

D.C. GENERATORS, 120 watt, 12/16 volts 30 amps. with vee pulley, 45/-. Shunt wound.—110 volts, ½ amp., 15 lbs., 10/6 ; 110 volts 1 amp., 15/-. ; 200 volts ½ amp., 17/6 ; 200 volts 1½ amp., 26/-.

WINDMILL GENERATORS, totally enclosed, ball-bearing, start charging at 300 revs., 6 to 12 volt., 8 amps., 75/-.

D.C. MAINS MOTOR GENERATORS.—D.C./D.C. 220 v. to 30 v. 10 amps., £7/10/-. M.G. Crompton, D.C./D.C., 100 volts to 17 volts 6 amps., £4/7/6, 200 v. to 16 v. 5 amps., £5. Estro M.G. ditto to 6 volts ½ amp., 45/-. Motor generators for all outputs up to 60 amps.

ALTERNATORS.

1-PH. PHASE HIGH CYCLES TEST ALTERNATORS.—The famous 52a WATFORD H.F. Alternators 250 watts at 500 cycles, 20 volts 10 amps. Self exciting inductor type, slot wound stator. Small size. Cost £30. Sale, 70/-. WOOLWICH 400 watt 46/W/A 500 cycles 50 volts 3 amps. and D.C. of 70 volts 3 amps., £5/10/-.

S.M.D. Co. 800 watts 500 cycles 200 volts, high speed, £8.

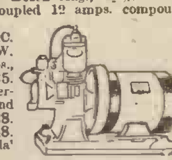
VERTICAL MOTOR-ALTERNATORS.—170 cycles. Marconi type, ½ kW. and ¼ kW. Motor off 100 volts D.C., £10. 2½ kW. NEWTON Vertical, 580 cycles 200 volts 25 amps. 1,600 revs. Motors, 220 volts D.C., £20.

3-PHASE ALTERNATORS.—G.E.C. 333 cycles 3 ph. 120 volts 1 amp., fitted reed Tachometer. Self exciting horizontal, £6/10/-.

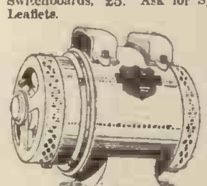
A.C. HAND ALTERNATOR.—Permanent steel magnets, wound armature driven by gearing and handle. Output of 80 volts, 20 m/a. A.C. For Medical Treatment. A.C. experiments, etc. Sale, 7/6. Carriage, 1/-.

ENGINE SETS.

ASTER Single Cyl. W.C. Engine Bosch Mag., 2½ kW. Set 220 volts. Claudel H. Carb. Coupled 12 amps. compound Dynamo, £20.



Horizontal Twin Petrol A.B.C. Engine fan-cooled, coupled 1½ kW. D.C. Dynamo 50/70 volts 25 amps., Mag. Ignition. Cost £190. Sale, £25. 2½ kW. **AUSTIN**, 2 Cyl. water-cooled Engine. Mag. Ignition and 110 volts 25 amps. Dynamo, £28. Austin 3½ kW., 110 volts, £48. Switchboards, £5. Ask for Special Leaflets.



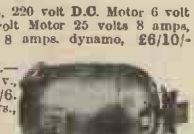
A.C. ROTARY CHARGERS.—3-phase Motor 200 volts Dynamo 8 volts 15 amps., D.C., £4/17/6. R.C.A. 3 ph. Motor 220 volts, 500 volts, 200 m.a., D.C., £5/10/-. Metvick 3 ph. 1 h.p. Motor Dynamo 12 volts 30 amps., D.C., £6.

Single phase to 230 volts A.C. Motor D.C. Dynamo 8 volts 16 amps., D.C., £5/10/-.

300 CELL A.C./D.C. CRYPTO MOTOR-GEN. SET.—220 v. A.C. For Radio Cells and ten 12-volt 10 amp. Car. Batts. D.C. output 160 volts 20 amps. Sale, £32.

CRYPTO Constant Potential Rotary Charger. Single Phase Motor. D.C. output 8 volts 50 amps. L.T. and 100 volts 1 amp. With switchboard, £30.

D.C. ROTARY CHARGER.—3 h.p. 220 volt D.C. Motor 6 volt 250 amp. Dynamo, £16. 200 volt Motor 25 volts 8 amps. dynamo, £4. Motor 220 volts 8 amps. dynamo, £6/10/-. And others.



SMALL A.C. MAINS MOTORS.—Enclosed, self-start on load. 230 v., 1/80 h.p. Type 40, 1,500 revs., 18/6. Split phase, 1/10 h.p., 2,500 revs., 45/-.

SMALL D.C. MAINS MOTORS.—1/40 h.p., Type 60, 220 v., K.B. series, 1,750 revs., 15/-. Ditto, 1/40 h.p., G.E.C., 230 v. series, 2,000 revs., 16/-. Ditto, 1/12 h.p., Croydon 110 and 230 v. shunt, 1,700 revs., 30/-. M.G. for A.C., 220 v. to 100 v., 1 amp. D.C., 60/-. 100 v., 15/-. All fully guaranteed.

Stamped envelope must be enclosed for the last month of Free Bargain List "W" or for all replies.

POSTAGE must be added to all mail orders.

ELECTRADIX RADIOS

218, UPPER THAMES ST., LONDON, E.C.4.

Telephone: Central 4611

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 April issue are accepted up to First Post on Monday, March 10th, 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 SERVICE

Service in these difficult times is service indeed! Owing to the difficulty in obtaining new wireless receivers we all have to reconcile ourselves to "making do" with our existing sets, but we cannot "make do" with deteriorated quality of reproduction.
Users of Armstrong Chassis are fortunate in not having to suffer this disability, as we can and will service any Armstrong Chassis, irrespective of age, and guarantee its original high performance.
We have been asked by many *Wireless World* readers to service their chassis which were not of our manufacture. Until recently it was not our policy to do so, but in view of limited servicing facilities generally we feel it is our duty to broaden our policy.
Therefore whilst we still have the skilled service engineers available we are willing to undertake the servicing of any make of chassis owned by private readers who cannot get the work carried out by the original makers.

ARMSTRONG CO.

have several chassis models which are offered at their original prices. Only one or two of each is available and particulars will gladly be sent on application.

ARMSTRONG CO.

have a limited number of High Quality Speakers also at their original prices, e.g.:

Goodmans 12in. High Fidelity Auditorium Speaker	£7 13 0
Goodmans 10in. High Fidelity Auditorium Speaker	£3 10 0
Goodmans 12in. Public Address Speaker, 1,000 ohm field, P.P. Transformer	£4 10 0
8in. P.M. Extension Speakers, with transformer	£1 5 0
8in. Energised Speakers, with P.P. transformer	£1 1 0
10in. Energised Speakers, with P.P. transformer	£1 15 0
Also Rola G12 Energised and P.M. Models.	
Crystal Pick-ups to match Armstrong Chassis...	£1 2 6

ARMSTRONG MANUFACTURING CO.
WARLTERS ROAD, HOLLOWAY, LONDON, N.7.
'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

McMURDO Silver 1940 15-17 in Georgic Radiogram Cabinet, less autocharger, £75; in Olympic radiogram cabinet, less autocharger, £66.—A.C.S. Radio, 44, Widmore Rd., Bromley. [9428

£15/10 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. [9422

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

HALLICRAFTERS S20R Communication Receiver, as new, 9 valves, 4 bands; £18.—Taylor, 3, Knowsley Rd., Wallasey, Cheshire. [9445

AIR Master 8v. Four-Wave A.C. Mains Console, exceptional performance, brand new, in makers' carton, listed 20 gns; our cash price 13 gns. Send 1½d. stamp list Portables-Midget bargains.—261-3, Lichfield Rd., Aston, Birmingham. [9450

"TOBE" Communication Receiver, covering amateur and adjacent frequencies on 20-, 40-, 80, 160-metre bands, £12, with speaker; perfect; stamp details. Wanted, "Thordarson" 11M77 modulation transformer.—G2XV, 89, Perne Rd., Cambridge. [9414

Wanted

GOODMAN'S 10-12in. P.M., also Quality amplifier.—Thomas, 323, Queuerford, Calne Wilts. [9439

H.M.V. 650 or Pilot 106, Burndept 290, Philips 837 AX.—Details to Meek, 73, Holmes Av., Hove. [9443

WANTED for Cash, R.M.E. DB.20; also all-wave sets.—Price details, 2, Church St., Evesham. [9406

HALLICRAFTER'S SX17, or similar; must guarantee.—Murphy Station-Master, 14, Common Rd., Evesham. [9433

PA. High Output A.C. amplifiers, 24 M.C. P.M. 10 watt horn speakers, 6 new P.M.G.12 speakers, gram motors, ganging oscillator, oscilloscope, television gear.—Aldergate Radio, Tamworth, Staffs. [9446

WANTED Immediately, new and used sets, radiograms (even if incomplete): quote make, model, type or catalogue number (see rear) and whether working or not; definitely best prices paid.—Snell, Arcade, Swansea. [9440

METAL CASES

FOR RADIO & RADIO INSTRUMENTS
also
CASES & BOXES IN WOOD & REXINE

MANUFACTURERS
of
FABRICATED PARTS IN WOOD AND METAL TO THE RADIO AND AIRCRAFT INDUSTRY

Send 2½d. in stamps for details of RADIO CABINETS FOR THE HOME.

LOCKWOOD & CO., Lowlands Road, Harrow, Middlesex. 'Phone: BYRON 1818.

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

Wanted

P.A. Amplifiers and Speakers Urgently Wanted; good prices paid.—John Bell and Croyden, Wigmore St., London, W.1. [9411

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 93 (Edit.).

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

Ode Partridge No. 5

TEE-DOODLE-OO

Tee-doodle-oo, Tee-doodle-oo,
What is it that keeps coming thro'
The Forces programme every night
And interferes without respite?

Just when we start a-listening in
With ears well back, all set to grin,
We hear a liquid rippling sound
The source of which we think we've found.

The Axis propaganda staff
Are busy on a "jamming strafe"
The radio waves perhaps they find
Are smoother than the Channel kind.

He is indeed a stupid man
Who thinks to weaken by this plan
The spirit and the heart so grand
Which permeates this queer old land.

To him must come another guess,
If he would cause us such distress
That flags now flying will be furled
And leave the Huns to rule the world.

"Nein, nein, mein freund" those childish pranks
Will cause no springing in our planks.
Our ships are strong and so are we
And just *how* strong, you're yet to see.

"Tee-doodle-oo" just when you like
And if you should decide to hike
Across the channel to this Isle,
We promise you a rousing Heil.

But not the "Heil" you know so well,
Ours will be spelt H-E-L-L
And if you've any cause to doubt
Ask Musso how he likes *his* clout.

Now we who Chokes and such like make,
Have set in verse without mistake
What ev'ry Briton knows is true,
So—— ! to your Tee-doodle-oo.

N. Partridge
B.Sc., A.M.I.E.E.
King's Bldgs., Dean Stanley St., LONDON——S.W.1
Telephone: VICtoria 5035.

WIRELESS DIRECTION FINDING *Third Edition*
By R. KEEN, B.Eng. *800 pages* *550 illustrations*

Price 25/- net. By post 25/9

From leading Booksellers or direct from the Publishers
ILIFFE & SONS LTD.,
Dorset House, Stamford St., London, S.E.1

NEW MAINS EQUIPMENT

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.

£5/10; 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.

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. [9423

GOODMANS C/810 8in. P.M. Speakers; 27/6.—A.C.S. Radio, 44, Widmore Rd., Bromley. [9430

SECOND-HAND LOUD-SPEAKERS

SALE.—Goodman's 10in. Auditorium Speaker with transformer to match P×4, lately renovated, £1/15.—Mann, 25, The Park, W.5. [9419

Wanted

CORNER Horn, acoustic labyrinth or similar.—Godwin, 11, Barrscourt Rd., Hereford. [9436

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 4.—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

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

BEAUTIFUL Highly Polished Walnut Wireless Cabinets, real salvage, bargains, 150 for disposal; 3/6 to 12/6; call and select, or send P.O. and leave to us.—"Bobs," 59, Chingford Mount Rd., E.4. [9424

Wanted

WANTED Immediately, new and used radiogram cabinets, quote make, model, type or cabinet number (see rear); definitely best prices paid.—Snell, Arcade, Swansea. [9441

DYNAMOS, MOTORS, ETC.

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

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

RECORDING EQUIPMENT

PRESTO Junr. Complete Portable Recorder, shop soiled, £45; V.G. recording amplifier, £30; Presto Disclube, 3/6; Permarec baking oven, 30/-; Rothermel S8 pick-up, 30/-; Permarec microphone, 57/6.—A.C.S. Radio, 44, Widmore Rd., Bromley. [9429

WHARFEDALE SPEAKER CONTROLS

SPEAKER SWITCH

The Switch may be mounted on the side or back of the Receiver, and gives the following connections by turning the knob:—
1 Set Speaker only.
2 Extension Speaker only.
3 Both Speakers.

A very useful fitting for any Set operating a LOW IMPEDANCE Extension Speaker PRICE **4/-**

"TRUQUAL"

LOUD SPEAKER VOLUME CONTROL

AVAILABLE WITH OR WITHOUT ESCUTCHEON

The "Truqual" Volume Control is of the **CONSTANT-IMPEDANCE TYPE.** Strongly made with self-cleaning contacts.

STANDARD TYPE for Speakers of 1/5 ohms, and
TRUQUAL TYPE "98" for Speakers of 6/15 ohms.

PRICE, less Escutcheon **5/-**
" with Escutcheon **6/-**

HEAVY DUTY TYPE for Speakers handling 5/10 Watts .... 1/- Extra.

In cases where the Set-Speaker is too loud in comparison with Extension Speakers fit a "TRUQUAL" to regulate Volume of main Speaker without distortion.

WHARFEDALE

WIRELESS WORKS
Sole Proprietor:—D. E. BRIGGS
HUTCHINSON LANE
BRIGHOUSE
PHONE . . . BRIGHOUSE 50

Constant heat makes neat efficient work

With ordinary soldering when the iron cools you get unsightly blobs of solder, wasteful and insecure. Change to Solon Electric Soldering! No stopping to heat up the iron. Once hot, and that takes only 4 minutes, the Solon stays hot—all the while you need it. It's simple, quick, cheap. 15 hours use for 1 unit. No coal grit—no soot; you get cleaner, stronger, joints with the Solon.

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. 25/E) Engineering Sales Dept., Milton Court, Westcott, Dorking, Surrey.

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.)

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.

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 16½in. 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.

SPEAKERS as Above, in portable cases, slightly soiled or marked, 10/9 each, less cable; amplifier carrying cases, 20in.x12in., slightly soiled or marked, 4/9.

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), gramophone 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.

CELESTION Ring Cone 10in. Speakers, medium pots, 1,000 ohms, less transformers, 8/9 each; white finish. Celestion speakers, 10¾in., brown finish, less transformers, 1,400 ohm, robust magnets, 8/9 each. Celestion 9in. 2,000 ohm, with pentode transformers, 8/9 each. Few only.

CELESTION 10in. Speakers, less transformers, with 4-pin Octal plug, fields 650 ohms, special curved (exponential type) cones, good bass response; 7/9 each; all have normal speech coils, about 2 ohms.

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.

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.

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. [9435

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

FARISH Ceramic Ribbed 1⅛×2 Coil Formers; 3/- doz., 30/- gross.—A.C.S. Radio, 44, Widmore Rd., Bromley. [9432

RICH and Bundy Transformer, 210-250 V., 465-465, 4 V. 2 A., 4 V. 5 A., 4 V. 2 A.; best offer.—Briers, c/o 327, Oxford Rd., Manchester. [9425

FOOLPROOF Battery Charger, charges from one to seven cells, at one ampere, complete kit, comprising Partridge transformer, metal rectifier, ballast lamp and holder, instruction sheet; twenty-six shillings. Postage 1/. Full guarantee.—Champion, 42, Howitt Rd., London, N.W.3. [9451

These TAX-FREE
★ SHELTER COMFORTS
will keep you dry and warm.

'Stuart' Centrifugal Electric
★ SHELTER PUMP

Quickly clears water from shelters. Ideal for many other A.R.P. uses. A sound job built for continuous running — as used on the "Queen Mary" for Garden Fountain.

Delivery from stock.

Ball-bearing motor, A.C. or D.C., any voltage. Low current consumption. Will lift water up to 35 feet below ground level. Connections for rubber hose. All parts non-rusting.

No. 10, 100 galls. per hour, £4.10.0. No. 11, 280 galls., £5.12.0. No. 12, 560 galls., £6.15.0. Foot valve and strainer (for over 5 ft. lift) 12/- and 14/6 extra.

★ MORPHY-RICHARDS ELECTRIC 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

A few Electric Irons also available.

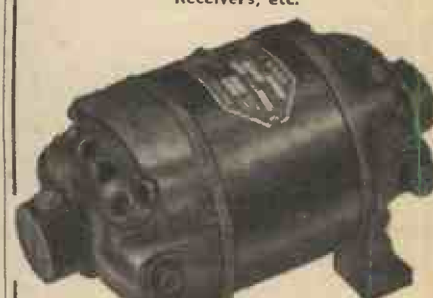
SPECIAL OFFER.
GENT'S FOB WATCH with neat stand. For use in pocket or on desk. Luminous dial. Excellent Swiss movement. Tax-free. Money back guarantee, 21/-.

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 RD., BALCOMBE, SUSSEX

•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.

PLESSEY 4 Waveband Coil Units, with switching, fully screened Pre H.F. stage, 465 k/c. oscillator 13 metres, 2,000 metres, 21/- each; I.F. transformers, 2/6 each extra; gang condensers for same, 2/11.

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

LISSEN Rectifier Valve, U650; 2/11 each.

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

LOW-LOSS Short-wave Condensers, variable, ceramic insulation, brass vanes, Lissen Hi-Q, minimum capacity 5 microfarads, 20 mfd., list 5/6 each; our price, 2/6 each.

ROTARY Coil Units, Lissen Hi-Q, 4-band from 4.3-91 metres, can be selected by turn of knob, with circuit, boxed, list 15/6; our price 6/11 each.

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

YAXLEY Type Switches, 4-pole, 3-way; 9d. each.

YAXLEY Switches, 4-bank, 2-pole, 4-way; 2/6 each.

YAXLEY Switches, 6-bank; 3/- each.

YAXLEY Switches, 9-bank; 3/6 each.

AMERICAN Line Cords, with fittings; 3/6 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; 12/6 each.

CLOCK-FACED Dials, 5in.×5in., with printed scale, 4-wave; 2/6 each.

STRAIGHT-LINE 3-waveband Dials; 1/11 each.

MAINS Transformers, G.E.C., American windings, 350-0-350v. 65 m.a., 5v. 2 amps., 6.3v. 3 amps., suitable for 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., 12/6 each; R.C.3 350-0-350v. 150 m.a., 4v. 2.5 amps., 4v. 2 amps., 4v. 5 amps., 15/- each; R.C.4 500-0-500v. 150 m.a., 4v. 2 amps., 4v. 2.5 amps., 4v. 5.6 amps., 21/- each; R.C.5 100-watt auto-transformers, 100-110v., 200-250v., reversible, 14/11 each; all above transformers 200-250v. tapped primaries; R.C.D. drop-through type, capped, 350-350v. 100 m.a., 5v. 2 amps., 6.3v. 5 amps., 10/6 each.

CHASSIS Mounting Valve Holders, American 4-5-6-pin, 4d. each; Octals, 6d. each.

CHASSIS Mounting Valve Holders, English Clix type, 4-5-7-pin, 3d. each; Celestion valve holders, 5- and 7-pin chassis type, 4d. each; baseboard type, 5-pin, 2d. each.

CENTRALAB Volume Controls, Midget type, 2,000, 5,000, 25,000, 50,000, 100,000, 500,000 ohms, less switch, 2/9 each; 1,000, 25,000, with switch, 3/6 each.

SPEAKER Transformers, pentode output; 3/6 each.

PRESS Button Units, size of unit 6in.×6in.×2in., complete with 6 press buttons and capacitators; 4/11 each.

PLESSEY Motor Tuning Units, including fractional h.p. A.C. motor for 12v. continual running on 24v., intermittent running and 2-gang 0.0005 condenser; 8/6 each.

12-WAY Push-button Switches, 1/6 each; 11-way push-button switches, 1/6 each; 6-way push-button switches, 1/- each; 7-way push-button switches, 1/- each.

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

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.

RESISTANCES, 100 ohms., 10 watt; 1/- each.

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

DUAL Capacitators, 300×600; 4d. each.

(This advertisement continued in column three.)

GALPINS

ELECTRICAL STORES

Owing to War Conditions this business is now transferred to :—

21, WILLIAM ST., SLOUGH, BUCKS.

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.

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 1/6.

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.

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/-.

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

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

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

PHILLIPS TRANSFORMERS, 220 v. input, output 2,000-0-2,000 volts, 200 m/a and 2 L.T.s., 50/-, carriage forward.

2 kW TRANSFORMER CORES for rewinding, sound windings but rating unknown, 20/- each, carriage forward.

STEEL CABINETS, suitable for large amplifiers, etc., size 42in. by 24in. by 16in. Price 35/-, carriage forward.

½ HP 110 v D.C. MOTOR, in good working order, 25/-, carriage forward.

4 M.F. T.C.C. CONDENSERS, 3,000 v. working, 20/- each, carriage, pass. train, 1/6.

SLIDER RESISTANCE, 2,500 ohms at 200 m/a, worm and wheel control, 25/-, post free.

MILLIAMPMETERS, 2in. dia. 0-30 m/a, 20/-; 2½in. dia. 0-500 m/a, 20/-.

PORTABLE VOLTMETER, 0-500v. moving coil, 5½in. scale, 50/-.

EPOCH 20-WATT SPEAKERS, 6-volt field, 45/-. Carr. forward.

FLOODLIGHTS, 12in. dia., multi mirror type with 5in. dia. margin spot centre, any bulb can be fitted, 15/-. Carriage paid.

AERO DYNAMOS, output 12v.-12 amps., new, 15/- each. Carriage paid.

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

(This advertisement continued from column one.)

COILS Kits, for superhet circuit, including 2-gang straight condensers, aerial coil assembly, oscillator coil assembly and 2.465 k/c. I.F. transformers, with circuit diagram; 8/11 each.

PUSH-ON Pilot Lampholders; 3d. each.

PLESSEY Single-gang 0.0005 Variable Condensers; 1/6 each.

2-GANG 0.0005 Variable Condensers, with Vernier control; 1/11 each.

PERMUABILITY Tuned Press Button Units; 2/6 each.

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

B.I. Bias Condensers, 50 mfd., 50v.; 2/11 each.

TUBULARS, wire-end non-inductive paper condensers, all sizes up to 0.01, 5d. each; 0.1, 7d. each

B.I. 4 mfd. Tubulars, 1/9 each; B.I. 8 mfd. cartons, 2/11 each.

T.C.C. 2 mfd. Electrolytic Condensers, 200v. working; 1/3.

HUNTS 8×8 mfd. Electrolytic Condensers, 700v. peak; 5/- each.

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

WESTON Metres, 0-50 m.a. and 0-300 m.a., moving coil type; 25/- each.

ROTHERMEL Senior Crystal Pick-ups; 32/6 each.

SMALL Brown Knobs; 2d. each.

WE Have in Stock a Large Selection of High Voltage Paper Condensers, all capacities but too numerous to advertise. Advise interested clients to call.

ALSO Large Selection of High Voltage Transmitters and Chokes.

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 valve list.

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

RADIO CLEARANCE, Ltd., 95, High Holborn, London, W.C.1. 'Phone: Holborn 4361. [9449

FRED'S RADIO CABIN.—12 assorted volume controls, some with switches; 3/- dozen; postage 7d.—75, Newington Butts, S.E.11. [9438

VAUXHALL.—Rola 8in. P.M. speakers, with transformer, 14/9; 3-gang bandpass H.F. iron-cored tuning coils, 19/6; one-watt resistors, 4d.

VAUXHALL.—Electrolytic condensers; 8 mfd., 500v., 2/3; 8+8 mfd., 500v., 3/9; mica condensers, 0.001 and 0.002 mfd., 4d.; paper tubulars, 0.25 mfd., 6d.; 0.001 mfd., 4d.

VAUXHALL.—Cosmocord pick-ups, 11/- and 18/9; Niclet 3½-1 L.F transformers, 5/9; S.H. Ferranti A.F.6, 8/6.

VAUXHALL UTILITIES, 163a, Strand, London. W.C.2. Postage paid orders over 3/-. Send 1d. stamp for new valve list. [9453

COULPHONE RADIO, New Longton, Preston.—For personal service. Guaranteed American Valves, 5/9 to 6/9, octal. Tungsram valves for replacements of all British types. 10in. Rola P.M. speakers with transformer, 22/6. 8in. Goodmans P.M., transformer, 17/6. Utility Dryshavers, 110/250 AC DC, 22/6. Cosmocord Crystal Pickk-ups, 23/6. 8+8 mfd. 500-volt Electrolytics 4/3, 50×50 2/6, Erie and Dubilier 1 watt resistors, all values 4/3 doz. All goods. Brand new. Stamp for latest list. [9418

Wanted

INFINITE Baffle Speaker, T1001 Pick-up and motor. —Read, 110, Mottingham Rd., S.E.9. [9421

ROTHERMEL Pick-up, model S. or SH.—J. Redfern, 122, Manchester Rd., Wilmslow, Cheshire. [9426

VALVES

LIMITED Range of American First Grade Valves; average price 10/-.—A.C.S. Radio, 44, Widmore Rd., Bromley. [9431

NIMANS RADIO.—Large stocks of English and American Valves. Send for price lists.—76, Park Rd., Prestwich, Manchester, 8. [6416

WE OFFER YOU

2 only **RECTIFIER UNITS**, suitable for charging, etc. Input 230 v. A.C. Output 75 v. @ 2 amps. £7 each.

1 only as above, but with 85 v. Output @ 3-5 amps £8-10-0.

B.T.H. CAPACITATOR GRAMOPHONE MOTORS, with 12-inch Turntable, 100-250 volts, 33/6; an unusual Bargain!

AUDAK PICK-UP HEADS. High resistance coil, 6/6.

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

1 only **E.D.C. ROTARY CONVERTER.** 250 D.C. to 230 A.C., 50 cycles, 100 w. £7. C.F.

1 only **E.D.C. ROTARY CONVERTER.** 230 D.C. to 210 A.C. 50 cycles, 150 w. £8. C.F. Both with filters and in silent steel cases.

NECO ROTARY TRANSFORMER. 220 D.C. to 12 volts 12 amps. D.C. Totally enclosed. £2. Carr. fwd.

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

ELECTRO-MAGNETIC COUNTERS, Resistance 500 ohms, counting from 1 to 12,999, 9/6. Smaller Type, 1 to 1999, 5/6. Innumerable uses.

TELEPHONE HAND SETS, Secondhand, in good order. Ideal for A.R.P., etc., 6/6.

WESTINGHOUSE RECTIFIERS. Type H.T.8, slightly used. Guaranteed O.K., 8/6.

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 8/6.

TAPPED MAINS RESISTANCES for .2 amp. valves tapped 200, 230-250, 4/-.

ASSORTED RESISTANCES. Erie, etc., our selection. 1/6 doz.

DOUBLE TRIMMERS, 140 mmfd. on ceramic. 6d. each.

3-WAY, 4-POLE SWITCHES. Rotary type, 1/6 each.

SATOR .5 meg. Volume Control and switch, lin. spindle, 1/9.

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

"ENGINEERING OPPORTUNITIES"

This unique Handbook shows the easy way to secure A. M. I. C. E., A. M. I. Mech. E., A.M.I.E.E., A.M.I.A.E., A. M. I. W. T., A.M.I.R.E., and similar qualifications. WE GUARANTEE—"NO PASS—NO FEE." Details are given of over 150 Diploma Courses in all branches of Civil, Mech., Elec., Motor, Aero, Radio and Production Engineering, Draughtsmanship, Tracing, Inspection, Government Employment, BUILDING (*the great after-war career*), R.A.F. MATHS., etc. Write for this enlightening Handbook to-day. FREE and post free. *Men with Radio knowledge can obtain attractive posts in the Services.*

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY, 387 Shakespeare House, 17, 18, 19 Stratford Place, London, W.1

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

GRAMOPHONE MOTORS

GRAMO. Motor, P.P. amplifier, 5 watts, both new and boxed, A.C. Collaro Foundhead, 12in. turntable; £4/10 the lot.—Ruddock, Stonehouse Cottage, Penn, Bucks. [9437

GRAMOPHONE MOTORS
Wanted

VARIABLE Speed A.C. Gramophone Motor.—J. Potter, 27, Kingsfield Drive, Didsbury, Manchester. [9452

FULL Price Paid for Electric Gramophone Units and Record Changers, 500 wanted immediately, cash waiting.—Adogram, 27, Worcester St., Wolverhampton. [9405

DISC Recording Apparatus Wanted, including mike, amplifier, complete, good working order, lowest cash price.—Ager, 2, Saville Rd., Woodthorpe, Nottingham. [9427

WANTED, new and used record players, automatic record changers, electric gramophone motors, etc., quote make, model, type or catalogue number (see engraved plate under turntable, and whether working or not; definitely best prices paid.—Snell, Arcade, Swansea. [9442

METERS, ETC.

46 Range Model 7 Universal Avometer, little used, new condition. What offers?—Pope, Bembridge, Chestnut Avenue, Christchurch, Hants. [9417

Wanted

UNIVERSAL AvoMeter, 40-46 range, first-class condition.—Alexander, Eaton Hill, Baslow, Bakewell. [9407

TEST EQUIPMENT

SIX Only, A.C.-D.C. Multimeters, closed case (3in. scale, 1,000 o.p.v. meter), new; 6 gns.

THREE Only, combined valvetester and multimeter (3in. scale, 1,000 o.p.v., A.C.-D.C. volts, ohms, capacity), new; 10 gns.

FERRANTI A.C. Test Set (2 instruments), £4/10; miniature current transformer, £2, or £6 pair.—MacLachlan and Co., Strathyre. [9444

Wanted

"HUNTS" Capacitor and Resistance Bridge, must be perfect condition.—Beaumont, Willingham, Cambs. [9454

CATHOL Ray Oscilloscope, preferably Cossor 3339, or similar.—Apply, stating condition and price, to Exeter Ignition Co., Summerland St., Exeter. [9456

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

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

REPAIRS AND SERVICE

L.T.P. (LONDON TRANSFORMER PRODUCTS, Ltd.), Willesden, N.W.10. Willesden 6486 (3 lines). [9227

EPOCH. . Epoch. . Epoch. . . .—Genuine replacement diaphragms for all models, guaranteed 12 months.—"R.E.C.S.," Crown St., Reading. 'Phone: 2796. [9447

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

PRINTING

CARDS, memos, billheads, 1,000 7/6; rubber stamps, samples.—"B" Tices, 11, Oaklands Grove, London, W.12. [9410

FOUNDATIONS of WIRELESS

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

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

LEARNING MORSE

Fifth Edition

AN EASY METHOD OF MASTERING THE INTERNATIONAL SIGNAL CODE

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

PRICE 6d.
By post 7½d.

Published from the Offices of
"THE WIRELESS WORLD"
Dorset House, Stamford Street, London, S.E.1

SITUATIONS VACANT

AIR MINISTRY.

CIVILIAN W/T. Operators Required, age 21 to 45, preferably with 1st Class P.M.G. or Air Operator's Certificate in Wireless Telegraphy, and experience in Radiotelephony, Direction Finding and Wireless Maintenance work.

SALARY 75/- a week, rising to 125/- a week, plus a temporary war bonus of 5/- a week on the earlier points of the scale.

APPLY by postcard for Application Form and full particulars to the Under-Secretary of State, Air Ministry (S.1(e)), Julian Rd., Bristol, 9. [9420

CROWN Agents for the Colonies.

COLONIAL Government Appointments.

APPLICATIONS from Qualified Candidates are Invited for the Following Post:—

WIRELESS Engineer Required by the Malayan Broadcasting Corporation, for three years with possible permanency. Salary $400 to $500 a month, according to qualifications, rising by annual increments of $25 a month to $800 a month. (The Government rate of exchange is now 2s. 4d. to the dollar.) A children's allowance is payable to married officers with children. Free passages, and if married, for wife and children not exceeding four persons. Liberal leave on full salary. Candidates age 23-32, must have been definitely trained as Electrical Engineers for Telecommunication work and have had not less than 2 years' experience in wireless work, preferably broadcasting. They must be Associate Members of the Institution of Electrical Engineers or, alternatively, possess educational qualifications carrying exemption from the Associate Membership Examination of that Institution.

APPLY at Once by Letter, stating age, whether married or single, and full particulars of qualifications and experience and mentioning this paper, to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M/9416. [9457

COMPETENT Service Engineers and Improvers, conversant all makes.—Particulars and wages to Star Radio, 35, Old Church Rd., Chingford, E.4. [9412

SERVICE Engineer, permanent, progressive position for first class man; good working conditions in London and excellent salary.—Alfred Imhof, Ltd., 112, New Oxford St. Mus. 5944. [9415

ENGINEERS Required for Installation and Maintenance of P.A. and Radio Equipment in Factories Engaged on War Work; interesting and permanent openings in several parts of the country for good service men.—Box 2565, c/o *The Wireless World.* [9413

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

DYNATRON RADIO, Ltd., can offer a very attractive proposition to radio engineer with first class abilities for the development and test of advanced radio frequency work; also require service engineer and tester, first class experience and able to drive car.—Ray Lea Rd., Maidenhead. [9455

BRITISH OVERSEAS AIRWAYS CORPORATION has vacancies for Ground Radio Operators for universal service. Candidates must be British subjects by birth, fit and in possession of a 1st or 2nd class P.M.G.'s Marine Certificate. Preference will be given to men with five or more years' recent seagoing experience. The above posts are permanent and opportunity will exist for promotion to flying rank.

LETTERS of Application, stating age, experience, whether married or single, licence number and military commitments (if any) should be addressed to the General Establishment Officer, Wellington House, Canynge Rd., Bristol, 8. Please mark envelopes GEO/WW/31. [9382

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

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. [9409

SITUATION WANTED

JUNIOR Radio Engineer Requires Progressive Situation.—Box 2566, c/o *The Wireless World*. [9434

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

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

A £15/15 "Tellus" Super Electric Cleaner, complete with accessories, £5/5, perfect; also Electrolux, £8/8; others from £3/3; satisfaction guaranteed.—"R.E.C.S.," Crown St., Reading. 'Phone: 2796. Exchanges, repairs. We buy Hoovers. [9448

BOOKS, INSTRUCTIONS, ETC.

THE "Wireless World" Great Circle Projection Map (on a Zenithal Azimuthal Graticule) gives the true distance and direction of every point in the world from London. Complete with scales and full explanatory notes, size 29in.×34¾in., price 2/- post free.—Iliffe and Sons Ltd., Dorset House, Stamford St., London, S.E.1.

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. [9408

CLASSIFIED ADVERTISEMENTS
intended for the
APRIL ISSUE
can be accepted up to
Monday, March 10th

BOOKS

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

"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.

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.

INDEX TO ADVERTISEMENTS

THE SIMMONDS GROUP OF COMPANIES

INVENTORS

We continually seek new inventions and products in all branches of industry for development and production by the manufacturing Companies of the Simmonds Group throughout the world.

SIMMONDS DEVELOPMENT CORPORATION LIMITED
BUSH HOUSE, ALDWYCH, W.C.2.

Longleys

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.