Wireless World

RADIO and ELECTRONICS

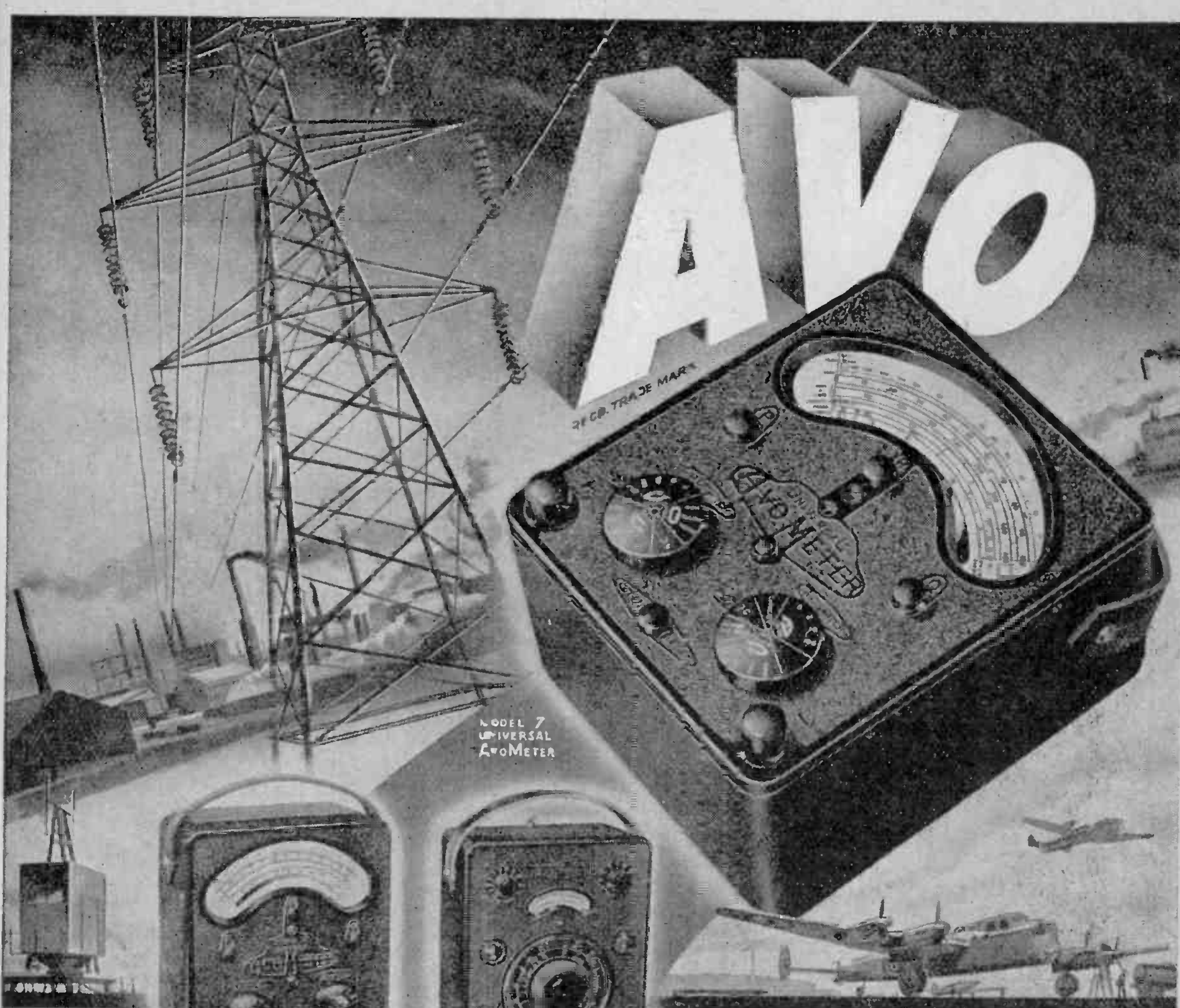
FEB. 1946

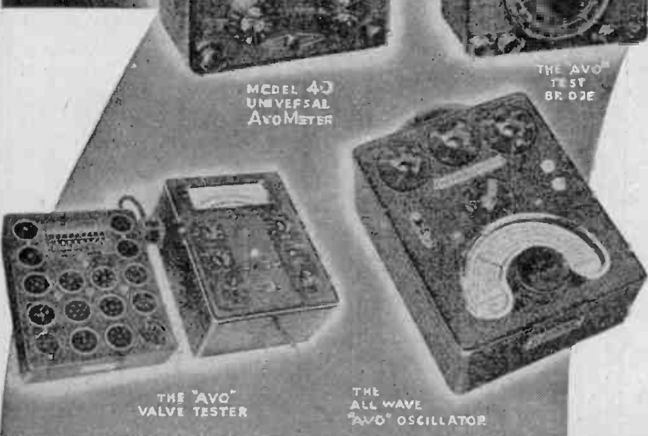
1/6

Vol. LII. No. 2

IN THIS ISSUE: NEW TEST AND MEASURING GEAR


Rola
Components
The best you can buy –
made by the organisation
with the greatest experience
BRITISH Rola LIMITED
GEORGIAN HOUSE, BURY STREET, ST. JAMES'S
LONDON S.W.1. ENGLAND



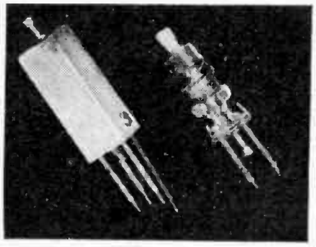


THE world-wide use of "AVO" Electrical Testing Instruments is striking testimony to their outstanding versatility, precision, and reliability. In every sphere of electrical test work they are maintaining the "AVO" reputation for dependable accuracy, which is often used as a standard by which other instruments are judged.

THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD.
WINDER HOUSE · DOUGLAS STREET · LONDON · S.W.1 TELEPHONE: VICTORIA 3404/7

A

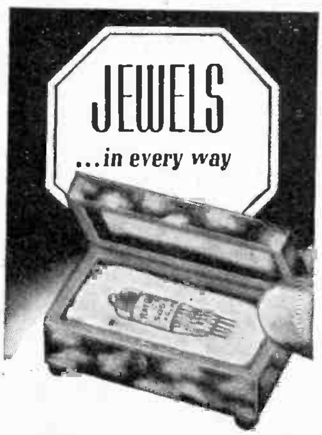
F·W·S·CO.



WORLD'S LARGEST RADIO COIL MANUFACTURERS

RADIO FREQUENCY INDUCTORS
INTERMEDIATE FREQUENCY TRANSFORMERS
RADIO FREQUENCY COIL CHOKES
MICA COMPRESSION CONDENSERS
AIR DIELECTRIC CONDENSERS
MICA MOULDED CONDENSERS
SICKLES SILVER CAP CONDENSERS
GANGED PERMEABILITY TUNING
COMMUNICATIONS EQUIPMENT
F.M. EQUIPMENT PARTS
U.H.F. RADIO EQUIPMENT
SPECIAL ELECTRONIC EQUIPMENT

The F. W. SICKLES Co.
CHICOPEE, MASS. U.S.A



RAYTHEON "FLAT" Hearing Aid Tubes

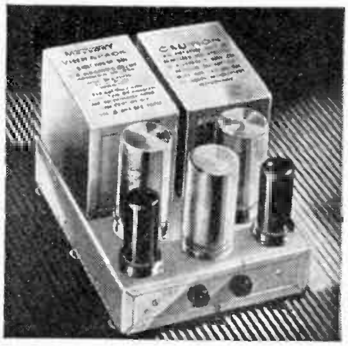
So tiny they must be built under a high powered magnifying glass . . . just as a jeweller assembles rare gems in a costly brooch. They're the hearts of famous hearing aids, providing utmost clarity and richness of tone.

RAYTHEON
MANUFACTURING COMPANY
HEARING AID TUBE DIVISION
Newton, Massachusetts

P. R. MALLORY & CO. Inc.

MALLORY VIBRATORS

ARE ALWAYS DEPENDABLE



Along every front Mallory has pioneered in Vibrator design to ensure safety, dependability and long service. Mallory offers synchronous and non-synchronous Vibrators for 6, 12 and 32 volt input, also a complete range of "STRATOSPHERE" Vibrators plus the world-famous Mallory "VIBRAPACK" (Reg. Trade Mark).

★ *Vibrapack is a registered trade mark, the property of P. R. Mallory & Co., Inc. Indianapolis, U.S.A. Units which do not bear this trade mark are not of genuine Mallory manufacture.*

P. R. MALLORY & CO. INC.
INDIANAPOLIS, INDIANA, U.S.A.
Radio and Electronics Division

ALSO
"MYKROY" CERAMIC INSULATING MATERIALS
GENERAL ELECTRONIC VACUUM CONDENSERS

FOR THE FUTURE

These Manufacturers will help solve your post-war problems.

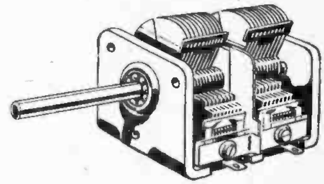
Register your name now for full details which will be sent you when supply conditions again permit.

FRANK HEAVER LIMITED

Kingsley Road, BIDEFORD
N. Devon

G. I.

VICTORY PRODUCTION



TYPE 2600 MIDGET VARIABLE CONDENSER

WE are now ready to help win the peace by making the best use of the still greater knowledge and experience gained in the manufacture of variable condensers, mechanical tuners, drives, etc

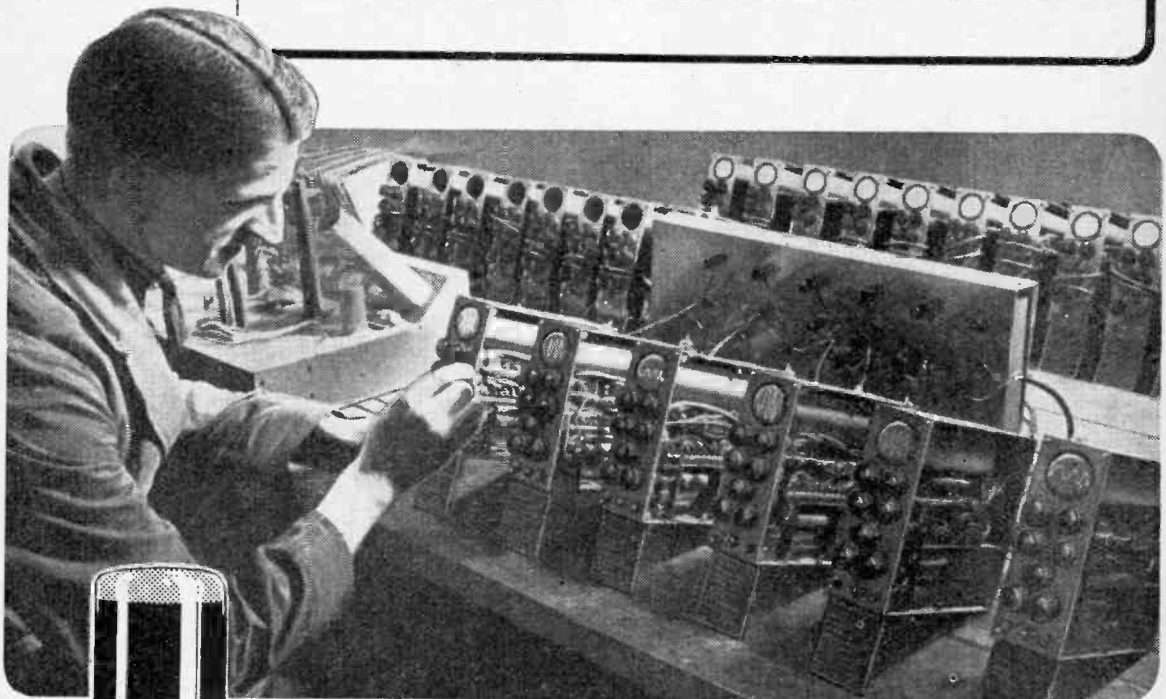
THE GENERAL INSTRUMENT CORPORATION
ELIZABETH, N.J., U.S.A.

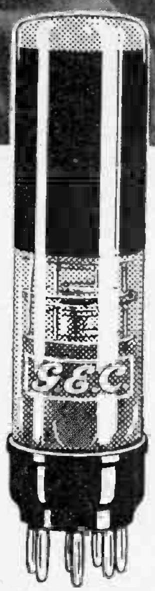
A D A A A
TRADE MARK REG.

RADIO
AIR CONDITIONING HEATING and REFRIGERATION EQUIPMENT
DOMESTIC APPLIANCES etc., etc.

Ad. Auriema, Inc.
Manufacturers' Export Managers
89 BROAD STREET,
NEW YORK, 4 N.Y.
U.S.A.

ELECTRONICS





The G.E.C. Cathode Ray Tube 4103 is a type widely used in industrial test gear.

made it possible!

The testing and maintenance of the tremendous range of electronic equipment produced for the fighting services, called for the production of many highly specialised testing devices. Equipment had to be available both for day-to-day servicing in the front line, and more detailed overhaul in service workshops and factories in the rear. A large proportion of such test equipment was valve operated and OSRAM were in the forefront of this new technique, which will bring to the pursuits of peace many well-tried electronic devices to speed, smooth and make safer our way of life.

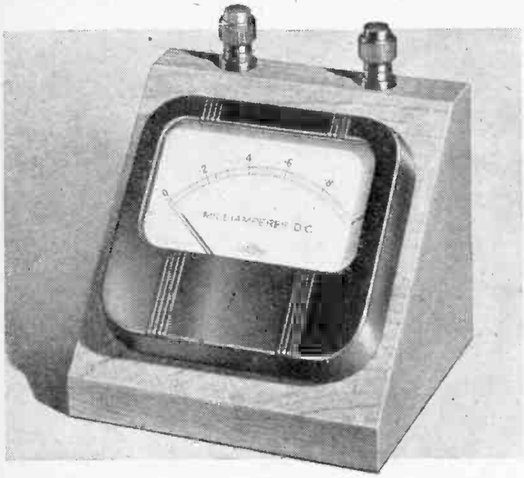
Osram PHOTO CELLS | **G.E.C.** CATHODE RAY TUBES | **Osram** VALVES

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

PULLIN INSTRUMENTS

for

MAINTAINED ACCURACY



SERIES 35 for panel mounting or as bench instruments.

Available either as single range panel instruments or mounted in sturdy bench stands, as illustrated, with up to three ranges self-contained. Scale length $3\frac{1}{2}$". Instrument size, $4\frac{7}{8}$" x $4\frac{3}{8}$"; panel opening $3\frac{1}{4}$".

Can be supplied (1) *Moving coil* — microammeters, milliammeters, ammeters, millivoltmeters, voltmeters, ohmmeters, decibelmeters.

(2) *Rectifier* — microammeters, milliammeters voltmeters, decibelmeters.

(3) *Thermocouple* — milliammeters, ammeters, voltmeters. All available in all standard ranges.

MIP LTD

MEASURING INSTRUMENTS (PULLIN) LTD

Please address all correspondence to : Phoenix Works, Gt. West Road, Brentford, Middx. *Ealing 0011.*

THE STATIC CONDENSER Co. Ltd.

★ *Manufacturers of STATIC CONDENSERS*

TOUTLEY WORKS, WOKINGHAM, Berks

Telephone: WOKINGHAM 708

PERSONALITY *by* P.A.

THE DIFFERENCE THE MIKE MAKES

War-shortage of sensitive microphones has caused mass murder of "personality" over many workshop sound-systems. Even the works-manager's voice giving staff-talks has been unrecognisable. But now Grampian are able to release again the Grampian Pressure Microphone Type M.C.S., there is no longer any excuse for poor "local" transmissions. Replace the war-emergency "mikes" you have been using in any P.A. systems you maintain with the high-sensitivity Grampian Type M.C.S., and get rid of one of your worst sources of trouble.

GRAMPIAN MICROPHONE TYPE M.C.S. Pressure operated. Swivel stand-adaptor. Frequency 70-8000c. Impedance 20 ohms. Sensitivity 42 d.b. PRICE £7.5

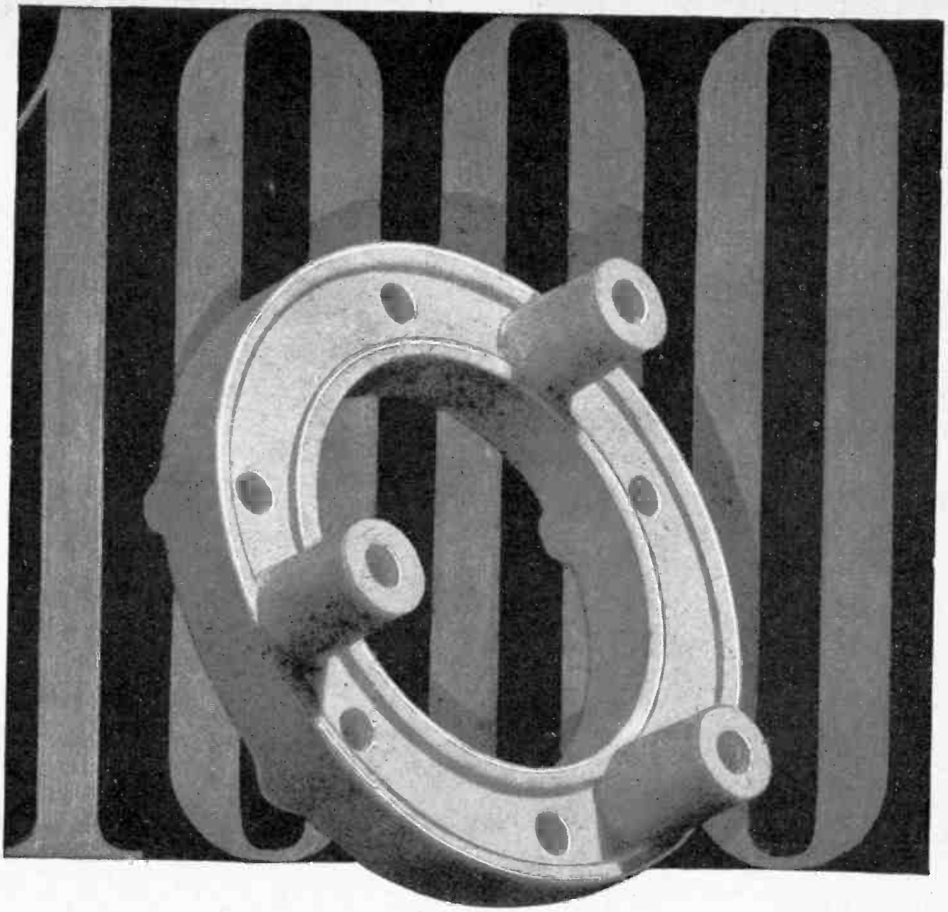
GRAMPIAN SPEAKER Projector Type PVH. Unit Max. Loading 10 watts. Impedance 15 ohms. Horn, length 42 in., diam. 24 in. Cut off, 170 C. P. S. PRICE £13.5

Available for early delivery

GRAMPIAN LOUDSPEAKERS

GRAMPIAN REPRODUCERS LTD., Hampton Road, Hanworth, Middlesex. *Phone : Feltham 2657*

Scientific G.6A



specify FREQUENTITE

The range of Frequentite components covers more than a thousand pieces of every shape and size. Before finalising the design of new components consult

STEATITE & PORCELAIN PRODUCTS LTD

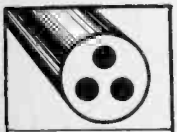
Head Office : Stourport-on-Severn, Worcs. Telephone : Stourport 111 Telegrams : Steatain, Stourport

S.P.17

Technical Reasons Why

★ ERSIN MULTICORE SOLDER

Is the Finest Cored Solder in the World



3 CORES OF FLUX

Three Cores of Flux ensure flux continuity. No lengths without flux are wasted. Consistent high quality joints are obtained with comparatively unskilled labour. Exactly the correct proportions of solder to flux are provided. Separate fluxing operations are obviated and no extra flux is required. The three cores of flux being evenly distributed over the cross section of the solder provide thinner solder walls than otherwise. This gives rapid melting and speeds up soldering. The flux does not tend to run out of the cores ; so there is always a supply available for the next joint. The utmost economy of solder and flux is achieved.

Ersin, contained in the three cores of Ersin Multicore Solder, is the fastest non-corrosive flux. Possessing all the non-corrosive advantages of rosin, it enables joints to be speedily made on oxidised or "difficult" surfaces such as nickel. Ersin not only avoids oxidation during soldering but removes surface oxide already present—this is particularly advantageous in respect of materials that have been in stock or apparatus that is being serviced. The use of Ersin Multicore, with correct soldering technique, avoids "HR" or dry joints.

Ersin Multicore Solder is made in most gauges between 10 and 22 S.W.G. (·128—·028") (3·251—·7109 m/ms). For general radio and electrical production and maintenance 13 and 16 S.W.G. are in most demand.

Virgin Tin & Lead

Five alloys of Ersin Multicore Solder, made from virgin metals, are available—all antimony free. Under present circumstances 45% tin and 55% lead is the most widely used alloy.

Technically, Ersin Multicore Solder is far superior to any other cored solder. A practical laboratory or production test will demonstrate this and show you that it is the most economical solder to use. The majority of British and overseas manufacturers already enjoy the advantages of Multicore. If you do not, and are engaged upon Government contracts, write for further technical information and free samples.

Single reel rate nominal 1 lb. reels.

13 SWG	-	**4/10**
16 SWG	-	**5/3**

Above prices subject to usual trade discount.

¼ cwt.—ton lots at bulk rate. 6d. cartons for home use, available at most good radio and electrical dealers, ironmongers, etc.

MULTICORE SOLDERS LTD.

Mellier House, Albemarle St., London, W.1.
Tel.: REGent 1411 (P.B.X. 4 Lines).

LEAK

"POINT ONE" RANGE OF ALMOST DISTORTIONLESS AMPLIFIERS

Here are performance figures, inclusive of output transformer, for the type 15 : —

TOTAL DISTORTION, including hum and noise, for 15 watts output : —
1,000 c.p.s. - 0·1% (one-tenth of one per cent)
60 c.p.s. - 0·2% (one-fifth of one per cent)

FREQUENCY RESPONSE: level within 0·25db. 20 - 20,000 c.p.s.

LOAD DAMPING FACTOR: 20 (10 times better than for average Class A triode).

GAIN: The basic amplifier requires 0·5v RMS at grid impedance. An additional two stages can be supplied built into the chassis, thus reducing the input to 0·005v R.M.S.

Full information on leaflet S.15

SPECIAL NOTE : The above figures establish such radically new standards that they may occasion some surprise. We therefore wish to stress that no error appears in this announcement. The circuits are original, and result from war-time research in our laboratory.

H. J. LEAK & COMPANY LIMITED
470 UXBRIDGE ROAD · LONDON · W.12
TELEPHONE : SHEPHERDS BUSH 5626

CERAMIC *High Voltage* CAPACITORS

Outstanding characteristics of U.I.C. Pot and Plate Capacitors are the high break-down strength, low loss factor, and small dimensions. *Working Voltage:* 10 KV D.C. only or 7.5 KV D.C. Peak+A.C. *Working Load R.F.:* Up to 25 KVA according to type. *Max. Current:* Up to 14 AMP. according to type. *Range of Capacitance:* 5 pF to 1200 pF. Tested to Specification K110. Full details on request.

UNITED INSULATOR CO. LTD. 12-22 LAYSTALL STREET, LONDON, E.C.1

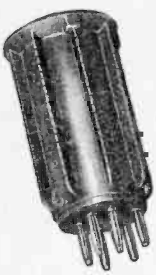
Tel.: TERminus 7383 (5 lines) Grams.: Calanel, Smith, London

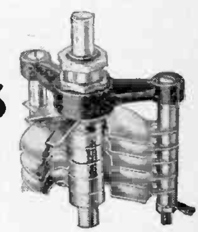
THE PIONEERS OF LOW LOSS CERAMICS

—For absolute RELIABILITY—*use*—

EDDYSTONE

SHORT WAVE COMPONENTS





COIL FORMERS

Moulded in D.L.9 insulating material with 8 ribs. Outside diameter 1½in. and a winding space of 2¼in. Very useful for construction of efficient low loss inductances for Receivers and low loss Transmitters. Type 1002 Plain. Type 1003 Threaded.

COILS.

Type 959. Above can be supplied with three windings (1 aperiodic, 1 tuned and 1 reaction) providing a comprehensive frequency coverage from 9—2000 metres.

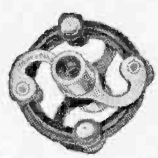
H.F. and V.H.F. CHOKES.

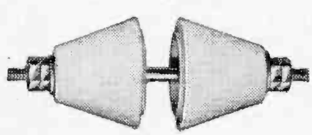
Wound on special D.L.9 former with rigid wire ends moulded in. Type 1010 and 1022 are section wound, 1011 is single layer spaced winding.

1010	1.25 mH	20 ohms	50 m/A
1011	5.32 uH	1.33 ,,	50 m/A.
1022	1.5 mH	10.53 ,,	250 m/A.

All brass construction, soldered vanes for low H.F. resistance and heavily silver-plated to prevent oxidation. D.L.9 endplate ensures constant capacity. ¼in. diameter extension spindle. Single hole fixing.

Type.	Air gaps.	Min. cap. mmfd.	Cap. swing. mmfd.
1094	8	5	15
1129	10	5	37
1093	15	6	56
1130	14	5	95
1131	22	5	170





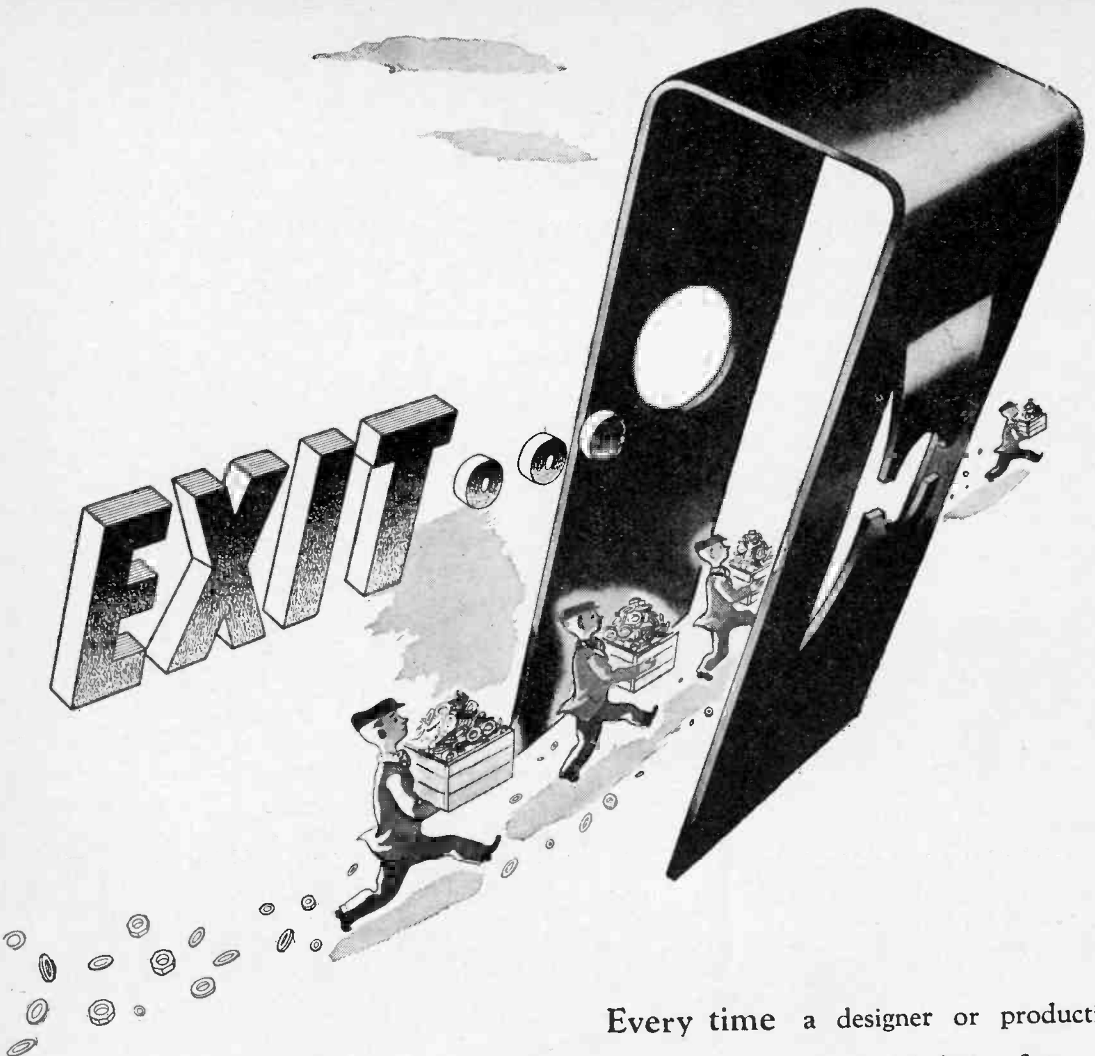
Type 1009. FLEXIBLE COUPLER. Free from backlash yet completely flexible. Banishes alignment troubles. D.L.12 Insulation and phosphor bronze spring arms. For ¼in. spindles.

Type 1018. GLAZED FREQUENTITE INSULATOR to facilitate carrying of high Frequency leads through metal chassis and screens with minimum loss. Cones are flanged at bottom to self-centre into the metal. A.2 B.A. rod is used as conductor. 3½in. long, 1⅝in. diameter.

RADIO PRODUCTS EDDYSTONE TRADE MARK

London Agents:
WEBB'S RADIO
14 SOHO ST., W.1

STRATTON & Co. Ltd.
EDDYSTONE WORKS, ALVECHURCH RD., WEST HEATH, BIRMINGHAM 31.



Every time a designer or production engineer decides to use some form of Spire fixing, he puts a few thousand (or a few million) nuts and washers out of a job. No more fumbling and holding the bits together with one hand while you get to work with the other. Spire fixing can tackle and simplify most light assembly jobs. The best thing is to send us the job — or the drawings. If a Spire fixing will improve the job we'll design it for you and show it to you in a week or two. Then you can judge for yourself.

THAT'S Fixed THAT!

Type CA 725.

Fixing knobs to shafts. Sounds simple but if you're a radio manufacturer you know what a headache it can be. The Spire fixing was designed to solve that particular problem. The CA 725 is made to measure for shafts of various diameters. Then it is snapped into position in the hub of the knob and the knob pushed straight on to the shaft.

Don't think of Spire as a 'kind of nut'. It is a great deal more than any nut. It is a simplified and sure method of fixing. Especially awkward fixings!

Spire

*** A BETTER way of fixing**

Simmonds Aerocessories Limited • Great West Road • London • A Company of the Simmonds Group

Wireless World

Radio and Electronics

35th YEAR OF PUBLICATION

Proprietors :
ILIFFE & SONS LTD.

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

Editor :
H. F. SMITH

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

Telephone :
Waterloo 3333 (35 lines).

Telegrams :
"Ethaworld,Sedist,London."

△

PUBLISHED MONTHLY

Price: 1/6

(Publication date 26th of preceding month)

Subscription Rate: Home and Abroad 20/- per annum.

Branch Offices :

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

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

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

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

△

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.

FEBRUARY 1946

MONTHLY COMMENTARY 35
AMATEUR COMMUNICATION RECEIVER
By H. B. Dent 36
TELEVISION PSYCHOLOGY
By Paul Bellac 40
NEGATIVE FEEDBACK
By "Cathode Ray" 41
PULSE-TIME MODULATION 45
INSTRUMENT PROGRESS : 1939—1946
By M. G. Scroggie 47
PHYSICAL SOCIETY'S EXHIBITION 48
WORLD OF WIRELESS 53
FUNDAMENTALS OF RADAR—5 55
MIXING CRYSTAL MICROPHONES
By G. N. Patchett 57
MULTI-CARRIER COMMUNICATION SYSTEM .. 59
UNBIASED
By Free Grid 62
LETTERS TO THE EDITOR 63
RADAR IN MERCHANT SHIPS
By S. T. Allsop 66
RANDOM RADIATIONS
By "Diallist" 68
RECENT INVENTIONS 70

This mathematical symbol means **'not less than'**

This well-known emblem means **'not less than the best'**

PHILIPS

PHILIPS

LAMPS · RADIO · X-RAY · COMMUNICATIONS EQUIPMENT AND ALLIED ELECTRICAL PRODUCTS

PHILIPS LAMPS LIMITED · CENTURY HOUSE · SHAFTESBURY AVENUE · LONDON · W.C.2 (125J)

Wireless World

Radio and Electronics

Vol. LII. No. 2 FEBRUARY 1946 Price 1s. 6d.

Monthly Commentary

Instruments on Show

SEVERAL useful conclusions can be drawn from the notable success of the recent Exhibition of the Physical Society. It was evident that radio practice has now infiltrated deeply into most branches of applied physics; indeed, the visitor who was overheard to say "physics now seems to be just another name for wireless" had some justification. Equally evident was the extraordinarily widespread interest in even the most highly developed testing, measuring and processing equipment for both radio and industrial purposes.

The exhibition, organised on its present basis, is no longer able to cater adequately for public demands, and we hope that next year it may be possible to hold it under more favourable conditions, giving greater facilities and comfort for both visitors and exhibitors. The show might last for a full week, instead of three days, and we think it should be thrown open for at least one or two days to the public, as distinct from ticket-holders. There can be little doubt that the industry would give the support necessary for these changes.

★ ★ ★

Servicing Technicians' Status

AS the complexity of radio and electronic equipment increases year by year, so the problems of maintenance, repair and routine testing become increasingly serious. Gone are the days when a few simple continuity and insulation tests, supplemented by a little judicious prodding with a screwdriver, could be depended on to reveal the nature of any fault. Now, when the technical developments of the war years are coming to be applied more widely to everyday uses, it will be more necessary than ever for the servicing technician to have a sound knowledge of fundamentals, plus the intellectual capacity for quick deductive thinking.

This journal has long contended that the status and monetary rewards of the competent servicing technician have been inadequate for the training and mental qualities that he should bring to his work. It is gratifying that the importance of servicing—and of those who carry out the work—is now more widely recognised.

When the servicing of domestic broadcast and television receivers was recently discussed at an informal meeting of the Radio Section of the Institution of Electrical Engineers, most of the speakers touched in one way or another on the training and work of servicing technicians. The desirability of a diploma or other recognised "paper" qualification was stressed, but perhaps the most significant contribution to the discussion was the suggestion that the maintenance branch of radio should be regarded, not as a blind-alley occupation, but as a stepping-stone to more responsible jobs in research and development.

★ ★ ★

Amateur Transmitters

BY the time this issue appears, a fair number of amateur transmitters of pre-war standing will probably have resumed operations. That is a tangible and welcome sign that the war is indeed over, though the long-range frequencies are still banned.

Conditions under which licences will be issued to new applicants have not yet been finally settled, but it is clear that evidence of technical competence as well as of morse operating proficiency will be required by the licensing authority—the G.P.O. Failing the possession of acceptable technical qualifications, applicants will be required, according to present plans, to pass a "Radio Amateur's Examination," to be conducted by the City and Guilds of London Institute.

This delegation of responsibility by the licensing authority to an independent non-government body is likely to raise a controversy, though it would be unwise to comment until all the facts are known. There will be no quarrel with the general principle that the would-be amateur wireless operator must give evidence of his ability to avoid interfering unnecessarily with other users of the ether. If, as we hope and think, protective rather than restrictive considerations are to govern the issue of licences, we can see a great future for amateur transmission—one of the finest of all hobbies.

C

AMATEUR COMMUNICATION RECEIVER

Possibilities of Double Frequency Changing

By H. B. DENT

AS the outlook for an early return to amateur radio activities is now considerably brighter, some justification can be found for allowing one's thoughts to dwell on the equipment for the post-war station. For some time to come many of the essential items, such as communication receivers, are likely to be in short supply and the returning amateur may find it necessary either to make do with his old set, if indeed it still exists, or to construct one from such parts as can be obtained to tide over the lean period. The purpose of this article is to offer a few suggestions for that temporary receiver.

Past experience with superhets on the short waves has shown that, while they can be made to provide all the sensitivity and adjacent-channel selectivity one generally requires, there is a very marked susceptibility to second-channel interference. Most of the obscure heterodynes encountered on these frequencies can ultimately be traced to this cause.

It may be remembered that at one time this form of interference was very prevalent on the medium and long broadcast wavelengths, and although a great improvement was effected by using band-pass input circuits in order to improve the signal circuits selectivity, it was not until a change was made to a much higher intermediate frequency that the trouble was effectively laid by the heels.

The intermediate frequency is, of course, not itself responsible for the interference, but it is a contributory cause; the seat of the trouble is to be found with the selectivity, or rather lack of selectivity, of the input circuits.

Perhaps it is not generally realised quite how poor is the selectivity of the average tuned circuit on the short waves. The curve in Fig. 1 may, therefore, be of some little interest as it relates to a quite average circuit tuned to a frequency of 10 Mc/s. Computed on the usual basis of a 3 db. attenuation of the signal, it shows a bandwidth of 120 kc/s, but the most disturbing characteristic is the long trailing skirts to the curve. Quite an appreciable response is obtained as much as one megacycle away from resonance, so it is not surprising that second-channel interference can be very troublesome, even with an IF of 465 kc/s.

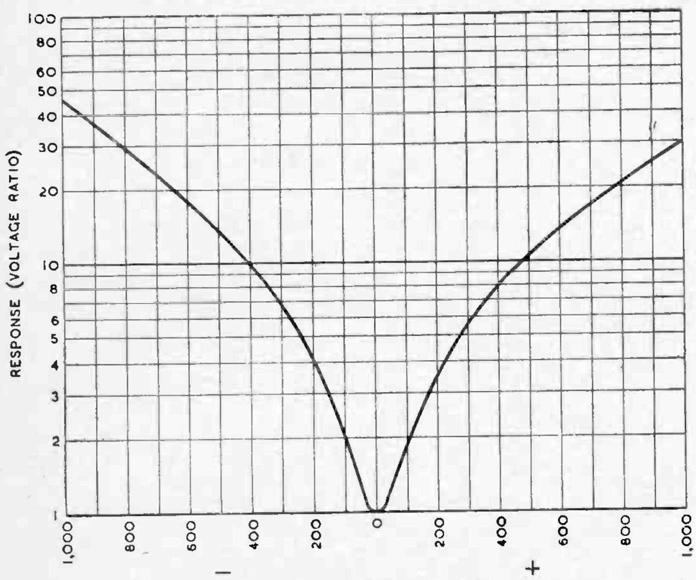


Fig. 1. Response curve of a single tuned circuit of average goodness at a mean frequency of 10 Mc/s.

It was largely because of this that consideration was given to the double frequency-changing system, as by adopting this idea it would be possible to use a much higher intermediate frequency after the first frequency changer, thereby applying the best-known remedy for second-channel interference. The second frequency conversion could then be to a comparatively low frequency in order to obtain adequate adjacent-channel selectivity in an economical manner.

Since the choice of the low IF is unfettered by any considerations of second-channel repercussions, there is no reason why it should not be made as low as practicable.

In the early days of the superheterodyne 110 kc/s was a popular intermediate frequency and it may be remembered that unless the transformers had double-peak characteristics the reproduction of broadcast matter was almost completely deficient in the higher musical register. It was decided, therefore, to investigate the response characteristics of a few typical transformers at this frequency, but using single peak coupling between the primary and secondary circuits.

The result of this investigation

is shown in the form of response curves in Fig. 2 where, for comparison purposes, the response of a good IF transformer designed for 465 kc/s is also included. The broken line curve is the computed response of two of the 100-kc/s transformers.

There does not appear to be any difficulty in reproducing these conditions in practice, so that a low intermediate frequency amplifier, having but one stage in addition to the frequency changer, with two IF transformers, may confidently be expected to provide a bandwidth of approximately 2.5 kc/s. This should more than satisfy the requirements for high selectivity on the short waves, and since even speech quality will suffer from the marked attenuation of the higher tones and harmonics, some form of variable bandwidth control ought to be embodied. The alternative would be to sacrifice some of the available selectivity and by slight over-coupling in the IF transformers set the bandwidth to about 5 kc/s, that is to say, ±2.5 kc/s, in respect to the mean frequency.

Variable bandwidth is not difficult to arrange, and there are several ways by which it can be achieved; possibly an opportunity may be provided to describe the 100 kc/s IF transformer in greater detail at some future date.

The decision to use 100 kc/s for the second IF was to some extent influenced by the belief that some old transformers of this kind were to be found in the spare parts box, and this offered a useful application for them. Many of these old-type transformers had the coupling set to give a band-pass characteristic, and some showed quite a marked double-peak response. If the highest attainable selectivity is desired, the coupling must be loosened, either to the optimum (single-peak response) or even to sub-optimum. The deterioration in the quality of reproduction that must inevitably follow will either have to be tolerated or corrected, as already

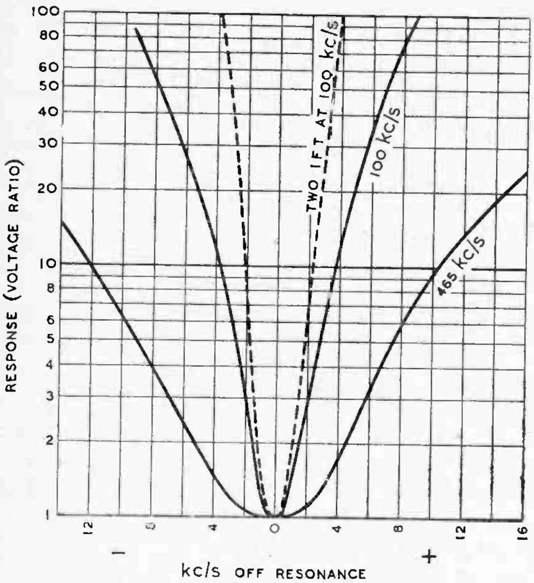


Fig. 2. Comparison between the response curves of two IF transformers designed for 465 kc/s and 100 kc/s respectively.

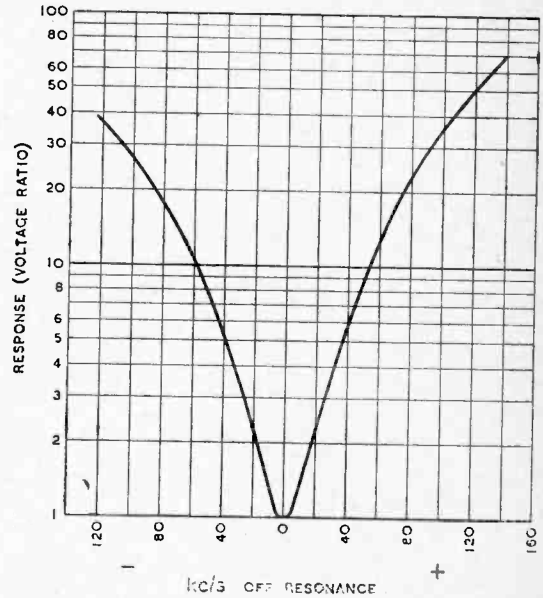


Fig. 3. Response curve of an IF transformer designed for 1.8 Mc/s using sub-optimum coupling.

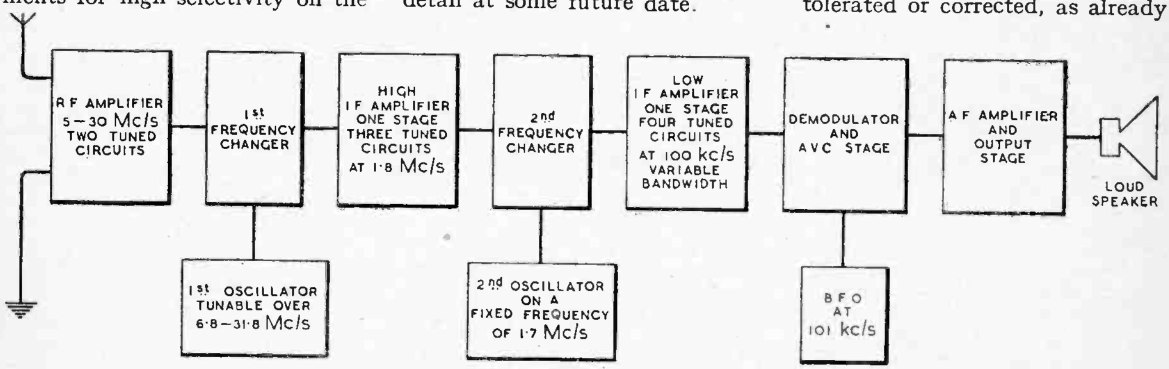


Fig. 4. Block schematic diagram for a double-frequency changer superhet.

Amateur Communication Receiver— suggested. It is possible, of course, to restore the higher frequencies in the AF amplifier by means of a simple form of tone control giving a rising characteristic.

To obtain anything like comparable selectivity at 465 kc/s would demand a long chain of transformers giving some ten or more tuned circuits, and these would have to be interspersed with amplifying stages to make good the attenuation of the signal during its passage through the filter.

Availability of an adaptable component largely influenced the choice of the low IF, and it now remains to be seen if an equally convenient peg can be found on which to hang the first, or high, intermediate frequency.

We could commence by eliminating the frequencies covered by the tuning ranges in the proposed set, assuming this to be 5 to 30 Mc/s. Likewise the frequencies above 30 Mc/s might be dismissed owing to the difficulty of constructing an oscillator for the second frequency changer having sufficiently good stability at these frequencies. Thus, there now only remain the frequencies below 5 Mc/s.

The link between the high and the low intermediate frequencies is the oscillator of the second frequency changer, since its frequency must be within 100 kc/s of the first IF. Now it is desirable that the frequency of this second oscillator be as far removed as possible from that of the first, or tunable, oscillator so as to minimise the risk of heterodyning, which could give rise to whistles as well as spurious signals. This then points to the lowest possible frequency for the first IF consistent with adequate second-channel protection.

Any frequency between 1 and 2 Mc/s should satisfy this condition, that chosen by the writer being 1.8 Mc/s. A satisfactory alternative would be 1.6 Mc/s, and it is quite likely that IF transformers to cover this frequency may soon become available, as it appears to be one of the standard frequencies for IF amplifiers. The response curve for one of the 1.8 Mc/s IF transformers built for a set of this kind is given in Fig. 3.

The block schematic diagram, Fig. 4, shows the functions of the various stages visualised in the proposed receiver. The next step is to translate this into a complete theoretical circuit diagram, but this is where paths will inevitably diverge, for some prospective designers may wish to embody waveband switching, ganged tuning and all the refinements of the commercial type communication set. Others, less exacting, may be content to compromise and gang only the signal circuits, thus avoiding the difficulties of tracking, but retaining the convenience of waveband switching.

The latter arrangement is well suited to a temporary receiver, since it gives to it a certain flexibility should modifications be required, either to the RF amplifier or to the oscillator assembly.

With a separately tuned oscillator it is optional whether one fits coils and waveband switching or

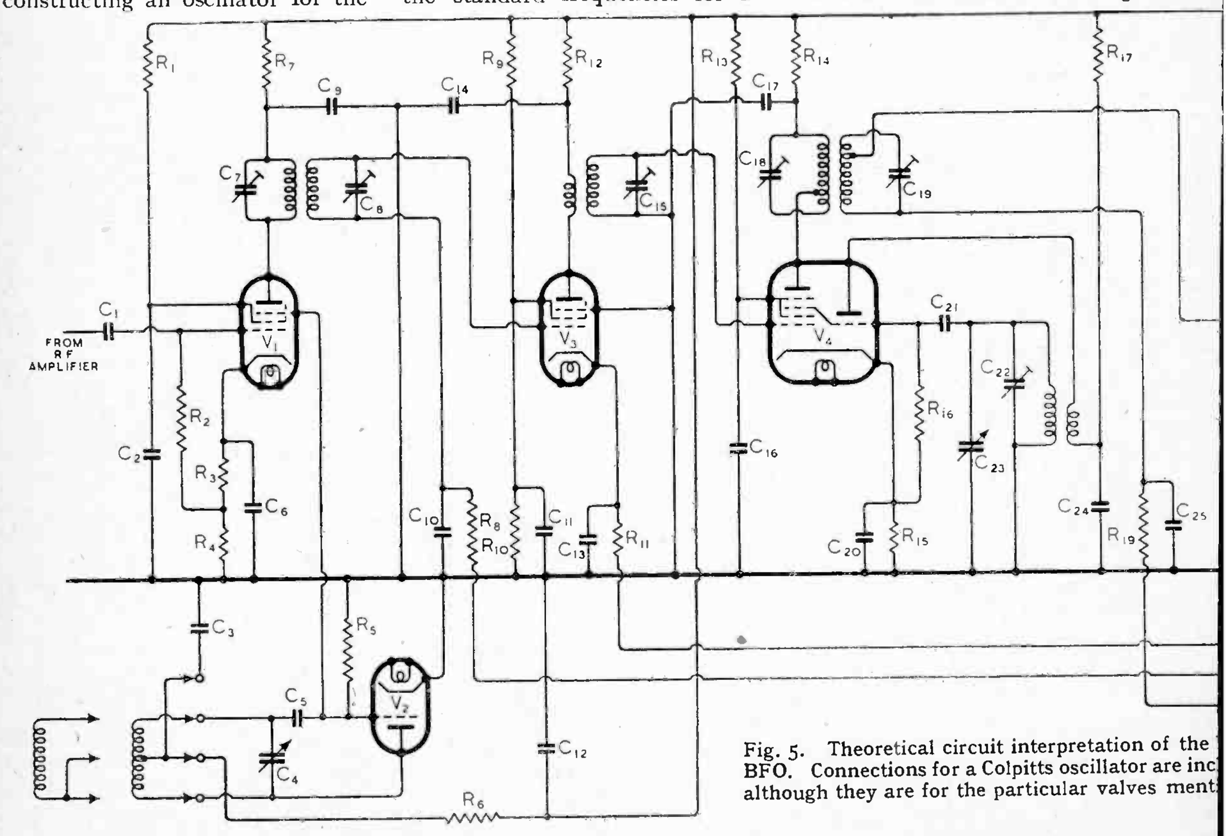


Fig. 5. Theoretical circuit interpretation of the
BFO. Connections for a Colpitts oscillator are inc
although they are for the particular valves ment

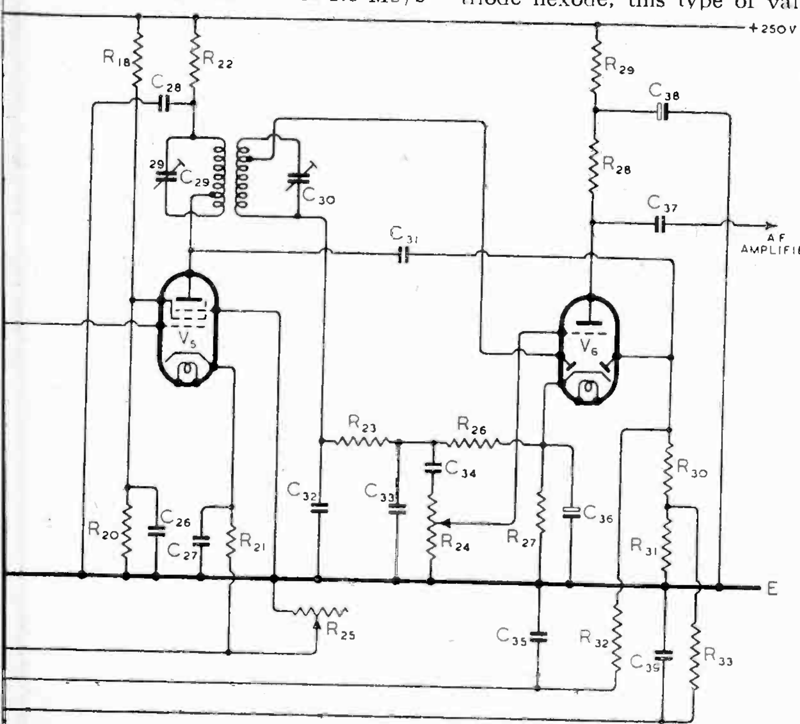
uses plug-in coils. The latter has the advantage that circuits best suited for the different parts of the waveband can be made readily accessible. For example, the Hartley oscillator can be employed for the lower frequency ranges, whilst a Colpitts will usually be more satisfactory for the higher ranges. One method of arranging this is shown in Fig. 5, which theoretical circuit is but one of the several possible interpretations of the block schematic diagram in Fig. 4. Here, coil assemblies for both types of oscillator circuit, including the Colpitts, are shown.

As the circuit in Fig. 5 is merely intended as a guide for the design of a double-frequency changing set, only those parts of the set not common to the orthodox superhet are included. Thus, no details of the RF amplifier are given, since this is perfectly straightforward and, moreover, can be designed to suit individual ideas. One RF stage is quite ample for a set of this kind, as with two tuned signal frequency circuits and a first IF of 1.8 Mc/s there will be practically no trouble from second-channel interference.

In this circuit the first frequency conversion is effected in V_1 with V_2 supplying the local oscillations. A two-valve frequency changer is best suited for wide-band operation on the short waves as it is then possible to choose the most satisfactory type of valve for each function. In this case V_1 could be a high *g* RF pentode such as the Mazda SP41, which has been found very satisfactory in this position, especially when the local oscillations are injected into its suppressor grid.

For best operation this grid must be given a small negative bias and this is provided by the two cathode resistors R_3 and R_4. The latter should be about 15 times the value of R_3, and suitable values for the SP41 valve are 330 ohms for R_3 and 4,700 ohms for R_4. The resistor R_1 can be 100,000 ohms.

A similar frequency changer could be used for the second conversion, but as very good results have been obtained with the X65 triode hexode, this type of valve is shown in position V_4 of the circuit. Here, conversion always takes place from one fixed frequency to another fixed frequency; i.e., from that of the high IF to that of the low IF, and so the second conversion oscillator can also operate the whole time at a fixed frequency. Were it possible without undue complication to ensure perfect stability in this oscillator there would be no need to provide tuning controls, but since it is not, then a small trimming condenser, accessible from the control panel, is used.



matic diagram in Fig. 4, omitting the RF and AF amplifiers and the ne signal oscillator stage. Values of the components are tabulated and will apply for alternative types having similar characteristics.

COMPONENT VALUES

10 $\mu\mu$F		C_1
10 $\mu\mu$F (Var.)		C_{23}
100 $\mu\mu$F		C_5, C_{21}, C_{31}, C_{32}
100 $\mu\mu$F (Var.)		C_4
150 $\mu\mu$F (Pre-set)		C_{22}
500 $\mu\mu$F		C_{33}
0.01 μF		C_2, C_3, C_6, C_9, C_{10}, C_{11}, C_{12}, C_{13}, C_{14}, C_{34}, C_{37}
0.1 μF		C_{16}, C_{17}, C_{20}, C_{24}, C_{25}, C_{26}, C_{27}, C_{28}, C_{35}, C_{39}
8 μF		C_{38}
25 μF		C_{36}
IF Trimmers (Air)		C_7, C_8, C_{15}
IF Trimmers (Mica)		C_{18}, C_{19}, C_{29}, C_{30}
330 ohms	½ W	R_3, R_{15}, R_{21}
1,000 ,,	½ W	R_7, R_{14}
1,000 ,,	1 W	R_{12}, R_{22}
1,500 ,,	¼ W	R_{27}
4,700 ,,	¼ W	R_4
10,000 ,,	Pot.	R_{25}
33,000 ,,	½ W	R_{11}, R_{23}, R_{29}
33,000 ,,	1 W	R_9, R_{18}
47,000 ,,	½ W	R_8, R_{10}, R_{19}, R_{20}
47,000 ,,	1 W	R_{13}, R_{17}
47,000 ,,	2 W	R_6
100,000 ,,	¼ W	R_1, R_5, R_{16}, R_{26}
100,000 ,,	1 W	R_{28}
470,000 ,,	¼ W	R_{30}, R_{31}, R_{32}, R_{33}
1 megohm	½ W	R_2, R_{24}
V_1		SP41
V_2		DL63 (Triode section)
V_3		KTW63
V_4		X65
V_5		KTW63
V_6		DL63

This, then, is the purpose of the variable condenser marked C_{23} in the oscillator circuit of V_4. It need have only a small capacity and about 10 $\mu\mu$F will generally suffice. Initial tuning of this oscillator is effected by the pre-set

Amateur Communication Receiver— condenser C_{22} which should be an air-dielectric type and be fitted with a slow-motion control, or have some form of reduction drive embodied in it. A fixed ceramic capacitor, in conjunction with a smaller air - dielectric trimmer, would possibly enable the slow-motion drive for C_{22} to be omitted and might simplify the initial adjustment.

Excessive amplitude of oscillation must be avoided in this stage and the maker's recommendations concerning the optimum peak oscillator volts should be strictly followed.

The only other matter that seems to require explanation is the arrangement of the 100-kc/s intermediate-frequency transformers. Very high amplification can so easily be obtained at this frequency that it is advisable, if facilities allow, to curtail it by tapping down the anodes and grids of the valves as shown in Fig. 5. A tapping ratio of 3 to 4, measured in terms of turns on the coils, is quite satisfactory, but it is. of course, only applicable in cases where the transformers are constructed especially for this purpose.

Where existing transformers are employed the only alternative is to slightly over-bias the valves V_4 and V_5 by assigning higher values than usual to R_{15} and R_{21}. If V_4 is an X65 and V_5 a KTW63 then these two resistors can be increased to 470 ohms.

Admittedly the amplification of V_5 is controllable by the manual gain control R_{25}, but this also controls the high IF amplifier V_3, in which stage a reasonable amplification must be maintained in the interests of a good signal-to-noise ratio. Although V_5 is included in the AVC circuit, only about half the control voltage is utilised.

This is a refinement that could be omitted and V_5 excluded from the AVC circuits, but unfortunately there then remains only V_3 and the RF amplifier as controlled stages, which would not be entirely satisfactory. It would be unwise to include V_4 in the AVC chain, since with a combined mixer and oscillator valve varying the characteristics of the hexode section often reflects on the triode and so causes a shift in frequency.

TELEVISION PSYCHOLOGY

Is the Large Screen Essential?

By PAUL BELLAC (Engineer, Swiss Broadcasting Service)

IT is extremely interesting to follow in the British and American technical periodicals the debate on the improvements of television reception. This fundamental problem has a direct and wide effect on the construction of television receivers. The question is: Ought we to keep on building receivers for the direct vision of the image on the screen of the cathode-ray tube, or should we go over to the intricate projection apparatus?

It is obvious that viewers are not satisfied with the size of the picture given by pre-war receivers; they insist upon seeing bigger images. For some people, the future of television depends upon the solution of this important question. It is a fact that the present 7½in. × 10in. picture or even the 9in. × 12in. image of the more expensive receivers is quite unsatisfactory. The mind of the viewer cannot free itself from the impression of midgets given by seeing the tiny figures moving on the screen.

On the other hand, many manufacturers take the point of view—which physically is unquestionable—that a small object seen from near appears just as big as a big one seen at a distance, providing both are observed from the same angle. To the spectator sitting in the back row of a cinema the big projection screen may well appear smaller than the screen of his home receiver. Therefore, the small screens should be sufficient, so far as the home television receiver is concerned.

However, this conclusion does not take into account the physio-psychological problems connected with the human eye which, as far as we know, have never been pointed out yet, though the part they play is an extremely important one.

When looking at a near-by object, the axes of the eyes strongly converge, contrary to their position when looking from a much greater distance. This convergency is brought about by a special tension of the optic muscles, and gives our consciousness the signal " near." Therefore everything we observe from a short distance gives us the impression " near." But we can receive the impression " big " only if we are involuntarily obliged to move our eyes or even our head in order to see the whole of it. The eye constantly sweeps the field of vision and the operating process of the eye combines the whole of the image by means of the impressions received. There are many examples of this. For instance, every photographer knows the advantages of enlargements even when they do not reveal new details. The effect of the Tanagra Theatre—in which, through the action of mirrors, living actors appear as small as dolls—is also based on this physio-psychological principle.

Further, we notice in television a marked discrepancy between the smallness of the image and the intensity of the sound. To see small figures move and to hear them speak or sing with the whole strength of the human voice produces an unpleasant impression. The combination of all these elements makes it desirable to give to the home television set a size approaching that of the home moving pictures. As long as this condition is not fulfilled, the reception of television will never be satisfactory, even when reproducing the transmitted image with all its details.

It is evident that there is a future only for the projection television receiver which meets the public's wishes.

BOOK RECEIVED

"Radio Valve Vade Mecum, 1945," by P. H. Brans. A comprehensive valve data book of British, American and Continental receiving valves (including Russian). Published by Algemeene en Technische Boekhandel, Prins Leopoldstr. 28, Antwerp.

NEGATIVE FEEDBACK

1. Some of the Awkward Points Explained

By "CATHODE RAY"

SUCH a lot has already been written about negative feedback that the thought of expecting anybody to read much more seems at first mildly revolting. But in spite of all the explanations that have been given (no, I would hate to say *because* of them) I personally have found the subject remarkably confusing. For example, some articles say feedback reduces hum, while others utter a warning about the increased smoothing needed to prevent hum when feedback is applied. Then, what is the real difference between "voltage" feedback and "current" feedback? A cathode follower looks rather like a "current" feedback circuit, but behaves in the opposite manner. And when one reads that voltage feedback reduces the internal resistance of the valve, but that this holds good for some purposes but not for others, what does it mean? Is the resistance reduced or isn't it? So, in case there are others who are not quite clear about all this, here are some of the shafts of daylight that eventually penetrated my mental gloom.

The general idea of feedback is simple enough ("negative" is understood from now on). Some or all of the output voltage of an amplifier is fed back to the input in such a way as to oppose the input voltage, thus reducing the amplification. To prevent the output from falling, then, the input voltage has to be increased, which is a disadvantage. But it is often worth it, because distortion and other unpleasant things are reduced too, and it is generally much easier to organise a higher input voltage than to obtain equal benefits in any other way. In fact, in designing a receiver to include AVC, the output from the detector is often more than is needed as an input to the audio amplifier, and part would have to be thrown away anyhow. So feedback was a discovery like those of manufacturers who suddenly find that what they had to pay men to cart away or stack into unsightly heaps is a by-product with a good market price.

Although I don't intend to fall back on mathematics in order to dodge saying things plainly in words, I think it is a mistake to fight shy entirely of symbols. So A will hereinafter stand for the voltage amplification obtained without feedback, and B for the fraction of the output voltage fed back. Some writers call these α and β respectively. The amplification factor and internal anode resistance of the valve will be μ and r_a as usual. R_L will indicate the load resistance and R_C the cathode resistance, if any. And v_{gc} will be the signal voltage applied between grid and cathode; v_i the total signal voltage input; and v_o the signal voltage output. They will do to be going on with, I think; and to make sure that the meanings of these symbols are clear let us take a simple example, illustrated by Fig. 1(*a*). Assume the valve has a μ of 25 and an r_a of 10,000 ohms. The amplification A, is $\mu R_L/(R_L + r_a)$; so if R_L is, say, 40,000 ohms, A is 20. R_C doesn't come into the signal question at all, because it is short-circuited to alternating currents by a very high-capacitance by-pass. So $v_{gc} = v_i$; and of course $v_o = Av_{gc}$. If v_{gc} is 1 volt, v_o is 20 volts.

Now suppose we feed back 20 per cent. of this output voltage (i.e., 4 volts); in other words, we make B = 0.2. In symbols, the voltage fed back is Bv_o or ABv_{gc}. In order to keep the output at its original level, v_{gc} must be kept constant; so it is necessary to increase v_i by the same amount as the voltage fed back, making it $v_{gc} + ABv_{gc}$, or $v_{gc}(1 + AB)$.* This, in the present example, is $1[1 + (20 \times 0.2)] = 5$ volts, which result you have of course already arrived at without bothering about formulæ, because I chose easy figures. If you count only what is in the dotted box in Fig. 1(*b*), the valve is still giving a gain of 20; but as regards the whole circuit

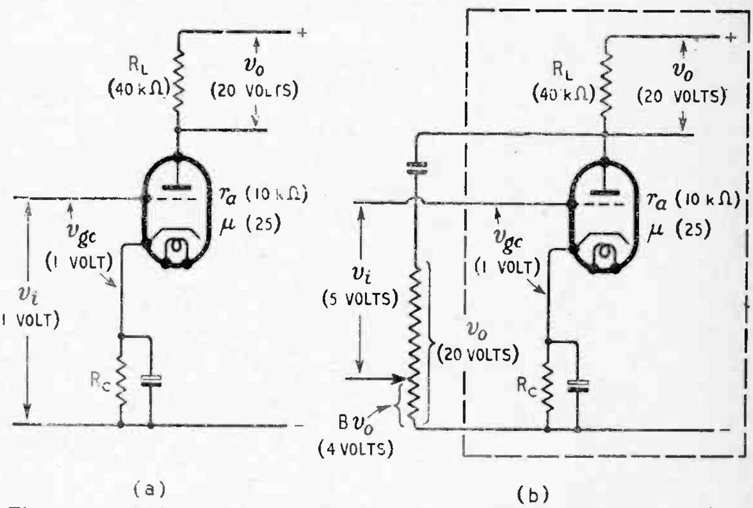


Fig. 1. **Typical example of a simple amplifier stage (*a*) without negative feedback, and (*b*) with 20 per cent. feedback.**

* The position at the input is rather like that of a man with a net salary of £500 a year. If his expenses are £2,000, his gross pay must be made up to £2,500. Strictly speaking, v_i should be v_{gc} (1−AB), and B should be −B to indicate that it is *negative* feedback; but as this article is about negative feedback exclusively it seems a waste of time putting in a minus every time just to be cancelled by another minus, and is one more thing to have to remember if mistakes are not to be made.

Negative Feedback—
the gain is reduced by negativ feedback to v_o divided by the new v_i; that is to say 20/5, or 4.

The general formula for the overall gain with feedback (call it A') is quite easily derived in the same way as the above example was worked out:

$$A' = v_o/v_i = Av_{gc}/v_{gc}(1 + AB) = A/(1 + AB)$$

So the gain with feedback is equal to the gain without feedback (or the gain inside the dotted line in Fig. 1(*b*)) divided by 1 + AB. If 100 per cent. feedback is employed—i.e., *all* the output voltage is fed back, as in the cathode follower—B is 1 and A' is A/(A + 1) or slightly less than 1, as we saw in the November, 1945, issue when considering the cathode follower.

Now to clear up the little mystery about "voltage" feedback and "current" feedback (seeing that in both cases it is voltage that is fed back!). The difference is important, because in one case the valve is made to behave as if its r_a were lower and in the other as if it were higher.

Fig. 1(*b*) is one of the many ways of obtaining voltage feedback. The voltage fed back is a proportion of *the signal voltage across the load*, R_L. Fig. 2(*a*) is the simplest form of current feedback, obtained by forgetting to connect a by-pass condenser across the bias resistor, R_C. Here, again, a voltage is fed back, but it is a voltage proportional to *the signal current through the load.*

The easiest way of seeing what this difference has got to do with r_a is to suppose that the load resistance (say, a loudspeaker) is reduced (by connecting another loudspeaker in parallel). The signal current rises because of the reduced resistance, and the output voltage falls because of the increased "drop" in r_a. If the valve is a pentode, in which r_a is generally much greater than the load resistance itself, the current is only slightly more than before; and as it has to divide between the two loads the voltage across them falls by nearly 50 per cent. But if voltage feedback is in use, the voltage fed back falls in the same proportion, and releases an equal quantity of v_i from its job of neutralising the feedback. There is therefore that much more v_i available to increase the output of the valve, thus wiping out most of the fall in signal voltage. The balance between these opposite tendencies leaves the output signal voltage much less reduced than it would have been without feedback. So one result of voltage feedback is to make the valve behave as if it had a smaller r_a, so far as constancy of output with varying load resistance is concerned.

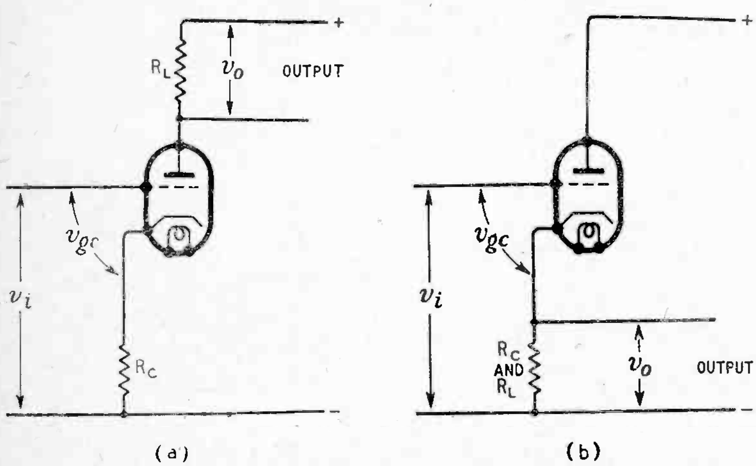


Fig. 2. (*a*) Simplest example of "current" feedback. (*b*), although apparently rather similar, is actually a "voltage" feedback circuit.

Compare with this the result of reducing the load resistance in Fig. 2(*a*), where the voltage fed back is that due to the signal current flowing through R_C, and is nearly proportional to it if R_C is much less than R_L. As the signal current is increased (if only slightly) the fed-back voltage increases, entirely at the expense of v_{gc}, which is thus unable to maintain the signal to the valve even at its original level. The tendency for the output current to rise is therefore checked, just as if the valve had a huge r_a. For operating loudspeakers this is the last thing one wants, so current feedback is avoided in such cases. In fact, unless stated to the contrary, "feedback" will hereafter mean "voltage feedback."

If it were not for R_L, Fig. 2(*a*) would be a picture of a cathode follower circuit. The position of R_L, however, is the essential thing in deciding what sort of feedback is happening; and in a cathode follower (Fig. 2*b*) R_C *is* R_L. So the result is 100 per cent. *voltage* feedback.

But what are we to say about Fig. 3? This is the "concertina" phase-splitter circuit, used in the *Wireless World* Quality Amplifier. As it is required to provide two equal outputs it has *two* load resistances, one of which serves as a current feeder-back for the other and a voltage feeder-back for itself. So, as it appears to be both sorts of circuit at once, what happens to r_a? Well, it is not like the chameleon in the story, that blew up when it was put on a Scotch tartan; it does manage to be two opposite things at the same time. It all depends on which way you look at it. Output No. 1 sees a high-resistance valve, because the voltage delivered to it is practically proportional to R_{L1} (combined with any other load impedances in parallel). Output No. 2, on the contrary, is certain the valve has a very low resistance, because its voltage is only slightly affected by alterations in the load impedance. If these two were human they would undoubtedly go to war to uphold their sovereign rights to the truth about r_a. As they are not, however, they co-operate quite amicably and deliver the goods.

All the same, there is obviously something rather queer about a resistance that can have three entirely different values (counting the original, proper, r_a) at the same time, same place, same current, and even the same frequency; and this should put one on guard against indiscriminate use of these "apparent resistance" values. The thing to remember—and which Fig. 3 brings out well—is that the apparent r_a due to feedback holds good only from the point of view of the load concerned. The valve itself is quite unaware that its own internal affairs are anything out of the usual.

Before investigating the problem of when to use the apparent r_a value (let us call it r'_a) and when to use the real r_a, it would be a good thing to know what r'_a is in relation to r_a. This in itself is a trap into which surprisingly learned people have sometimes fallen. We have already worked out that the effect of feedback is to divide the gain by $1 + AB$. It can be shown (but don't ask me to do it just now) that distortion, noise, hum, etc., are, within certain limits, reduced in the same proportion. But the catch is that r_a is divided (apparently) by $1 + \mu B$. With a triode there may not be much difference between A and μ. In the example with which we started this story, A was 4/5ths of μ. But in a pentode A is likely to be only a small fraction of μ. The result is that r_a is reduced (apparently) far more than the gain or the other things mentioned. In fact, a pentode's μ is so large that even if B is only a moderate fraction, μB is much larger than 1, so r'_a is approximately equal to $r_a/\mu B$, or $1/g_m B$, g_m being the mutual conductance of the valve. The largest possible B (achieved in the cathode follower, for example) is 1; in which case r'_a is very nearly $1/g_m$. In a high-conductance valve, g_m may be as much as 0.01 amps. per volt, making r'_a only 100 ohms. This for a valve with an r_a perhaps getting on for a megohm! So it makes rather a difference which value one uses for one's calculations.

So far we have reckoned that voltage feedback makes the valve behave as if it were an imaginary valve with a lower anode resistance, as regards its "regulation," i.e., the extent to which the output voltage varies due to changes in the output current drawn (or what is the same thing, changes in load impedance); and have called the imaginary valve's internal resistance r'_a. To complete our dream picture it is necessary to give it an imaginary μ, too (call it μ'), which is the real μ divided by the same factor as we have used for r'_a, namely, $1 + \mu B$. So the imaginary g_m is the same

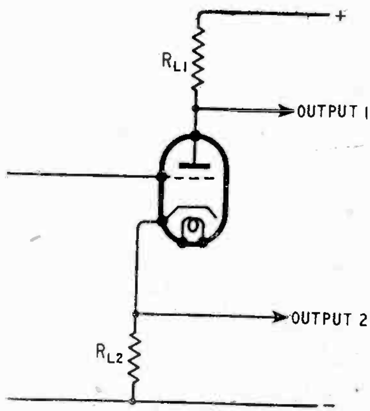


Fig. 3. This phase-splitter circuit is an interesting and instructive case, so far as apparent valve resistance is concerned.

as the real one and needs no new symbol. The real valve with feedback, then, can be replaced in imagination, and in calculations, by one with characteristics μ' and r'_a each $1 + \mu B$ times less than μ and r_a. I am not going to waste the Editor's space by copying out a textbook proof of this; but let us try it on our original example, Fig. 1(*b*). Here the dividing factor is $1 + (25 \times 0.2)$, or 6. So μ' is 25/6, or $4\frac{1}{6}$, and r'_a is 10,000/6, or 1,667. Suppose an input of 5 volts is applied to a valve of these characteristics (*without* feedback). Then the output, $v_i\mu' R_L/(R_L + r'_a)$, is $(5 \times 4\frac{1}{6} \times 40{,}000) / (40{,}000 + 1{,}667)$ or 20 volts, which is what we have found the real valve *with* feedback gives.

Now see what happens to this output voltage when R_L is halved, say, by adding another 40,000 ohms in parallel. The new output is $(5 \times 4\frac{1}{6} \times 20{,}000)/(20{,}000 + 10{,}000)$, or 19.2 volts. (Check it by the "real" way if you wish.) Compare this with the drop in volts that would occur in the Fig. 1 (*a*) circuit; $(1 \times 25 \times 20{,}000)/(20{,}000 + 10{,}000)$ or $16\frac{2}{3}$ volts — a drop of 3.3 volts instead of 0.8. It is clear that feedback is a great help in a system where, for example, varying numbers of extension loudspeakers are used. The improvement is even more marked with pentodes, which have a much higher r_a.

Moving coil loudspeakers have a mechanical resonance usually in the region of 80 c/s. If you give the coil a flick it vibrates several times at that frequency before coming to rest. The same thing is liable to happen whenever a sudden transient in speech or music occurs in whatever programme it is reproducing; and the resulting 80 c/s note, though short-lived, is something that doesn't belong to the programme. It is distortion that has found its way in, giving the reproduction a false 80 c/s "coloration" or boom. I said "*liable* to happen," because it will not do so if the loudspeaker has a comparatively low resistance shunted across it. The reason is that the coil vibrating in the powerful magnetic field generates an EMF, just like any other electric motor, and if it has a low resistance across its terminals the resulting current causes a force tending to oppose the motion of the coil. I don't think I need recite the rest of any elementary book on Electricity and Magnetism, and will merely mention that a visual demonstration of precisely the same phenomenon, called damping, can be obtained by shaking a moving coil milliammeter with and without its terminals short-circuited.

The anode-cathode path of the valve, having an AC resistance r_a, is virtually across the terminals of the loudspeaker (though the route may be a devious one, including a transformer, the power supply smoothing condenser and the bias by-pass condenser). So the extent to which this particular form of distortion occurs depends on r_a. Or r'_a?

If a loudspeaker, or any other generator forming part of R_L, tries to pump current into the anode circuit, and voltage feedback is in operation, its own EMF is fed—not *back*, because it didn't come from there—to the

Negative Feedback—

grid. Suppose that at any particular moment the EMF is of the same polarity as the HT source, increasing the current through the valve. It is therefore fed positively to the grid, which makes the anode current increase more, for a given loudspeaker EMF, than if there had been no feedback. The valve therefore appears to the loudspeaker to have a lower resistance than r_a, and—yes, you are right!—what it appears to be is r'_a. [If you complain that the idea of anything appearing to a loudspeaker is too much like an Æsop's fable, you will prefer to say that the anode current generated by an EMF e caused by the coil of the loudspeaker vibrating is equal to $e/(r'_a + R_L)$ instead of $e/(r_a + R_L)$.]

By now the nature of this make-believe resistance may be becoming clearer. What we are doing is using Ohm's Law in a circuit where two EMFs are operating, and calculating the resistance of the circuit by dividing *one of the* EMFs (generally the smaller one at that) by the current. So, of course, we get a queer answer! In most cases this procedure would be just as silly as it sounds, but in a feedback circuit there is some method in the madness, because the neglected EMF, μv_{gc}, is itself rather of the "apparent" variety, and has for some time been the occasion for a lively technical dogfight, which I have no intention of joining. The point is that there is another voltage—the fed-back voltage is real enough, at least—controlling the anode current, and as this voltage is exactly proportional to the original EMF, it is sometimes simpler to consider the results as being due to a lower resistance instead. It is as if a Rich Uncle (this is a Tale of Long Ago) adopted the benevolent practice of contributing half a guinea for every 4*s*. 6*d*. saved by young Harry for the purpose of buying Savings Certificates. From young Harry's point of view—and from nobody else's—Savings Certificates would cost 4*s*. 6*d*. It would only be reasonable to express the situation in this way so long as Uncle's "EMF" was strictly proportional to Harry's smaller one.

Incidentally, exactly the same convention is adopted with regard to the apparently enormous input capacitance of a valve due to Miller effect. The large extra capacitance does not really exist at all; it just appears to do so because we leave out of the account a second and relatively large charging voltage because it happens to be proportional to the input voltage.

Reverting to our loudspeaker damping question, applying the optimum damping resistance is merely a matter of choosing the amount of feedback, B, which makes $r_a/(1+AB)$, which is r'_a, equal to that resistance. The only problem, then, is to decide what *is* the optimum. Mr. Amos recommends something of the order of half the mid-frequency loudspeaker impedance (referred to the primary of the output transformer).*

Bearing in mind that r'_a is what the valve looks like to the load, the same technique covers other problems in which it is desirable to match the impedance of the signal source to the load. For example, a transmission line. Here the source should be *equal* to the line impedance, and as that is generally quite low, a cathode follower is almost the only answer.

Do you think this sounds like the end of the valve-and-load story? That in all such questions it is on r'_a, not r_a, that the answer is based? If so, you must not miss the sequel next month.

* *Feedback and the Loudspeaker*, December, 1944 issue.

A SIMPLE OHMMETER

IN the July issue of *Wireless World* a description was given of a method of measuring resistance by means of a milliammeter and a voltmeter. The writer has been using a similar instrument requiring only one meter, and the following details may be of interest to readers.

The milliammeter R_m has a resistance of 100 ohms and a full-scale current consumption of 1 milliamp. A resistance R_2 equal to the resistance of the meter is connected as shown. R_3 is a wire-wound resistance of 10,000 ohms, correct to within ±1 per cent. The resistance to be measured, X, is connected to terminals T_1 and T_2.

With the switch down, the meter will be in series with the unknown resistance X and will measure the current flowing through it; R_2 will be in series with R_3 and will simulate a voltmeter load. If the switch is thrown up the meter becomes a voltmeter reading 0-10 volts. The voltage indicated will be that across X and R_2. As R_2 is equal to R_m it will compensate for the removal of R_m from the circuit; in other words, the voltage now indicated is that across X and R_m when the switch was down. Strictly speaking, R_3 should be 9,900 ohms to take into account $R_m = 100$ ohms, but the error will be very small.

The following ranges of resistances can be measured:—(1) With the switch down:—Vary R_1 to such a value that the milliammeter indicates 0.1mA. Then throw the switch up and read the voltage. Then from Ohm's Law we get—

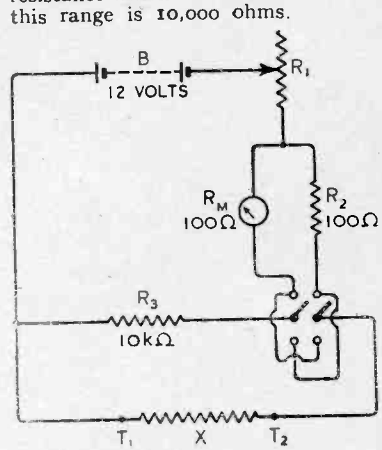
$$\text{Resistance } X = \frac{\text{Volts}}{0.0001} \text{ ohms}$$

In other words, the resistance equals the voltage multiplied by 10,000. For example, a reading of 6.3 volts means that $X = 63{,}000$ ohms. The maximum resistance which can be measured on this range is 100,000 ohms, corresponding to a reading of 10 volts.

With R_1 adjusted to give a current of 1.0 milliamp., on throwing the switch up the voltage is read, and we get:—

$$X = \frac{\text{Volts}}{0.001} \text{ ohms}$$

or, the resistance equals voltage multiplied by 1,000. The maximum resistance which can be measured on this range is 10,000 ohms.



The meter is switched for successive current and voltage readings without altering the load on the battery.

It should be clear that in each case the resistance of R_m (100 ohms) should be subtracted from the resistance obtained above, but in most cases, however, R_m can be neglected. "CALIBRATOR."

PULSE-TIME MODULATION

An Explanation of the Principle

IN a recent article[1] it was said that a train of recurrent pulses could be modulated in amplitude, duration or frequency in order to convey an audio signal, and an explanation was given of the pulse-duration (or pulse-width) system. The principle of pulse-amplitude modulation has also been rather fully described in a paper[2] which also gave some details of pulse-time modulation disguised under the title of pulse-delay modulation.

With this method of modulating pulses, all the pulses have the same amplitude and duration, and modulation is effected by varying the timing of the pulses with respect to a series of marker or synchronising pulses. Fig. 1 shows three cycles of a pulse wave in which the marker pulses are of larger amplitude than the others. In practice, they are not usually of larger amplitude, but have some other feature which enables them readily to be distinguished.

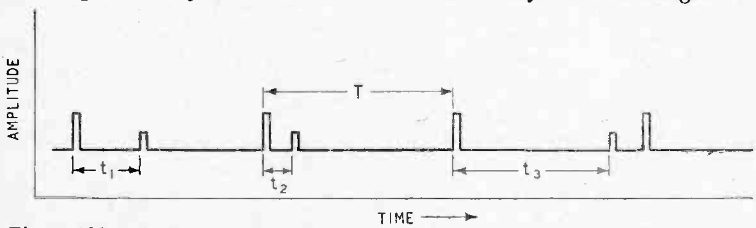


Fig. 1 (Above) This diagram shows the basis of pulse-time modulation. The signal is conveyed by a variable time interval between the tall marker-pulses and the shorter signal pulses.

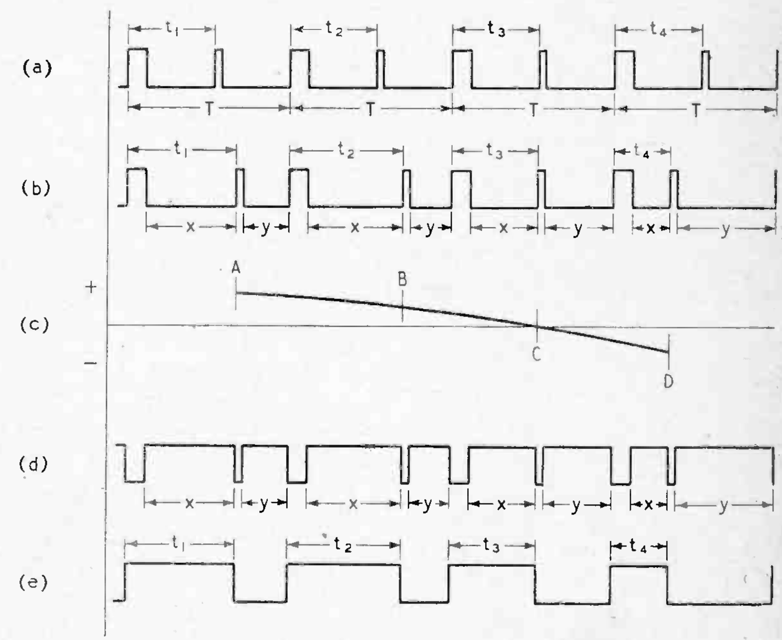


Fig. 2. (Right) Here the marker pulses are shown as broader than the signal pulses instead of taller. Unmodulated pulses appear at (*a*) and a set modulated by the waveform (*c*) is shown at (b). The same pulses appear in opposite phase at (*d*) and at (*e*) the pulses of (*b*) have been converted to width-modulation by a trigger circuit.

It will be remembered that pulse modulation is adopted primarily because most centimetre-wave generators do not take kindly to the conventional amplitude or frequency modulation but are readily pulsed. It is used also because it lends itself particularly well to multi-channel operation with equipment which is relatively simple compared with that of the ordinary sub-carrier method.

Some trials have recently been carried out in the U.S.A. of a 25-cm. twelve-channel system utilising pulse-time modulation.

These marker pulses occur regularly at a frequency $f = 1/T$ where T is the interval between successive leading edges. The timing, and indeed all characteristics of these pulses, are unaffected by modulation. Another set of pulses between the markers conveys the intelligence. In Fig. 1 a single small pulse is shown after each marker with time-spacings from the markers of t_1, t_2 and t_3. These pulses are all of the same amplitude and duration, and the spacing from the marker pulses is varied by the modulation.

Fig. 2 shows at (*a*) the unmodulated pulse waveform and here the marker pulses are distinguished from the carrier pulses by being of longer duration instead of greater amplitude. Four cycles are shown with a constant time T for each cycle. The carrier pulses of shorter duration are spaced from the markers by the time intervals t_1, t_2, etc., which are all the same in this unmodulated case.

The modulation affects the value of t_1, t_2, etc., in accordance with the amplitude of the modulating signal as shown in (*b*). The small piece of the modulating signal itself corresponding to these four cycles has the form (*c*). At A, the signal is positive and the timing t_1 of the first pulse is increased above the unmodulated value. At B the

[1] Pulse-Width Modulation, *Wireless World*, December, 1945.

[2] Multi-Channel Communication Systems, by F. F. Roberts and J. C. Simmonds, *Wireless Engineer*, November, 1945.

Pulse-time Modulation—
signal is still positive but not to such a great extent, so that the second pulse interval t_2 is less than t_1, but still above the unmodulated value.

The signal at C is passing through zero, so that the timing of the corresponding pulse is unaffected. At D the signal is negative and consequently t_4 is less than the unmodulated value.

In the case of a single-channel system the difference between pulse-time and pulse-width modulation is not large. If the waveform (*b*) is drawn inverted as at (*d*) it will be clear that the intervals between the end of a marker pulse and the start of the carrier pulse in (*b*) becomes a set of width-modulated pulses in (*d*). The further intervals in (*b*) between the ends of the carrier pulses and the beginnings of the markers, becomes a further set of width-modulated pulses in (*d*).

The first set of intervals in (*b*) is designated by *x* and if the corresponding pulses in (*d*) are regarded alone, it is clear that they form a duration-modulated series with constant leading edges. Similarly the second set of intervals in (*b*) is labelled *y*, and regarding the *y*-pulses in (*d*) alone, these also plainly form a width-modulated series, but this time with constant trailing edges.

Demodulation

Now it was explained previously[1] that a width-modulated set of pulses is equivalent to the modulating frequency plus the spectrum of the pulse waveform and certain modulation products, and that to reproduce the original modulating waveform it is only necessary to filter out the unwanted frequencies. The waveform of Fig. 2 (*d*), and this is only the signal of (*b*) in opposite phase, shows two width-modulated sets of pulses. The two sets of pulses, however, are modulated in opposite phase and to the same degree. Inspection of (*d*) makes this clear, for if an *x*-pulse decreases in width by any amount the following *y*-pulse increases in width by the same amount.

If the waveforms of (*b*) or (*d*) are passed through a low-pass filter, the *x*-pulses will produce the original modulating signal and the *y*-pulses will also produce it but in opposite phase. The two cancel and the resulting output is zero. The pulse-time modulated signal, therefore, cannot give the original modulating signal merely by a simple filter.

One method of obtaining the audio signal is with a trigger circuit. It is not hard to devise a valve circuit having the property of changing from one fixed output to another each time a pulse is applied. Thus, the anode voltage of a valve might change between two fixed values of 100 volts and 200 volts. If originally at 100 volts it would jump to 200 volts on the application of a pulse and stay there until the next pulse makes it return to 100 volts, and so on.

Such a device applied to the waveform of Fig. 2 (*b*) would produce an output (*e*). This is a single set of width-modulated pulses and the audio signal can now be produced by passing it through a low-pass filter.

Multi-channel operation can be obtained by interlacing sets of staggered pulses, for it is only the changes in the pulse timing which convey the modulation. A common set of marker pulses can be used for each channel. Three such channels are shown in Fig. 3. The marker waveform is at (*a*) and the three sets of channel pulses at (*b*), (*c*) and (*d*). On these the pulses themselves are shown by solid lines and the limits of the pulse excursion by the dotted lines. Under the influence of the modulating signal the pulse can move anywhere within the limits of the dotted rectangle.

The three sets of channel pulses and the marker pulses are added together at (*e*) and give the complete pulse waveform. The variations of timing t_b give the signal corresponding to channel *b*, the variations of timing t_c that corresponding to channel *c* and so on. At the receiving end, the channels are first separated by a gating device, which is triggered by the marker pulses, and then demodulated individually.

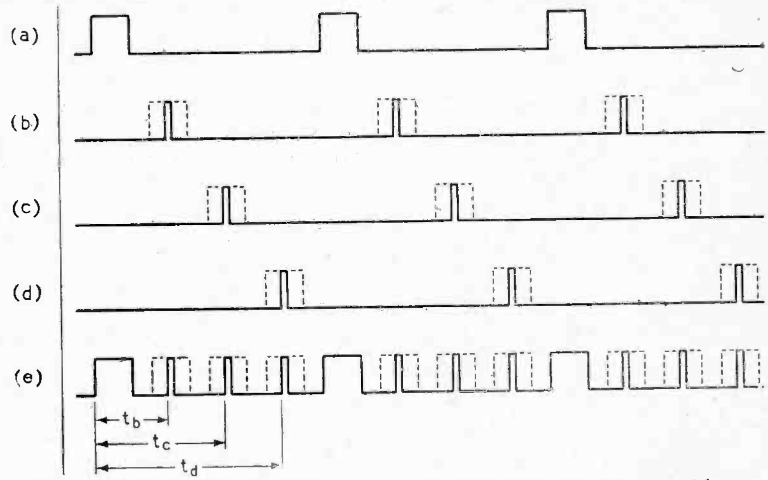


Fig. 3. A three-channel pulse-time modulation system is illustrated here. The marker pulses are shown at (*a*) and three individual channels at (*b*), (*c*) and (*d*). The combined waveform appears at (*e*).

VACUUM-SEAL BUSHING

A TECHNICAL leaflet describing Ferranti's Type 625B1 bushing gives dimensions and methods of application. The insulator is a hollow truncated glass cone ($\frac{7}{16}''$-$\frac{5}{16}''$) with copper flange and end cap for soft soldering to metal case and lead-out wire. If desired, the insulator can be inverted and mounted inside the case, when the cone can be used to give support to a flexible lead; the live connection is then completely protected and the component can be handled with safety.

Under normal conditions maximum working potentials up to 1,000 volts can be employed.

The leaflet is obtainable from Ferranti, Ltd., Hollinwood, Lancs.

INSTRUMENT PROGRESS: 1939–1946

Reflections on the Physical Society's Exhibition

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

NOT least among the marvels at the Physical Society's Thirtieth Exhibition was the catalogue. It was a novel experience in these days to see such good value for money; but to get a much greater quantity of paper—and good paper at that—than in 1939 . . . . surely this raised the whole affair to the plane of the miraculous at the very start. A grateful tribute must be paid to those who, under great difficulties, compiled this valuable work of reference; and to the Paper Controller for what we hope is but a sample of a more enlightened attitude to scientific and technical needs.

Whether the Exhibition itself fulfilled expectations, pitched peak-high by its being six war years instead of one peace year since the last, depended on how closely one had been in touch during that interval. Even the visitors who were not inside some part of the veil of secrecy during the war had opportunities in the last few months of reading about the more spectacular developments, and for them the edge must have been dulled. But to any Rip van Winkle coming in fresh from 1939 the atomic bomb itself would have been less unexpected than the magnetron, weighing a mere pound or so, but capable of generating 500 kilowatts at 3,000 megacycles per second, via a single-turn coupling coil only ¼in. in diameter. He would have been impressed—to put it gently— with this example of the way in which a one-hundredfold extension of radio frequency had been exploited. The whole centimetre technique, colloquially called plumbing, to him would have been new and strange. Perhaps the most significant fact about it all is that, instead of a few scientists playing around in laboratories with elusive milliwatts, many mechanics have been handling real power in a most practical manner in the field.

For another of the outstanding changes is that, instead of the perfunctory "tropical finish" of pre-war days, apparatus of greater and greater complexity and precision has had to be made so that it can go from stratospheric cold to steaming heat, be dropped in the sea, blown up, installed in termite's nests, fired from guns, and still work. This experience should be all to the good in tackling one of the biggest peacetime problems—the export trade.

Another war influence that should be seen in future products is the so-called miniaturization. Very small valves and components used to be too "special." Now they have had to be mass produced.

Looking at the Exhibition more particularly for its measuring and test gear, two things (both traceable to the war) struck one. In the old days, it was assumed that most of the instruments shown would be used, if not by scientists, at least by "persons skilled in the art." Now, not only is the tendency to make them as foolproof as possible, but many exhibits had no other purpose than to enable skilled operations to be carried out by unskilled persons. An example outside our field, but making use of its technique, was the large variety of "magic eye" instruments for indicating the end-point in chemical titration. The emphasis of the Exhibition, in fact, was far more on industrial needs than ever before.

The other notable feature was that the instruments, with some exceptions, were more specialised. There were fewer "do-alls" and "pocket laboratories." One notable exception was the AVO Multi-Range Electronic Testmeter. Its specification is one of the things that would have wakened Rip van Winkle with a start. The applicability of many of the other AVO instruments has been widened by accessories, so that — another "industrial" touch — our old friend the Avometer can now measure up to 480 amps. Another versatile new instrument was the Labgear Fault Tracer. With one of these miniature cathode-ray oscilloscopes and an AVO 1,000 ohms-per-volt AC/DC test meter, there are few service jobs that could not be tackled.

A significant trend was seen in the Cossor Type 448 oscilloscope, which might well be called an "oscillo*meter*," for its controls are directly calibrated in time and voltage, and facilitate quantitative study of waveforms.

While progress has gone ahead in so many directions, none has been made towards dropping the absurd term "DC current," which was more prevalent than ever. But while terminology was unregulated, the same could not be said of power supplies. The ubiquity of equipment designed to counteract fluctuations in mains voltage was no compliment to supply authorities. Constancy of voltage with change of load was also well provided for.

Among many other signs of progress, the following are stray samples: 0.012 *farad* capacitors (TCC); 100,000 ohms-per-volt moving-coil multi-range meters (Tinsley); ohmmeters reading to 5,000,000 megohms (British Physical Laboratories); oscillograph sensitivity of 0.005 volts/cm. from 2 c/s to 2 Mc/s (Mullard); and 40 Mc/s quartz crystals (Marconi). And if one found all these things rather tiresome, one had the opportunity of learning how to measure the radius of curvature of razor blade edges, the turbidity of beer, and the firmness of cheese (considered as a highly viscous Newtonian fluid or an approximately Hookean solid). One of the great values of this annual Exhibition, in fact, is that it helps to broaden the outlook by revealing the ways in which progress in so many sciences and industries is increasingly inter-related.

PHYSICAL SOCIETY'S EXHIBITION

First Post-war Show of Testing and Measuring Gear

AVO valve tester incorporating an overload cut-out

EQUIPMENT for test, measurement and research still forms the backbone of the Physical Society's Exhibition, but, perhaps to a greater extent than in pre-war years, new materials and accessories intended for more general use were exhibited. At the Exhibition, held in London on January 1st-3rd, radio was well to the fore; hardly a stand, except perhaps in the optical section, failed to show something of a radio or radio-like nature.

Meters of the type which may be described as pointer instruments cover a very wide field as they form the nucleus of all multi-range test sets and figure in one form or another in most test instruments. Meters of this kind were shown by many firms, including British Physical Laboratories, Elliott, Measuring Instruments (Pullin), Sangamo - Weston and Ernest Turner.

An interesting development was seen in the AVO instruments in which there is embodied an overload cut-out which not only protects the delicate movement of the meter, but now safeguards the instrument as a whole. Among the new Avometers is a multi-range meter similar to the earlier standard type but fitted with a high-sensitivity movement requiring only 50μA for a full scale deflection. This gives a resistance on the DC voltage ranges of 20,000 ohms per volt.

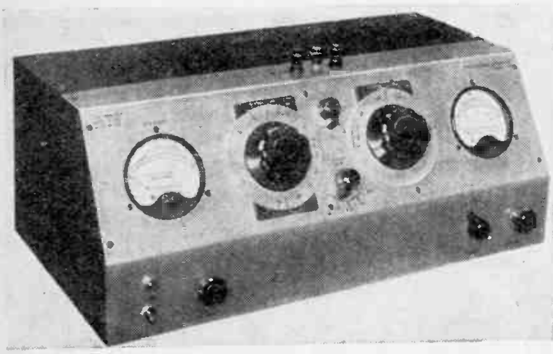
Dynamometer instruments in two- and three-element types were shown by Sangamo-Weston. These are doubly magnetically shielded and have an accuracy of from 0.1 per cent. to 0.25 per cent.

Measuring Instruments (Pullin) were showing a meter with scales engraved for multi-range use, but without shunts, series resistances and other adjuncts. This is for use as the nucleus of a comprehensive test set for which the firm can supply circuit values and other data.

Test Equipment.—There was a wide range of factory production test equipment and radio servicing apparatus, among which the new Model 11 AVO valve tester was conspicuous. This is a very flexible instrument enabling every practical test to be carried out on all normal type valves in general use. It provides for measuring mutual conductance, reads current to all electrodes and voltage to the majority, and enables a complete set of valve characteristic curves to be plotted. Inter-electrode insulation can also be measured. The AVO safety cut-out already mentioned is included.

British Physical Laboratories have developed a range of test sets covering the requirements for production-line testing of radio equipment. These include a high-frequency capacitance bridge for measuring capacitors of from 1pF to 3,000 pF at 1Mc/s, an electrolytic condenser bridge covering capacitors of 0.2μF to 2200μF and fitted with an automatic overload protection device, various ohm and megohm meters and a comprehensive coil analyser giving "Q" values and the self-capacity of coils from direct-reading scales. It covers a range of inductances from 0.8μH to 100mH and "Q" values between 10 and 500. A coil comparator designed for rapid testing and adjustment of coils under mass-production conditions was also shown.

A "Q" meter for measurements of coils, condensers, aerial equip-



Coil Analyser made by British Physical Laboratories

Leland VHF "Q" meter

ment and dielectrics at the unusually wide frequency range of 30 to 200Mc/s was shown by Leland Instruments. Described as the Boonton Model 170A it covers a range of "Q" values of 0-300 by direct reading, which is extended to 1200 by a multiplier.

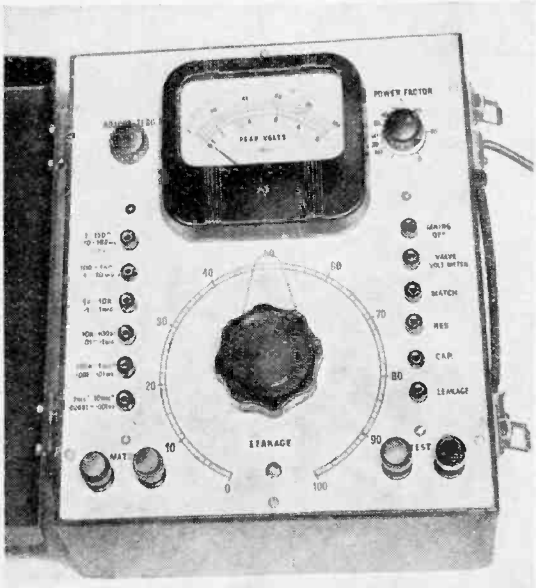
Made by the same firm is a series of combined frequency and amplitude-modulated signal generators. The standard model 150A provides a signal voltage in two frequency bands, a carrier frequency variable between 41 and 50Mc/s and an intermediate frequency covering 1 to 10Mc/s. Either AM or FM can be used on either radio-frequency band. Other models in the series provide different frequency ranges.

The television test oscillator shown by E. K. Cole provides a standard signal pattern for checking and adjusting television receivers. It is normally connected by cable to the set, but a short aerial rod may be used to give a feeble radiated test signal.

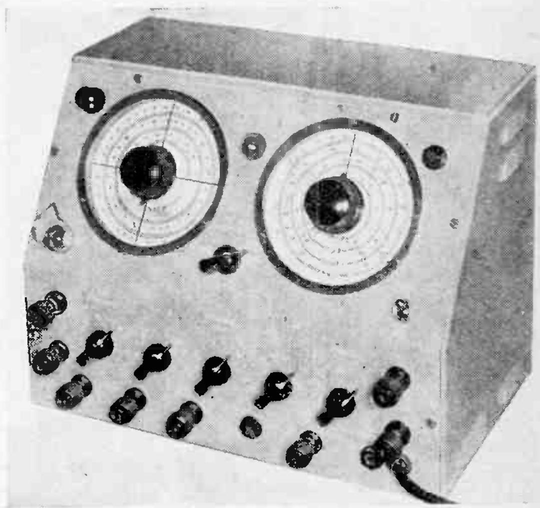
A versatile resistance-capacitance bridge embodying a valve-voltmeter was shown by Measuring Instruments (Pullin). Apart from measurements against built-in standards the bridge can be employed with external standards and as a valve-voltmeter. The resistance range is 1Ω to 10MΩ and the capacitance coverage is 10pF to 100μF.

An interesting piece of apparatus is the Labgear Fault Tracer. This consists of a signal generator covering 100kc/s to 30Mc/s with a 1,000-c/s AF oscillator which can be used for modulation. Ganged to the frequency control are the tuned circuits of a built-in receiver which can be used to detect a signal in the early stages of a set and so enables each stage to be tested independently. A resistance-capacitance bridge is also included.

Resistance-capacitance oscillators were to be found on the stands of many firms. Dawe Instruments have two models, one covering 20c/s to 20kc/s with an output of 1 watt and another covering 20c/s to 200kc/s, but with only 100mW output. Marconi Instruments have one covering 15-20kc/s in three ranges with outputs of 50 volts in 5kΩ or 10 volts in 600Ω for 0.4 per cent. distortion.



(Above) Pullin resistance - capacitance bridge embodying a valve-voltmeter



(Right) The Labgear Fault Tracer

This firm had also a VF oscillator; it is a BFO with outputs from 50c/s to 5Mc/s in two bands. The output is 1 watt into impedances from 20Ω to 1,000Ω.

A feature of the Marconi Instruments TF867 signal generator, which covers 15kc/s to 30Mc/s is an AGC system to keep the output constant within ± 1db. without resetting. There is a manual adjustment for precise setting as well, and a crystal calibrator is included. The TF801 covers 6-300Mc/s in four bands with turret coil-changing; there are no switch contacts, the coil connections being made through the capacitance of vanes attached to each coil meshing with fixed vanes. Pulse or sine-wave modulation is provided.

The Mullard BFO Type E810 has 4 watts output for 1 per cent. distortion and the output is constant within 1db. from 15c/s to 20kc/s. Impedances of 15,600 and 2,500Ω are provided.

The electronic frequency meter shown by Salford Electrical Instruments has a range of 50c/s to 45 kc/s and is independent of waveform. The frequency to be measured is first converted to a square waveform of constant voltage and then applied to a rectifier stage in which the indicating instrument shows a deflection proportional to frequency.

Two interesting high-voltage valve voltmeters were shown by Salford. One makes use of the lineal relationship which exists between grid and anode voltages in a cathode-ray tube at the point of extinction of the beam. The voltage to be measured is applied to the anode and the extinction voltage is read off a calibrated grid bias control. Peak voltages up to 10,000V may be measured and the instrument is suitable for audio or radio frequencies and pulses. The other, incorporating a capacitance potential divider, has been developed for the plastics industry for measuring potentials up to 10,000V in RF heating equipment.

Impedance measurements are catered for in several ways. Dawe Instruments have a T-bridge for inductances between 10mH and 100H, the measurement being made at 1,000c/s and also an impedance comparator covering 20μH to 100mH, 20pF to 0.1μF and 40Ω to 100kΩ. An impedance meter of the "ohmmeter" type was shown by

Physical Society's Exhibition—

Labgear. It measures impedance from 3Ω to 5,000Ω in two ranges and is normally calibrated with 10 per cent. accuracy at 50c/s. Special calibrations can be made up to 20kc/s.

A valve electrometer due to Dr. F. T. Farmer was shown by the Baldwin Instrument Co. Three voltage ranges cover zero to 280V, and the instrument has the remarkable input impedance of 10^{16} ohms and a capacity of only 1pF.

Precision apparatus of the laboratory type was shown by Gambrell Bros., Clifton Instruments, W. G. Pye and W. H. Sullivan.

Materials and Components.—The principal interest in magnet materials was provided by the demonstrations of "Alcomax II," shown by the Permanent Magnet Association, a nickel-aluminium-cobalt-iron alloy, with a magnetic energy nearly three times as great as Alnico. Numerous fabricated examples ranging from miniature pick-up bars to magnetron field magnets were shown.

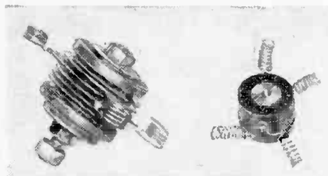
"Telcothene," one of the newest thermoplastic materials having a polythene base is now available in a variety of styles. It was shown by the Telegraph Construction and Maintenance Company in the form of thin flexible sheet as well as in rod, tube and strip. Insulating sleeving is now made from this material and is available in a wide range of sizes and colours. Telcothene is used also in the Telcon high frequency cables. The same firm also showed "Telcoseal," a new alloy for use in glass-metal seals; the use of this form of sealing is rapidly spreading from valves to humbler components.

Included among the latest TCC products is a range of small disc-type metal-cased capacitors with mica dielectric. The receiving styles are described as the Type CM30 and they are made in values from 100 to 500 pF for 350 volts DC working. There was shown also a new range of tubular paper capacitors enclosed in hermetically sealed glass tubes and available in sizes ranging from 0.001 μF to 0.1 μF in working voltages of 200, 350 and 500 DC.

Accessories.—A gramophone pick-up with a response of −2db. at 25c/s and −5db. at 9,000c/s was shown by Standard Telephones and Cables, Ltd. Of 600 ohms impedance, it is of the moving-iron type with a large air-gap and has an output of 30db. below 1mW. A sapphire needle is used. It is designed primarily for use with acetate recordings and a moving-iron recording head for making these was also shown.

STC moving-coil microphones are available in tropical and non-tropical types. The latter have aluminium wire for the coil, whereas copper is used in the tropical pattern, which is also sealed.

Standard Telephones also showed a range of Thermistors; also selenium rectifiers, the latter low-current tubular types for outputs up to 2,000 volts at 10mA and single plate rectifiers of which the smallest is some 0.55in. × 0.2in. × 0.1in. These last are for use in AC voltmeters and in AF communication circuits.



Moisture-proof Westinghouse instrument rectifiers

The latest improvement made in the Westinghouse range of copper-oxide instrument rectifiers render them entirely moisture-proof. Indeed, unsealed units operate satisfactorily when immersed in water.

Relays were shown in great number and variety, ranging from heavy current types for controlling power circuits to low-capacitance types for aerial switching. Both normal pattern and mercury-contact types were shown by Hendrey Relays, while Londex had aerial change-over types with polystyrene insulation. The AECO4 will handle 4A and requires 3VA for operation.

The principal item of interest among the exhibits of the Telephone Manufacturing Co. was the Carpenter high-speed telegraph relay. It combines the features of high sensitivity and high contact pressure.

Several firms were showing variable mains transformers. Gresham Transformers had one handling 10kVA and providing an output of 0-230 volts for an input of 230 volts. It consists of a transformer with a tapped winding and a separate commutator-type selector switch.

Valves.—Miniature battery valves rated for 1.4 volts LT supply were shown by Cossor. They comprised a complete range with a ring-seal base to fit the miniature 7-pin socket. Ferranti have a cold-cathode gas-triode capable of controlling a peak current of 20mA and drawing less than 4μA from the triggering circuit. It needs a minimum signal of 5 volts. Ferranti also showed an interesting double electrometer triode with an ion screen between the filament (2V, 0.1A) and the grids. The grid and anode structures surround the screen as in a single triode, but are each split into two separate halves, thus making a double valve for balanced circuits.

Although details of the cavity magnetron have not yet been officially divulged, specimens (including cut-away demonstration models) were shown by exhibitors. Other wartime valves are referred to later in this review.

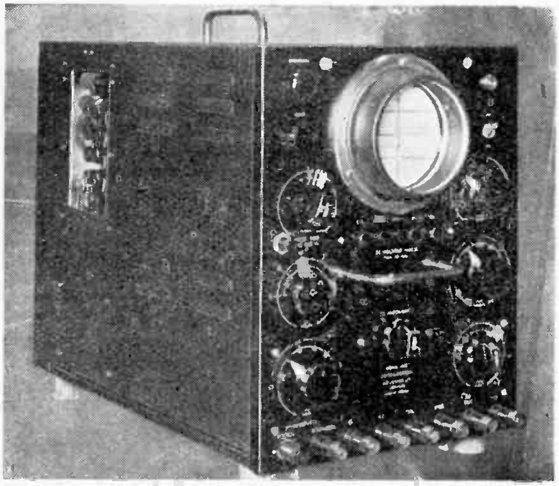
A wide range of selenium barrier-layer photo-cells was shown by Evans Electroselenium. Of particular interest is a high-voltage type intended for use with valve amplification. This consists of an assembly of series-connected photo-electric elements; the output across 1MΩ is about 1 volt for an illumination of 5ft.-candles, rising to 7.3 volts for 500ft.-candles.

There is now a tendency to seal quartz crystals in an evacuated glass envelope similar to that of a valve, and samples of this technique were to be seen in the exhibit of Marconi's W.T. Co. and Salford. Types for frequencies up to 10Mc/s were shown by Standard Telephones.

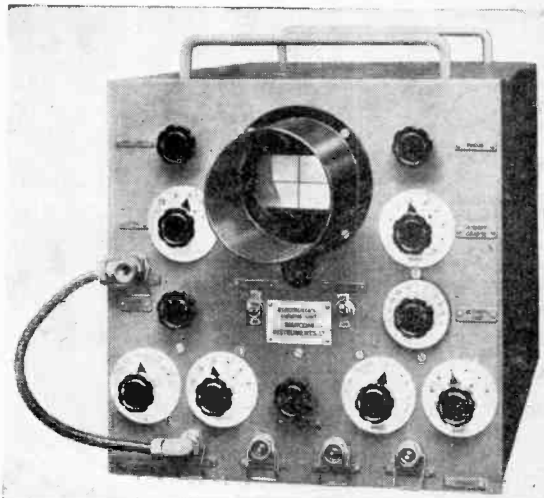
Industrial Electronics. — Several examples of dielectric heating equipment were shown in operation. The trend of design is towards self-contained metal cubicles incorporating a screened heating chamber with safety switches. In the generator shown by Scientific Acoustics, press-button controls are employed with a self-resetting process timer, and the heating chamber is interchangeable. The output power from the single air-cooled oscillator is 2kW at 45Mc/s. The Ferranti-Wild-Barfield equipment employs a push-pull circuit

Multitone Type B pocket hearing aid with 10mm. valves and layer-built HT battery giving 2kW at 35Mc/s, and an interesting feature is the automatic power output control in which the spacing of the "work" electrodes is varied by a small motor. Demonstrations were given by Rediffusion of their RH2 generator working in conjunction with apparatus for drying powders and the rapid concentration of temperature-sensitive chemical solutions.

The application of valve voltmeter methods in conjunction with a "magic eye" indicator has simplified potentiometric titration end-point measurements which can now be carried out by junior laboratory assistants. Examples shown were the Griffin and Tatlock "Tep-meter" and the Mullard-BTL potentiometric titration apparatus. These operate from AC mains, and the EMF developed by suitable electrodes in the test solution is balanced against a calibrated potentiometer.



(Above) Cossor Model 448 double-beam oscilloscope



(Right) Marconi Instruments Electrostatic Viewing Unit

Several methods are employed for the detection of cracks in metals. In the Salford crack detector the principle involved is the change in frequency of a tuned circuit caused by interruption of the surface eddy currents in the specimen. The supersonic flaw detector shown by Henry Hughes works on the echo sounding principle, 2.5Mc/s quartz crystals being used as surface transmitters and receivers. A pulse technique is employed in conjunction with a CR tube display, and indications of cracks, porosity and other faults are given up to depths of 12ft. with accurate information of the distance below the surface.

Another application of valves was seen in the Honeywell-Brown electronic continuous balance potentiometer pyrometer. In this the unbalanced voltage is amplified and converted to AC which is then applied to a reversing motor which moves the potentiometer slider towards the new balance point.

Grain moisture measuring equipment was shown by many organisations, and usually functions by measuring the capacitance of a standard quantity of grain. The NPL showed the circuit of a simple AC-operated meter in which an alternating voltage is applied through a phase-shifting network to the grain cell. The output is compared with the phase of the supply in a valve circuit. The Marconi Instruments models—both battery and mains driven — measure the effect of the grain cell upon the "Q" of a circuit, and means are provided for ensuring that the cell always contains the standard quantity of grain. The Mullard instrument measures the capacitance change and covers the ranges of 11-30 per cent. moisture content for wheat, 10-25 per cent. for oats, and 12-25 per cent. for barley. The Dawe Instruments model functions by measuring the alternating current passed by a standard quantity of grain, and this same principle is also applied for ascertaining moisture content of timber.

Marconi Instruments showed a pH meter employing an electrometer triode with an HT supply stabilised by a thyratron. It is AC operated and the warming-up drift does not exceed 15 minutes.

Medical Applications.—Many new developments in hearing aids, both in principle and practice, were to be found on the stand of Multitone Electric. Those who are unable or unwilling to take advantage of the system of "unmasked hearing" which requires the use of separate earpieces are now offered the alternative of "differential compression" for which only one earpiece is necessary. Amplitude compression is applied in the middle and low frequencies but not to the high frequencies; thus the masking effect of sounds in the regions of highest energy is reduced and intelligibility improved. A range of new pocket aids employing British-made 10mm. valves and layer-built batteries was shown. The Type B measures only 5¾in. × 2⅞in. × 1½in. with self-contained batteries and weighs 12½ oz. The LT consumption is only 60mA at 1.5 volts. Instruments for research in hearing deficiencies and permanent hearing aid installations for schools for the deaf were also exhibited.

The portable Cambridge electrocardiograph makes use of a string galvanometer, projection lamp and continuous paper camera and measures only 20in. × 11½in. × 9in.

Cathode-ray Gear.—The cathode-ray oscilloscope has now been with us for many years, but is steadily being improved, particularly in its accuracy for quantitative work as distinct from its use as a pictorial wave indicator. The Model 448 double-beam oscilloscope shown by Cossor has a tube giving a particularly fine trace; the time-base can be used to give a single stroke triggered by the input wave as well as to provide a repetitive scan synchronised by the input. The amplifier has a gain control which operates by varying negative feedback and at low gain its response extends from 50c/s to 5Mc/s. An amplifude scale calibrated in volt-

Physical Society's Exhibition—

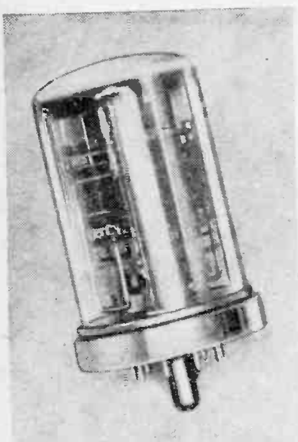
age is provided, and a camera attachment is available.

Mullard had two oscilloscopes, one for low and the other for high frequencies. The former, Type E800, includes an amplifier flat within 2db. from 0.1c/s to 40kc/s and gives a deflection sensitivity of 1cm. per mV RMS. The time-base has a range of 0.25c/s to 16kc/s. The other oscilloscope is the E805, and has an amplifier flat within 3db. from 2c/s to 2Mc/s and is usable up to 5Mc/s. The sensitivity is 5mV per cm. and the time-base range is 5c/s to 150kc/s.

The Electrostatic Viewing Unit shown by Marconi Instruments is specially designed for pulse work and includes a time calibration system in which known time intervals are obtained by a ringing circuit.

An electron microscope with a resolving power some fifty times greater than that of the best optical instrument, and capable of a magnification up to 50,000 times, was shown by Metropolitan Vickers. This is the latest model, the Type EM2, and it operates at 50kV.

VHF Equipment.—A joint exhibit of the Research Staffs of the M.O. Valve Co. and General Electric contained some interesting developments of modern VHF technique. Various types of oscillators using line and cavity resonators were shown, including also some examples of the latest type of butterfly circuit. One such push-pull oscillator fitted with the new disc-seal valves, Type CV273, and incorporating a standard split-stator condenser of the butterfly pattern, had a frequency range of 250 to 900Mc/s.



Prototype for new television valves by M.O. Valve Co.

The many applications that have been found for VHF, and especially for the centimetric waves, is reflected in the latest Marconi-Osram valves. These include magnetrons and the new disc-seal triodes.

In the latter the cathode, grid and anode electrodes take the form of copper discs extending beyond the normal diameter of the glass envelope and connection is made by external bands clamped to these discs.

With this form of construction the inductance of the internal connections to the electrodes is reduced to a minimum and the valves are suitable for use at very high frequencies. For example, the CV273 triode will oscillate up to 3,500 Mc/s and it is designed for insertion into the end of a concentric line.

Some new 8-pin pressed glass base valves, which are suitable for the television frequencies, were shown in prototype form and a complete range covering all requirements is expected to emerge shortly.

The NPL was showing a wavemeter covering 500-10,000Mc/s using a cavity resonating in a hybrid TM_{010}-coaxial mode with a non-contact plunger. A crystal detector is incorporated and the accuracy is 1 part in 10^4. A similar wavemeter to NPL design was shown by Standard Telephones. This firm also showed several centimetre-wave signal generators. One model covers 7.1-11cm, using a velocity-modulated valve in a waveguide. The frequency control operates, by means of a micrometer-head, a piston moving in a cavity resonator.

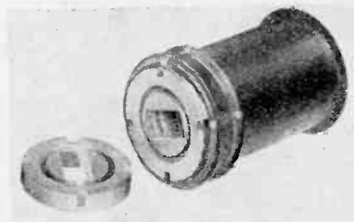
High-frequency and centimetre-wave cables with polyethylene dielectric were shown by British Insulated Callender's Cables, and on this same stand were to be found a number of flexible waveguides. In one of these metal discs are spaced in a rubber hose so that the gaps form resonant cavities to give an effectively continuous structure at the operating frequency.

Miscellaneous Exhibits.—Voltage stabilisation and regulating devices are important ancillaries in many laboratory, industrial and production testing equipment. Apparatus of this kind was shown by the Zenith Electric Co. in the form of motor-controlled and manual-operated variable voltage transformers.

Westinghouse also include among their products a range of constant potential AC voltage units giving an output of good waveform and described as "Stabilistors." They include no moving parts.

The Cossor Dot-Mosaic Scanner is designed for testing the linearity of CR tubes with electric deflection. The scan voltages are derived in accurate small steps from wire-wound potentiometers, the tapping points being selected by mechanical selector switches to produce a series of accurately spaced dots.

Ilford were showing a wide range of paper and film specially designed for photographing cathode-ray traces. One blue-sensitivity type can cover a range of writing speeds of 10^4: 1 and can be completely processed in 30 sec.



BI Callenders flexible waveguide

Among the vacuum thermo-junctions shown by the Cambridge Instrument Co. were a range of centimetre dipole types with the aerial electrodes fused directly into the sides of the glass bulb. Thermocouples designed for building into the walls of resonators and waveguides for monitoring purposes were shown by Standard Telephones. They are designed for frequencies of 300-6,000Mc/s with a maximum current of 15mA.

In the "ASAC" system (automatic selection of all channels) demonstrated in the GEC Research exhibit, any one of 336 channels in a band in the region of 3 metres can be selected in a matter of seconds. Only three crystals are used; one of these controls an oscillator, the harmonics of which determine the channel spacing. When a channel has been selected for communication by means of numbered dials, the band is swept by a motor-driven tuning condenser and the harmonics are grouped and counted by a uniselector switch until the required channel is found, when the motor stops. An AFC system then holds the frequency to ±10kc/s.

OUR COVER

THE electron microscope illustrated on this month's cover was shown by Metropolitan-Vickers at the Exhibition. It embodies a pump for maintaining vacuum continuously, and the image can be examined either visually or with the help of a photographic record. The illustration is reproduced by courtesy of Firth-Brown, of Sheffield, who are using the apparatus for metallurgical research.

WORLD OF WIRELESS

TIME SIGNALS

IT is thought that some readers will be interested to have the revised schedule of rhythmic time signals, controlled from the Royal Observatory, Greenwich, which are radiated by GPO stations.

January 1st-March 31st.			
09.55-10.00	GBR	16	kc/s
	GKU.4	4.025	Mc/s
	GIC	8.640	Mc/s
	GYB.8	19.080	Mc/s
17.55-18.00	GBR	16	kc/s
	GIC	8.640	Mc/s
	GKU.3	12.455	Mc/s
April 1st-September 30th.			
09.55-10.00	GBR	16	kc/s
	GIC	8.640	Mc/s
	GKU.3	12.455	Mc/s
	GYB.8	19.080	Mc/s
17.55-18.00	GBR	16	kc/s
	GKU.3	12.455	Mc/s
	GKU.2	17.685	Mc/s

Each transmission starts at 53 min. 54 sec. with a preparatory signal consisting of the call sign, repeated four times, followed by a tuning note. The rhythmic time signal comprises 306 dots in 300 seconds (mean time), the concluding dot marking the hour.

RADAR CONVENTION

A THREE-DAY "Radar Convention" is to be held by the Institution of Electrical Engineers in March. An introductory lecture will be followed by a number of "integrating" papers on radar and allied subjects.

One is tempted to ask whether detailed information on British wartime developments is still being withheld from general publication in this country in order that it may be saved up for the Convention. Be this as it may, devices still officially regarded as "secret" here are being freely described in American journals.

GERMAN MAGNETOPHONE

A GERMAN sound recording system, heralded in the lay Press as secret and new, has been discovered recently in German broadcasting studios by technicians attached to the BAOR.

Actually the system is neither secret nor new, as Dr. Erwin Meyer described it in one of his lectures at the IEE in the autumn of 1937. The equipment, known as the magnetophone, uses a thin plastic tape, about 0.25in. wide, coated with a metallic powder film. A frequency response up to 15,000 c/s is claimed for the latest models of this magnetic recording equipment, which is made by A.E.G.

The novel feature of the system, apart from the reported high quality, is the cheapness and flexibility of the ribbon recording medium (made by I.G. Farbenindustrie), which can be cut with scissors and sections added or removed by joining the ends with a special adhesive fluid.

HONOURS

BELOW are given the names of many people in all branches of radio who figured in the New Year Honours List.

Knighthood

N. V. Kipping, J.P., lately head of the Regional Division, Ministry of Production.
B. Lockspeiser, Director of Scientific Research, MAP.
T. G. Spencer, Managing Director, Standard Telephones and Cables.

K.C.M.G.

W. J. Haley, BBC Director General.

M.V.O.

R. H. Wood, Engineer-in-Charge, BBC Outside Broadcasts (London).

G.B.E.

Sir Edward Appleton, K.C.B., F.R.S.

K.B.E.

Sir Robert Renwick, Bt., lately Controller of Communications, Air Ministry, and of Communications Equipment, MAP.

C.B.E.

Dr. P. Dunsheath, O.B.E., Chief Engineer and Director, W. T. Henley.
C. W. Goyder, Chief Engineer, All-India Radio.
Dr. W. G. Radley, Controller of Research, Engineer-in-Chief's Office, GPO.
C. O. Stanley, O.B.E., Managing Director, Pye Radio.

O.B.E.

C. S. Agate, Joint General Manager, HMV Design and Development.
W. F. R. Campling, Deputy Director (Radio Components), Directorate of Communications Components Production.
Dr. R. Cockburn, Superintendent, Telecommunications Research Establishment (TRE).
Major C. Collaro, Collaro, Ltd.
E. Harle, lately Director of Communications Components Production, Radio Production Executive.
C. A. W. Harmer, Director, Pye Radio.
W. G. R. Jacob, Engineer-in-Chief, Cable and Wireless.
Lt.-Col. H. A. Lewis, REME.
A. H. Mumford, Staff Engineer, Engineer-in-Chief's Office, GPO.
W. H. Peters, Assistant General Manager, GEC Works, Coventry.
J. A. Ratcliffe, Superintendent, TRE.
J. W. Ridgeway, Manager, Ediswan's Radio Division.
K. C. Sinclair, lately Deputy Coordinator of Radio Production, Radio Production Executive.
P. A. Sporing, General Manager, TCC.
Major E. P. Stanton, Royal Signals.
W. F. Taylor, Director, TCC.
Dr. D. N. Truscott, Deputy Director (Radio Valves), Directorate of Communications Components Production.

M.B.E.

J. Banner, Experimental Officer, Naval Air Radio Department, Admiralty.
C. C. E. Bellringer, Scientific Officer, TRE.
G. W. Bird, Senior Production Officer, Radio Production Executive.
C. E. Bottle, Engineer-in-Charge, BBC.
W. A. Bryce, Managing Director, W. Andrew Bryce and Co.
A. R. Chance, Manager, Valve Department, E. K. Cole.
J. H. Cotton, Works Manager, Dubilier.
G. W. A. Dummer, Principal Scientific Officer, TRE.
B. J. Edwards, Chief Engineer and Technical Manager, Pye, Ltd.
J. G. Flint, Chief Engineer, TMC.
M. R. Gavin, Head of Special Radio Group, GEC.
F. S. Inglis, Superintendent, Radio Production Unit, MAP.
Dr. F. E. Jones, Senior Scientific Officer, TRE.
N. Jubb, Radio Officer, No. 45 Group, Air Ministry.
H. J. Mildren, Asst. Director of Radio Components, Directorate of Communications Components Production.
G. Nutter, Chief Radio Officer.
G. R. Polgreen, Chief Engineer, Salford Electrical Instruments.
O. S. Puckle, Cossor Research.
H. Ransom, Asst. Director (Valves), Directorate of Communications Components Production.
F. D. Redington, lately Senior Radio Production Officer, Directorate of Communications Components Production.
B. J. Smith, Chief Radio Officer.
Dr. C. L. Smith, lately Scientific Officer, TRE.
W. H. Warman, Rediffusion, Ltd.
E. D. Whitehead, Technical Superintendent of Radio Components, Inter-Service Components Technical Committee.
E. S. Wright, Assistant Engineer, Quartz Crystal Development, ST & C.

B.E.M.

H. C. Betts, Instrument Shop, TRE.
J. A. Blackburn, Murphy Radio.
F. W. Bryant, Foreman, Pye Radio.
Miss F. H. Budden, Bush Radio.
Mrs. N. K. Clough, Peto Scott.
V. J. Cox, Test Apparatus Designer, E. K. Cole.
H. Harrison, Radio Assembly Works Foreman, McMichael Radio.
Mrs. M. Kennedy, Cossor.
J. Knight, Head of Prototype Department, RGD.
A. W. Lapham, Civilian Instructor, No. 1 Radio School, RAF.
Mrs. G. L. Perman, Philco.
J. Rackstraw, Foreman, Dynatron Radio.
Miss M. Reynolds, Radar Assembler, Metropolitan-Vickers.
S. L. Robinson, Engineer, Masteradio.
G. R. Silvester, Foreman, Mullard.
W. N. Smith, Wireless Telegraphist.
G. H. Tottman, Established Wireless Operator, Naval W/T Station.
L. R. Ward, Engineer, Truvox.

PERSONALITIES

Humfrey Andrewes, O.B.E., has joined the Dubilier Condenser Co. (1925) as Laboratory Manager. He will be remembered by our pre-war readers as a writer on sound recording and allied topics. As Wing Commander in the RAF he was Chief Radar Officer, Base Air Forces, South-East Asia Command.

J. Bell, M.Sc., is relinquishing his appointment with the Admiralty to join Muirhead and Co. as Chief Research Engineer.

R. G. D. Holmes, who recently became Chief of Research and Design of McMichael Radio, has now taken over the duties of Chief Engineer of the Company's Radio Division.

A. McVie, B.Sc., General Manager and Director of Kolster-Brandes, has been elected chairman of the Council of the British Radio Equipment Manufacturers' Association.

C. T. Nuttall, who was formerly with the Gramophone Company, is now Sales Engineer in the Radio Division of the Telegraph Condenser Company.

D. Sisson Relph has been appointed

World of Wireless—

Managing Editor of the Book Department of Iliffe and Sons—our Publishers. Before the war he was Editor of *The Wireless and Electrical Trader.*

C. E. Rickard, who has been associated with the Marconi Company for 47 years, has retired. He returned from his original retirement in 1941 to assist

C. E. Rickard.

the war effort and took up the position of General Manager. He served on many Post Office Committees and International Conferences on wireless matters and in 1930 was chairman of the Radio Section of the IEE.

F. D. Smith has been appointed General Manager of Britannic Electric Cable and Construction Company.

W. H. Stevens will be responsible for the design of television receivers at R.F. Equipment, Ltd. He was until recently in Cossor's research laboratories.

OBITUARY

We regret to record the deaths of:—

Grp. Capt. G. P. Grenfell, D.S.O., on December 29th, who was a pioneer of wireless telegraphy in the RAF, from which he retired in 1934. He was appointed Commandant of the wireless experimental station at Biggin Hill after the 1914/18 war and was for a time officer in charge of administration at the Air Defence of Great Britain headquarters, Uxbridge.

Col. M. J. C. Dennis, C.B. (EI2B), Ireland's oldest and most well-known amateur, on October 27th at Baltinglass, Co. Wicklow. His first transmitter, employing an eight-inch spark coil, was licensed, with the call DNX, in 1910. The "Dennis" detector, employing the crystal combination Tellurium-Zincite, was used extensively by the Navy during 1914-18.

IN BRIEF

A new use for radar was recently described during a lecture on "Modern Maps and How They are Made" at the Royal Geographical Society. By using aircraft fitted with H2S radar and a special recording device it was possible to make tactical maps of areas in the Far East in enemy hands, of which maps were almost non-existent.

Record total of 9,884,300 wireless receiving licences were in force in Great Britain and Northern Ireland at the end of November.

Telecommunications Exhibition.—Visitors to the exhibition sponsored by Cable and Wireless at Charing Cross Underground Station will see a working telegraph circuit which includes the direct printer evolved by the Company's engineers. Instead of the previous dual process of passing through a perforator and Creed printer the incoming signal is automatically translated into "plain language" and typed on gummed tape by this piece of apparatus. The exhibition will remain open until February 3rd.

RSGB Membership has increased by a further 1,902 during the year ended September 30th, the report for which has just been issued. The total membership was then 9,646.

McMichael employees have for some time had the opportunity of discussing current developments in radio at meetings organised by the Radio and Allied Discussion Group. The Group is now extending an invitation to technicians from other companies to take part in the discussions. Particulars are obtainable from D. Hiscock, McMichael Radio, Wexham Road, Slough, Bucks.

Industrial Research.—Standard Telephones and Cables announce the formation of a central laboratory organisation to undertake long-term research and development in telecommunications and electronics. The new laboratories, to be known as Standard Telecommunication Laboratories, Limited, will be housed at Progress Way, Great Cambridge Road, Enfield, pending the erection of suitable permanent premises.

Civilian Sets.—According to figures recently issued by the Board of Trade on the reconversion of industry and the expansion of civilian production during November, licences have been issued for 878,000 proprietary receivers for the home market and 489,000 for export. Up to the end of October 18,550 sets had been completed under the new programme, of which 1,382 were exported.

RSGB Council.—At the Annual General Meeting of the Radio Society of Great Britain the following officers were elected for this year: President, E. L. Gardner (G6GR); Executive Vice-president, S. K. Lewer (G6LJ); Hon. Treas., A. J. H. Watson (G2YD); Hon. Sec., H. A. M. Clark (G6OT); Hon. Editor, A. O. Milne (G2MI).

Slade Radio Society has restarted and is holding meetings on the last Friday in each month at its headquarters, Bloomfield Road, Erdington, Birmingham. Particulars of the society, which already has a membership of 35, are obtainable from the Secretary, L. Griffiths, 47, Welwyndale Road, Sutton Coldfield, Warwickshire.

Leicester Radio Society has sent us a new programme of meetings, the next of which will be held on February 12th at 7.30 at Charles Street United Baptist Church (side passage entrance). "Loudspeaker Development" is the subject of the lecture to be given by Parmeko, Ltd.

Stockport Short-Wave Society is being reformed and enthusiasts are invited to write to A. W. Hewitt, Hollybank, Row of Trees, Alderley Edge, Manchester, for particulars of its activities.

The London Chapter of the International Short-Wave Club is to resume its meetings. Past members and others interested are invited to communicate with Arthur E. Bear, 100, Adams Gardens Estate, S.E.16.

MEETINGS

Institution of Electrical Engineers

Radio Section.—"A Method of Transmitting Sound on the Vision Carrier of a Television System," by D. I. Lawson, M.Sc., A. V. Lord, B.Sc.Tech., and S. R. Kharbanda, on January 30th. Joint meeting with the Television Society.

"Tendencies in the Design of the Communication Type of Receiver," by G. L. Grisdale, Ph.D., and R. B. Armstrong, B.Sc., on February 5th.

"New Methods for Locating Cable Faults, Particularly in High-Frequency Cables," by F. F. Roberts, B.Sc. (Eng.) on February 20th.

"Comparison of Electrostatic and Magnetic Deflection in Cathode-Ray Tubes." Discussion to be opened by C. A. Stanley and E. W. Bull on February 26th.

All meetings will commence at 5.30 and will be held at the IEE, Savoy Place, London, W.C.2.

Students' Section.—"The Measurement and Reduction of Noise," by Dr. A. J. King, M.Sc.Tech., at 7.0 at the IEE, Savoy Place, London, W.C.2, on February 18th.

Cambridge Radio Group.—"Colour Television," by L. C. Jesty, B.Sc., at 6.0 at the Technical College, Collier Road, Cambridge on January 29th.

"Some Principles of Ultra-Short-Wave Aerials," by Prof. E. B. Moullin, M.A., Sc.D., at 6.0 at the University Engineering Laboratory, Cambridge, on February 19th.

Radio Society of Great Britain

"The Amateur Bands, Past, Present and Future," by A. O. Milne (G2MI), at 6.30 on February 15th at the IEE, Savoy Place, London, W.C.2.

British Institution of Radio Engineers

"Gold Film Electrodes for High-Frequency Quartz Plates," by R. Spears, on January 29th.

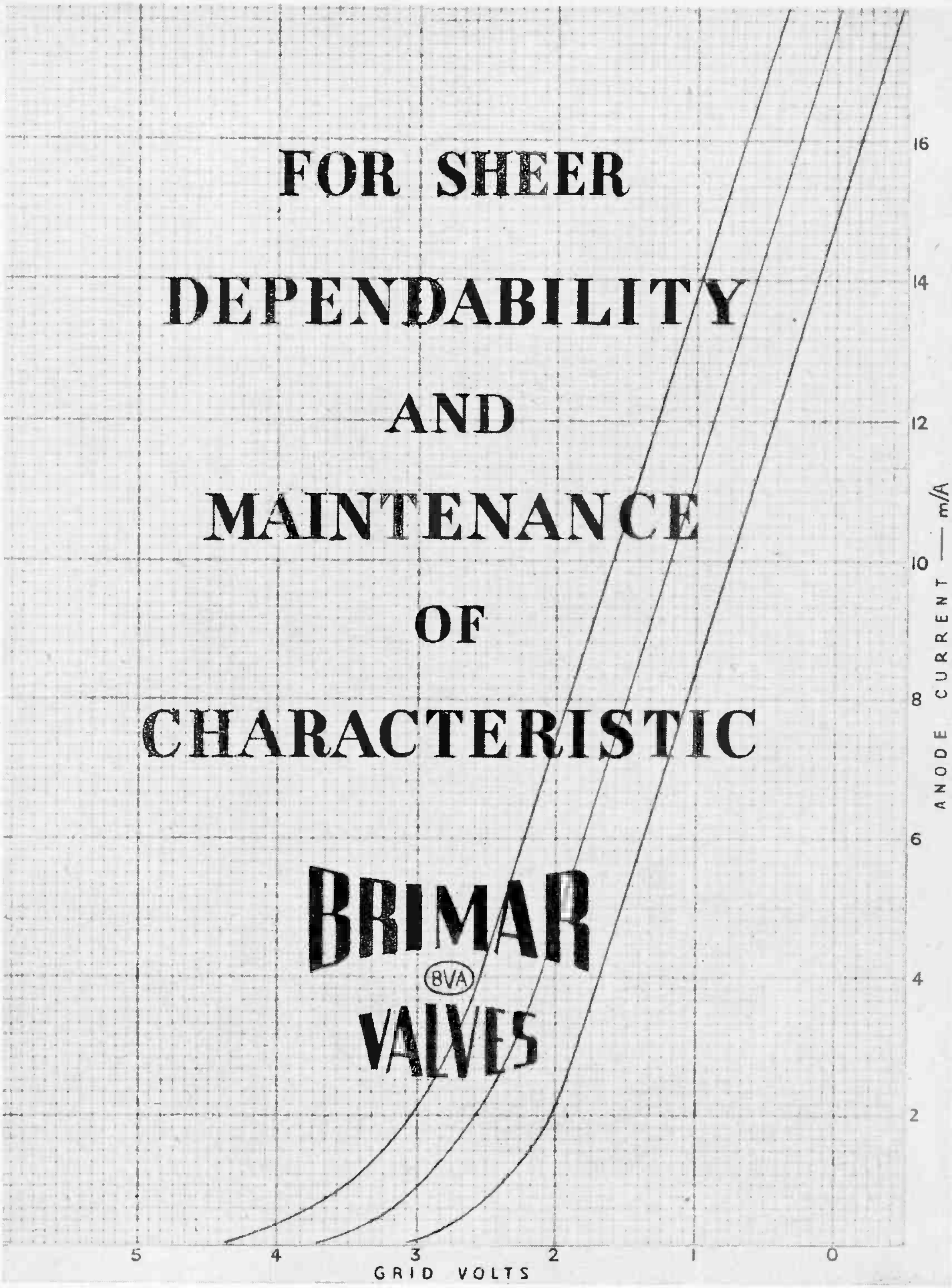
"Aircraft Radio," by F/Lt. C. Bovill, on February 20th.

Both meetings will commence at 6.15 at the Institution of Structural Engineers, 11, Upper Belgrave Street, London, S.W.1.

North Eastern Section. — "Reproduction from Sound on Film," by G. Dobson at 6.0 at Neville Hall, Westgate Road, Newcastle-on-Tyne, on February 13th.

Royal Society of Arts

"Radar," by Prof. J. T. Randall, D.Sc., at 1.45 at Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, on February 20th.


FOR SHEER
DEPENDABILITY
AND
MAINTENANCE
OF
CHARACTERISTIC
BRIMAR
BVA
VALVES
16
14
12
10
8
6
4
2
ANODE CURRENT —— m/A
5
4
3
2
1
0
GRID VOLTS

—VORTEXION—

"SUPER FIFTY WATT"

AMPLIFIER

"SUPER FIFTY WATT" AMPLIFIER has a response of 30 cps. to 15,000 cps., within ½ db, under 2 per cent. distortion at 40 watts and 1 per cent. at 15 watts, including noise and distortion of pre-amplifier and microphone transformer. Electronic mixing for microphone and gramophone of either high or low impedance with top and bass controls. Output for 15/250 ohms with generous voice coil feedback to minimise speaker distortion. New style easy access steel case gives recessed controls, making transport safe and easy. Exceedingly well ventilated for long life.

Amplifier complete in steel case, with built-in 15 ohm mu-metal shielded microphone transformer, tropical finish .... Price 29½ gns.

Chassis only, with valves .... Price 25½ gns.
or
Complete with fitted microphone transformer Price 26½ gns.

Laboratory Model, 10 cps. to 35,000 cps., in above case .... Price 42 gns.

4-WAY MIXER UNIT for use with Record Reproducer, suitable for high or low impedance pick-ups and two 15 ohm microphones. Mu-metal shielded transformers are built in. All or any of the microphones can be used at once .... Price £13 10 0

RECORD REPRODUCER.—This is a development of the A.C.20 amplifier with special attention to low noise level, good response (30—18,000 cps.) and low harmonic distortion (1 per cent. at 10 watts). Suitable for any type of pick-up with switch for record compensation, double negative feedback circuit to minimise distortion generated by speaker. Has fitted plug to supply 6.3 v. 3 amp. L.T. and 300 v. 30 M.a. H.T. to a mixer or feeder unit .... Price £18 0 0

A.C.20 AMPLIFIER.—This well-known model has been retained, and has a response 30—15,000 cps., mixing arranged for crystal pick-up and microphone, large output transformer for 4—7.5 and 15 ohms to deliver 15 watt at less than 5 per cent. total harmonic distortion to the speakers .... Price £15 15 0

DEALERS AND EXPORT AGENTS should write for special terms to:—

VORTEXION LTD.

257-261 THE BROADWAY, WIMBLEDON, S.W.19

Telephones: LIBerty 2814 and 6128

Telegrams: VORTEXION, WIMBL., LONDON

G.E.C.

QUARTZ PLATES

REGD TRADE MARK

Standard Crystals cover 3·5/10 Mc/s,— but can be supplied for other frequencies and for a wide range of frequency-temperature characteristics.

Made in hundreds of thousands per annum for the services all over the world.

for Communication Equipment

Made by

SALFORD ELECTRICAL INSTRUMENTS LTD.

PEEL WORKS, SALFORD, 3.

Proprietors: THE GENERAL ELECTRIC Co. Ltd., of England

FUNDAMENTALS OF RADAR

5.—Beacons Employing Pulse Technique

IN earlier articles of this series brief mention has been made of radar beacons used with systems such as ASV. Although the development of radar beacon technique has provided no spectacular results such as are obtained with systems like H2S, beacon systems are likely, because of their simplicity, to play a very important part in the peacetime development of radar.

One beacon-like device which must be described for its importance in war is IFF. The use of radar for locating aircraft destroys one piece of information which is available with visual location: aircraft recognition. It is essential that the radar operator, whether he is a controller at a GCI station or the observer in a night fighter, should be able to tell whether the aircraft giving an echo is friendly or hostile. To do this, it is necessary that the target aircraft should give the password when challenged: the challenge and the password are both radar signals.

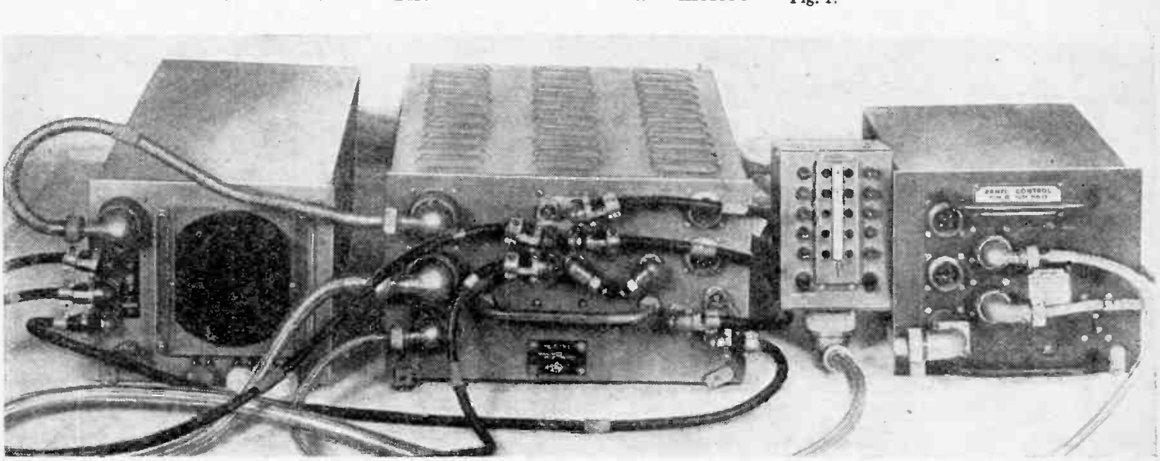
In the earliest IFF systems a small receiver-transmitter carried in friendly aircraft picked up the pulses from the CH stations and retransmitted them immediately at the same frequency. The receiver-transmitter used had a bandwidth which did not cover the whole CH band, and the system was therefore tuned continuously by a motor-driven condenser. Each time the IFF set was in tune with the CH station floodlighting the aircraft, the echoes at the ground receiver became much stronger. The ground observer could therefore recognise formations of friendly aircraft on patrol and direct them to the interception of unidentified aircraft, which might be hostile, might be friendly with no IFF fitted, or might have had their IFF damaged by enemy action.

As the number of wavebands in use increased, IFF on all bands became quite impracticable and a specific IFF band was introduced. The interrogator transmitter on the ground or in an AI aircraft sends out pulses on a wavelength of about two metres. The "transponder" system receives these and re-radiates them to be picked up by the "responder." The information presented is that a friendly aircraft is at a given range, and this serves to identify the target echo which is found at the same range.

In the general use of radar beacons, the transponder is on the ground or in an aircraft carrier. The aircraft carries an interrogator and responder, and the aerial system is usually of the form used in early airborne radar systems.* A fairly good bearing indication is provided, together with an indication of the range of the beacon. The directional information is not as full as that given by an ordinary radio beacon with direction-finding facilities, but radar beacons are designed on the assumption that the aircraft will normally fly on a track leading over the beacon. Radar beacons are, in fact, homing and approach aids, and are not intended to provide directly any information about the aircraft's current position, although, of course, it is possible to derive a fix from the beacon information.

If the transmitted and received pulses were both on the same wavelength, the interrogator-responder system would be simply an ordinary radar set, and as we saw in considering the 1½-metre AI equipment, echoes from the ground would blot out the echoes from distant points. The beacon transponder, therefore, re-radiates the received pulses on a different wavelength, and ranges up to 100 miles can be obtained. With such ranges, an aircraft will

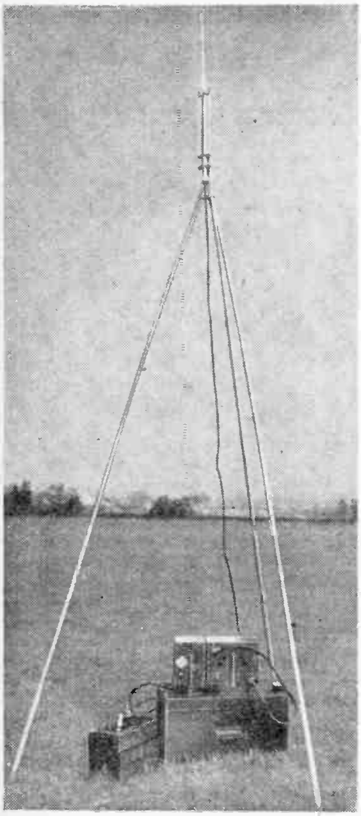
* See *Wireless World*, November, 1945, p. 326, Fig. 1.



Airborne interrogator equipment. From left to right: CRT indicator unit, T-R switch unit, control unit and voltage-control panel.

Fundamentals of Radar—

often be within the working area of several beacons, and the responses are therefore coded so that the beacon may be identified. Just as a lighthouse or buoy flashes its light in a standard pattern, so the radar beacon interrupts its response to give, in effect, a morse identity mark.



"Eureka" transponder beacon, Mark II.

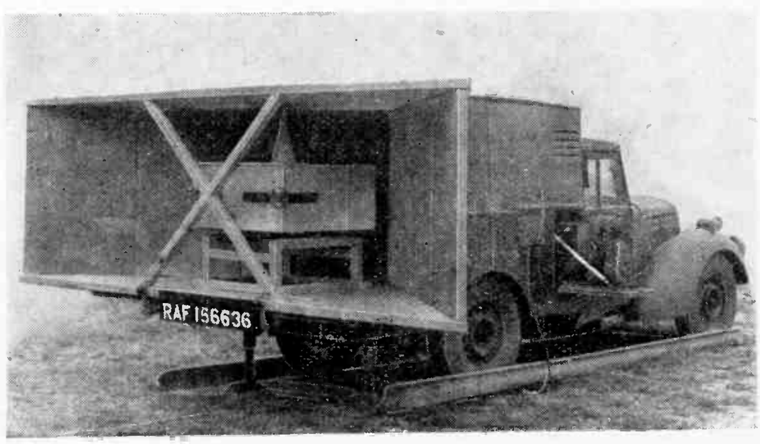
The discussion above shows how beacons are used as radar lighthouses, with the additional feature that they only speak when spoken to. An extension of this use was provided by the "Eureka" system in which a very small beacon carried by parachute troops was used to guide further airborne forces to a rendezvous in enemy territory. Here the beacon response could be controlled by the operator, so that while the beacon was being interrogated messages could be sent from the ground to the supporting forces still on their way.

A very important refinement of the beacon principle is the beam approach system known as BABS. The homing beacons enable aircraft to home on their aerodrome from distances up to about 100 miles. As the aircraft nears the aerodrome the problem becomes that of approaching the correct runway from the correct direction. With BABS, the aircraft equipment can be used, when the aircraft is within about 20 miles of the aerodrome, to approach the runway accurately. The aircraft equipment is the same for beam approach as for homing, but the beam approach beacon differs somewhat from the homing beacon. The aerial system is no longer a broadcast system, but is beamed along the runway. The detailed arrangement is rather like that of the CW Lorenz system, though the term used in radar technique is "split." The beam axis is swung from an angle a few degrees on one side of the runway to an equal angle on the other side. On one side the retransmitted pulses are lengthened to provide a "dash" signal. When the aircraft is on one side of the runway line, the dash signals are stronger than the dots; on the other side the dots are stronger than the dashes. If the aircraft is manoeuvred so that equal amplitudes of dot and dash are obtained on the cathode-ray tube, the aircraft is on the axis of the runway. The advantage of this system over the Lorenz is that in addition to giving this directional information, the radar beam approach system gives a continuous record of the range to the end of the runway. No vertical markers are needed to give spot information and thus with the aid of an absolute (radio) altimeter a landing approach can be made.

It is possible also to provide guidance in the vertical plane by means of a radar beacon, thus giving a glide path for a landing approach. The actual landing still involves a view of the ground. In the beam approach system, homing and approach beacons work on different wavelengths, so that a changeover must be made at about twenty miles from the aerodrome. This prevents interference between the beamed transmission from the approach beacon and the broadcast transmissions from the homing beacon.

Beacon technique, it will be seen, involves very simple equipment which is relatively light and cheap. It seems likely, therefore, that it will form the backbone of peacetime aircraft radar.

In this series of articles on radar fundamentals, no attempt has been made to give technical details of any specific equipment, but to provide a background of broad principles. With this knowledge it should be possible to form a reasonable judgment of what radar really is, what it can do, and what it can be expected to do in the future.



"BABS" truck, opened out for operation, and driven on to its alignment rails.

MIXING CRYSTAL MICROPHONES

Circuit Suitable for High-impedance Inputs

By G. N. PATCHETT,
B.Sc., Grad. I.E.E., Assoc. Brit. I.R.E.

A COMMON method of mixing the outputs from two or more channels is that using one valve for each channel with an anode load common to all the valves, as shown in Fig. 1. The valves may be triodes, but are preferably pentodes to prevent appreciable loading of one valve by the AC resistance of the others.

When crystal microphones are used this arrangement cannot normally be applied due to the minimum resistance of about 5 megohms which can be placed across this type of microphone. As volume controls are not normally manufactured of such high value, a fixed grid resistance must be used, with the result that there is no way of controlling the volume of the individual channels. An alternative is to place the individual channel volume controls after the valves, but this leads to difficulties in mixing. If the volume controls were arranged as shown in Fig. 1 (b), the effect of turning one volume control to the minimum position would be to short the other two; therefore this arrangement is useless. This defect can be largely overcome by including fixed resistances at points X, but this causes a reduction in the gain. An alternative is for each volume control to feed a separate valve, the anodes of the three valves having a common load. This has the obvious disadvantage of the large number of valves required.

In order to overcome these difficulties, the pentode valves are replaced by heptodes of the 6L7 type, the amplification of which can be controlled by varying the potential on the third grid. The arrangement as applied to three channels is shown in Fig. 2. A suitable negative bias for application to grid 3 is obtained from the variable potentiometers connected across the lower section of the potential divider, placed across the HT supply. The operation of the volume controls is made *absolutely* silent by the filters of 100,000 ohms and 0.5 μF. This is in itself a big advantage since in high-gain amplifiers it is difficult to prevent the volume control being noisy.

The arrangement also has the advantage that since no volume control is placed in the control grid circuit of the valves, screening can be very complete resulting in the reduction in the hum, often difficult to eliminate. This screening is very easily arranged with 6L7 valves since the top cap is the control grid. One other advantage is that, since the volume controls now control only a small DC potential, they may be placed in any convenient position in the amplifier, or, if required, may be situated at a point remote from the amplifier. The leads to the volume controls may be extended for considerable distances without the need for screening.

The arrangement has been used

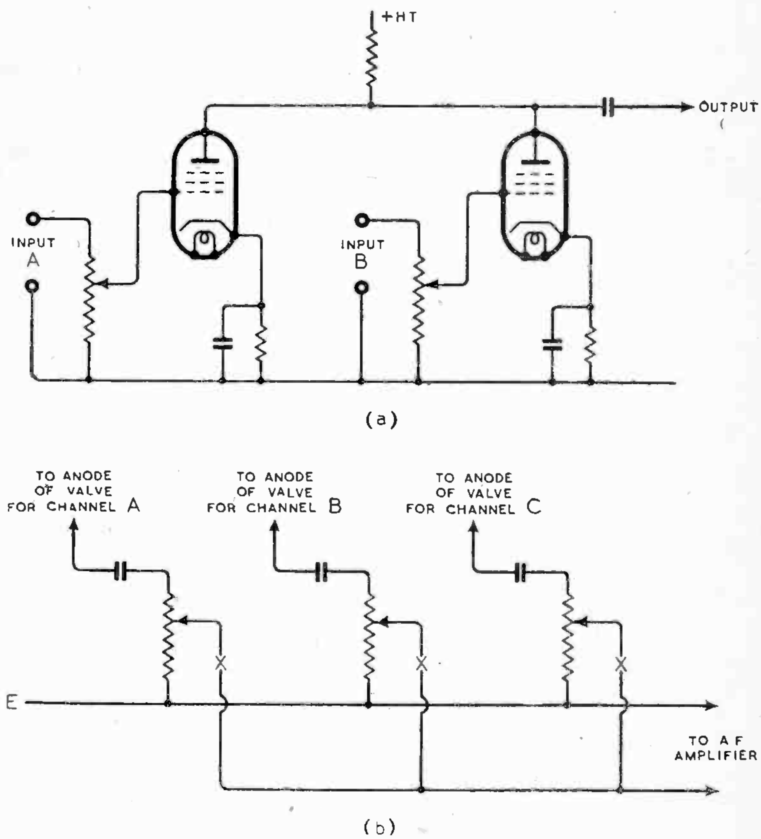


Fig. 1. Conventional methods of mixing microphone channels.

Mixing Crystal Microphones—successfully in an AC/DC amplifier with the arrangement shown in Fig. 2 feeding a KTZ63 (triode connected) transformer coupled to two KT33C valves, operating in push-pull. The amplification given by this arrangement, using D.104 crystal microphones, was greater than normally could be employed owing to acoustic feedback.

This idea can, of course, be applied equally well to other types of microphone or to pick-ups, but the input to the 6L7's should not exceed about ½ volt or distortion is likely to occur.

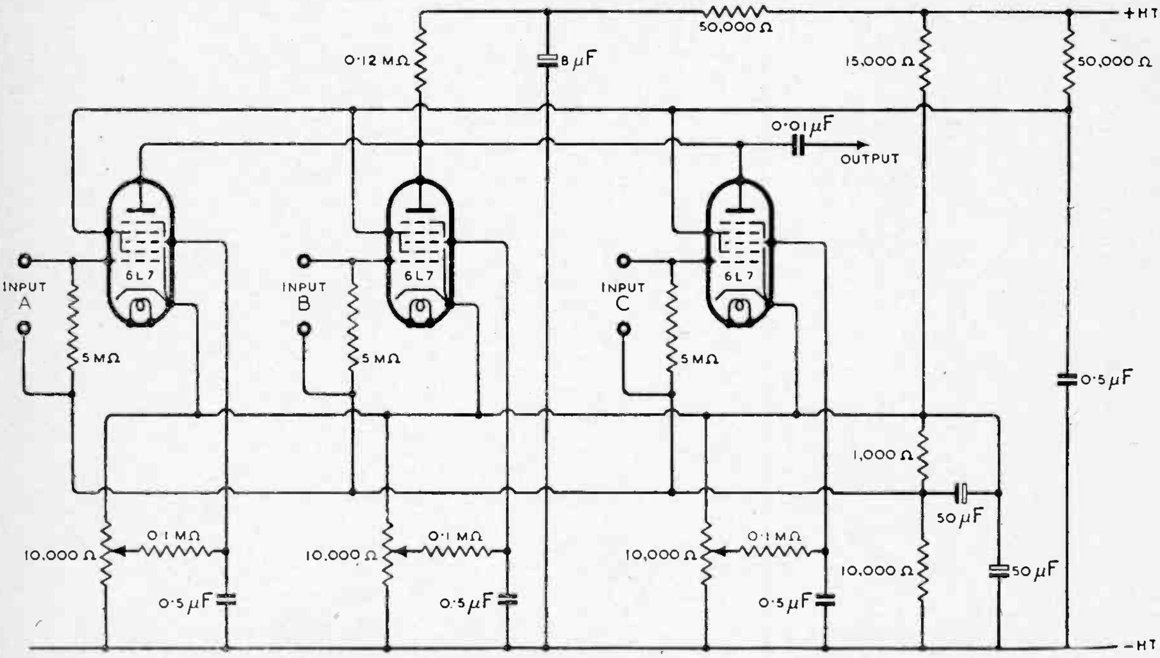


Fig. 2. Silent volume control and high-impedance input circuits are possible with heptode mixing valves.

BOOK REVIEW

Radio Receiver Design, Part II. By K. R. Sturley, Ph.D., B.Sc., M.I.E.E. Pp. 480 + xv. Published by Chapman & Hall, Ltd., 39, Essex Street, London, W.C.2. Price 28s.

It is some two years since Part I of this book—covering receiver design from aerial to detector—was published. Part II has now appeared and completes the book by treating AF amplification, power stages, mains equipment and AGC systems. In addition, it covers automatic tuning control, receiver measurements, frequency modulation and television.

The treatment adopted follows the same lines as in Part I. It is largely mathematical but not in a way which should cause undue difficulty even to a beginner. Little more than ordinary algebra and a smattering of complex numbers is needed to follow the working and even less to use the results.

With the exception of the chapter on television, Part II conforms to the high standard set by Part I. The treatment is both accurate and comprehensive and there is little which the designer of broadcast receivers needs which cannot be found within it. Even the design of transformers, both mains and output, and smoothing chokes is included.

Class AB and Class B amplifiers are rather scantily treated—having only five pages—and push-pull systems generally could with advantage have been dealt with in greater detail. These are small points, however, to set against the excellent treatment of discriminators for both AFC systems and frequency modulation and the discussion of reactance valves.

In such an excellent book it is particularly unfortunate that the chapter on television should be so much below the general standard. It is a long one of over 100 pages, but even this space is inadequate to deal properly with the special circuits of television. The three pages devoted to electromagnetic deflection, for instance, are unlikely to assist anyone and do not even contain an account of the particular difficulties of this form of deflection.

The treatment of IF couplings is somewhat dangerous because the approximate equations of Part I are applied without warning to the case of a large band-width, for which the approximations cause more than a negligible error. The results obtained must therefore be treated with reserve. It is probably because of this that the author considers stagger tuning of single circuits to be inferior to coupled circuits for IF amplifications. He does not state the grounds of comparison, however, and there are many practical cases where the reverse is true.

In dealing with integrating circuits a serious error occurs. The output waveform of Fig. 16.18 (c) is impossible because it shows a long frame pulse as providing a larger output than a line pulse when in both cases the leading edges of the output pulses are completed in less time than that taken by a complete input line pulse. In fact, the whole basis of the action of the integrator is that the rise of output should be far from complete in the time of one line pulse.

It is a great pity that this chapter should have been included. Without it one could have nothing but praise for the book.

W. T. C.

LINAGLOW LIMITED

We have purchased from a prominent manufacturer valuable stocks of all types of Radio Components, New and Unused, ex-Government Surplus. As advertising space does not permit a full list, we have selected the following:

VITREOUS WIRE WOUND TUBULAR RESISTANCES, NEW AND UNUSED

by Paignton, Watmel, Standard Telephones, Berco, etc. Up to 10 watts, 1/-, from 10—25 w., 1/6., from 25—75 w., 2/-, from 75—250 w., 3/6. Finest quality. Low Tolerance + or − 5%.

(1) 100.000 ohms 2 watt; (1a) 4,000 ohms 6.5 w.; (2) 50 ohms 10 w.; (3) 2 ohms 10 w.; (4) 1.3 ohms ½ w.; (5) 2.6 ohms ½ w.; (6) 3.2 ohms ½ w.; (7) 20 ohms 4 w.; (8) 36 ohms 6.5 w.; (9) 2.4 ohms 4 w.; (10) 16 ohms 1 w.; (11) 49 ohms 1 w.; (12) 8.2 ohms ½ w.; (13) 16 ohms 10 w.; (14) 250 ohms 6.5 w.; (15) 6,000 ohms 4 w.; (16) 100 ohms 4 w.; (17) 150 ohms 10 w.; (18) 250 ohms 10 w.; (19) 100 ohms 10 w.; (20) 400 ohms 10 w.; (21) 500 ohms 10 w.; (22) 5.000 ohms 6.5 w.; (23) 1,000 ohms 4 w.; (24) 500 ohms 25 w.; (25) 2 ohms 25 w.; (26) 5,000 ohms 25 w.; (27) 500 ohms 15 w.; (28) 1,000 ohms 15 w.; (29) 1.500 ohms 15 w.; (30) 200 ohms 15 w.; (31) 5,000 ohms 25 w.; (32) 250 ohms 35 w.; (33) 250 ohms 25 w.; (34) 800 ohms 20 w.; (35) 10.000 ohms 15 w.; (36) 7,000 ohms (tapped at 2,000) 25 w.; (37) 800 ohms 50 w.; (38) 10,000 ohms 45 w.; (39) 25,000 ohms 50 w.; (40) 10 000 ohms 35 w.; (41) 6,000 ohms 75 w.; (42) 3,500 ohms 75 w.; (43) 2,500 ohms 50 w.; (44) 1 ohm 50 w.; (45) 2,700 ohms 50 w.; (46) 27,000 ohms 50 w.; (47) 2 ohms 50 w.; (48) 200 ohms 25 w.; (49) 5,000 ohms 75 w.; (50) 25,000 ohms 25 w.; (51) 25,000 ohms 200 w.; (52) 2,000 ohms 200 w.; (53) 10,000 ohms 100 w.; (54) 4,000 ohms 100 w.; (55) 1,200 ohms 100 w.; (56) 500 ohms 100 w.; (57) 75,000 ohms 100 w.; (58) 50,000 ohms 100 w.; (59) 36 ohms 100 w.; (60) 45 ohms 100 w.; (61) 100,000 ohms 200 w.; (62) 1,000 ohms (tapped at 500) 150 w.; (63) 60 ohms (tapped at 30) 130 w.; (64) 5.3 ohms 100 w.; (65) 20 ohms 150 w.; (66) 20,000 ohms 150 w.; (67) 7,000 ohms 150 w.; (68) 20.000 ohms (tapped at 3,000 and 6,000) 100 w.; (69) 6.000 ohms 150 w.; (70) 2,500 ohms 150 w.; (71) 125 ohms 100 w.; (72) 200 ohms 150 w.

CARBON RESISTANCES

by famous Manufacturers. Up to 1 watt, 3d.; up to 10 watts, 5d. All + or — 5 per cent.

(73) 140 ohms 2 w.; (74) 300,000 ohms 1/3rd w.; (75) 240,000 ohms 3 w.; (76) 200,000 ohms 3 w.; (77) 200 ohms 3 w.; (78) 25,000 ohms 2 w.; (79) 80,000 ohms 3 w.; (80) 3,000 ohms 2 w.; (81) 4,000 ohms 2 w.; (82) 20,000 ohms 2 w.; (83) 80,000 ohms ½ w.; (84) 5,000 ohms 1 w.; (85) 1,000 ohms ½ w.; (86) 100 ohms 1 w.; (87) 3,000 ohms 1/3rd w.; (88) 5,000 ohms ½ w.; (89) 4,000 ohms 1 w.; (90) 2,000 ohms ½ w.; (91) 4,000 ohms ½ w.; (92) 800 ohms 1 w.; (93) 600 ohms 1/3rd w.; (94) 500 ohms 1/3rd w.; (95) 25,000 ohms 1/3rd w.; (96) 30,000 ohms 1/3rd w.; (97) 15,000 ohms 1/3rd w.; (98) 130,000 ohms 3 w.; (99) 250,000 ohms 1/3rd w.; (100) 50,000 ohms 1/3rd w.; (101) 20 ohms 3 w.; (102) 51 ohms 2 w.; (103) 51 ohms 3 w.; (104) 68 ohms 2 w.; (105) 24 ohms ½ w.; (106) 500 ohms 2 w.; (107) 100 ohms 2 w.; (108) ½ meg. 2 w.; (109) ½ meg. ½ w.; (110) ½ meg. 2 w.; (111) 2 meg. ½ w.

PAIGNTON HEAVY DUTY FILAMENT RESISTANCES

with two adjustable tappings all at 15s.6d. ea.

(112) 17.5 ohms 8 amps.; (113) 7.5 ohms 4 amps. with slider.

B.P.L. UNIVERSAL TEST SET

D.C. Volts.	D.C. Milliamps.	A.C. Volts.
0-75 MV	0- 1	0- 10
0-10	0- 10	0- 50
0-50	0-100	0-100
0-100	0-500	0-500
0-500		

Resistance, 0-10,000 ohms.

1,000 ohms per volt on all voltage ranges. Accuracy 2 per cent. except for lower values on the 10 volt A.C. range. Dimensions, 6" × 4½" × 3½".

Price **£8 . 17 . 6**

POTENTIOMETERS

by Morgan, Stackpoole, etc., all values 1s. 3d. each without switch.

(114) 50,000 ohms; (115) 5,000 ohms; (116) 500,000 ohms; (117) 10,000 ohms; (118) 2 meg.; (119) ½ meg.; (120) 1,000 ohms with switch, 2/3.

METERS

(167) Volt meters, panel mounting 3½", M.V.E. type AC, 25 KVS, £5; (168) 3½" panel mounting, 0-100 m.a., £2 10s.; (169) 2" panel mounting, 0-2 m.a., £2 10s.; (170) 2" panel mounting, 0-50 m.a., £2 10s.; (171) 2" panel mounting, 0-5 m.a., £2 10s.

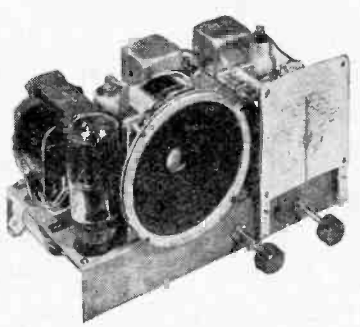
TRANSMITTING COILS

Finest quality Silver-plated. All at 10/6 ea.

(172) 1.3 microhenries, (173) .9 microhenries, (174) 1.5 microhenries, (175) 1.7 microhenries, (176) 2.2 microhenries, (177) 2.7 microhenries.

● IT IS ESSENTIAL THAT OUR REFERENCE NUMBER IS QUOTED WHEN ORDERING ANY OF THE ABOVE ITEMS.

—LINTONE—
5-VALVE MIDGET SUPERHET CONSTRUCTORS KIT



Complete with Cabinet
16 - 50, 200-550 metres

A SUPER-SENSITIVE & SELECTIVE CIRCUIT

Brief specification: Frequency changer, 6 tuned circuit 465 K.C.'s iron cored I.F.'s. 4-watt output. P.M. speaker and output transformer, all valves, chassis, practical and theoretical diagrams. Parts list, nuts, bolts and wire and modern cabinet. Dimensions: 12in. × 8in. × 6in. deep. Ready to assemble, 200/250 volts, A.C. Parts new and ex-television. Including Purchase Tax. .. Case and packing 10/- extra (refunded upon return of case). **13½ Gns.**

AMERICAN MIDGET RADIOS

General Electric Model L643

6-valve Superhet with built-in frame aerial, AC/DC 100/250 volts 200/550 metres. Fine quality figured walnut cabinet.

Price **£15 . 5 . 10**

CONDENSERS

Tubular paper, Block paper, Mansbridge, etc., by famous manufacturers. Dubilier, T.C.C., etc.

(121) Dubilier .01 mfd. 6,600 volt working, 50 cycle type 193/SP1, in porcelain case, 10/6. (122) .00045 mfd. tubular 30.000 volt working, 35/-; (123) .005 mfd. mica condenser, 5,000 volt working, porcelain case, 7/6; (124) As above, .0015 mfd. 25,000 volt DC working, 10/6; (125) .01 mfd. tubular tag end, 1,500 volt working 3/-; (126) .0035 mfd. ceramic 25,000 volt working, 22/6; (127) .004 mfd. mica 4,000 volt DC test, 5/6; (128) glass and paxolin transmitting aerial condenser, .0002, 21/-; (129) .1 mfd. 500 volt working tubular tag end. 2/-; (130) as above, 1,000 volt working, 2/6; (131) .01 mfd. 1.000 volt working tubular, 3/-; (132) ceramic condenser, 100 pfd. + or − 2 per cent. wire end, 1/-; (133) block condenser, 2.25 mfd. + 2.25 mfd. 5,000 volt DC working, 25/-; (134) block condenser, 4 + 2 mfd. 4,500 volt DC working, 25/-; (135) block condenser .5 + .5 + 1 mfd. 3,500 volt DC working, 17/6; (136) block condenser 4 mfd. 1,000 volt DC working, 10/-; (137) block condenser, 2 mfd. 1,000 volt D.C. working, 6/-; (138) block condenser, 4 mfd. 1,500 volt DC working, 8/6; (139) block condenser, 10 mfd. 1,500 volt DC working, 15/-; (140) mica tubular, .01 mfd. 5,000 volt DC working, 5/-; (141) 40 mfd. 500 volt working tubular ceramic, 5/-; (142) mica tubular .001 mfd. 250 volt DC working, 2/6; (143) tubular paper .5 mfd. 350 volt DC working, 1/-; (144) tubular paper .02 mfd. 350 volt DC working, 9d.; (145) tubular paper .75 mfd. 350 volt working, 1/-; (146) mica flat type .01 mfd. 750 volt DC working, 2/6; (147) tubular paper .075 mfd. 450 volt DC working, 9d.; (148) mica block type .00005 mfd. 350 volt working, 1/-; (149) as above, .0003, 1/6; (150) block type paper 10 mfd. 400 volt DC working, 3/6; (151) .02 tubular paper tag end 350 volt working, 6d.; (152) .01 tubular paper tag end 1,000 volt working, 2/6; (153) flat mica .0002 mfd. 350 volt working, 6d.; (154) .5 mfd. block paper 400 volt DC working, 1/6; (155) 2 mfd. 400 volt DC working, block paper, 2/-; (156) .1 mfd. block paper 1,000 volt DC. working, 5/-; (157) 8 mfd. 400 volt DC working, block paper, 4/-; (158) mica type .0001 1.500 volt DC working, 5/-; (159) 75 mfd. paper, bakelite case, 50 volt DC working, 1/6; (160) 1 mfd. tubular paper, tag end, 350 volt working; (161) .002 mfd. mica flat tag end type, 2,200 volt DC working, 6/-.

TRANSFORMERS AND CHOKES

(162) heavy duty transformer: primary 230 volt 50 cycle, secondary 11/12.6 volts 70 amps, £5. (163) 230 volt 50 cycle primary, 13/15 volts secondary, 60 amps, £5; (164) Ferranti OPM1 output transformer, tropical windings, ratios 1/1, 2.7/1, 1.6/1, price 15/-; (165) 230 volt primary 12 volt secondary, 1.67 amps, 15/-; (166) L.F. Choke, 30 henries 1,000 volt DC, 100 m.a., 25/-.

SUNDRIES

(178) Relays, 3,000 ohms double pole heavy contact, single pole light contact. 2/-. (179) 100 watt Cosmos lamps, 230 volt, double-ended tubulars, 3/6 (180) Cosmos Neon Indicator Bulbs, ½ watt B.C., 80/100 volts, 6d.; (181) Muirhead communication receiver dials, precision model, 0-180 degrees 4" geared 60/1 ratio, 30/-; (182) Belling & Lee 1¼" 60 m.a. glass cartridge fuses, 1d. each; (183) Eddystone short-wave microdensers, No. 1130, 600 mfd., 1/-; (184) Screws, very useful for the work-bench. Box containing 250, 0-4-6 and 8 B.A., varying in size from ¼" to 3" cadmium and chromium plated. Various oxydised and rust-proof finishes, 3/6 per box.; (185) Assorted parcel, Rivets (various sizes), Terminal Tags. Anode Connectors, Cable Lugs, etc., 1/6.

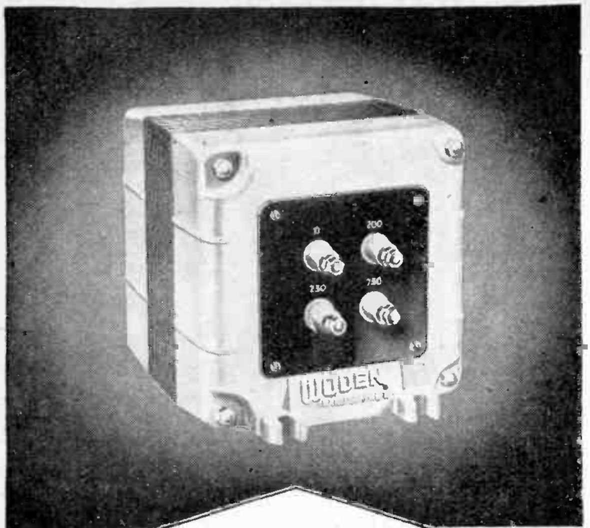
4 VALVE T.R.F. RADIO

Latest model, fine quality reproduction Band Pass. Very selective 8" P.M. speaker, 3 watts undistorted output. AC mains 200/250 volts. Valves, 6K7, 6K7 6V6, 6X5. Contained in fine quality highly polished cabinet.

Price **£12 . 15 . 0**

POST ORDERS ONLY WE REGRET THAT DUE TO PRESSURE OF BUSINESS WE ARE UNABLE TO HANDLE SHOWROOM, CALLER OR C.O.D. TRADE UNTIL FURTHER NOTICE

LINAGLOW LTD., Dept. MO 56, 61, HIGHGATE HIGH ST., N.6 'Phone: MOUntview 9432



HERE IS THE NEW TRANSFORMER THAT HAS *Everything!*

- SUPERB TECHNICAL DESIGN
- FINEST QUALITY MATERIALS
- HIGH OPERATIONAL EFFICIENCY
- GUARANTEED RELIABILITY
- BEAUTIFUL APPEARANCE

BRIEF DETAILS OF THE RANGE . . . .
Mains Transformers, 5—5,000 Watts.; Input and Output Transformers; Filter Chokes.

. . . . AND OF THEIR CONSTRUCTION
High Quality Silicon Iron laminations; wired to B.S.S. Standards; finest grade insulation; Die Cast Streamline Shrouds; Black bakelite Terminal panels; High Vacuum Impregnated coils layer wound with condenser tissue interleaving; Porcelain terminals insulated and/or silver plated soldering tags.

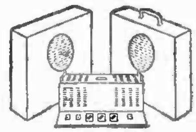
WODEN *de Luxe* TRANSFORMERS

WODEN TRANSFORMER CO. LTD.,
MOXLEY ROAD, BILSTON, STAFFS.
Telephone: BILSTON 41959

YOU CAN STILL GET

PORTABLE P.A. EQUIPMENT

IF YOU ORDER **NOW**



The R.S. "Universal Fifteen" is the most truly portable "portable" outfit yet made available. Operating equally successfully on either AC or DC at all voltages from 200 to 240, the two loudspeakers, microphone, amplifiers and cables are quickly assembled into one compact unit ready for easy transport. Write now for fullest details—but, a word of warning, only limited supplies are available.

R.S. Amplifiers

R. S. AMPLIERS LTD., 2-4, HIGHFIELD RD., SHEPPERTON, MIDDLESEX
TELEPHONE - WALTON - ON - THAMES 1019

A COMPLETE RANGE *of metal rectifiers*

is available for:

H.T. SUPPLIES to radio receivers of all types and transmitters.

•

L.T. SUPPLIES to transmitters.

•

G.B. SUPPLIES to transmitters and receivers.

•

BATTERY ELIMINATORS AND TRICKLE CHARGERS for battery-operated receivers.

•

DETECTION AND A.V.C.

•

WESTINGHOUSE

Write for literature to Dept. W.W.
WESTINGHOUSE BRAKE & SIGNAL CO. LTD.
Pew Hill House : Chippenham : Wilts

MULTI-CARRIER COMMUNICATION SYSTEM

Diversity Transmission for Mobile Working

IN 1939 three bands of frequencies in the vicinity of 100 Mc/s were allotted to the Home Office for use by the police and fire services, the actual bands concerned being 78.5 to 82 Mc/s, 95.5 to 100 Mc/s and 128 to 131 Mc/s respectively. Subsequent tests have shown that with these frequencies it is possible to provide a two-way telephone service of good standard and reliability with mobile units in all the large cities, including Greater London. With a well-sited transmitting aerial some 400 to 500 feet high a service range of about 20 miles can be assured.

The penetration of streets, steel-framed buildings and even tunnels is extremely good, and so far there has been no trace of interference from long-distance sources, such as has proved so troublesome with some of the contemporary services operating on the 30 to 40 Mc/s police bands. Further, tramcar, trolley-bus and general switching and commutator noises, often so troublesome on the pre-war television frequencies, are virtually non-existent above 100 Mc/s and there remains only ignition noise as the major source of interference.

Whilst this could be made innocuous by using frequency modulation, certain technical difficulties arise when two or more transmitters are used, with synchronised modulation, for covering an extensive service area. A comparable reduction of interference was found possible with amplitude modulation by fitting suitably designed noise limiters in the receivers, and their effectiveness was most convincingly demonstrated during a recent tour of the London Metropolitan area in a VHF-equipped Home Office vehicle.

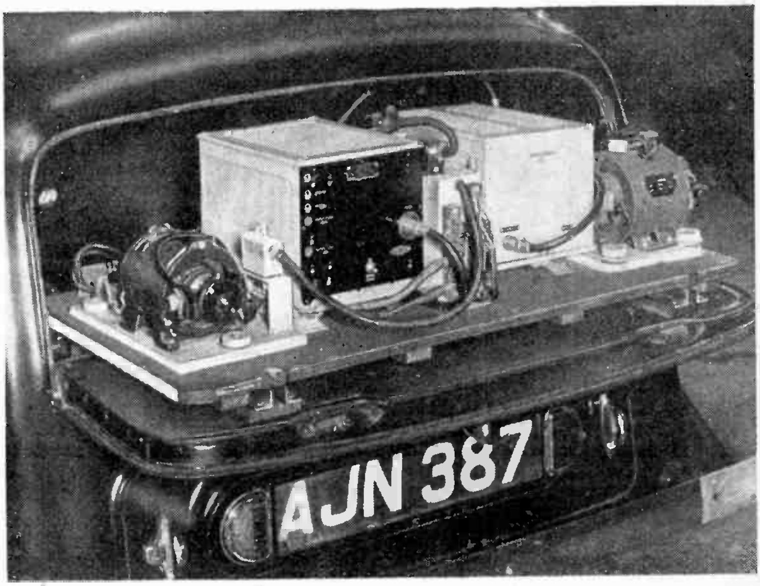
The need for more than one transmitter to ensure reliable coverage of a large rural or built-up area was revealed quite early in the development of the scheme, and it was realised that multiple transmitters strategically located throughout the required service area would have to be provided.

The possibility of synchronising transmitters at these high frequencies was ruled out and eventually a scheme was evolved in which two or more transmitters, supplied with synchronised and correctly phased amplitude modulation, radiate on closely related radio frequencies. The carrier frequencies of the transmitters comprising a single installation are set sufficiently far apart to avoid audible beats, yet close enough to be within the band-width of the receivers. This is about 100 kc/s.

This requirement was imposed in order to obviate the need to retune the mobile receivers when passing from the service area of one transmitter to that of another. At these very high frequencies service areas are not well defined, but are intricately interwoven owing to the lay of the land of the country in the rural districts and to the structural nature of buildings in the built-up areas.

Initial tests were made with two transmitters on a common site and with their aerials separated by several wavelengths; an arrangement that might be described as diversity transmission. With both transmitters radiating, no distortion could be detected anywhere within the service area, while the average field strength was considerably greater than that provided by a single transmitter.

With a single transmitter radiating and when cruising in built-up areas, signals were often subjected to a bad "flutter," presumably due to standing wave patterns brought about by reflection from the adjacent buildings. The measured variations in signal



VHF transmitter and receiver, with two motor generators supplying HT, mounted on a removable tray and fitted into the luggage boot of a patrol car.

Multi-Carrier Communication System—

strength often amounted to as much as 10 db at points only a few feet apart. Where two carriers were used the " flutter " effect was considerably reduced, and in areas where the AVC could operate effectively a perfectly steady signal resulted.

The initial tests having proved so satisfactory, a more ambitious scheme was launched to cover Greater London. For this purpose three transmitters were erected, one located on Hampstead Heath, another at the Crystal Palace, and the third at Newlands Corner, near Guildford, these sites being chosen because of their commanding elevation.

Frequencies in the vicinity of 100 Mc/s are used for the three main transmitters, which give about 100 watts carrier output and are modulated from a common source, in this case the Hampstead station, over a radio link on 130 Mc/s. Precautions are taken to ensure that the modulation phases and amplitudes are approximately equal at all transmitters.

Transmission from the mobile units is made on any one of the available bands, and this is receivable at all the three transmitting sites. From each of these the signal is relayed to the control station, where they are combined and transmitted to the area control centre.

Where facilities permit, land lines would be used for the relaying services, but elsewhere radio links may have to be employed. Radio control by VHF links was in fact used for an experimental system installed to cover a large rural district embracing parts of the counties of Buckinghamshire, Berkshire and Oxfordshire. The control point was at Reading.

This system employed three transmitting stations each of 100 watts output and operating on the triple carrier frequencies of 96.32 Mc/s, 96.30 Mc/s and 96.28 Mc/s respectively. The three transmitting sites were separated by about 20 miles in each case, and they were all about 600 feet above sea level.

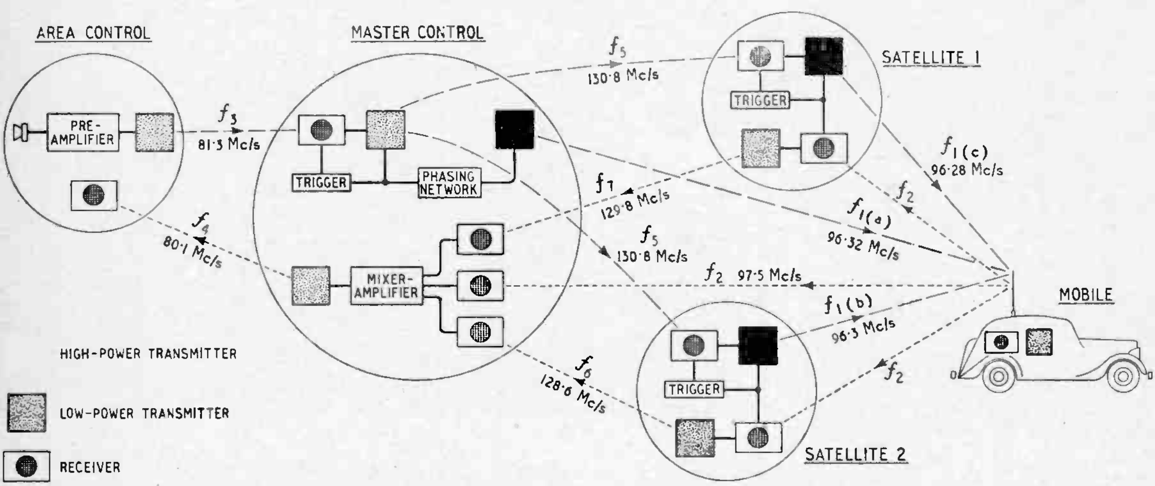
Of the three transmitters, one served as the master control centre through which all incoming and outgoing messages had to pass. The other two transmitters were merely satellite stations and served to relay the messages to and from the mobile patrols.

A schematic block diagram showing the various transmitters and receivers used at the different sites is reproduced here from a paper read before The Institution of Electrical Engineers by J. R. Brinkley. Outgoing traffic is conveyed over the radio channels marked f_1 (a), (b) and (c) and f_3, whilst the incoming traffic uses the channels f_2, f_4, f_6 and f_7 respectively. The channel f_5 is the control link between the master station and the two satellites, and carries the modulation for the 100-watt traffic transmitters at these sites.

Geographical considerations necessitated the transmitters being situated closer together than was actually desirable, and there was a wasteful overlap in the centre of the triangle they formed, but it admirably demonstrated the outstanding advantages of the multi-carrier system over a single station installation, and in this respect served its purpose.

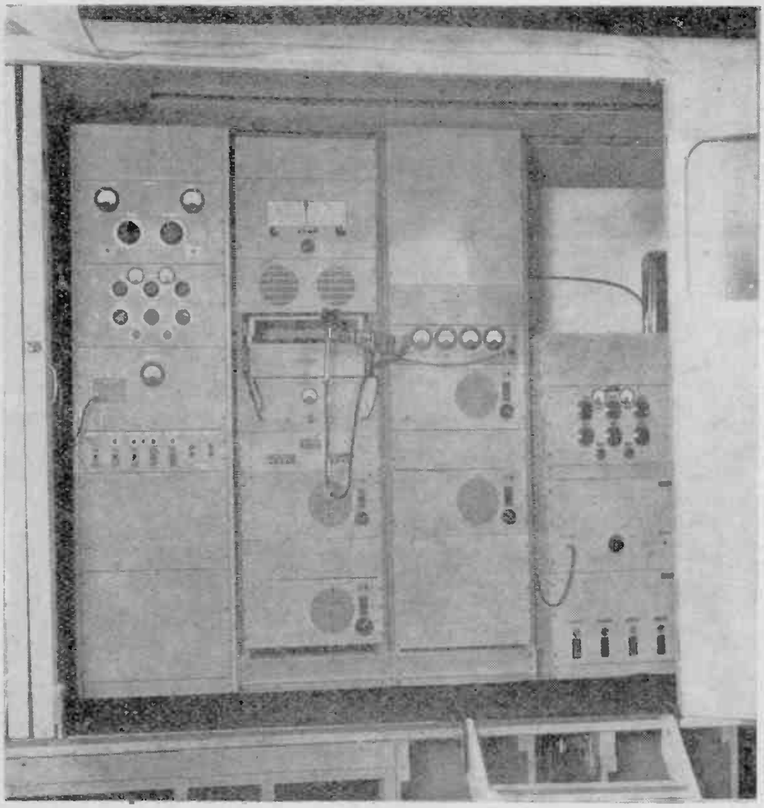
So far most of the work carried out has been of an exploratory nature, and as a consequence the equipment used is of a mobile type. Even the main transmitters and power supplies are assembled in specially designed lorries, although the grid electric supply can be used wherever access to it can be had. Likewise where line telephone circuits are available the radio links could be omitted, but these are matters of detail that have to be worked out for each separate installation.

The equipment fitted to the mobile units, which are mainly private motor cars, consists of a pre-tuned crystal controlled superheterodyne receiver having a band width of 100 kc/s and a 7-watt VHF transmitter. Power for operating both these units is obtained from small motor generators operated from the car accumulator.



Block schematic lay-out of the triple-carrier communication system operated entirely by radio links.

As the receiver is pre-tuned, it, and the transmitter, can be stowed anywhere that is convenient in the vehicle, since switching on and off and changing over the aerial can be effected by remotely controlled relays. Thus the only items of equipment that need be accessible are the microphone, loudspeaker, on-off and changeover switches. And these latter two items could be operated by a press-to-speak button on the handle of the microphone. Alternatively, voice-operated switching could be used.



One of the mobile 100-watt VHF transmitters with its ancillary equipment mounted in a vehicle for use at temporary transmitting sites.

In one of the illustrations reproduced here the mobile equipment is shown mounted in the luggage boot of a car.

The multi-carrier scheme would appear to have many applications outside the police and fire services for which purpose it was originally developed. Indeed, it is learnt that some exploratory tests are already in hand to assess its usefulness in connection with train communications and doubtless many other uses will emerge.

The Home Office has been mainly responsible for the field work involved in the development of the scheme, while active collaboration in the technical development and production of the actual equipment have been shared by the General Electric Co., and Stratton & Co.

"Wireless World QUALITY AMPLIFIERS"

IN Fig. 2 of this article in the January issue, the value of the bass-lift capacitor was omitted. This capacitor is in series with the 22,000-ohm resistor, and it should have a value of 0.05 μF.

Two of the resistors included in the ½-watt list, R_9 and R_{10}, should preferably be of the ½-watt type.

UNBIASED

By FREE GRID

Universal Telecommunication

NOW that the transatlantic telephone service is in operation once again I find myself in the Alice-in-Wonderland situation of being able to get in touch with anybody in Tennessee or Texas and quite unable to get a message home from a taxi to Mrs. Free Grid to say that I am detained by business and shall not be home until late. I found myself in this predicament only last week when dictating some important letters to my secretary as she and I sped along the Great North Road to Brookmans Park. It is, of course, possible to stop a taxi at the nearest 'phone box, but why in the name of all that is scientific is not each public and private vehicle equipped with a proper USW transmitter-receiver designed to contact the nearest telephone exchange?

I think that the least excuse for this sort of omission is to be found on our trolley-bus systems. Here we have a flock of public vehicles all linked by an insulated wiring system to a central point. These wires could be used as the carriers of a comprehensive "carrier current" system and so no ether space would be occupied. Overcoming the effects of the "flashes and bangs" which

Dictating important letters.

seem inseparable from trolley bus systems would provide excellent scope for inventive ingenuity and would contribute much valuable data to the final elimination of interference from our domestic receivers.

Underneath our streets are a multiplicity of waste pipes and other metal conductors, all of which could be made to serve as "carriers" in order to link private cars and other vehicles with the nearest telephone exchange. The fact that they are not insulated does not, of course, veto matters where modern UHF technique is concerned. On highways in the country there are roadside telegraph wires to act as carriers, and so only in the country byways should we have to employ a direct USW link from vehicle to telephone exchange although even in this case hop would probably be made to the nearest telegraph wires or other metal conductor.

It is no use saying that the ether is already overcrowded and that there are no ether channels available even for hopping from car to the nearest conductor. Actually, of course, the number of channels is infinite, for I take it that we can never get to a wavelength so short that it is zero or to a frequency so high that it is infinite. Mind you, I am not saying that I have worked all this out in detail. I am far too busy and in any case it is none of my business, it being more a matter for what the newspapers, when discussing Government plans, refer to rather contemptuously as the "permanent officials."

Golfers Menaced

MY first impression when the photograph reproduced herewith was sent to me for my comments was that it was phoney in more senses than one, and without attributing any dishonest or dishonourable motives to anybody associated with the photographs or to those appearing in it I am still of that opinion. The picture originated in America and the idea is that the earnest golfer should always be in a position to receive an urgent business call or a message from his wife.

Now, as all fellow-followers of the Royal and Ancient game will agree, who on earth, especially an American, has the remotest desire to risk being put off his game by an untimely message from anybody? The whole thing betrays utter and crass ignorance of the golfer's mind or

The Links radio link.

even of the fundamental idea behind the great game. It is one of the few pursuits which enable a man for a brief spell to enter a new and enchanted world where wives, business and all the other evils to which the flesh is heir can be momentarily forgotten.

Whenever I receive a photograph of this sort I always have a nasty feeling that it is a preliminary to my being asked to invest my hard-earned cash in some highly imaginative financial scheme of which I have had many instances in my time. Probably the most interesting of a radio or like nature was one known as the "Transatlantic Homing Guide for Liners." The idea was simple. Ships were to be provided with suitable electrical apparatus whereby they might, as the prospectus said, pick-up by induction the magnetic radiation from the transatlantic telegraph cables, thus being led straight from Liverpool to New York in the foggiest weather, using the cable as a homing beam.

For the moment even I was struck by the stupendous possibilities of the whole idea until I recollected that the screening effect, not only of the metallic covering but also of the equally restrictive salt-water shield, would put paid to the whole scheme. Apart from that, I suppose the cable people took a pretty dim view of the enterprise, as it was not proposed to pay any fee or royalty of any kind for this gratuitous use of the cables.

Letters to the Editor

Problems of Export B.B.C. Transmissions Pickup Construction

Export Trade

I WHOLEHEARTEDLY agree with Mr. Cribb (your September, 1945, issue) on export receivers. In the tropics reception on medium waves is marred by static and is useless except for local broadcasting confined to ground waves only. In East Africa we have only one station and that of very low power; consequently we are dependent on more powerful distant stations, working on short waves of 13 to 60 metres. To obtain satisfactory reception, attention must be paid to elimination of frequency drift and attainment of high sensitivity and selectivity.

What is required is standardisation of components, particularly valves. This would restrict the range of spares which must be carried by dealers and ensure servicing of radios irrespective of make and manufacture. All physical dimensions and characteristics must be standardised and the range made as compact as possible. While American manufacturers are devoting their energies to plugging certain preferred types, taking interchangeable components, British manufacturers cannot even agree on standardisation of valves. A lead in the pooling of export effort has been given by British manufacturers of small machine tools which can be improved upon by radio manufacturers to their general benefit. Yet the report of the I.E.E. meeting on valve standardisation in your April issue makes depressing reading overseas.

British manufacturers expose a grave weakness in their lack of understanding of export requirements and insistence on each going their own way. There are perhaps 10,000 radios throughout East Africa; that is, 10,000 covering about 450,000 square miles. Service is obtainable at three or four centres in that area. Users may have to pack and send their radios 500-600 miles, sometimes in lorries over rough roads, for the most simple repair or replacement, as with non-standard components the dealer may have to do considerable work if the maker's type component is not available. With standardised components, in many cases users could, and would, do simple replacements themselves. This is where overseas servicing differs from that in the U.K., and the Americans have long known it.

Further, by adopting standards produced on a pool basis the cost of manufacture would be bound to drop and British radios would become competitive. Competition must remain to ensure the best possible deal to the user, but the competition should not lie between manufacturers in the same country to the extent it now does in the U.K.; instead, in the main, it should lie between exporting countries. So now, British Manufacturers, be up and doing.

Dar-es-Salaam, MAHMOOD.
Tanganyika, E. Africa.

"Wartime Hangovers"

WE, the undersigned radio engineers, were very interested to see the paragraph entitled: "Wartime Hangovers," in the January issue of *Wireless World* and thoroughly endorse your remarks.

In addition to your request that a statement should be made by the BBC on this subject, we think it high time some action was taken to bring the present standard of transmission up to something much more worthy of the prefix "British."

Apart from general complaints, such as lack of apologies for programme breaks, faulty recordings, incorrect transmissions and the general low standard of operating, we have in this area certain local complaints some which we enumerate as follows:—

(a) Ever since the changeover in system of distribution at the

Letters to the Editor—

end of July there has been a marked inferiority of the Home Service quality as compared to the Light (lack of "top" response).

(b) The local Home Service transmitter gives a proportion of items each day which are only of interest to listeners in Northern Ireland. Surely if a wave-length has to be shared, we have much more in common with the North Region.

(c) Although during hours of daylight the Light Programme reception is reasonable on both wave-lengths, after dusk the Droitwich transmission is marred by interference from the BBC European station on 1,200 metres, *i.e.*, "Luxembourg effect." In addition, periods of marked fading and night distortion occur and the programme value at such times is negligible. The alternative local transmitter on 261 metres is on such low power that it too fails after dark to provide a satisfactory service, due to hetrodyne whistles.

We hope that through the medium of your columns our complaints are noted by the authorities concerned at the BBC and that some attempt is made to give the listeners, especially in this area, the high standard of reception they expect and deserve.

20 SIGNATURES.

Newcastle-on-Tyne.

Pickup Construction Under Difficulties

SOME of your readers, and possibly also the author himself, may be interested to hear some details of an attempt made to construct the moving coil pickup described in the July, 1942, issue of *Wireless World*.

The difficulties in finding the necessary materials were probably even greater on this isolated little island than they were at home, so that although the design followed Mr. Brierley's in principle, certain minor details had to be altered.

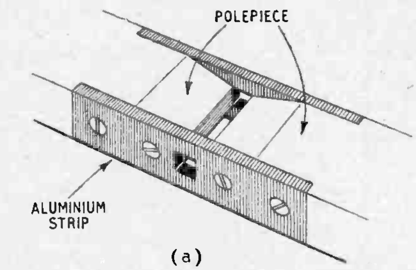
The only magnet I was able to obtain was one from a very ancient moving-iron pickup, the weight of which was somewhat greater than that of the Eclipse magnet recommended. As its field was not as strong as might have been desired, it was decided to avoid the magnetic short-circuiting caused by the four spurs left at the corners of the polefaces in the original design, and the necessary gap of 1/10th inch was obtained by screwing small strips of aluminium along the thin edges of the polepieces as shown in the accompanying sketch (a). A hole 1/10th inch square was then cut in the centre of each piece of aluminium in line with the gap between the polefaces. The same result was thus obtained without the magnetic short-circuit.

The coil former was made exactly to specification, except that it had to be $\frac{1}{2}$in. long instead of $\frac{1}{4}$in., since the thickness of the magnet, and thus also the width of the polepieces, was $\frac{1}{2}$in.

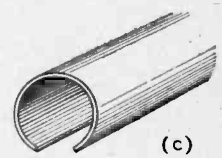
Difficulty was encountered in finding any rubber tubing of the correct dimensions; cycle valve tubing was out of the question, there being no bicycles on St. Helena. The rubber insulation from ordinary lighting flex was tried, but proved too irregular and lacking in elasticity. Eventually, by a sheer fluke, a small piece of rubber sleeving from the end of a pair of headphone leads was found.

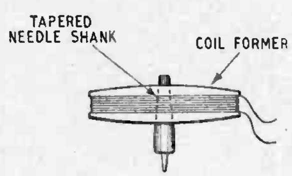
The next problem was the needle. Silent Stylus needles were unheard of here; ordinary steel needles were obtainable and I had a few HMV High Fidelity needles. It was obvious, however, that the hole necessary in the coil former to accommodate either of the latter two types would be so large in relation to the size of the former that it would leave little or no material at the sides of the needle, and would practically cut the former in half, or at all events considerably weaken it. To grind the needles down to a smaller diameter would be a long and tedious, but not impossible job. Eventually I discovered that the HMV Tungstyle needle, of which I had but four in my possession, consists of an unhardened steel sheath through the centre of which runs the hard wire which forms the actual point. It was therefore an easy matter to reduce one of these needles to a smaller diameter, and at this point I departed from Mr. Brierley's design, in that instead of making the needle shank parallel I tapered it towards its upper end and used a standard small taper reamer with which to bore the hole in the former; this prevented the needle being inserted too far into the former, and made a very secure fit which would become better in the event of any tendency for the needle to embed itself further into the former due to vibration. (See sketch (b).)

The tone arm presented some difficulty; the only material suitable for the job that could be found was an old aluminium car number plate, which was cut and bent into a tube $\frac{3}{8}$in. diameter, except that the longitudinal edges

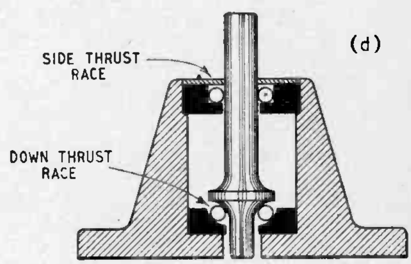


(a)


(c)



(b)



(d)

did not meet, leaving a gap of about ½in. between the edges on the underside. See sketch (c).

In view of the recommendations by certain subsequent contributors as to the importance of absolute freedom of the pivoting of the tone-arm both horizontally and vertically, I modified the pivoting base of a Garrard pickup by making a vertical thrust ball-race at the bottom of the pivot spindle, and a side thrust race at the top, as shown in sketch (d).

The coupling transformer was made up according to specification, but I was unable to obtain Mumetal for the core, having to use the laminations from a scrapped AF transformer of small dimensions, cut down to the measurements given.

I have not been able to construct the low-pass filter recommended, due to lack of wire, and I must admit I was also somewhat put off by the very large dimensions of the completed filter unit.

The pickup feeds via the coupling transformer to the grid of an extra stage of amplification provided for gramophone only, using an L63 resistance coupled to the grid of the triode section of an EBC3, in the anode circuit of which is included the tone-control networks used in the *Wireless World* Communications Receiver, with the exception of treble boost, which is arranged in the feedback network in the amplifier itself. This stage feeds the *Wireless World* DC Quality Amplifier, modified to run on AC supply, using KT61s in the output stage.

The results, using full bass boost, and one degree of treble cut have given immense pleasure and satisfaction, and are a very substantial improvement over the results with a moving-iron pickup of modern design by a famous maker. All who have heard it and compared it with the latter pickup have remarked on the "cleanness" of the reproduction, and the complete freedom from distress on heavy orchestral pieces. There is no sign of any bass resonance whatsoever, and the scratch noise from modern recordings is not excessive, although, no doubt, a properly designed filter, rather than ordinary treble cut, would improve matters.

The downward pressure required is not more than 13 grammes, and the needle shows no signs of enlarging the hole in the coil former, or working loose.

I have not yet taken a curve of the response, but the needle of an output meter across the output transformer primary has been watched whilst playing through HMV gliding frequency record, DB4037, and showed no signs whatsoever of any peaks of troughs. There seems to be some small loss of extreme treble, and I wonder whether some reader who knows more about this subject than I do can suggest the reason. Might it be due to the type of needle I am using?

G. M. CATTLEY.

Island of Saint Helena.

"FUNDAMENTALS OF RADAR"

Potential Accuracy of "Oboe"

THROUGH an arithmetical error, a misleading impression of the high navigational accuracy obtainable from the Oboe system was given in the last paragraph on p. 25 of our January issue.

The amended relevant paragraph is reproduced below, with corrections italicised.

If the velocity of propagation is taken as 200,000 miles per second, to simplify the arithmetic, the delay per mile of range in the Oboe system will be *10 microseconds*. If we can measure time intervals with an accuracy of 1/10 microsecond, therefore, we can determine position lines to within *20 yards*. This does not mean that the position can be determined accurately as within *20 yards* of a chosen point. In Fig. 5 is shown the error diagram when the two fixed stations are 100 miles apart and the position lies on the two 600-mile position lines within measurement accuracy. For this particular example, which is a very simple one, the long diagonal of the slightly curved parallelogram is six times the length of the short diagonal, and the short diagonal is approximately equal to the range error. Thus, if the error in time measurement is 1/10th microsecond, the error in position may be as much as ± *60 yards* along the arc of the position lines.

RADAR IN MERCHANT SHIPS

Details of the Equipment Which Has Been Adopted

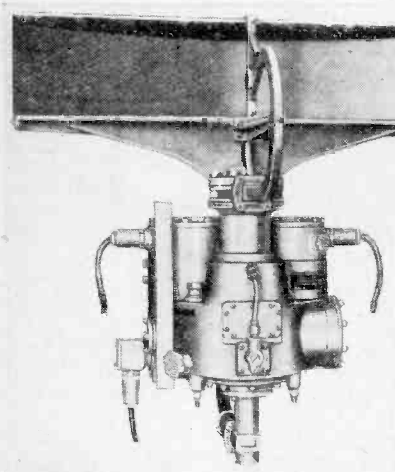
By S. T. ALLSOP,

Assoc. Brit. I.R.E.

THE radar which has been installed in the whaling factory ship, *Southern Venturer* is a naval type surface warning set designed and manufactured in Canada.

Although originally designed for naval purposes the set is very suitable for commerical use, being compact, easy to install and maintain and requiring a minimum of operating skill. It is intended to give warning of icebergs or the approach of other surface craft, and because of its PPI (Plan Position Indicator) type of presentation will show the position and outline of a coastline.

The aerial rotates continuously in one direction at about 22 r.p.m. and has a beam about 3° wide and 17° in the vertical. The bearing of an object can be taken to an accuracy of about 2° and the range to about 200 yards. The maximum range which can be obtained on a trawler is about 6 miles, but larger ships or coastlines can be detected at considerably greater ranges.



The beam reflector and its rotary mechanism are of light construction suitable for mounting at the mast head, as shown in the inset.

Three PPI displays can be provided, one in the main chassis and two remote from it which can be fitted in places convenient for navigation or observation.

The main chassis, in addition to housing the PPI display, contains the trigger unit, the modulator, the transmitter, the transmit/receive switch, the receivers and a monitoring unit together with the power supplies. The chassis is built in three sections bolted together. Each of these sections may be removed separately and each is small enough to pass through a hatchway 18in. by 36in.

The pulse repetition frequency, that is the number of transmitted pulses per second, is locked to the supply frequency which is 500 cycles per second. A pulse is developed which synchronises the time base with the transmission and this is used after amplification to operate the "trigatron" valve in the modulator circuit. The modulator consists of an artificial line which is resonantly charged to about 14,000 volts. The line is discharged by means of a trigatron to develop a square negative voltage pulse of 10,000—14,000 volts at the cathode of the magnetron, the anode of the magnetron being earthed. The trigatron valve contains a spark gap which is "triggered" by the synchronising pulse and which then sparks over to discharge the artificial line.

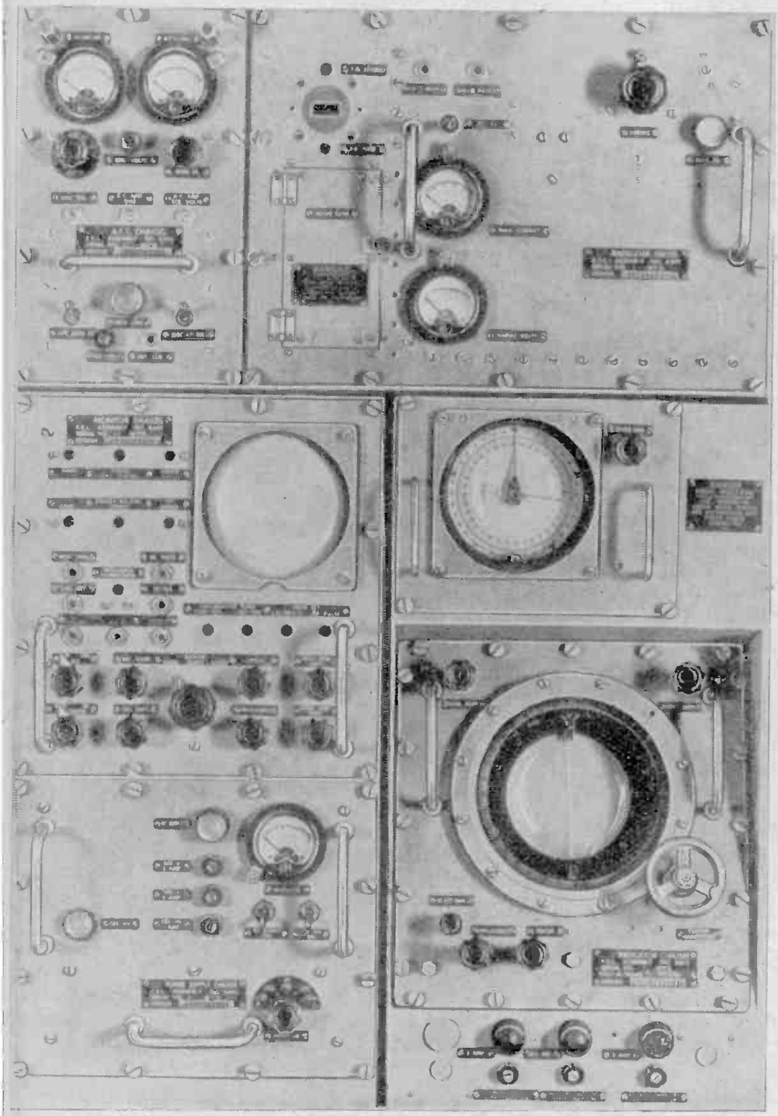
The magnetron operates at about 10,000—14,000 volts and has a peak anode current of about 30 amperes. The voltage pulse developed at the cathode has a duration of about 0.7 microseconds. The output from the magnetron is taken by means of a probe directly into the waveguide.

Received signals are also extracted from the same waveguide and a transmit/receive switch is built into the waveguide to prevent transmitted energy reaching the receiver. A length of rectangular waveguide of a size which will propagate only the H_{01} mode is taken to the aerial pedestal which must be situated within 60ft. of the main rack; the continuous rotation of the aerial necessitates the use of a rotating waveguide joint in the pedestal. The rectangular waveguide is changed to a circular section propagating an E_{01} wave. The H_{11} wave which can also exist in a guide of this diameter is eliminated by matching stubs. Finally, the waveguide becomes rectangular again the mode of propagation being changed back to H_{01} and taken to the aerial reflector and terminated in a matching flare.

The aerial itself is extremely light and is rotated by a 1/10 horse power DC motor contained in the pedestal. The aerial reflector is a section of a parabolic cylinder about 30in. wide and 6in. high.

Received signals are picked up by the same aerial and fed down the waveguide as far as the transmit/receive switch. The action of this switch causes the signals to be deflected to a crystal rectifier. Local oscillations are applied to the rectifier at the same time and an IF of 31 megacycles is extracted. The local oscillator consists of a klystron valve which can be tuned by adjusting the cavity sizes or by adjusting the reflector anode voltage. This straight line trace on which echoes are deflected upwards.

The PPI display in the main chassis consists of a 5in. cathode-



Main instrument rack which includes: transmitter, modulator, receiver PPI and "A" displays and power supply unit.

second form of tuning can be carried out manually or automatically by means of an automatic frequency control circuit.

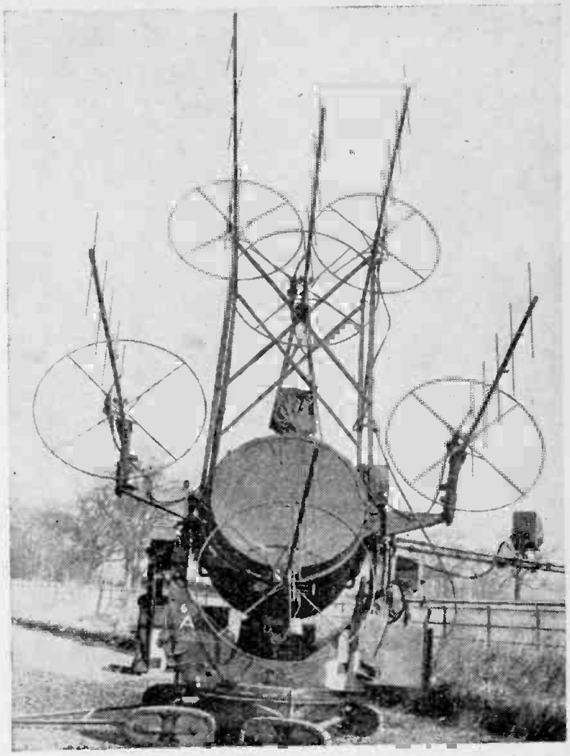
The 31 Mc/s IF is amplified by six stages of IF followed by a diode detector. Video amplifiers are provided for the PPI's and for the monitor tube on which an "A" display can be presented. The "A" display is the normal

ray tube with a long-persistence screen using a radial time base synchronised with the transmitter and also with the rotation of the aerial by means of a selsyn motor.

Maintenance of the set is not expected to be a serious problem and Merchant Service personnel are being trained to operate and service the equipment.

RANDOM RADIATIONS

By "DIALLIST"



The sixth Yagi array on this searchlight is for the IFF.

"Elsie"

ONE of the neatest radar jobs to my mind was SLC (Searchlight Control), usually known as Elsie. Using a frequency of the order of 200 megacycles, Elsie is more or less intermediate between USW and microwave radar. The transmitter and the receiver are each about the size of an ordinary communication receiving set; a third box of about the same size houses the DC/AC converter (the searchlight generator supplies DC) and a motor-driven rotary switch. On the searchlight itself was mounted (in the type which I came across) five Yagi aerial arrays, each consisting of a half-wave dipole and four directors. Each array is backed by a circular wire-netting screen to minimise backward radiation. The polar diagram of such a Yagi is cigar-shaped and has a width of about 30 degrees of angle. The uppermost aerial is that of the transmitter. The receiving aerials are mounted at "12 o'clock," "3 o'clock," "6 o'clock," and "9 o'clock" respectively round the searchlight. These receiving aerials are slightly splayed, each diverging by about 7 degrees from an imaginary line joining searchlight and target. The rotary switch cuts each receiving aerial in turn, the net effect being the same as if a single cigar-shaped polar diagram were made to rotate. The output of the "9 o'clock" and "3 o'clock" arrays is applied to the bearing CRT, that of the other pair going to the elevation CRT.

In Operation

The "Number One" of the detachment has before him a small CRT, on which a horizontal time-base appears, representing a maximum range of some 50,000 yards. On this a break is seen if a target is picked up. By turning a knob he causes this break to be "strobed" or brightened; the strobed break and nothing else appears on the bearing and elevation CRTs, on which it is seen as a bright spot. All that the bearing and elevation numbers have to do is to work their controls (which also move the searchlight) until their spots are central on the tubes. So long as both keep them there, the searchlight is "on target." What actually happens in the case of the bearing operator is that if he does his stuff a signal of equal intensity is received from each when the polar diagram of the "3 o'clock" aerial and that of the "9 o'clock" aerial are equidistant on either side of the target in azimuth. Similarly the elevation operator gets his spot central when the "12 o'clock" and "6 o'clock" aerials are pointing an equal amount above and below the target. All this time the searchlight itself has been dowsed. When the bearing and elevation operators report "on target" the order to expose is given and in over 90 per cent. of instances the target is at once seen in the searchlight beam, though the width of this is only about 2 degrees. In spite of its small size, the Elsie transmitter gives pulses peaking to 10 kW.

□ □ □

Gas Man's Day Out

CURIOUS, rather, that the people sent by gas companies to install this, service that or repair t'other aren't taught just a wee bit about the electric circuits for lighting or power that they may expect to find in the modern home. Would that their training might include inculcation of the respect that should be shown for the wiring of such circuits. Such thoughts were aroused in me the other day when I was just in time to save one of these folk from himself. Mrs. "Diallist" had summoned the gas man to install a water-heater over the sink, and this for some reason involved the running of a supply pipe right from the meter. Having heard him jingling his bag of tools in a corridor that led to the kitchen department, I went along to make sure that he committed no crimes upon the many lead-covered cables lying beneath its floorboards. When I arrived on the scene he had just finished making a hole with brace and bit and was about to cut straight across a plank with one of those finer-than-keyhole saws that seem to have a place in every gas man's outfit. The big idea, I learned, was to raise a short length of floorboarding so as to make a gap in which to "fish" for the gas pipe pushed through by his mate from the cellar. An excellent scheme in many ways, I agreed; but had it occurred to him that that jolly little saw of his would have to cut through one loudspeaker extension, two power and two lighting cables before it severed the plank? It had not. He was (and rightly) aghast at the thought. I explained (*a*) that corridors in a modern house are amongst the main stamping grounds of the electrician; (*b*) that if planks, as is normally the case, run down and not across a corridor, the joists to which they are anchored must lie across it from side to side; (*c*) that in that event the electric cables are housed in shallow grooves cut into the joists and therefore run immediately under certain of the floorboards; (*d*) that to my knowledge there were such cables under the very board on which he was proposing to operate; (*e*) that it really wasn't sound practice to saw through live 230-volt cables, and (*f*) that the wisest course was to raise the whole plank with the help of the tool known as an electricians' chisel, which all gas men, even those most ignorant of electricity, carry in their tool kits. You probably know the gadget in question—it looks rather like a cold chisel, but has a very thin blade 2-2½in. in width. You smack it down between two planks and heave on the shank; then up comes the plank you want.

Other Crimes

And that kind of thing is by no means all that a well-meaning but uninstructed gas man can do in the way of electrical crimes. There is, for instance, an I.E.E. regulation that the lead sheathing of an electric cable, or the steel conduit through which a cable runs, shall not come into contact with gas mains. Very well: you stipulate accordingly when having any wiring job done in your home, or take the necessary precautions if you do the work yourself. Sometime later the cheerful gas man, knowing nothing and caring less about such things, is called in to install a new piece of piping. He finds the grooves that you have cut in the joists for your cables and, regarding them as a gift from the gods, lays his miserable pipes in them along side the cables. He has never been taught that there is anything wrong in so doing, so you really can't blame him. I am open to wager that the I.E.E. regulations are infringed in nearly any house in which alterations in or additions to the gas system are made after the electric wiring was done. Plumbers, too, are sad, if unwitting, offenders when dealing with water pipes. I can almost believe the story of the man who complained that his new geyser delivered nothing but dance music, whilst clouds of steam issued from the extension loudspeaker.

□ □ □

"Se Non e Vero . . ."

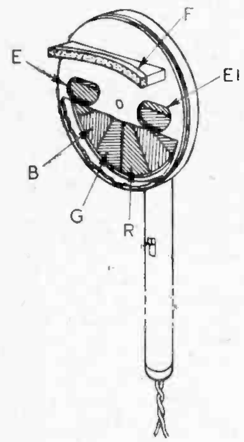
A GOOD story about L. H. Bedford came my way the other day. If it isn't true, L. H. B. must blame the friend of his who told it to me. Here's the story. When Bedford was in the Home Guard he was one of a party being shown round an AA gunsite by a young officer. They came at length to a GL1 receiver and the YO gave a sketchy description of its various features. "This," he said, "is the EF attachment, invented by a fellow called Bedford. No relation of *yours*, I imagine, Private Bedford?"

RECENT INVENTIONS

A Selection of the More Interesting Radio Developments

COLOURED TELEVISION

It has been proposed to transmit a sequence of black-and-white pictures in repeated groups of three, the image signals of successive pictures being derived from light which has passed through red, green and blue filters respectively. If the received pictures are viewed through correspondingly coloured filters, which are synchronised with the transmission, the colours in the original scene are restored.



Colour viewing filter.

A convenient form of viewing device is shown in the drawing. It consists of a rotating disc with twelve transparent segments arranged in a repeated sequence of red, green and blue. The disc is driven by a 12-pole synchronous induction motor, the supply leads passing through a phasing-switch in the handle to ensure that a segment of the right colour registers with both eye-pieces E, E1 simultaneously. A curved support F, held against the forehead of the observer, helps to steady the device and avoid eye-strain.

Marconi's Wireless Telegraph Co., Ltd. (assignees of E. J. Quinby). Convention date (U.S.A.) July 9th, 1942. No. 568982.

USW DETECTORS

It is known that very high frequencies can be set up in the ionised "plasma" of a gaseous discharge tube, the free electrons responding to oscillations that are too rapid for the ions to follow.

This allows the "plasma" to be used as a non-linear element for detecting ultra-short waves. For instance a tube filled with neon gas is made with a cylindrical cathode surrounding a rod-shaped anode, so that the two electrodes can be aligned with the two conductors of a concentric-line feeder supplying the signal input. A suitable DC voltage is applied to maintain the luminous discharge, and is adjusted until the "plasma" is most sensitive to the input frequency; or alternatively to the value which gives the most favourable signal-to-noise ratio, this being a function of the ion density. When the device is used as a frequency converter, the locally applied oscillations may also serve to flash the tube, in place of the DC bias.

D. Weighton and Pye Ltd. Application date May 17th, 1943. No. 569562.

SCREENED LECHER WIRES

When screened Lecher wires are used to feed signals to the frequency-changer of a short-wave receiver, there is a tendency for the wires and the screen to co-operate and form a "parasite" coaxial line, on which disturbing standing-waves may be built up.

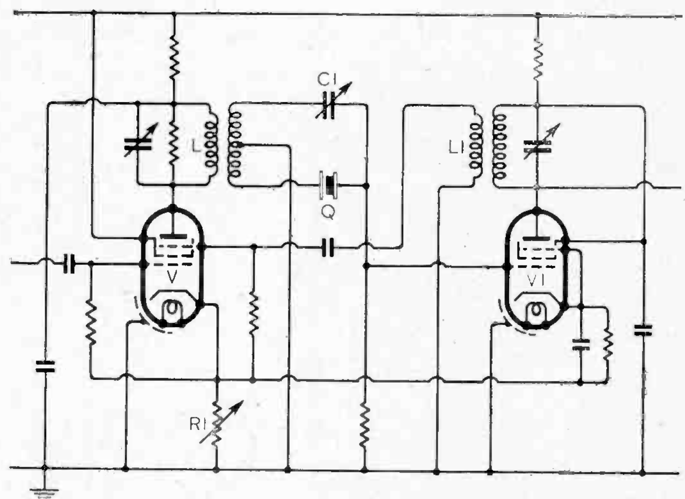
As a safeguard, the short-circuited end of the Lecher wires is shunted to the closed cap of the screen through a resistance, which is preferably made equal to the surge impedance of the unwanted coaxial line. This serves to prevent the formation of voltages that would otherwise interfere with signal reception.

Standard Telephones and Cables Ltd., and C. N. Smyth. Application date June 21st, 1940. No. 570359.

RADIOLOCATION

Exploring signals are radiated in the form of intermittent pulses, which are separated by comparatively long intervals to allow for the return of the reflected echo. Each pulse is transmitted as a short train of waves of constant frequency.

In the circuit shown, this type of transmission is generated by periodically interrupting the normal discharge current through a pentode valve, thereby shock-exciting a piezo crystal which continues to oscillate until the valve blocking bias is removed. A square shaped negative voltage (from a source not shown) is applied at constant intervals to the control grid of the valve V. As the current in the anode inductance L collapses, it applies an inductive kick to the crystal Q. This then delivers a sinusoidal train of waves to the amplifier V1 for a period determined by the duration of the blocking bias. When the latter is removed, and the valve starts to conduct, the crystal oscillations are damped out. The initial build-up of each wave-train is accelerated by feedback from a common cathode resistance R1, and also by the passage of a part of the primary surge from the coil L through a condenser C1 direct to the grid of the amplifier V1. Negative feedback is applied from a coil L1 to damp out each wave-train immediately the conductivity of the first valve is restored.



Pulse generating circuit.

The British Thomson-Houston Co., Ltd., and D. J. Mynall. Application date December 19th 1941. No. 569339.

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.


MULLARD
VALVES
FOR DOMESTIC RECEIVERS
Recommended Types for
A.C. Mains Operated Receiver.
ECH 35 Frequency changer.
EF 39 Intermediate Frequency Amplifier.
EBC 33 Detector L.F. Amplifier.
EL 33 Output Pentode.
AZ 31 Rectifier.
Other recommended types are available for A.C./D.C., battery and portable receivers.
MULLARD THE DOMINANT NAME IN ELECTRONICS

OKERIN WAXES

AND DIELECTRIC COMPOUNDS TO GOVERNMENT SPECIFICATIONS—FOR

- **CONDENSERS**
- **CABLES**
- **TRANSFORMERS**
- **COILS**

A.I.D. AND C.I.E.M.E. TYPE APPROVED FOR ARCTIC AND TROPICAL CONDITIONS

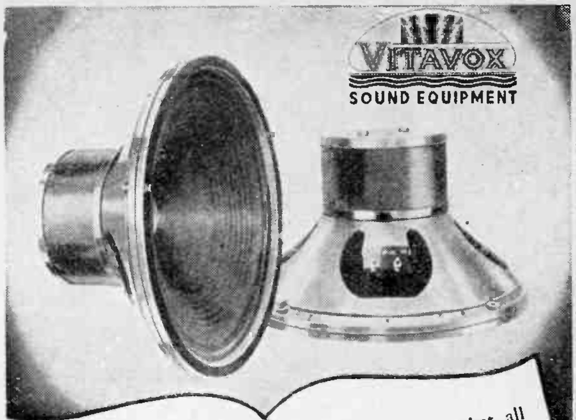
Used and Recommended for Service Components

ASTOR BOISSELIER & LAWRENCE LTD.

SALES DEPT.

NORFOLK HOUSE, NORFOLK ST., STRAND, LONDON, W.C.2

Telephone : TEMple 5927

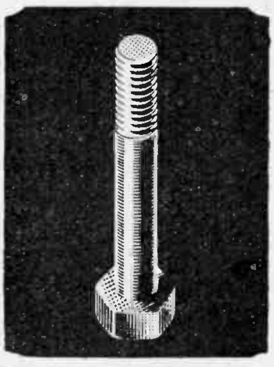


IT is a fact that although VITAVOX K12/10 and K12/20 P.M. Speakers are not available in unlimited quantities, their quality is such that they are well worth waiting for.

It is a fact too that all specification figures are actual and not nominal.

VITAVOX LIMITED, WESTMORELAND RD., LONDON, N.W.9. Phone Colindale 8671/3

FAMOUS FASTENERS



HIGH TENSILE HEXAGON BOLT

Three distinct tests ensure the standard of Linread Bolts. The first is checking of raw material, the second is specialised Quality Control during manufacture, and the third, inspection of finished products.

Specialists in Cold Forging; Roll Threaded Screws; Solid and Tubular Rivets; Nuts and Bolts in all metals; Small Pressings; Auto and Capstan-turned Parts.

LINREAD LTD., STIRLING WORKS, COX ST., BIRMINGHAM, 3.
TELEPHONE No.: CEN. 3951 P.B.X.
TELEGRAMS: "LINREAD BIRMINGHAM."
London Office: Clifton House, Euston Road, London, N.W.1.
Tele. No.: Euston 8261.

Linread
SPECIALISTS IN COLD FORGING

Remember Walter

RADIO **STAMPINGS** • RADIO **CHASSIS** • RADIO **PRESSINGS**

FARM LANE, FULHAM, S.W.6. TELEPHONE: FULHAM 5234

C.R.C.A

I am the c.g.s. unit of energy—you'll find me in every radio circuit.

ERG

ERG is the trade mark that will identify our products of quality—small parts for big jobs.

ERG RESISTORS LTD.
1021a, FINCHLEY ROAD, LONDON, N.W.11. *PHONE* : SPEEDWELL 6967

Rate 6/- for 2 lines or less and 3/- for every additional line or part thereof, average lines 5-6 words. Box Numbers 2 words, plus 1/-. Press Day: March 1946 issue, first post Thursday, February 7th. No responsibility accepted for errors.

NEW RECEIVERS AND AMPLIFIERS

H.P. RADIO SERVICES, Ltd., offer:—

NEW receivers, 1946 Alba 5v all-wave superset, £18/4/6; Kolster-Brandes 5v, £21/14/4; Philips 15w amplifier, with mike and 2 speakers, 12v dc or 110-250v ac, £58/10; 5w ac/dc amplifier, neat chassis, with valves, £6/10.

ELECTROLYTIC condensers.—B.I. 8mfd 500v, 3/1; 8×8mfd 500v, 4/11; 8×16mfd 500v, 6/3; 25 mfd 25v, 2/-; Dubilier, 8mfd 500v, 4/-; Dubilier, 50v 50mfd, 3/6; block condensers, 4mfd 500v, 3/-.

METERS.—Highest grade 0-1ma meters, 2½in, 48/-, 3½in 55/6; 3-range pocket meters, 15/-; Avominor, 4gns.

COILS.—Midget T.R.F. medium wave, 5/- pair; all-wave superhet, 9/- pair; i.f. trans., 465kc/s, screened (with trimmers), 12/9 pair.

LOUD Speakers.—5in Rola, 18/6; Rola, 8in, 19/6; Celestion, 8in, with trans., 25/-; Celestion, 8in, energised, 2,000ohms field, with trans., 36/-; R. & A., 10in, with trans., 45/-; Vitavox, 10w, 12in, £7.

BOOKS.—Radio Circuits, 2/-; Radio Manual, 1/-; Amplifier Manual, 2/-; Modern Radio Test Gear Construction, 1/6; Radio Inside Out, 4/6; Manual of Disc Recording, 2/-; Radio Valve Manual, 3/6; Short Wave Handbk., 2/-.

ALL new goods; prompt dispatch; satisfaction guaranteed; postage extra under £4.

H.P. RADIO SERVICES, Ltd., 55, County Rd., Walton, Liverpool, 4. Tel. Aintree 1445. Estab. 1935. [4742

COMMUNICATION receivers.—As soon as civilian supplies recommence we shall be at your service.—A.C.S. Radio, 44, Widmore Rd., Bromley, Kent. [4528

COMMUNICATION receivers. — "Dale" will have them as soon as trading conditions allow.—Remember—Dale Electronics, Ltd., 105, Bolsover St., W.1. Mus. 1023.

FOR sale, Eddystone communication receiver complete with packs and speaker, new; also Hallicrafter 329 Sky Traveller.—Coombe Bridge, S.W.20. Tel. Kingston 2233.

COMMUNICATION receivers serviced and aligned by experts; transmitting valves, T55, 35T, etc; Eddystone components from stock; stamp lists.—Radiovision, Syston, Leics.

5-VALVE all-wave superhet chassis, complete, ready for use, £12/10; kits for W.W. amplifier or any parts separate; amps. built to order; full details s.a.e.—R.E.S., Maurice Rd., Canvey, Essex. [4724

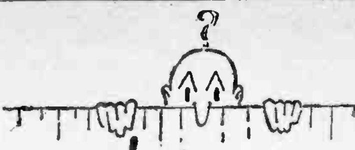
AMPLIFIERS.—Grampian, 15watt, mains or battery, complete, £33; Grampian type Ensa, complete stage or dance band equipment, £36; Vortexion 15watt, mains or battery, £22/10.—For details of above send 1d. stamp for lists to Potter, 9, White Hart St., Thetford, Norfolk. [4655

ANELOY RADIO offer set of components for making M.W. semi-midget 4-valve ac/dc t.r.f. receiver, including cabinet, valves, drilled chassis, 6½in speaker, screws, etc.; nothing more to buy; complete with circuit, £8, packing and post 5/-.—Aneloy Radio, 36, Hindmans Rd., E. Dulwich, S.E.22. [4663

BAKER'S.—New 7-valve "Wireless World" Quality amplifier with tone control stage, 8 watts push-pull triode output, price includes super Quality triple cone, 12in permanent magnet speaker, with large output transformer and all valves; also as above but with 15 watts tetrode output, ideal for realistic reproduction for public address; 2½d. stamp for particulars, prices, etc.—Bakers Selhurst Radio. Tel. Croydon 4226. [3680

DE WITT AMPLIFIERS present their new 25watt high-mu amplifier chassis, comprising high gain input stage, twin 6L6 tetrode output, rectifier and power pack for ac mains, fitted heavy duty OP transformer for 2.5 and 15ohms, complete, ready to use, £7/19/6; packing and carriage 5/- extra; special bass and treble uplift tone control stage, a guinea extra.—Available only from Kossuth Radio Co. 410, Dudley Rd., Edgbaston, B'ham. [4734

BRIERLEY quality amplifiers, 200-250v ac, 5watt, 8½gns.; 12watt, £14; for high fidelity reproduction of radio and records: PA and SOF types available; s.a.e. for copy of Design for Quality, illustrated leaflet on amplifiers, and list of chokes, transformers, switches, etc. We thank everyone for their enquiries regarding our pick-ups; these are far too numerous for us to be able to send immediate individual replies, but full technical details, illustrations, operating notes and prices will be forwarded to all as soon as possible.—J. H. Brierley (Gramophones & Recordings), Ltd., 46, Tithebarn St., Liverpool, 2. [4732



BUT CHAD IS WRONG—

PARTRIDGE TRANSFORMERS ARE AGAIN AVAILABLE

Large selection of items now held in stock. "Specials" manufactured to order in 14 days. May we send you our 1946 Price List?

Telephone: Abbey 2244

PARTRIDGE TRANSFORMERS LTD

76-8, PETTY FRANCE, LONDON, S.W.1

Beautiful Cabinetwork

Gradually we are getting into our stride and soon shall be able to manufacture articles of the exquisite standard attained before the war. The timber problem is very difficult and we are fussy as to what we use, but good times will come again and we shall be ready . . . with very interesting cabinetwork, so in the meantime get your name on our lists to facilitate our planning for the future.

If you have Licences to manufacture we shall be pleased to receive your enquiries for Radio Cases, Instrument Cases, Baffles, Horns, etc., and in fact any articles in wood for Radio and Scientific Instruments.

Lockwood & COMPANY

67, Lowlands Road, Harrow, Mdx.

Phone: BYRon 3704

T.R.F. ac/dc medium and long wave kit of parts, with drilled chassis, size 9½×4½×1½, and all components, condensers, etc., and circuit nothing else to buy, £4; valves, £2/10; 5in speaker, trans., 27/6.

HENRY'S, 5, Harrow Rd., Edgware Rd., W.2.

AMPLIFIERS. — Complete equipment for P.A. industrial, dance and stage installations and portable apparatus from 15 to 150w; early deliveries; illustrations and spec. on request.—Broadcast and Acoustic Equipment Co., Ltd., Broadcast House, Tombland, Norwich 26970. [2903

RECEIVERS, AMPLIFIERS—SECOND-HAND

H.R.O., 9 coils, 230volt pack, and speaker; offers.—Box 2875. [4591

FOR sale, Hallicrafters SX28 receiver, fine condition.—Box 4818. [4643

HALLICRAFTER SX24, 550 kcs/30 P/C, perfect condition; offers.—Box 4863.

HALLICRAFTERS, SX28, 27, 25, 24; McMurdo Silver, 358X; H.R.O. Senior; cash offers.—Box 4941. [4681

PARMEKO complete P.A. equipment, Quality amplifier, mike, 2 turntables, crystal pick-ups, speaker; best offer.—Box 4542. [4604

H.R.O. with 230volts ac power pack, coils for 50kc/s to 430kc/s, and 900kc/s to 30kc/s in 7 bands.—Offers to Box 4949. [4702

VORTEXION 50w amplifier, £25; Hallicrafter Skyrider Defiant SX24, Xtal, £30; both perfect order, good condition.—Box 2781.

EDDYSTONE 358X communication receiver, 1942 model, 90-31,000 kcs, complete with all coils and mains pack, as new; £70.—Box 2979. [4595

A.C.S. RADIO, 44, Widmore Rd., Bromley, Kent, offer small selection com. sets, radio receivers, amplifiers and televisors; list free. [4530

H.M.V. 6-valve, 5 waveband, ac auto radiogram, 7-145 metres short wave, beautiful condition inside and out; £95; nearest offer, carriage paid.—Box 4632. [4626

MODEL A.R.77 G.P. communications receiver, in perfect condition; £40, with matched speaker and spare set of valves.—Sqn. Ldr. Nigel Harris, 11, Chester Terrace, Regents Park, N.W.1. [4594

AMATEUR'S stock for sale, including 8v sw receiver, 2v preselector, power supply, 1,000kc Xtal oscillator, sig-gen, c and r bridge, new 0-1ma meters and valves, etc.; s.a.e. enquiries; offers around £95 lot, or separate.—F. Skinner, 69, Ashley Rd., St. Albans, Herts. [4693

COMPONENTS—SECOND-HAND, SURPLUS

SPECIAL offer for February.

WHILE existing stock lasts.

SPEAKERS.—Celestion P.M. 6½in. L/Trans., 16/6; 6½in. P.M. W/Multi ratio trans., 26/6; 8in. M. energised (1,500 coil), 18/11.

CENTRALAB v/controls L/S, 2/6; w/s, 3/6.

CONDENSERS, .1, .01, .05, .002; 6/- doz.

STANELCO & Solon soldering irons; 13/6 ea.

TWO- and three-gang condensers, .0005, 2-gang, 11/6; 2-gang s/motion, 13/6; 3-g. 14/6.

ROTHERMEL crystal p/ups de luxe; £3/18/9.

LINE cord, .3amp (60ohms p.ft) 2-way, 1/6 per yard; 3-way, 2/6 per yard.

T.R. cable, 1/044 asstd. lengths; 7d. per yard.

EIRE resis, ½watt, ¼meg., 1 mag., 4,700, etc.; 4/6 doz.

ALL goods are new; many other lines in stock; large assortment B.V.A. and U.S. valves.

MATT RADIO SERVICE, 152, Richmond Rd., Kingston-on-Thames. [4728

COULPHONE RADIO, Station Rd., New Longton, nr. Preston.

RETURN of post mail order service; c.o.d. or c.w.o.

NEW goods only; no surplus; all orders over 5/- post free. Compare these prices.

LINE cord, 60-70 ohms per foot. 2-way 1/6 yd., 3-way 1/9 per yd.

MAINS transformers.—Paper interleaved wax impregnated; primaries for 200-230-250 volts, 300-0-300v, 60ma, 4 or 6v, 17/6; 350-0-350v, 100ma, 4 or 6v, 24/-; bobbin as above model, 15/6; 450-0-450v, 200ma, with 4v 8a, 4v 4a, 4v 4a or 6v 4a, 6v 4a, 5v 3a, 42/6.

SUPERHET coil packs, 3 waveband, completely wired with switch and trimmers on chassis, with circuit for 5-valve receiver, all components for which are available from stock, 465 k/c, 32/6.

SPEAKERS, Magnavox, Rola, Plessey, p.m. less tran., 2½in 24/-, 3½in 27/6, 5in 19/6, 6½in 20/-, 8in 21/-, 10in 30/-; with tran., 6½in 24/-, 8in 25/-, 10in 36/-.

ENERGISED with tran. 1,200 or 2,000ohm field, 8in only, 32/6.

MAINS droppers, feet, 2 slider, 0.2amp 4/3, 0.3amp, 4/6. Send s.a.e. for 8-page list.

BRIDGEMEGGER, perfect, £25; 954, 955, 9002, 9003, new, unboxed, £6.—Box 2780.

ARMSTRONG

During the total war our total manufacturing capacity was engaged on the production of high priority apparatus for the fighting services. Considerably over 12 million high precision components were made by us and accepted by the Ministry of Aircraft Production for use by the R.A.F. In the immediate future the same initiative and drive will go into the production of Armstrong radio for export.

We are pleased to announce that we are now permitted to make a limited number of radio receivers for the home market.

The first model Armstrong Chassis will be in production within the next few weeks. The Chassis will be of entirely new design and incorporate wave-band expansion, the 15-50 metre band will occupy over 20 inches, greatly facilitating short-wave tuning. Eight octal valves will be used in the circuit and the output stage will be capable of giving 8 watts of Armstrong Quality Output. The price has not yet been fixed but we hope will not exceed £12 12s. 0d., plus tax.

A demonstration set of the New Model is now available for interested callers to hear.

Illustrated technical specifications will be available in two or three weeks.

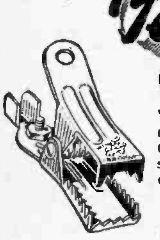
ARMSTRONG WIRELESS & TELEVISION CO. LTD.
WARLTERS ROAD, HOLLOWAY, LONDON, N.7
'Phone: NORth 3213

COMPONENTS

You may think it impossible, but you can actually get **all** your requirements from **one** source, saving endless chasing around and disappointment, to say nothing of time and cash.
We carry unquestionably the most complete and comprehensive stocks in the whole of the Industry, and if you want first-class components and material (not salvage, etc.) and very keen prices, you should lose no time in contacting us.
No catalogues, unfortunately, but if you send us your list of wants, worded clearly and simply, and enclose S.A.E., your enquiry will be dealt with the same day. Please **print** your name and address. Better still, come and see us!

WIRELESS SUPPLIES UNLIMITED
264-266 Old Christchurch Road, Lansdowne, Bournemouth, Hants.

Improved Terminal CLIPS



Well made of steel, double ridged for strength. Teeth on three sides of lower jaw and special design of upper jaw ensure firm grip and good contact.

Wingard
CHURCH ROAD · HENDON · LONDON · N.W.4

SOUTHERN RADIO'S wireless bargains:—
LATEST radio publications: "RADIO Valve Manual," equivalent and alternative American and British types with all data, 3/6; "Radio Circuits," fully illustrated receivers, power packs, etc., 2/-; "Amplifiers," fully descriptive circuits, 2/-; "Radio Coil and Transformer Manual," 2/-; "Short Wave Handbook," 2/-; "Manual of Direct Disc Home Recording," 2/-; "Test Gear Construction Manual," 1/6; "Radio Pocket Book," formulas, tables, colour-code, etc., 1/-; "10-Hows for Radio Constructor," 1/-. Just published, "Radio Reference Handbook," comprehensive and up-to-date, covering all branches of radio, 10/6.
PAPER condensers Post Office type, upright, 2mfd. high working (used but guaranteed perfect), 2/6 each. Brand new 2mfd mainsbridge, 3/6, 1mfd 3/-, 1.-1.-1. 2/6; 4 C.C. electrolytic reversible 4-4mfd 70v, 3/6, multicon mica condensers, 28 capacities in one, 4/-.
ACE "P.O." microphones, complete with transformer, usable with any receiver, 7/6. Permanent crystal detectors, 2/6. Crystals 6d., with cat's-whisker 1/-. Insulated pushback wire, 25 yards, 5/-. Insulated sleeving, assorted sizes and colours, 3/6 per dozen yard lengths. Single screened wire, 10/- per doz. yards. Twin screened wire, 17/- per dozen yards. Power rheostats cutler harmer, 30 ohms and 10 ohms, 4/6 each. Press-button switches, 3-way 4/-, 8-way 6/- (all complete with knobs). Escutcheons for 8-way switches, 1/6. Yaxley type rotary switches, 11-way single bank, 6/6. Hundreds more bargain lines.
SOUTHERN RADIO SUPPLY Co., 46, Lisle St., London, W.C. Gerrard 6653. [4234

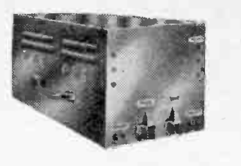
CHARLES BRITAIN RADIO offers a wide choice of components, etc., including:—
SPEAKERS.—Philco mains energised, fitted with new cones, with trans, 3,000, 5.000 fields, 21/-; Goodmans p.m. 8in. with multi-ratio trans, £1/10; Celestion p.m. 8in. with pentode trans, 25/-; R.A. p.m., less trans, £1; mains transformers type E1, 350-0-350 6v or 4v types, usual prims, new, £1; type D1 350-0-350 120ma, can be used for 2v, 4v, 6v heaters, shrouded, £1/10; mains taps for above, 1/-.
CABINETS as used for the utility radios, either model, £1/10; dials, all-wave ivorine complete with escutcheon drum drive and pointer, 5/6; Marconi vertical type, 2/-; small dials for midgets, 8/- doz.; tuning conds., 2-gang midget 12/- ea., 3-gang 10/- ea.; small steel chassis, 3/9 ea.; coils, 2-band with reaction, 7/- pr.; all-wave coils, superhet, with diagram, 14/- pr.; i.f. trans, 465k/c. 12/6 pr.; P type coils, m.w. only, a. and h.f., 2/- ea.
RESISTANCES, new Erie and Dubilier, 4/6 doz. (our selection), 5/6 doz. to your requirements; 1watt, 6/6 doz.; tubular conds., new, 4/6 doz., incl. 0.1. 0.05, etc., asstd.; chokes, 100ma 350ohm, 8/- ea.; multi-ratio speaker transformers, 3ohm sec., 7/- ea.; large type 30watt, 10 ratios, £1/10; push-back wire, various colours, 2/- doz. yds.; rubber covered wire, 2/- doz. yds.; sleeving, 2/- doz. yds.
SPECIAL offers. 2mfd Mansbridge condensers, 100v wkg., with fixing feet, new, 6/6 doz.; small moving coil mikes, damaged, 1/6 ea.; undamaged, 5/- ea.; send for list "W"; terms, cash or c.o.d. over £1.—Note new address: Charles Britain Radio, Radio House, 2, Wilson St., London, E.C.2. Tel. Bis. 5985, ext. 7.

SUPREME RADIO, 746b, Romford Rd., Manor Park, London, E.12. Est. 15 years. Tel. Ilf. 1260.
THE noted firm for component parts, as we employ a staff of service engineers we know what you want. That is service and satisfaction. Send list of your wants, large or small. Orders same attention. Guarantee value for money. S.a.e. for price list, 1d. Over 3,000 valves in stock at b.o.t. prices; line cord, 60-70 Ω per ft, 3-way, 2/- yd; all-wave dials, 3½×4in, coloured, 1/9; slow motion drives, 2/9; droppers with sliders and fixing feet, 0.02, 3/9, 4/-; 0.03, 5/-; V/Cs with Sw, 4/-, less Sw, 3/9; wire wound, 2,000 U.S.A. pattern, 2/6; wire wound resistances, assorted, 200-240,000 Ω, 24 in pkt., colour coded, 7/6 pkt.; midget chokes, 60 mils, 6/-; heavy, 100 mils, 10/-; P.P. trans, 6/6; midget speaker trans, 4/6; mains trans, from 22/-; speakers all sizes, all sundries for servicing; s.a.e., all enquiries, 6d. extra for post., no c.o.d.

CO-AXIAL cable, 45 ohms and 75 ohms, 35ft lengths, 7/6; send s.a.e. for sample.
ELECTROLYTIC condensers, 8mfd, 500-volt, 4/-; aluminium can type, 8mfd, 4/10; all above carriage paid.—Drury and Beardow, 45, Wangey Rd., Chadwell Heath, Essex.

BEAUTIFULLY finished black crackle steel panels, 17in×9in, 6/- each; other sizes available; prompt despatch.—J.H.B., 18, Marion Rd., Norwich. [4597

Introducing
TOM THUMB



A small, compact amplifier, using 6F6's in push-pull, with new linear phase changing circuit. Complete in case, 9 × 8 × 6½ inches.

Ready to assemble, **£8.18.0.**
(Carriage and packing, 2/6.)

ALSO
The **A.23**, an improved version of famous A.20, still in vigorous demand. **£14.0.0.**

Call on your local dealer or write for illustrated literature.

Mains trans. for W.W. circuits, Type W - - - - - - 45/-
Multiratio 50w in metal case with terms. OP12K - - - - 52/-

Horn Speakers, 12-inch P.M.'s Mikes and Stands.
Every conceivable transformer or component is available from us—Specialists in the design for Home Construction.

RADIO INSTRUMENT CO.
Radio Products
294, BROADWAY,
BEXLEYHEATH, KENT

THE AURI-PHONE

Pat. pend. 10525/45

A miniature Ear-phone with a high-fidelity reproduction of Speech and Music equal to best headphones known. 11/16 inch diam.; weight ⅜ oz.; holds in Ear without headband or wire loop. Two interchangeable nipples, large and small; two models, 10 ohms. and 1000 ohms. Operate from prim. or sec. terminals of Speaker transformer, ideal for pocket radio, Valve or Crystal set. 5ft. flex cord. Price, black or flesh-colour enamel, 39/-. Reg. Post free. **NOTE**: We do *not* make Deaf Aids.

CEFA INSTRUMENTS, 38a, York Street, TWICKENHAM, Middx. *POPesgrove 6597.*

"ENGINEERING OPPORTUNITIES"

This unique handbook shows the easy way to secure A.M.I.Mech.E., A.M.Brit.I.R.E., A.M.I.E.E., City and Guilds, etc.

WE GUARANTEE—"NO PASS—NO FEE."

Details are given of over 150 Diploma Courses in all branches of **Civil, Mech. Elec., Motor, Aero., Radio, Television and Production Engineering, Tracing, Building, Govt. Employment, R.A.F. Maths., Matriculation, etc.**

Think of the future and send for your copy at once—**FREE.**

B.I.E.T., 387, SHAKESPEARE HOUSE, 17, STRATFORD PLACE, LONDON, W.1.

BIG stocks of radio valves, all types, list prices; 8in Field energised speakers, 35/-; c.o.d. or pro-forma.—David Robinson. Ltd., 100, High St., Bedford. [4577

PRE-WAR radio cabinets, new, 35/- upwards; Shame, 30/- utility cabinets; state make, model or measurements required; beautiful design, finish.—Snell, Arcade, Swansea. (Est. 1900.) [4726

AMATEUR'S surplus.—Superhet Radiopak, 2 I.F.s, 45/-; 3-wave 10 PB unit, 10/-; 150v Weston meter, £1; AF5c, £1; 50w OP12K, 30/-; 12 new Bulgin whistle-scratch filters, 3-5 kc/s (list 12/3), 5/-, lot £2.—56. Clayhall Ave., Ilford. [4617

B. & H RADIO offer all sizes of electrolytics, 2- and 3-core line cord, transformers, chokes, volume controls, etc.; everything for the service man; competitive prices; trade only; send for list.—Victoria Garage, Hargreave Terrace, Darlington. [4690

HENRY'S offer.—Philips wet electrolytics, small cans, 8mfd, 450v wkg, 8mfd 320v wkg, midget, 25mfd 320v wkg, at 6/6; also 8×8 450v wkg, 6/9; 8mfd 350v wkg, 2/3; 8mfd, 450v wkg, 4/-; 16×16 block, 350v wkg, 8/-; 4mfd, 200v wkg, 2/-; 2mfd, 1,200v wkg, 7/6.

T.R.F. m and l wave coils with reaction, 8/6 pr, with circuit; T.R.F. med wave midget coils, 6/6 pr, with circuit; 3-bank 3-way, 3-pole, with screen, 4/6; toggle switches, 2/-.

GOODMANS 3in P.M. 3 or 15ohms, 35/-, with trans; 2-gang 0.0005 midget condensers with trimmers and feet, 12/6; and 2-gang 0.0005 ceramic ins with feet drum and drive spindle, 14/-; 3-gang 0.0005 ceramic ins, 12/6; Litz wire wound h.f. chokes, 2/-; midget strong steel chassis, size 9½×4½×1½, with cut-out for 5in speaker, holes for 5-valves and drilled for components, 4/6; s.a.e. for latest price list, 4-page.

HENRY'S, 5, Harrow Rd., Edgware Rd., W.2. Pad. 2194. [4426

WIRE-WOUND non-inductive resistances, 2 watt, ideal for meter shunts, resistance boxes, etc., 2½% accuracy, wound on bakelite bobbins ⅞in×¼in, one of each of the following ratings: 25, 50, 100, 200, 400, 600, 1,000 and 2,000 ohms, 5/6 per lot, postage paid; quantities available.

MOVING coil headphones, p.m., energised by Alni magnets, 45 ohms, ½in coil, ideal for mikes, miniature loudspeakers, etc., 1½in overall, in bakelite cases with 3in front flange; 7/6 each; per pair, with headband, 16/6.

ENCLOSED type synchronous motor by C. & H., self-starting, with greater torque, rotor speed 200 rpm, 200-250 volts a.c., 5c. consumption, 3 watts, size 2⅛×2⅛×1⅞in, described in "Model Engineer," October 4th, as Motor No. 2; geared to 1 rev 30 minutes to run clockwise, fitted with friction drive, etc. shaft length ⅞×¹⁄₁₆in, 27/6 each; ditto, 1 rev 60 minutes to run clockwise, fitted with friction drive, etc. shaft length ⅞×¹⁄₁₆in, 27/6 each, reg. postage 1/-.

TO callers only.—A comprehensive stock of scientific instruments, meters, gears, relays, etc.

H. FRANKS, Scientific Stores, 58, New Oxford St., W.C.1. Tel. Museum 9594. [4435

NORMAN ROSE'S 1946 illustrated components price list now available to radio dealers, 2½d., post paid.—Now open trade counter and showrooms at 53, Hampstead Rd., London, N.W.1 (corner of Tottenham Ct. Rd and Euston Rd.). Norman Rose (Electrical), Ltd., 53, Hampstead Rd., N.W.1. [4646

SERVICEMEN.—The following products are well designed and of high quality; volume controls, carbon type, all values, with or less switch, wire-wound resistors, 1 to 60watts; dropper resistors, 0.2 and 0.3 amp; line cords and razor resistors; terms and quotations on req.—Dagole, Ltd., 5, Torrens St., London. E.C.1.

P.M. speakers, 2½in 23/-, 3½in 27/6, 5in 18/6, 6½ and 8in, 19/6, 12in £6; resistors, 1w 7d, ½w 6d, vol. controls 3/-, with sw 4/10; small 2-gangs, 9/6; mains transf., with 6 or 4v fils, 27/6; voltage droppers, 4/-; electrolytics from 1/9; full list and Radiomag, 1/-.—Radio Sales, 76, Canwick Rd., Lincoln.

C.C. instrument wires, ¼lb reels, 18, 20, 22, 24g, 1/6; 26, 28g, 1/9; 30, 32g, 2/-; 34g, 2/3; enamelled ditto, same prices; also 36g, 2/3; 38, 40g, 2/6; silk-covered. 2oz reels, 24, 26, 28g, 1/6; 30, 32, 34, 36g, 1/9; 42g, 2/-; 16g D.S.C., 1lb. 5/-; R.C. stranded wires, 1d., 1½d., 2½d. yard; stranded push-back wire, 2/3 doz yds.

LAMINATED bakelite panels, ⅛in thick, 6in ×4in, 1/3; 6in×6in, 1/9; 8in×6in, 2/3; 10in ×6in, 2/9; 10in×8in, 3/6; 12in×8in, 4/-; B.A. thread screws, gross useful sizes, 2/6; ditto, nuts, 2/6 gr.; assorted gross screws and nuts, 2/6 gr.; ditto, brass washers, 1/6 gr.; fibre washers, 1/6 gr.; assorted soldering tags, 2/- gr.; assorted small eyelets and rivets, 1/3 gr.; all postage extra.—Post Radio Supplies, 33, Bourne Gdns., London, E.4. [4532

PREMIER RADIO

(MORRIS AND CO. (RADIO) LTD.)

ALL POST ORDERS TO: JUBILEE WORKS, 167, LOWER CLAPTON RD., LONDON, E.5. (Amherst 4723)
CALLERS TO: 169, FLEET ST., E.C.4. (Central 2833)

1946 LIST now available, hundreds of new lines.
Terms of Business: Cash with order or C.O.D. over £1. All enquiries must be accompanied by a 2½d. stamp.

BRAND NEW GOVERNMENT SURPLUS, ETC. MANY ITEMS AT PRE-WAR PRICES.

ELECTROLYTIC CONDENSERS. 8 mfd., 500 v.w., **3/-**; 8 + 8, 500 v.w., **5/6**; 16 mf., 150 v.w., **3/-**; 12 mf., 500 v.w., **4/6**; 50 mf., 12 v.w., or 25 mf., 25 v.w., **2/3**; 50 v., 50 v.w., **3/-**; 500 mf., 12 v.w., **4/6**; 16 + 16 450 v.w., **8/9**; 4 mf., 450 v.w., **3/6**. Wet aluminium can, 8 mf., 44 o.v. **6/-**; 16 mf., ditto **7/-**.

MIDGET RADIO KITS. Complete with drilled chassis, valves and loudspeaker, only cabinet required, medium and long wave t.r.f., size 10×6×6, 4 valve, inc. rect., tone control, AC/DC operation, 200/250 v. Circuit and Constructional Details supplied. Price including tax **£6/17/6.**

MOTOR GENERATORS. Input 6 v. DC. Output 220 v. DC. 50 mA, with smoothing, **£6/10/0.** Input 22-26 v. DC. Output 1,700 v. 150 mA, **£9/0/0.**

ROTARY TRANSFORMERS. DC to DC. Input 12 or 18 volts. Output with 12 v. input: HT 200 v., 60 mA, and 8 v. 2 a, with 18 v. input; HT 300 v., 70 mA and 12 v. 2 a, **£5/0/0.** Smaller model, input 12 or 18 volts, with 12 v. input HT 180 v., 30 mA LT 4 v. 3a with 18 v. input; HT 300 v., 30 mA; LT 6.5 v. 3 a, **£3/0/0.** Input 24/28 v. Output 1,000-1,200 v., 70 mA, **£5/0/0.**

VIBRATOR POWER UNITS. Input 6 v. Output 120 v., 15 mA, **£3/0/0.** Input 12 v. Output 240 v., 100 mA., 6 v. 10 a., **£7/0/0.**

TRANSMITTING CONDENSERS. 1 mf., 2,500 v.w. **10/-**. 1 mf., 5,000 v.w., **20/-**. 2 mf., 2,500 v.w., **15/-**. 4 mf., 1,000 v.w., **15/-**. 8 mf., 500 v.w. oilfilled **10/-**. Electrolytic 16 mf., 700 v.w., **15/-**.

PLATE SUPPLY TRANSFORMERS. 1,000 x 1,000, 250 mA. **£4/0/0.** 1,200 x 1,200 250 mA, **£5/0/0.** Constant Voltage Transformer, input 190/260 v., output 230 v. 150 w., **£6/0/0.**

CO-AXIAL CABLE. Super quality, single, screened, weatherproof. **1/6** yd.

PAPER CONDENSERS. 8 mfd., 750 v.w., **17/6**; 4 mfd., 750 v.w., **12/6**; 4 mf., 450 v.w., **7/6**; 2 mf., 350 v.w., **4/6**; 1 mf., 600 v.w., **4/9**; 1 mf., 1,000 v.w., **7/6**; .01, 1,000 v.w., **1/6**; .1 1,000 v.w., **2/-**.

LOUDSPEAKERS. Rola, 5in., P.M., **21/6**; 6½in. P.M. **22/6**; 8in. P.M., **24/-**; 2½in., P.M., **25/-**; 3½in., P.M. **30/-**. Goodmans 10in., 6-watt, 15 ohm. V.C. P.M. **47/6.**

TEST METERS. Army type, in shock-proof unbreakable bakelite case, 10, 100, 500 volt AC and DC at 1,000 ohms per volt. 10, 100, 500 milliamps DC, 0-10,000 ohms, **£8/15/0.**, or with external transformer for 100 mA, 1 a and 10 a AC, **£10/14/9.**

SUPERHET TUNING KIT, comprising 9 midget coils for H.F., Aerial and Osc. covering 16-47, 200-557 and 700-2,000 m., suitable switch, all padders and trimmers, **38/10.** Worth double. Also available a suitable 3-gang condenser with complete S.M. drive and dial **30/-**.

10-WAY PUSH BUTTON SWITCHES, complete with knobs and escutcheon plate, six iron cored coils. Trimmers and Padders. No circuit or other particulars available. To clear at **12/6.** Original cost **45/-**.

FIRST-GRADE METERS. 3½in. diameter, 1 milliamp, **£2/12/0**; 500 microamps, **£2/18/6.** 4½in. 1 milliamp, **£3/5/0**; 500 microamps **£3/11/6.** Westinghouse Meter Rectifier for either type, **10/-**. Multiple shunts, 10, 100, 500 **mA, 10/-**. Any value multiplier, **2/6** each.

12-WATT AC AMPLIFIERS, 3 stages. High and low gain inputs. Mike pick-up mixing feedback, provision for 2, 3, 4, 8 and 15 ohms output, **£14/14/0.**

SUPER QUALITY AC/DC 15 W. AMPLIFIER. 3-stage, high gain, push-pull, in steel cabinet, **£15/15/0.**

AC/DC AMPLIFIERS, 5 watts output, high gain, three stage, feedback, **£8/8/0.**

BATTERY CHARGERS for 2 v. batt. at ½ a., **25/-**; for 2, 4 or 6 volt batt. at 1 a., **45/-**; for 6 v. batt. at 1 a., **30/-**; for 2, 6 or 12 v. batt. at 1 a., **49/6**; for 6 v. or 12 v. batt. at 4 a., **£4/0/0.**

MAINS TRANSFORMERS, 300 + 300 v., 60 mA, three 4 v. 2-3 a. windings, **25/-**; 350 + 350 100 mA 5 v., 2 a., 6.3 v., 2-3 a., **29/-**; 350 + 350 100 mA three 4 v. 2-3 a. windings, **29/-**; 350 + 350 150 mA, 4 v., 2-3 a., 4 v. 3-6 a., 4 v. 1-2 a., 4 v. 1-2 a. windings, **39/-**; 350 + 350 150 mA, 5 v. 2 a., 6.3 v 2 a., 6.3 v. 2 a. **36/-**; 500 + 500 250 mA, 5 v. 3 a., 6.3 v. 2 a., 6.3 v. 4 a., **65/-**; 425 + 425 200 mA, 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-6 a., **47/-**; 350 + 350 150 mA. 4 v., 1-2 a., 4 v. 2-3 a., 4 v. 3-4 a., **36/-**; 500 + 500, 150 mA, four 4 v., 2-3 a. LT windings, **47/-**.

1-VALVE BATTERY S.W. RECEIVER, with 2-volt valve, 4 coils, 12-170 m. bandspread tuning, **55/-** including tax.

CHASSIS, 10 × 8 × 2½in., **7/-**; 16 × 8in., **8/6**; 20 × 8in., **10/6**; 12 × 9 × 2½in., **7/9.**

SHORT-WAVE COILS fit octal sockets, 4-pin, aerial coils, 9-15, 12-26, 22-47, 41-94, or 76-170 m., **2/6** each; 150-350 or 255-550 m., **3/-**; 490-1,000 or 1,000-2,000 m., **4/-**; 6-pin. HF Trans., 9-15, 22-26, 22-47, 41-94 or 76-170 m. **2/6** S.W. chokes, 10-100 m., **1/3**; 5-200 m., **2/6.**

SURPLUS marine radio equipment for disposal, receivers, transmitters W/T and R/T, motor generators, resistances, condensers, etc., at disposal prices.—Write, giving details of requirements, Box 4416. [4384

MAINS transformers, first grade, brand new, 350-0-350v 80ma, 4v 4a and 4v 2.5a or 6.3v 3a and 5v 2a, 20/- ea.; post 1/-.

ELECTROLYTICS. 8mfd 500v 3/-, 8×8mfd 450v 5/6, 16×8 350v cans 6/6, 16×8 450v tub. 6/6, 25-25v or 50-12v 1/9; s.a.e. for list of other bargains.—Aneloy Radio, 36, Hindmans Rd., E. Dulwich, London, S.E.22.

BUY direct and save; complete kits; Victory 4v ac/dc, £6/19/6; L/MW 7/6 extra; Victory 3v S.G., battery, automatic bias, £5/19/6; L/MW 7/6 extra; S.M. dials, escutcheon, glass, round, square, 7/-; full vision 8/6; M.T. 350-0-350 90ma, 6v, 4v, shrouded, 23/6; 2-gang Midget S.M. trimmers, 14/6; line cord, 2-way 1/6 yd, 3 way 2/-; spk. cones, all 6/9, ¼lb enam. wire, all 2/3; 8mfd. 150v, 2/-; "P" coils, 2/3; 0.5 amp 2v chargers, 25/-; chassis, 4/6; send for full lists.—Buccleuch Radio Manufacturers, 1 and 2, Melville Terr., Edinburgh. [4367

CARDING'S world-renowned 20-watt amplifier again, 2 6L6's, sw. push-pull, transformer coupled, assembled on grey stoved chassis, fitted with separate tone control, volume control and on-off switch, sockets for mike-gram and low impedance p.m. speaker, excellent quality reproduction, no hum, 200-250v ac only, brand new and complete with all valves, £8/15, carriage 5/-, c.w.o.; also mains trans., 350-0-350 volts, 90 ma, 6.3v 5a, C.T., 5v 3a, 200-230-250v input, boxed, 14/- each, minimum quantity 12.—M. Carding, 28, Dudley St., Wolverhampton. [4598

METAL rectifiers, charger kits, etc.—Metal rectifier, 12v 1.5a type, with transformer and ballast bulb for 2v to 12v charger, no rheostat or ammeter needed, 37/6, post 10d; ditto, with larger 2.5amp rectifier, 46/6, post 10d; ditto, with 6v 2amp rectifier for 2v and 6v only, 37/6 post 10d; de luxe car owner kit, transformer, 12v 3amp rectifier and ballast bulb for 2v to 12v charger, 59/6; metal rectifier, 2v 0.5amp type with transformer, makes ideal trickle charger for 2v cell, 13/6, postage 7d.; metal rectifiers, 12v 1.5amp 10/6, post 6d; 12v 2amp, 16/6; 2.5-amp, 18/6, post 7d; 12v 3amp. 25/-; 12v 4amp, 32/6, postage 8d; Type M.B.S.1 instrument rectifiers, 1 milliamp, 18/6; chargers 2v to 12v up to 4amp, variable, with ammeter, £6/17/6. carriage 5/-.

ROTHERMEL crystal mikes, and bakelite pick-ups in stock, Dubilier and Hunts, 8mfds 450v and 500v electrolytics, 4/- ea.

CHAMPION, 43, Uplands Way, London. N.21. Tel. Lab. 4457. [4743

ALIGNED INSTRUMENTS SERVICES, 25, Park Grove Rd., Leytonstone, E.11. Tel. Leytonstone 5061.—Model 10 superhet coil pack, 16-47, 200-550, 800-2,000m. cpte., with trimmers, padders, switch, aligned, tested ready for use, only 5 connections, 35/-; aligned i.f. trans., 465k/cs, iron-cored, permeability tuned, high Q, aligned, tested with above, ready for use, 17/6 pair; 2-gang cond., matched to Model 10, correct tracking assured, 15/-; valves for above, 6K8, 6K7, 6B8, 6V6 and 5Z4, 62/3 set (supplied separately at B.O.T. prices); mains trans. for above, 350-0-350 h.t., 30/-; all-wave superhet kit, including all above, speaker, chassis and all components, £11/10; high fidelity amplifier kits as follows: ac/dc, 5watts £6, 15-watts £12; ac, 6watts £7, 12watts £11, all with multi-ratio O/P trans.; supplied assembled and tested at 30/- extra; circuits and constructional information supplied with all above, or separately, 2/- each, post free; large stocks valves and components; send 1d. for list; post trade only; terms, c.w.o., c.o.d. or pro forma; no c.o.d. under £1; post free over £5.

TELE-RADIO (1943), Ltd.—Everything for the amateur or professional constructor.

HIGH power valves for transmitting or industrial applications (including new U.H.F. types just off the secret list), Partridge high voltage transformers, heavy duty chokes, intervalve and modulation transformers, high voltage condensers, precision condensers, Q.C.C. crystals, Cossor cathode ray tubes, G.E.C. photocells and photocell amplifiers. Pullin 3½in rectangular meters—moving coil, rectifier and thermo-couple—black or coloured mouldings, "spot on" precision resistors, standard relay racks, chassis and panels, communication receivers and complete transmitters, dielectric heating apparatus, Denco "Maxi Q" plug-in or chassis mounting coils—wound on miniature polystyrene formers, iron cored, permeability tuned—for high gain T.R.F. or superhet receivers, Polystyrene coil turrets, permeability tuned, iron cored, 465 kc I.F. transformers, standard size or miniature, measuring instruments, bridges, signal generators, valve testers.—Tele-Radio (1943), Ltd., 177, Edgware Rd., London, W.2. Tel. Pad. 6116.

SIX 954s, 6 955s and 2 9003s for sale; 25/ each.—Box 4944. [4686

12 1L4's, 3 3A4's, 4 3Q4's, 3 956's, new and used; what offers?—Box 5015. [4713

NEW LOUDSPEAKERS

£5/18/6.—New Baker Super Quality 12in Auditorium permanent magnet speaker with triple cone, manufactured by Bakers Selhurst Radio, the pioneer manufacturers of moving coil speakers since 1925, wide frequency range, even response, ideal for quality reproduction, fitted with magnet, having exceptionally high flux density in the air gap suitable for public address equipment when quality reproduction is first consideration; send 2½d. stamp for leaflet giving details of above and constructional details of a new acoustic chamber designed to extend loud speaker frequency range

£8/19/6.—New Baker super power cinema permanent magnet speaker with 18in triple cone of new design, giving wide frequency response free from objectionable resonances; speech is clear and natural and music is reproduced with exceptional realism; fine engineering job, extremely sensitive; ideal for public address equipment when power handling capacity, plus realistic reproduction, is required; prompt delivery per pass. train.—Bakers Selhurst Radio, 75, Sussex Rd., S. Croydon (Croydon 6813).

LOUDSPEAKERS, SECOND-HAND

WESTERN Electric 595A, 14in speaker, 12 ohm 4in voice coil, 20 ohm field: £3.

LOUDSPEAKER, Baker Sellhurst, energised 12in. for use in conjunction with a Tweeter; £3.—Box 4556. [4606

BAKER 15Ω infinite baffle P.M. spkr, walnut cab., £4/10; Novotone, 15/-.—James, 31, Glen Drive, Stoke Bishop, Bristol. [4660

VOIGT speaker, complete, latest 3-corner cabinet and rectifier; best offer secures.—Higham, Oaks, Clayton-le-Dale, Blackburn.

SALES, S.S. TriChannel equipment, complete speakers; also Bakers' super power triple cone, with self-energising unit, Magnavox 66; offers.—Box 4948. [4701

HARTLEY-TURNER duode 1,250Ω field, £7; H.-T. standard 2,500Ω field, £6; H.-T. p.m. standard, £4/10; 60watt field rectifier, £3; special H.-T. baffle, 24in×16in×14in, £3; baffle for 2 speakers, 34in×34in and 1 acoustic tube, £2.—Pulford, 37, Motcombe Rd., Eastbourne, Sussex. [4699

GRAMOPHONE AND SOUND EQUIPMENT

PAILLARD gram. motor, BTH pick-up, new cond.; highest offer; London.—Box 2978.

ROTHERMEL Piezo crystal pick-up, cond. as new; 50/-.—56, Approach Rd., Margate.

GARRARD ac unmixed changer, perfect condition; £10.—Lush, Thorner, Yorks.

M.S.S. recording machine, 20w amplifier, special matching transformer, new, guaranteed; £95; suit professional.—Box 4559.

ENSIGN 16mm 750w projector, sound head, cell, amplifier, less valves, power transformer, £45.—10, Newport Rd., Shifnal.

BURGLARS swiped my auto record changer gram.; have you spare mechanism, also want disc recording gear.—Price to 16, Knowsley Ave., Southall. [4745

COILS for filters, tone controls, all types of transformers for "Wireless World" circuits.—R. Clark, 30, Langland Crescent, Stanmore. Wor. 5321 [4584

ROTHERMEL brush mike (type D104), with heavy base, adjustable chromium stand, as new, hardly used; £10.—Linney, 10, Osborn Rd., Farnham, Surrey. [4696

B.T.H. 16mm sound film projectors, as supplied in large quantities to the Services during the war for instructional purposes; a limited number are now available for civilian use, immediate delivery against B.O.T. licence.—Apply Electronic and Sound Reproducer Sales, B.T.H., Rugby. [4555

BRAND new Collaro 1946 electric gramophone motors, £4/16/3: ac/dc, £8/1; with pick-up, £7/9/8, ac/dc £10/14/5; automatic record changer (mixed records), £24/2/2, ac/dc £27/6/11; order yours now! used models often advertised dearer.—Snell, Arcade, Swansea. Est. 1900. [4725

TEST EQUIPMENT

WESTON analyzer, in case, £20; 2 TZ 40's, £5; 2 832's, £10.—Box 4697. [4632

AVOMINOR Universal, new, perfect; £8/10.—King, 38, Sycamore Grove, Malden, Sy.

PIFCO Rotameter, £3; spring gram. motors, £1.—Allen, 38, Silverwood Rd., Peterboro'.

TAYLORMETER, £18; Avo DC minor, 90/-; new.—48, Brecks Cres., Rotherham.

SIGNAL gen. wanted, good condition.—Particulars and price required to Box 4862.

TAYLOR valve tester, 45AP, light oak, as new; £18.—33, Wrose Rd., Bradford.

UNIVERSAL Avominors, £8/10; No. 7 model Avometers, £19/10; new, immediate delivery.—Young, 134, Old Shoreham Rd., Southwick, Sussex. [4683

ELECTRADIX

METERS. Switchboard type, D.C., moving-coil ammeters I/C 0-30 amp, 4½in. dia., 55/-. Flush panel, moving-coil ammeter, 0-1 ma, 100 ohms resistance, 2½in. dia. bakelite case, 55/-. Westinghouse metal rectifier, 1 ma, 10/6. Precision moving iron voltmeters, AC/DC, 3½in. dia., flush panel type, 0-60 volts, 45/-.

MEGGERS. Evershed bridge megger, with decade resistance box. As new. Cases store soiled. Few only.

GALVOS. Tinsley moving-coil reflecting mirror galvo, 100 ohms resistance, £5 10s. G.P.O. vertical circuit test galvos, 35/-. Reid horizontal galvo on heavy brass stand, mirror scale, 75/-.

RELAYS. Siemens' High-speed Relays in heavy brass case, £3 5s. Telephone type No. 6. 2-coil polarised, S.P.C.O., 6 volts 25 ma., 325 ohms, 8/6. No. 1A, S.P. on-off, 2 volts 40 ma., 5/-. Relay movements 1,000 ohms, less blade and contact, 2/6. Moving-coil relays by Weston, Elliott and Sullivan.

CHARGING DYNAMOS. We are now able to offer a line of Charging Dynamos for prompt delivery. 6 volts 10 amp, £4; 12 volt 10 amp, £4 10s.; 12 volt 15 amp, £5; 24 volt 40 amp, £10; 30 volt 5 amp, £7 10s.; 32 volt, 6/8 amp, £8 10s. These machines are all in first-class condition, circular body; by leading makers.

BATTERY CHARGERS. We can supply small battery chargers for small wireless cells, to large models for car accumulators. Send for special Charger Leaflet "W."

CUTOUTS. Air Ministry enclosed type cut-out, 12 volt 40 amp, or 24 volt 40 amp, in bakelite case, 35/-; 6 or 12 volt triple auto. car type cut-out, dynamo control box, armature field and battery, 21/-; 24/30 volt D.C., 30 amp contactors, 30/-; 12/24 volt D.C., 500 amp I/C contactors, 50/-.

SOLENOIDS. 24 volt solenoids massive type to lift 14 lbs., 15/-; small 12 volt solenoids, pull, 1 oz., 1in., 6/6.

ROTACEPTORS. Pre-war type for E.H.T. at 50 cycles from 12 volts D.C., two sizes 5,000 volts and 10,000 volts at 20 ma, for portable neon luminous tubes or daylight colour matching lamps. Completely ironclad with small interruptor motor at top, transformers and condensers below. Overall size 6in. x 4¾in. x 13½in. high, £6 10s. each

MOTOR BLOWERS. In addition to mains AC/DC Blowers we have some for low voltage D.C. 32 volt ¼ h.p. with output of 500 cub. ft. per minute, £8 10s.; also some small valve cooling or Lab. Blowers work off 12 volts, £5 10s. We have other Blowers in stock up to 6 h.p.

MIKES. Recording and announcer's hand-mikes, multi-carbon, metal clad, service type, by Tannoy and Truvox, with neat switch in handle, 21/-.

BUZZERS. Cambridge Townsend high-note buzzer, the smallest made, used by Government on precision wavemeters, platinum contacts, 10/-. Practice buzzers, tunable, in metal case, 7/6; small buzzers in bakelite case, 3/6.

MAGNETS. The wonder midget Magnet, alni perm. steel disc, weight only ¼ oz., ⅝in. dia., ⅜in. thick with 3/16in. centre hole, 3/6 each. Large selection of horseshoe Magnets in stock. Send for leaflet "W."

PARCELS. 10 lb. Parcel of useful oddments for your junk box, all clean and dismantled from Government and other apparatus, 7/6, post free.

Send us your enquiries for Switchgear and Charging Boards, Meters, Dynamos, Knife Switches, Variable Resistances. We carry stocks, but cannot always advertise them.

ELECTRADIX RADIOS

214, Queenstown Rd., London, S.W.8

Telephone: MACaulay 2159

FERRANTI electrostatic meter, 450v, as new, 55/-. Pickersgill, 30, Monnery Rd., N.19. [4593

SEVERAL Avometers (7s and 40s); Minors and Yankee meters for sale; reasonable.—Box 2515. [4489

FERRANTI multi-range DC test set (1,000 o.p.v.); offers.—Wright, 57, York Rd., Acomb, York. [4672

S/H Strathyre kit. AC signal generator, £5; D104 crystal mike, £3.—Cole, 4, Pearson St., Workington. [4588

COSSOR oscillograph 339, 343 oscillator, Avo 40.7 oscillator, bridge, v-tester; offers.—Box 4942. [4682

7IN E.M.-C.R. tube with def. coils, m'tng. base, 230-4000v, Xsformer, new and unused; £5.—Offers, Box 4621. [4622

SURPLUS Mullard Master test board, 400 cards, overhauled by makers during war period; first reasonable offer.—Box 4939. [4692

UNI., Avo and Avodaptor valve test panel; £8/10; c.w.o. or c.o.d.; exchanges.—J. Brown, Carharrack, Redruth, Cornwall. [4670

SERVICE oscillator, constructed Maclachlan kit, requires adjustment; £9 or nearest.—Kay, 12, Sorn Rd., Mauchline, Ayrs. [4585

HICKOK signal generator, model 18, 230v ac, incorporating output meter, variable audio, wobbulator, ranges continuous 100kc to 30mc, perfect; best offer.—Box 4943. [4684

COSSOR double beam oscillograph, model 339A, £40; Cossor ganging oscillator, model 343, £35; kit oscillograph, special test leads, £3; all above new and unused; ordered surplus to requirements.—Rampling, Downderry, Torpoint, Cornwall. [4645

DYNAMOS, MOTORS, ETC.

NEW ac motors, ¼hp, high starting torque, 200-250v, £5; ⅓hp, £5/10; ½hp, £7/10; 1hp, £9/15; all other sizes available; also machinery.—John W. W. Steel, Bingley, Yorks.

ALL types of rotary converters, electric motors, battery chargers, petrol-electric generator sets, etc., in stock, new and second-hand.—WARD, 37, White Post Lane, Hackney Wick, E.9. Tel. Amherst 1393. [4677

VARIOUS machines.—Rotary converters, 1,500 watts Crompton Parkinson, 250v d.c. to 110v a.c., £22/10; 500 watts Phyme, 110v d.c. to 230v a.c., £17/10; Reliance (U.S.A.) 110v d.c. to 110v a.c., 30 cycles, £10. Dynamos: 6v 30 amps, £4; 25v 13amps, £4; 6v 100 amps, £17; 25/37v 70amps, £22; 12/16v 15amps, £9; 55v 22amps, £11; 100/140v 65amps, £18; 40v 72amps, £10. D.c. motors: 1/16hp 110v, 30/-; ¼hp 110v, £3/10; ⅓hp 110v, £4/10; 1½hp 110v, £9/10; 3hp 110v, £14; 10hp 110v, £19; ¼hp 220v £3/10, with clutch £4/10; ¾hp 220v, geared 280rpm, £8; 2hp 230v, £7; also a.c. motors, power transformers, meters, etc., as previously advertised; lists available; stamp please.—H. Harris, Strouds, Bradfield, Berks.

REPAIRS AND SERVICE

REWINDS.—24-hour service; best quality, guaranteed; low price.—Radiowinds, Brundall, Norfolk. [3606

REWINDS and conversions to mains and output transformers, fields, etc., from 4/6.—N. L. Rewinds, 4, Brecknock Rd., N.7. [4442

ACCURATE radio rewinds, mains transformers, fields, op. transformers, etc.—Southern Trade Services, 297-299, High St., Croydon. [3971

MAINS transformer rewound and constructed to any specification; prompt delivery.—Brown, 3, Bede Burn Rd., Jarrow. [3460

LOUDSPEAKER repairs, British, American, any make; moderate prices.—Sinclair Speakers, 12, Pembroke St., London, N.1. Terminus 4355. [3308

ALL types of radio receivers serviced; Murphy and Pilot specialist; valves in stock; sound repairs for 13 years.—T. E. Fevyer, F.I.P.R.E., 50, Vine St., Uxbridge.

METROPOLITAN RADIO SERVICE CO. for guaranteed repairs to British and American receivers of all types.—(Service Dept.), 1021, Finchley Rd., N.W.11. [3886

TESTGEAR REPAIR SERVICE, specialists in repairs, recalibration, etc., of test equipment of every description for the radio industry.—2, Tower Bridge Rd., London, S.E.1. Tel. Ber. 1669. [4506

"SERVICE with a Smile."—Repairers of all types of British and American receivers; coil rewinds; American valves, spares, line cord.—F.R.I., Ltd., 22, Howland St., W.1. Museum 5675. [1575

STURDY rewinds, mains transformers, chokes and fields; we give prompt delivery and guarantee satisfaction; 14 years' experience; prices on request.—Sturdy Electric Co., Ltd., Dipton, Newcastle-upon-Tyne. [4316

LOUDSPEAKER repairs and mains transformer rewinds; we can now give prompt service at reasonable prices to dealers and service engineers; send 1d. for our latest list.—A.W.F. Radio Products, Borough Mills, Sharpe St., Bradford. [4495

MORSE CODE TRAINING

The Candler System of Morse Code Training has been demonstrated its value for the past 34 years.

Each CANDLER SYSTEM Course (JUNIOR for Beginners—ADVANCED for Operators) is arranged in a series of 10 progressive lessons which are fascinating, instructive and practical. They teach you the most vital principles of telegraphing technique, the fundamentals of successful, efficient, accurate and speedy Receiving and Sending of the Morse Code.

RADIO AMATEURS AND W/T OPERATORS

are invited to send for the

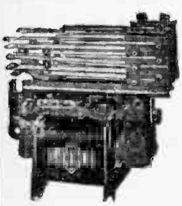
CANDLER "BOOK OF FACTS"

It gives full details of all courses. Sent free. No obligation.

Courses supplied on Cash or Monthly payment terms.

THE CANDLER SYSTEM CO.
(Room 55W) 121 Kingsway, London, W.C.2
Candler System Co., Denver, Colorado, U.S.A.

LONDEX *for* RELAYS



Multiple contact Relay LF.

for A.C. and D.C.

2 VA Coil consumption from 2 to 600 volts and tested to 2000 volts, Aerial Changeover Relays, Mercury Relays, Measuring Relays and Time Delay Relays

Ask for leaflet 205/WW

LONDEX · LTD
MANUFACTURERS OF RELAYS
ANERLEY WORKS 207·ANERLEY ROAD·LONDON·S·E·20 PHONE: SYDENHAM 6258/9

COVENTRY RADIO

COMPONENT SPECIALISTS SINCE 1925

1st Grade Sangamo Weston, Pullin, Turner and Sifam 0—1 milliamp 1% meters, 100Ω res., Moving Coil. New stock, not surplus.

All Fully Guaranteed.

2¼" Flush Mounting,	2"	Hole		40/-
3¼" ,, ,,	2½"	,,		45/-
3¼" ,, ,,	2½"	,,	Super	52/-
4¼" ,, ,,	3½"	,,	Super	72/-
5¼" ,, ,,	4½"	,,	Giant	110/-
3¼" Projecting Type	3¼"	Scale		68/9

For other sizes and types, see our new

1946 LIST OF COMPONENTS

The most comprehensive published to-day, sent on receipt of a stamp.

PROMPT SERVICE. COMPLETE SATISFACTION

COVENTRY RADIO
191, DUNSTABLE ROAD, LUTON.

RADIO repairs quickly executed to all makes, English or American; lowest possible prices.—The Music Box, 89, London Rd., London, S.E.1 (Tel. Waterloo 4460 and 6766.)

REWINDS, mains transformers, field coils, chokes, high-grade workmanship, 7-day delivery; new transformers constructed to customers' specification, singly or in quantities. —Metropolitan Radio Service Co., 1021, Finchley Rd., N.W.11. Speedwell 3000. [3719

REWINDS, mains transformers, layer wound, wax impregnated. O/P transformers, chokes, fields, clock coils, pick-ups, fractional h.p. motors, competitive prices; prompt delivery; guaranteed work.—W. Groves, Manufacturing Electrical Engineer, 154, Icknield Port Rd., Birmingham, 16. [4547

ALL makes and kinds of electrical and radio instruments repaired by skilled technicians A.I.D. approved; over 60,000 instruments repaired for R.A.F.; all work quoted by return without charge.—C. Gertler, Dept. D, 71-79, Waterside, Chesham. Bucks. [4308

REWINDS.—Repairs to moving coil speakers, cones, coils fitted, fields wound or altered, mains transformers, eliminators and clock coils rewound; competitive prices; speaker transformers and pick-ups rewound, 4/6 each; post free; guaranteed satisfaction; prompt service.—L.S. Repair Service, 49, Trinity Rd., Upper Tooting, London, S.W.17.

DEGALLIER'S, Ltd., for Service with a Guarantee; let American specialists with proper test gear do your work; we can handle any receiver from a Midget to the 24-tube Scott; send chassis and valves only; all railway companies deliver daily: s.a.e. with all enquiries.
DEGALLIER'S, Ltd., 9, Westbourne Court, London, W.2. [4650

MISCELLANEOUS

TIME recorders.—Write for particulars.—Gledhill-Brook Time Recorders, Ltd., 84, Empire Works, Huddersfield. [2419

WE wish to place orders to produce a newly designed radio set, with radio manufacturers possessing B.O.T. licence.—Box 4868.

SPARKS' data sheets.—These data sheets provide complete constructional details, together with full-size prints, etc., of tested and guaranteed designs.
ELECTRIC guitar units (3rd edition), 5/-.
ELECTRONIC one-string fiddle, 3/6; 6-8watt ac/dc amplifier; phase inverter; push-pull output; neg. feed-back; portable for use with above or mike, p.u., etc., 3/6.
A.C. two-valver, med. wave, coil details, 2/6; 3½watt ac amplifier, 2/6.
SPARKS' DATA SHEETS (W.), 9, Pheobeth Rd., Brockley, London, S.E.4. [3622

WANTED, EXCHANGE, ETC.

WTD., National NC-240C or latest model H.R.O.—Receiver GW3KY, Holyhead.

WTD., Accuratune micrometer control S.M. drive.—Davies, 2a, Russell St., Bedford.

DOUGLAS or similar coil winder for experimental wave wound radio coils.—Box 4821.

REQUIRED, one or two Mazda P650 directly heated output valves for R.G.D. dc radiogram.—Box 4951. [4707

EXCHANGE 4 doz. engineer's dial gauges (or separately) for valves, showcards, parts, meters, wire, etc.—Box 4817. [4642

WANTED, valve tester, universal meter, also dc mains sets.—Write N. Reder, 49, Coborn Rd., Bow, London, E.3 [4685

WANTED.—Colvern 10, 11, 12, 13 coil unit, also Telson W349, perfect.—Wills, 6, Lennox Gardens, Neasden, London. [4590

WANTED.—Audio frequency oscillator (B.F. type), range at least 40 to 12,000 c.p.s., mains operated, 230v.—Box 2873. [4587

WANTED.—Voigt domestic corner horn, in good condition, good price paid.—Johnson, 16, Lansdown Parade, Cheltenham, Glos. [4618

WE offer cash for good modern communication and all-wave receivers.—A.C.S. Radio, 44, Widmore Rd., Bromley, Kent.

WTD., ac gram. motor and turntable; can offer exchange Garrard Junior mechanical ditto.—Heath Davies, Queen St., Neath.

WANTED, Avo valve tester, latest switch panel type, with 1.4volt heater att. must be in new condition; good price paid.—W. Macdonald, Brae Gardens, Dingwall, Ross-shire. [4687

REPAIRS required to 12 Ever Ready battery type portable radio receivers, some have been converted for mains connection.—Firms able to overhaul please communicate with S.L., 65, Portland Place, London, W.1, where the sets may be inspected. [4654

WE buy for cash, new, used, radio, electrical equipment all types; especially wanted, radios, radiograms, test equipment, motors, chargers, recording gear, etc.—If you want to sell at the maximum price, call, write or 'phone to University Radio, Ltd., 22, Lisle St., Leicester Square, W.C.2. Ger. 4447

PITMAN RADIO BOOKS

AN EXPERIMENTAL COURSE IN THE FUNDAMENTAL PRINCIPLES OF RADIO

By **R. H. Humphry**, M.Sc., F.Inst.P. A laboratory course designed for those who have little or no knowledge of electricity and magnetism. The fundamental principles of the subject are dealt with, and a statement of the theory underlying each experiment, is given in a concise form. **12s. 6d. net.**

PROBLEMS IN RADIO ENGINEERING

By **E. T. A. Rapson**, A.C.G.I., D.I.C., etc. A classified collection of examination questions set from time to time by some of the more important examining bodies in Radio Communication. Suitable to the needs of those preparing for examinations. Sixth Edition. **5s. net.**

RADIO SIMPLY EXPLAINED

By **John Clarricoats.** A brief and interesting introduction to the subject. Waves, current conductions, insulators, power, magnetism, valves, coils, condensers and transformers are all explained. **9d. net.**

N.B. Paper rationing means a shortage of books. The one you want may be temporarily out of stock.

PITMAN HOUSE, PARKER ST., KINGSWAY, W.C.2

WE LOOK FORWARD to the restoration of our prewar right to go ahead in our own way and improve the standard of reproduction.

15, SILVERDALE, LONDON, S.E.26

VOIGT PATENTS LTD.

84 BELSIZE LANE · LONDON · N·W·3
TEL. HAMPSTEAD 5389 & 5515.

ELECTRICAL AND RADIO ENGINEERS OHM'S LAW CALCULATOR

Whether you are constructing, or servicing a radio set, problems involving voltage, current and resistance can delay progress.

Flik-o-Disk will give the answer in a jiffy. For example, what resistance should you use to obtain a voltage drop of 100 v. when current equals 25 m.a. ? A flick o the disk and there is your correct answer—4,000 ohms. The scales read from 1 millivolt to 1,000 volts. From 1 ohm to 1,000,000 ohms. From 1 milliamp to 10 amperes. From 1/10th of a milliwatt to 10,000 watts.

PRICE 6/6 D.

The calculator is sold complete and with ful instructions at Radio Stores and Stationers. If unable to obtain, write to **IONIC LABORATORIES LTD.** Dept. W., Cranbourne Terrace **SALT HILL, SLOUGH, BUCKS** for name and address of your nearest stockist.

YOU can become a first-class RADIO ENGINEER

We are specialists in Home-Study Tuition in Radio, Television and Mathematics. Post coupon now for free booklet and learn how you can qualify for well-paid employment or profitable spare-time work.

T. & C. RADIO COLLEGE
North Road, Parkstone Dorset

(Post in unsealed envelope, 1d. stamp)

Please send me free details of your Home-Study Mathematics and Radio courses

NAME ....

ADDRESS ....

W.W.45.

TUITION

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

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

THE Tuitionary Board of the Institute of Practical Radio Engineers have available home study courses covering elementary, theoretical, mathematical, practical and laboratory tuition in radio and television engineering; the text is suitable coaching matter for I.P.R.E. Service-entry and progressive exams. tuitionary fees—at pre-war rates are moderate.—The Syllabus of Instructional Text may be obtained post free from Secretary, 20, Fairfield Rd., Crouch End, N.8

SITUATIONS VACANT

QUALIFIED radio television engineer, knowledge of p.a., r.f., and h.f. heating; London.—Box 2302. [4464

SERVICE engineer wanted, excellent prospects to energetic young man.—Apply Radiovision, Syston, Leicester. [4711

RADIO service engineer, capable taking charge sales and service.—Hammant, Woodlands Park, Maidenhead, Berks. [4627

RADIO service engineers required immediately; first-class men only need apply, by letter, to Benn Radio and Electrical Co., Ltd., 122, Hillmorton Rd., Rugby. [4720

OPPORTUNITY for draughtsman with knowledge of radio factory drawing office practice, write stating qualifications, age and salary required.—Box 4634. [4625

SERVICE engineer wanted by sound equipment manufacturers; central London, good prospects for keen man well qualified. —Write with details, Box 4589. [4614

DRAUGHTSMEN and engineers, with radio frequency experience, required in the Warrington area for instrument design work.—Replies to G.P.O. Box 20, Warrington. [4633

MANAGER and assistant manager required for high-class radio and electrical establishment, East Midlands, good prospects and salary, capable taking full charge.—Box 4823.

RADIO service engineer to take complete charge of small retail shop in Holborn district, good wages and commission paid to experienced man, ex-Service man preferred.—Write Box 4834. [4667

OPPORTUNITY for laboratory assistant with knowledge of industrial electronics equipment, power oscillators and central circuits, must be practical, write stating qualifications, age and salary required.—Box 4633.

RADIO laboratory assistant, either sex, experienced in laboratory measurements, principles of radio receiver design, and with sound basic knowledge of electrical theory; salary according to qualifications and experience; N.W. London.—Box 5035. [4746

LABORATORY assistant required in S.W. London area with knowledge of electrolytic condenser manufacture, able to assist in development and process control; permanency with good prospects for keen person.—Write, giving all essential details, Box 2518.

EXPERIENCED electrical engineer required, age 30-35, to train as works manager, used to mass production of light electrical equipment, ex-Serviceman from electrical technical branch only, also considered, commencing salary £600-£700 incl.—Box 4620.

REQUIRED, chief for small Radar and radio research and development laboratory, B.Sc. in physics preferred, with experience in design and development in radio and radar test gear.—Reply, giving full particulars and salary required, to Box 4543. [4605

DESIGNER draughtsman required for S. London by Philips Laboratories, exp. in communications equipment (elect. and mech.). —Apply in writing, giving full details to R.T.E., Ltd., 45, Nightingale Lane, S.W.12.

MECHANICAL designer required for light electrical appliances, S.E. London district; good opportunity for a man with original ideas.—Write, giving details of experience and qualifications, to Box 4945.

ESTABLISHED electrical contractor and radio engineer on Sussex coast requires experienced showroom salesman, one able to build up pre-war and new contacts and apply energy, determination and tact, sound position with good future prospects for right applicant. —Box 4606. [4620

ELECTRICAL and mechanical engineer for varied and interesting duties in small works; competence and initiative essential, knowledge of electronics desirable; good pay to live man under 40; full or part-time.—Box No. 466, c/o Dawsons, 31, Craven St., London, W.C.2. [4639

M. WILSON LTD

Everything we advertise is absolutely new.

1946

We are reorganising our business, and as a result of the improved labour situation have been able to increase our staff. This, with co-operation from manufacturers and wholesalers will enable us to make future deliveries promptly from stock.

SPECIAL!

RADIO CHASSIS (riveted corners) in 18-S.W.G. "ALCLAD," undrilled, specially manufactured for us by a well-known firm of aircraft manufacturers, to Aircraft (A.I.D.) standards. Srrong as steel, rigid yet easy to work. Dimensions 12½ × 7¾ × 4in. Price **12/6** Post and packing 1/-.

COILS, Aerial and H.F. Transformer, small, with reaction medium and long waves. 10/6 pair.

CHOKES, Short Wave, 2/- each.

COILS, 3 wavebands on one former: Long (800–2,000m.), Medium (200–500m.), and Short (16–50m.) Aerial and Osc., 12/6 per pair. A. and H.F. with reaction, 12/6 per pair.

NOW READY

COMPLETE SUPERHETERODYNE SCREENED COIL UNIT, colour-coded, wired-up and tested. Includes 3 waveband coils for R.F. stage, H.F. and Oscillator, short 16-50, medium 200-550 and long 800-2,000 metres. (465 K/CS) 3 gang condenser, 3 bank switch, 2 valve holders, (R.F.-F.C.) all trimmers, padders and resistances together with blueprint. With calibrated dial and slow motion drive. Price **£3 10 0**

Tuning units for all standard circuits supplied.

FOUR-WAVEBAND COILS on one former: Long (800–2,000m.), Medium (200–550m.), and Short (12–20 and 19–50m.), 15/- per pair.

I.F TRANSFORMERS, 465 k/cs., permeability-tuned iron-cored, centre-tapped colour-coded, screened, 15/- per pair.

INPUT TRANSFORMERS (Push-pull), Midget parallel-feed split secondary 4 to 1 ratio, 6/-. Standard, 9/6. Heavy Duty, 12/6.

CIRCUIT No. 17

7-VALVE SUPERHETERODYNE A.C. (or No. 18) A.C./D.C. RECEIVER. Valve sequence: Radio-frequency stage (6K7), first detector and oscillator (6K8), intermediate-frequency amplifier (6K7), second detector A.V.C. and first A.F. (6Q7), output beam tetrode (6V6) with negative feed-back, Y63 tuning eye if required. Six wavebands covering 5 to 2,000 metres, including television-sound. A.V.C. rapid, normal and off. Controls R.F. gain; wave-change switch; B.F.O. on/off; A.V.C. on/off audio-gain control and on/off switch; tone-control; radio-gram. switch. 6 watts output. Full-wave rectifier (U50).

CIRCUIT No. 20

10-VALVE SUPERHETERODYNE A.C. or (No. 21) A.C./D.C. RECEIVER. Six wavebands covering 5 to 2,000 metres, including television-sound, A.V.C. rapid, normal and off. Controls R.F. gain; wave-change switch; B.F.O. on/off; A.V.C. on/off; audio-gain control and on/off switch; tone-control; radio-gram. switch. 12 watts output. Full-wave rectifier. Complete sets of Blueprints (two practical and one theoretical), full size, with complete price list of components, all of which we can supply, for circuits Nos. 17, 18, 20 and 21: 5/- per set for each circuit.

For other circuits see October issue.

Look out for Special Television Announcements

To OVERSEAS TRADERS

Wholesale and Retail enquiries are invited.

Orders can be executed for B.A.O.R., C.M.F., M.E.F. and S.E.A.C. customers.

307, HIGH HOLBORN.
LONDON W.C.1. 'Phone HOLborn 4631

THESE ARE IN STOCK

AN INTRODUCTION TO THE THEORY AND DESIGN OF ELECTRIC WAVE FILTERS. By F. Scowen. 15/-. Postage 6d.
ELECTRICAL ESSENTIALS OF RADIO. By M. Slurzberg and W. Osterhead. 24/-. Postage 6d.
ULTRA-HIGH-FREQUENCY RADIO ENGINEERING. By W. L. Emery. 16/6. Postage 6d.
PROBLEMS IN RADIO ENGINEERING. By Rapson. 5/-. Postage 4d.
FOUNDATIONS OF WIRELESS (Completely Revised). By M. G. Scroggie. 7/6 Postage 4d.
AMERICAN MIDGETS. Radios and Valves. By J. Bull. 2/6. Postage 2d.
TELEVISION RECEIVING EQUIPMENT. By W. T. Cocking. 10/6 Postage 4d.
RADIO ENGINEER'S POCKET BOOK. By F. J. Camm. 3/6. Postage 3d.
CLASSIFIED RADIO RECEIVER DIAGRAMS. By E. M. Squire. 10/6. Postage 5d.
TIME BASES SCANNING GENERATORS. By O. S. Puckle. 16/-. Postage 6d.
VALVE REPLACEMENT MANUAL. For Radio Engineers. By A. C. Farnell and A. Woffenden. 6/-. Postage 3d.
THE WIRELESS WORLD VALVE DATA. 2/-. Postage 2d.

WRITE OR CALL FOR COMPLETE LIST. 1d.

THE MODERN BOOK CO.
(Dept. W.10) 19-23, PRAED STREET, LONDON, W.2.

Held-up for Special Cutting Tools?

Let **BRIDGES** *make them for you*

DRILLS • MILLING CUTTERS • END MILLS • REAMERS • COUNTER-SINKS • COUNTER-BORES

Phone RENOWN 2425 and ask for Mr. Bridges personally, or write to:

S. N. BRIDGES & CO. LTD.
6, PARSONS GREEN, LONDON, S.W.6

ALERT RADIO CO.

(F. L Channell, A.M.Brit.I.R.E.)

Temporary Address:—

27, TEMPLE FORTUNE MANSIONS, LONDON, N.W.11

Our old premises no longer exist, but we hope shortly to get going again on our post-war programme. In the meantime we would be glad to hear once again from our old friends. At the moment we are able to service all types of receivers. We re specially able to cope with the repairs and realignment of high grade receivers, such as, The Scott Radio Laboratories Philharmonic XXX, High Fidelity 23 Valve, Allwave XV and Communication Receivers, Hammarlund Super Pro., H.R.O., R.M.E. 69, etc. Our Television clients should contact us as soon as possible.

JUNIOR and senior draughtsman required by manufacturers of radio and domestic electric equipment; permanent post; salary according to qualifications and experience; N.W. London.—Box 5036. [4747

SOUND equipment engineers required for testing, analysis and fault finding on production tests of high-grade amplifiers; good prospects; central London.—Write with details of experience, Box 4588 [4613

LABORATORY executive required; applicant should already hold similar position such as chief engineer or assistant to same and have first-class electrical and scientific training and experience; excellent opportunity with well known London manufacturing company.—Box 2602. [4508

MANUFACTURERS of radio and electrical components require a well-educated young and energetic man to run sales office; must have some technical knowledge; previous sales experience and be good organiser of office routine; commencing salary £400 p.a.; permanent and progressive post.—Box 5029. [4733

HIVAC, Ltd., invite applications from young radio valve technicians with experience in all branches of receiving valve production, the post offered will be a staff appointment and will ultimately be pensionable.—Replies should be addressed to the Manager, Hivac, Ltd., Greenhill Crescent, Harrow-on-the-Hill, Middx.

DRAUGHTSMEN and tracers required for S. London, with exp. in prod. of working drawings from data supplied by designers; (1) Mech. draughting; (2) Elect., preferably with exp. on radio comm. equipment; workshop exp. preferred.—Apply in writing, with full details, to R.T.E., Ltd., 45, Nightingale Lane, S.W.12. [4635

EX-FORCES woman, knowledge radio or similar training, to train as public address engineer for installation and operation of fixed and mobile equipment, must be pleasant, good manners, well spoken, dependable, outdoor work in summer, extremely pleasant and interesting job, good pay, permanency, interview, expenses paid.—Write, Holder Brothers, Ltd., 118, High St., Scunthorpe, Lincs. [4612

ASSISTANT electrical planning engineer required for factory South East London area, capable of design and development of complicated circuit work for test gear used in radio valve manufacture, must be of at least National Certificate standard.—Write, giving full particulars, age, experience, qualifications, salary required, to Box 5107 A.K. ADVG., 212a, Shaftesbury Ave., W.C.2. [4621

RADIO and electrical engineering.—Industrial organisation in London requires for its patent department a young technical assistant of Inter. B.Sc. standard, and preferably intending to continue his studies to graduation; the work is literary rather than practical, though in close contact with research.—Write fully, giving age, qualifications, experience and salary expected, to "G. J.," Box 7948, A.K. Advg. 212a, Shaftesbury Ave., W.C.2. [4482

HIVAC, Ltd., invite applications for the position of senior valve development engineer, applicants should have had extensive experience in the design and production of receiving valves and their applications, the possession of academic qualifications will be considered an advantage, the post is pensionable under the company's pension scheme, the salary offered will be commensurate with the applicant's experience and qualifications.—Replies will be treated in the strictest confidence and should be addressed to the Manager, Hivac, Ltd., Greenhill Crescent, Harrow-on-the-Hill.

DEVELOPMENT engineers. — Progressive manufacturing organisation in North London have vacancies in the following sections for which applications from fully experienced development engineers are invited: (a) Radio development engineers; applicants should have at least five years pre-war experience on actual development of domestic radio receivers with a firm of repute; B.Sc degree an advantage. (b) Audio frequency section: applicants should have at least five years pre-war experience on actual development of small and high power audio amplifiers, subsidiary equipment, recording equipment, etc., with a firm of repute; B.Sc degree an advantage. (c) Junior engineers: several vacancies exist for junior development engineers with pre-war laboratory experience in connection with (a) and (b) above. (d) Mechanical design section: applicants should have previous experience of development of small electric mechanical equipment from schematic sketches or specifications and preparing detail drawings; previous experience in telecommunication equipment or small electro mechanical components an advantage; some knowledge of their electrical application desirable.—State, in confidence, age, full details of experience and salary required, to Box 4861. [4668

ELECTROLYTIC CONDENSERS

ALL NEW AND TESTED BY WELL-KNOWN MANUFACTURERS.

2 mfd., 450 v.w. tub 2/9. 8 x 8 mfd., 500 v.w. tub 5/6. 4 mfd., 500 v.w. tub. 2/10. 16 x 16 mfd., 450 v.w. tub, 7/6. 8 mfd., 500 v.w. tub., 4/-. 8 x 8 mfd., 150 v.w., tub, 3/6. 8 mfd., 450 v.w. tub, 3/-. 16 mfd. wet can, 450 v.w. 7/6. 8 mfd., 600 v.w. can, 5/6. 4 mfd., block, 650 v.w., 5/9. 75 mfd., 12 v.w., tub, 1/6. 50 mfd., 12 v.w., tub, 1/9. 25 mfd., 25 v.w., tub 1/9. Only a few examples of our extensive stocks. .1, .01, .001, .05, .02 mfd., 400 v.w., 7/6 doz., 8d. each. .5 and .25 1/6 each or 16/- per doz.

P.M. SPEAKERS.—3 Ω Voice Coil, less trans. Celestion 2½", 27/-; 8", 21/-. Goodmans, 3½", 29/6; 5", 21/6. Rola, 5", 21/6; 8", 23/6. Goodmans 10", Celestion 10", Rola 10" in stock. Larger type Speakers, 10" and 12" prices on application. Magnavox 8" energised. 2,000 Ω field, with trans., 33/-.

MIDGET TYPE ROTARY WAVECHANGE SWITCH, 2/6. **MIDGET MEDIUM WAVE COILS**, high gain, 5/6 and 6/6 pair. **MIDGET, MEDIUM AND LONG WAVE COILS,** 8/6 pair. **MEDIUM AND LONG WAVE COILS**, with reaction, 10/6 pair. **I.F. TRANS.**, in cans, 465 kc/s, 15/- pair.

VALVES.—6,000 mains and battery valves in stock. All B.V.A. makes at list prices. Also most types of American Tubes, G, GT, Metal and UX.

MAINS TRANSFORMERS.—Mains Standard, 350-0-350 6.3 and 5 v., 350-0-350, 4 v. and 4 v., 29/6, with fixing feet. Or Chassis Mounting Types. Larger or smaller types, prices on request.

SPEAKER TRANS.—Midget type, pentode, 5/9. Universal, Multi Radio, 7/6 and 8/6. Rola Universal Multi Radio, 12/6.

GANG CONDENSERS, .0005. Ceramic insulation, 2 gang with fixing feet, drum, drive, spindle, M. and S. wave dial, 14/-. 2 gang only, 11/6; 3 gang, 10/-; 2 gang with trimmers, 12/6.

MIDGET SMOOTHING CHOKES, 500 Ω 60 ma., 6/6.

LINE CORD.—.2 and .3 amp., 2 and 3 way, 2/6 and 3/- per yd.

MAINS VOLTAGE DROPPERS.—800 Ω .2 amp. 5/6; .3 amp., 5/9.

CARBON RESISTANCES.—Assorted values, 6/- doz.

ALL GOODS GUARANTEED. Satisfaction, or cash refunded. Let us quote, for all your requirements. Terms, Cash with Order, pro forma, or C.O.D. (No C.O.D. under £1.) Orders over £5, post free. Send 1d. for our Current List.

LASKY'S RADIO
364 & 370 Harrow Rd., Paddington, W.9
(Opp. Padd. Hospital). 'Phone: Cunningham 1979.

W. BRYAN SAVAGE LTD.

Expert assistance in the solution of problems relating to

- TRANSFORMERS, CHOKES
- AMPLIFIERS
- POWER UNITS

and Specialised Equipment embodying

ELECTRONIC CONTROL

WESTMORELAND RD., N.W.9
COLINDALE 7131

RADIO BATTERY TESTER

Use "Quixo" method of battery testing.
Reliable results. Guaranteed.
Send for interesting leaflet R115 on battery testing.

RUNBAKEN • MANCHESTER 1

MIDLAND INSTRUMENT CO.

Comprehensive range of Lewcos instrument wires, resistance wires, flexes and cables, sleeving, Empire tape, rubber grommets, L.T. selenium rectifiers and transformers, Avometers, speakers, chassis, dual range and s.w. coils, var. conds., counters, synchronous motors, microphones, etc., etc.

Lists, 1d. s.a.e. Enquiries, 2½d. s.a.e.

18, Harborne Park Rd., Birmingham, 17

VALVES

10,000 Popular and Rare Radio VALVES, exact type or suitable Replacement, ACHLDD, ACP, AC2HL, ACpen, AC2pen, AC2penDD, AC5pen, AC5penDD, ACSGVM, ACTP, ACVP1, ACVP2, ACO44, APP4A, APP4B, APV4, AZ31, C1, C1C, CBL31, CCH35, CY1C, Cy31, D63, DA30, DCP, DD41, DD207, DDT, DH63, DH73M, DL, DL63, DO24, DW2, DW4/350, DW4/500, EB34, EBC3, EBC33, EBF2, EBL1, EBL31, ECH35, ECR30, EF5, EF6, EF8, EF9, EF39, EL2, EL3, EL32, EL33, EL35, FC4, FC13, FC13C, H63, HD24, HL2, HL13C, HL21DD, HL23, HL23DD, HL41DD, HL133DD, HL1320, HL/DD/1320, IW4/350, KT2, KT24, KT33C, KT61, KT63, KT66, KTW61, KTW63, KTZ41, KTZ63, LP2, MH4, MH1118, MH4105, MHD4, MHL4, ML4, MS4B, MSP4, MSpen, MSpenB, MU14, OM4, OZ4, P2, P215, P650, PA20, PM2A, PM2HL, PM22A, PM22D, PM24A, PM24B, PM24M, PM256, PP3/250, PP5/400, PP3521, PX4, PX25, Pen4DD, Pen4VA, Pen25, Pen45, Pen45DD, Pen46, Pen141, Pen383, Pen428, Pen1340, PenA4, PenB4, PenDD4020, QP22B, QP25, QP230, R4, S4VB, SP13, SP2, SP2BS, SP4, SP4B, SP41, SP42, SP2220, TDD13C, TDD2A, TDD4, TH2, TH21C, TH30C, TH4B, TH41, TH2321, TP25, TP26, TX41, U5, U10, U14, U16, U18, U21, U31, U50, U52, U403, U4020, URIC, UR3C, UU5, UU6, UU7, V914, VHT4, VMP4G, VMS4B, VP2, VP4, VP4A, VP23, VP41, VP133, W21, XSG, XP, XLO, X24, X41, X61M, X63, X65, Y63, Z22, —01A, 024, 1A4, 1A5, 1A6, 1A7, 1B4, 1C5, 1C7, 1D5, 1D6, 1D7, 1E5, 1E7, 1F4, 1F5, 1F6, 1F7, 1H4, 1H5, 1H6, 1J5, 1J6, 1LC6, 1Q5, 1T5, 2A7, 2B7, 2D13C, 2D4A, 2P, 5U4, 5V4, 5Y3, 5Z3, 5Z4, 6A4, 6A7, 6A8, 6AE6G, 6B7, 6B8, 6C5, 6C6, 6C8, 6D5, 6D6, 6F6, 6H6, 615, 617, 618, 6K6, 6K7, 6K8, 6L5, 6L6, 6L7, 6P5, 6Q7, 6R7, 6SF7, 6T7, 6U7, 6V6, 6X5, 6Z5, 7A7, 7A8, 7B5, 7B6, 7B7, 7B8, 7C5, 7C6, 7D3, 7D5, 8D2, 9D2, 10, 10D1, 11D5, 12A, 12E5, 1215, 12Q7, 12Z3, 12Z5, 13SPA, 14, 15, 18, 19, 20, 20D2, 22, 24, 25A6, 25Z4, 25Z5, 25Z6, 26, 27, 29, 31, 32, 35, 35Z4, 35Z5, 33, 37, 38, 40, 40SUA, 41MP, 41MTL, 41STH, 431U, 42, 42MPpen, 43, 48, 50, 53, 55, 57, 71A, 74, 75, 76, 79, 80, 81, 82, 83, 85, 89, 99, 164v, 210DDT, 2201PT, 220TH, 301, 302, 303, 304, 354v, 402P, 954, 955, 956, 1821, 1853, 402OT, 506BU.

All at list prices. Order C.O.D. Stamp with enquiries. Under 10/- orders C.W.O.

EXPORT ORDERS INVITED

Forces and Demobilised—Special Attention.

J. BULL & SONS

(Dept. W.W.)

246, HIGH STREET, HARLESDEN, N.W.10

POST-WAR TELEVISION

The advance in Radio Technique offers unlimited opportunities of high pay and secure posts for those Radio Engineers who have had the foresight to become technically qualified. How you can do this quickly and easily in your spare time is fully explained in our unique handbook.

Full details are given of A.M.I.E.E., A.M.Brit.I.R.E. City & Guilds Exams., and particulars of up-to-date courses in Wireless Engineering, Radio Servicing, Short Waves, Television, Mathematics, etc., etc.

We Guarantee "NO PASS—NO FEE"

Prepare for to-morrow's opportunities *and post-war competition* by sending for your copy of this very informative 112-page guide NOW—FREE.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (Dept. 388)

17, Stratford Place, London, W.1

LABORATORY assistant with some knowledge of physics and electrical training required in S.W. London area.—Write, giving details of age, experience, etc., Box 2519.

SITUATIONS WANTED

EXP. radio Serviceman, salesman, car driver, wants work, business or partnership.—Mortimer, 384, Meadow Lane, Nottingham.

TELEVISION.—Man, exp. in manufacture, test, service, installations of domestic receivers, req. respons. posn.—BM/HHHG, W.C.1.

B.I.R.E., student, ex-R.A.F., Sgt. W/optr, seeks part-time work, radio or electronics, London area; diligent student; immediately available.—Box 4816. [4640

R.A.F. W/O., 6 years radar, 3 years pre-war servicing, age 27, City and Guild, 1st class radio service, seeks progressive situation; release Feb.—Box 4946. [4695

A.Q.M.S. R.E.M.E. Arm. art., requires position with reputable firm in any capacity radio industry; fully conversant all types test equipment; available immediately.—Box 5030.

R.A.F. sgt. wireless mechanic, released, seeks progressive situation, 12 years' pre-war servicing and sales experience; P.A., sound theory and practical; own gear; London area.—Box 5013. [4709

RADIO mechanic, ex R.A.F. Sgt. 5 yrs., prior to war 15 yrs. domestic radio servicing, P.A. and television exper.; own test instruments and car; London area.—Box 5040.

R.A.F. signals officer, licensed amateur, pre-war ex-Cranwell aircraft apprentice, wireless electrical mechanic, expecting release during January, desires suitable radio or electrical employment.—Box 2874. [4589

RADIO engineer, 10 years' civilian experience, desires partnership or responsible position in small business, any area considered; demobilised and available immediately, driver.—Box 4950. [4705

RADIO engineer, age 38, at present assistant to chief engineer of large radio manufacturers, seeks advancement, 15 years' all-round experience, including centimetre radar; salary £750.—Box 4541. [4603

STAFF Sgt., Army radar, requires progressive position, demob. February, 8 years' thorough experience in pre-war radio and television service (manufacture and retail); London or Brighton areas pref.—Box 4947. [4697

CPL., R.E.M.E. (tele-mech.), release March, 5 years' workshop experience in maintenance of radar, wireless and test equipment, seeks progressive post with manufacturers of radio, television or test equipment.—Box 4822.

YOUNG ex-senior radio officer M.N., age 25, 8 years' experience marine communications equipment, desires post in radio or recording industries, design construction or research; now studying for professional exams.—Box 5014. [4712

RADIO officer, M.N., 7 years' experience, age 25, P.M.G. 2nd class, City and Guilds Garde I, desires progressive post in radio engineering, preferably South England, with opportunity for technical study.—Priest, Lynfield, Medrose, Delabole, Cornwall. [4641

SERVICEMAN, 26, release March, seeks technical position with opportunity for advancement; 3 years' full-time pre-war technical education, radio commun. diploma, C.G. certs., amateur lic., studying for graduateship, I.E.E.; thoroughly practical.—Box 4602.

R.A.F. Sigs. Officer, age 31, available April, seeks progressive situation, preferably administrative or development, Assoc. Member Brit. I.R.E., sound knowledge all communication equipment, including high-speed auto, cables, telephones, interference suppression, transmitting licence; 4 years' experience radio instructor.—Box 4940. [4680

FLT. SGT., R.A.F., age 25, radar mech., anticipating release about July, invites offers of post requiring integrity and adaptability; 3 years' development work at National Research Council (Canada) on centimeter layout design, laboratory tests, sweeps; also experienced in high quality P.A., servicing, organisation, supervision and stage technique.—Box 4558. [4608

YOUNG man (31), desires responsible post, preferably with directorship, in small firm manufacturing high grade radio equipment, 6½ years' experience sales and organisation with well-known firm of mechanical engineers, fifteen years' amateur and service experience of radio, including receiver and amplifier design, and requirements for tropical conditions; at present serving in Technical (Signals) Branch of R.A.F., due release approx. May/June; prepared to invest £2,500-£3,000.—Box 4779.

PATENT NOTICES

THE proprietors of British Patent No. 513650, entitled Improvements in Closures for Evacuated Envelopes, offer same for license or otherwise to ensure its practical working in Great Britain.—Inquiries to Singer, Ehlert, Stern and Carlberg, Chrysler Building, New York City 17, N.Y., U.S.A. [4486

R.A.F. RADIO!

Readers have quickly appreciated, and proved, the value of these receiver chassis, components and other types of R.A.F radio gear we advertised last month. Here are a few examples offered at a fraction of their cost. As it is impossible to get continuous supplies of R.A.F. materials you should purchase now whilst available.

R.1155. RECEIVER CHASSIS. Absolutely packed with valuable components. Total value of individual components nearly £15. Many experimenters have added valves and a few components and thus completed receiver. Includes 3-gang .0005 condenser, large-scale dial calibrated from 7.5 mc/s to 1,500 kc/s, 7 variable switches, variable resistances, coils, chokes, condensers and fixed resistors of every type and value, coils, trimmers, etc., etc. All stamped "Air Ministry" and made to their stringent specifications. **£5.**

R.1125B. RECEIVER CHASSIS. 2 7-pin ceramic valveholders, 8 condensers, 8 resistors, 2 transformers, coils, plugs, sockets, etc. All on totally enclosed metal chassis. All to Air Ministry specifications. **17/6.**

D.C. MOTOR GENERATOR. 9 v. input, 450 v. output, complete with cooling fan and switching device; fitted on chassis 12¼ x 8 x 2¼, weight 17 lb. **£3 17s. 6d.** Also for 18 v. and 24 v. input.

WIREWOUND VOLUME CONTROLS. 400 ohms, **2/9.**

NEW MOVING COIL D.C. VOLTMETERS. 0-40 v. 2" flush type, **25/-.**

R.A.F. 3-GANG CONDENSERS. Same as used in R1155 chassis. .0005 mfd. **12/6.**

R.A.F. MIDGET VOLUME CONTROLS. 100,000 ohms. **1/9** each or **16/-** doz.

R.A.F. TWIN VOLUME CONTROLS. 500,000 ohms each section **5/6** each.

R.A.F. 2 mfd. CONDENSERS. Mansbridge type, 500 v. wkg. **1/3** each.

R.A.F. TUBULAR CONDENSERS. .1, .15 and .25 mfd., 350 v. wkg. **7/6** doz.

R.A.F. TUBULAR CONDENSERS. Metal-cased. .1+.1+.1 mfd., 500 v. wkg. **2/3** each.

R.A.F. TUBULAR CONDENSERS. .5 and .25 v., 350 v. wkg., with short wire ends. In 25 lots only. **5/6**

R.A.F. .02 MFD. CONDENSERS. 1,000 v. wkg., **7/6.**

R.A.F. SELECTOR SWITCHES. Useful for remote control. **21/6.**

R.A.F. 10-POINT DEWAR SWITCHES. **2/6.**

R.A.F. PARCEL 1. Six each .1, .15, .25 mfd. Tubular Condensers, three .1+.1+.1 mfd. Tubulars, metal-cased, three Midget Volume Controls, 100,000 ohms, two Toggle Switches. **20/-.**

R.A.F. PARCEL 2. Twelve each .1, .15, .25 mfd. Tubular Condensers, six Midget Volume Controls, 100,000 ohms, three Volume Controls, one gross 6 BA Nuts and Bolts, one gross 4 BA screws, one gross Rivets. **30/-.**

MULTI-RANGE Moving Coil TEST METERS New. First-grade army type in bakelite case. Ranges: 10, 50 100 and 500 volts at 1,000 ohms per volt A.C. and D.C. 1, 10, 100 and 500 mA and 0-10,000 ohms. **£8 15s. 0d.**

NEW 6 and 8in. LOUDSPEAKERS in beautiful polished Plastic and Wood Cabinets: 6in., **30/-**; 8in., **35/-.**

NEW 0.2 mfd. CONDENSERS, 250 v., **8d.** each, **6/6** doz.

SINGLE SCREENED CABLE, 12 yds. **7/6.**

EX-GOVERNMENT PLUGS AND JACKS, 5/6.

MAINS DROPPERS. 1,000 ohms, .2 amp., **5/6.**

7-PIN PAXOLIN VALVEHOLDERS, 7/6 doz.

INTERNATIONAL AMPHENOL VALVEHOLDERS. 7/6 doz.

CARBON RESISTORS. Assorted values, **22/6** per 100.

MOVING COIL INSERTS. Can be used as Headphones, Midget Speakers (with trans.), Speech Mikes, or adapted for P.U. **6/-.**

LOUDSPEAKERS, less transformers. Rola. 6in., **19/6**; 8in., **21/6.**

NEW MAINS TRANSFORMERS. Superior quality. 300-0-300 v., 6.3 v., 3 amp., 5 v. 2a. Also 300-0-300 v., 4 v. 3 a., 4 v. 2 a. Dim. 3½ x 3½ x 3. Weight, 4½ lbs. Blue enamel finish. **24/6** each.

ELECTRO-MAGNETIC COUNTERS. Ex-G.P.O., every one perfect, electro-magnetic, 500 ohm coil, counting to 9,999, operated from 25 v.-50 v. D.C. Has many industrial and domestic applications. **6/-**

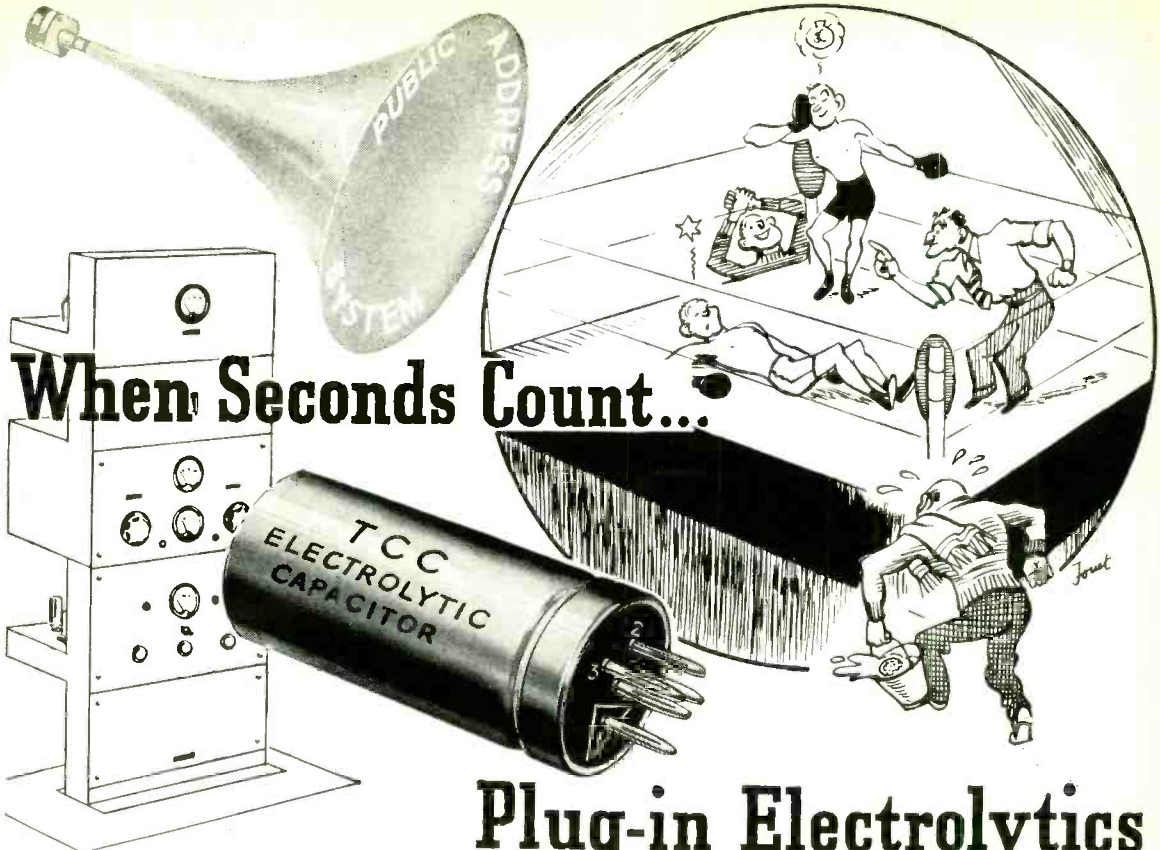
READERS SHOULD CALL AT

LONDON CENTRAL RADIO STORES

23, LISLE STREET, LONDON GER. 2969 **W.C.2**

Closed Thurs. 1 p.m. Open all Sat.

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. "Wireless World" can be obtained abroad from the following—AUSTRALIA and NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: Imperial News Co.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd.; William Dawson & Sons (S.A.), Ltd. UNITED STATES: The International News Co.



When Seconds Count...

Plug-in Electrolytics

RANGE		
Capacity MFDS	*Peak Working Volts*	*Retail Price*
SINGLE SECTIONS		
16	500 (600v. Surge)	11/-
32	450 (550v. Surge)	12/-
100	250	13/6
250	100	13/6
500	50	13/6
1000	25	13/6
2000	12	13/6
DUAL SECTIONS		
8-8	500 (600v. Surge)	12/6
16-16	450 (550v. Surge)	13/6
32-24	350v.	13/6
TRIPLE SECTIONS		
8-8-4	500 (600v. Surge)	15/-
16-16-8	450 (550v. Surge)	15/6
20-20-20	350v.	14/6

We show above the range at present standardised in an aluminium can measuring 3¾" × 1⅜", fitted with 5-pin valve base. This list will be added to from time to time, according to demand.

From being the wayward child, the Electrolytic Capacitor, as a result of continuous research and the rigours of hard usage under years of active service conditions, has become the model offspring in the matter of reliability and efficiency.

Even so, accidents must and will happen, and particularly at public meetings and functions it is vital to be able to locate and correct a cause of breakdown instantly . . . or even before it happens.

It can be more than a mere inconvenience to have to locate by test a defaulting capacitor, disconnect from the wiring and replace with a new one. The advent of the T.C.C. Plug-in Electrolytic reduces such anxieties to almost nil and the replacement time to a matter of seconds. It now takes no longer to replace than a valve.

Although the present-day dependability of T.C.C. productions is such that you may never have to do this, you should be prepared for the time. . . .

WHEN SECONDS COUNT.

TCC

CAPACITORS

THE TELEGRAPH CONDENSER CO. LTD.

RADIO DIVISION

NORTH ACTON · LONDON · W·3 *TELEPHONE:* ACORN 0061

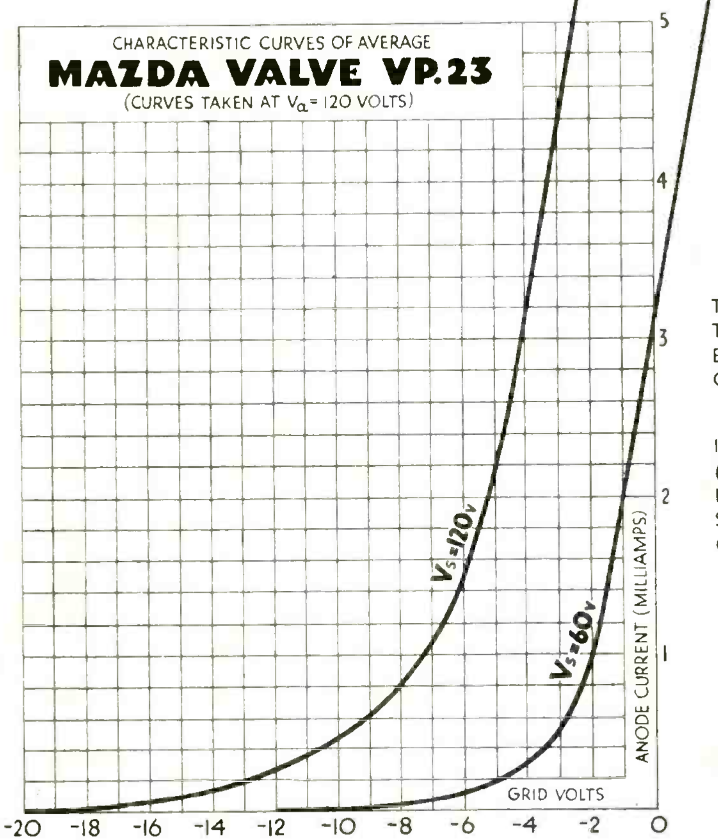
THE MOST FAMOUS SET MAKERS ARE AGAIN FITTING

MAZDA

RADIO VALVES AND CATHODE RAY TUBES
because of their
PERFORMANCE AND RELIABILITY

LOW "I_f"

HIGH "g_m"



THE FILAMENT CURRENT OF THE MAZDA VP 23 IS EXCEPTIONALLY LOW; IT IS ONLY 50mA.

ITS MUTUAL CONDUCTANCE (g_m = 1.3mA/V) IS REMARKABLY HIGH FOR A VALVE HAVING SO LOW A FILAMENT CONSUMPTION.

THIS VALVE MAY BE USED AS A REPLACEMENT IN THE CIVILIAN WAR-TIME RADIO RECEIVER.

THE EDISON SWAN ELECTRIC COMPANY LIMITED 155, CHARING CROSS ROAD, LONDON, W.C.2