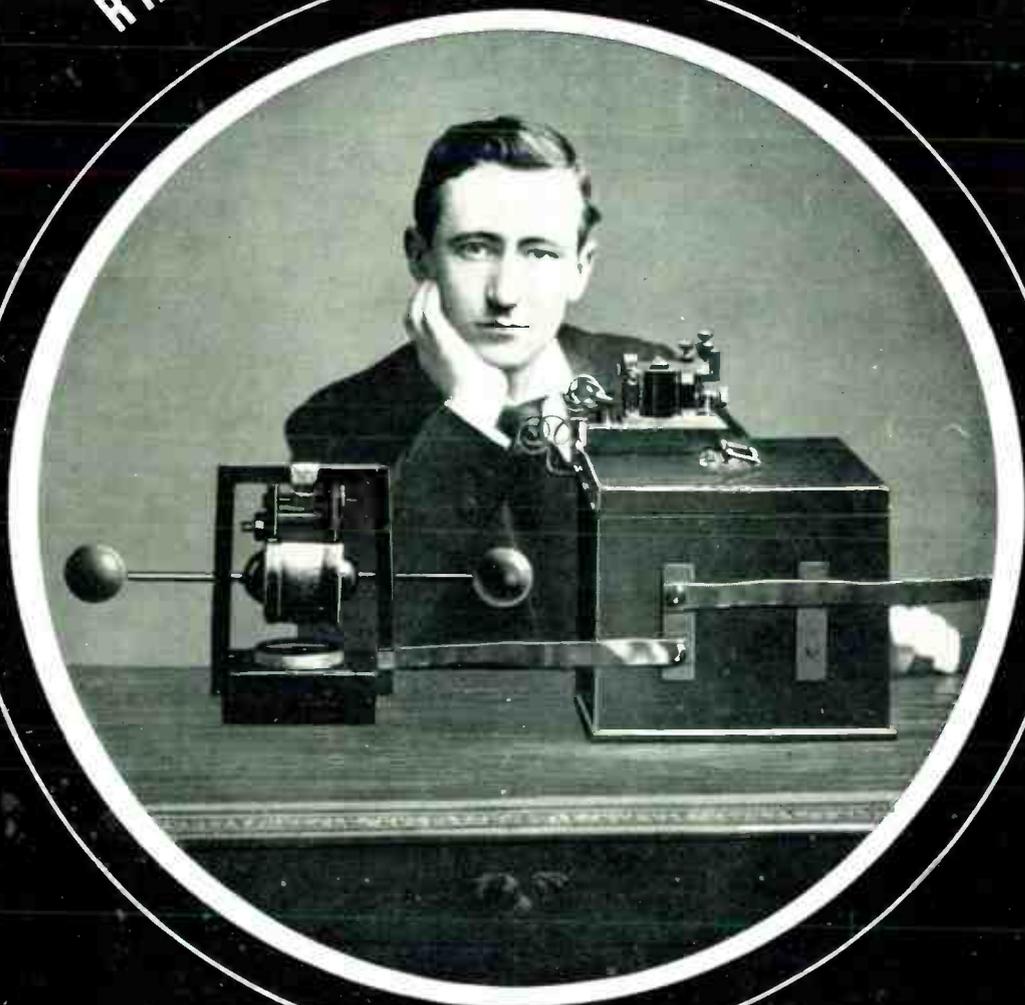


# Wireless World

RADIO AND ELECTRONICS



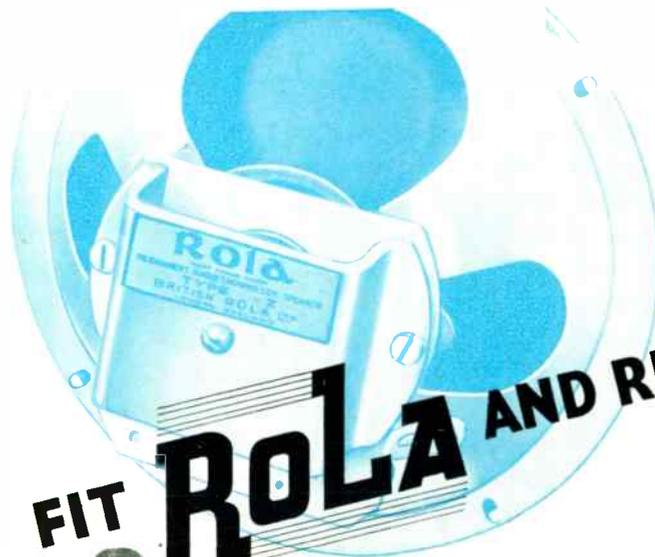
JUNE 1947

1/6

Vol. LIII. No. 6

IN THIS  
ISSUE :

NEW TESTING AND MEASURING EQUIPMENT



**FIT ROLA AND RELAX**



A radio receiver is judged by the quality of its reproduction more than by any other single factor. That is why the speaker is such a vital part of any set. No wonder so many Planning Engineers decide on Rola speakers for all their models. They know they can fit Rola and relax!

**ROLA SPEAKERS**  
**THEIR QUALITY SPEAKS FOR ITSELF**

BRITISH ROLA LTD • GEORGIAN HOUSE • BURY ST • ST JAMES'S • LONDON. S.W.1



# AVO

MODEL 7  
UNIVERSAL  
AVOMETER

MODEL 40  
UNIVERSAL  
AVOMETER

THE AVO  
TEST  
BRIDGE

THE "AVO"  
VALVE TESTER

THE  
ALL WAVE  
"AVO" OSCILLATOR

**R**AUDIO manufacturers, service engineers, workshops and laboratory technicians are familiar with the precision and dependability of "AVO" Electrical Testing Instruments. Long years of successful experience in the design and manufacture of first-grade instruments have produced a consistently high standard of accuracy which has become a tradition as well as a standard by which other instruments are frequently judged.

**THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD.**  
 WINDER HOUSE · DOUGLAS STREET · LONDON · S.W.1 TELEPHONE: VICTORIA 3494/7

*Something new—  
Something better...*

**AVAILABLE  
NOW →**



**AVAILABLE SHORTLY  
AMPLIFIERS—IN STREAMLINED CASES.**  
 Model T.12 for AC/DC mains 12/15 watts output **12 GNS.**  
 MODEL T.25 for AC mains 200/250 volts 25  
 watts output ..... **18 GNS.**  
 TABLE MODEL RADIO RECEIVER S63 AD.  
 for AC/DC mains ..... **22 GNS.**

**MODEL T.40 DE LUXE AMPLIFIER**  
 For outdoor meetings, large halls, factories etc. Superior in appearance, design and performance. 40 watts undistorted output, 4 separate matched inputs. Separate volume controls, electronic mixing, unique treble or bass tone control system.

**OBTAINABLE FROM YOUR LOCAL DEALER AND  
IN CASE OF DIFFICULTY DIRECT FROM US.**

Overall dimensions 18½ in. long, 11 in. high, 8½ in. wide.  
 Guaranteed for 12 months, valves for 3 months  
**PRICE COMPLETE, ready to operate 27 GNS.**

**TRADE ENQUIRIES INVITED**

**REYNOLDS UNIVERSAL MANUFACTURING COMPANY LTD.**

410, DUDLEY ROAD, EDGBASTON, BIRMINGHAM, 16.

Telephone : SMethwick 0201

*For efficient detection and A.V.C.*

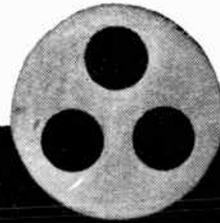
**WESTINGHOUSE**  
**WESTECTORS**

**WESTINGHOUSE BRAKE & SIGNAL CO. LTD., 82, YORK WAY, LONDON, N.I.**

**SAVE SOLDERING TIME**

**ENSURE PRECISION JOINTS**

**AVOID WASTE OF SOLDER**



**USE**

*The Finest  
Cored Solder  
in the World*

Whether you are manufacturing a thousand radio sets or repairing one, it will pay you to use only the finest quality solder. Although the cost of a single soldered joint is very low, when this cost is multiplied by thousands, the advantages of speed, economy, and freedom from waste are very real indeed.

Ersin Multicore Solder gives you all these advantages. The three core construction means thinner solder walls, instant melting and speedier soldering. Flux continuity is assured — there is always a supply of flux available for the next joint. Added to this—Multicore contains Ersin, the extra - active non - corrosive flux which enables joints to be made on heavily oxidised surfaces. Write for technical information and free samples.



SIZE 7 REEL  
for Factory use,

SIZE I CARTON  
for Service Engineers and Workshops.

PRICES SIZE I CARTONS

Catalogue Ref. No.	Alloy Tin Lead	S.W.G.	Approx. length per carton.	List price per carton (subject)	
				s.	d.
C18014	60 40	14	44 feet.	6	0
C11018	60/40	18	114 feet.	6	9
C14013	40 60	13	27 feet.	4	10
C14016	40 60	16	60 feet.	5	3

**MULTICORE SOLDERS LIMITED**

MELLIER HOUSE, ALBEMARLE STREET, LONDON, W.1. Telephone: REgent 1411.

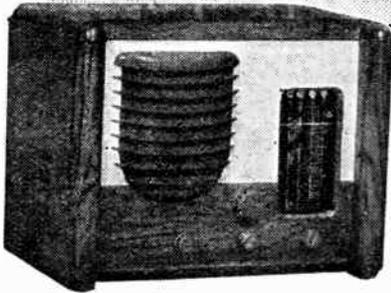
# DID YOU READ—

Wireless World July, 1946

## Test Report

# SOBELL Type 615

A.C. Table Model Superhet  
(Five Valves + Rectifier)



*The following are brief extracts from a report which appeared in the July 1946 issue of "Wireless World" on the Sobell 615 6-valve A.C. Table Model Superhet:—*

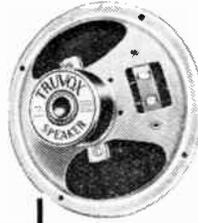
"The quality of reproduction is decidedly above the average for a table model . . . The lower register has breadth and an extended top response gives clarity and brightness without being shrill . . . With two I.F. stages there is no lack of sensitivity and the selectivity is exceptionally good. The division of the short-wave range into two parts gives a degree of band spread which makes for ease of tuning and both ranges provide a wide choice of stations. The sensitivity is well maintained at the high-frequency end . . . The chassis is of ample size and components are well spaced . . . The finish of the cabinet work is of a high order . . . The set is backed by a comprehensive free maintenance scheme for two years. In the event of breakdown the fault will be remedied or the chassis changed on the spot by one of the maker's servicemen."

Price 24 Gns., plus £5. 8. 4d. purchase tax.

# SOBELL RADIO

**TWO YEARS' FREE ALL-IN SERVICE IN THE HOME**

SOBELL INDUSTRIES LTD., LANGLEY PARK, NR. SLOUGH, BUCKS.



Pioneers in public address loudspeakers, TRUVOX now introduce a range of permanent magnet radio speakers of unique and very efficient construction under the name "MONOBOLT". First supplies, in 5", 6½", 8" and 10" sizes, will be available to the radio amateur early in the New Year.

**TRUVOX**  
ENGINEERING CO. LTD.

TRUVOX HOUSE, EXHIBITION GROUNDS, WEMBLEY, MIDDX.

- Entirely new patented construction with single bolt fixing of components concentrically locates the chassis and complete magnet assembly.

- Brass centring ring prevents magnet being knocked out of centre.

- Special magnet steel gives powerful flux with compactness and light weight.

- Speech coil connections carried to suspension piece, ensuring freedom from rattles, cone distortion and cone tearing.

- Clean symmetrical surfaces, no awkward projections.

- Speech coil and former bakelised to prevent former distortion and speech coil turns slipping or becoming loose.

- Two point fixing to the suspension piece with four point suspension for the speech coil.

- Widely spaced fixing points for the suspension permit maximum movement of the cone, producing the lowest response physically obtainable from each size of speaker.



## GOOD NEWS

for the Deafened!

# RAYTHEON

## Hearing-Aid Valves

Now Available in Quantity

YES—good news for all who use hearing-aids, and for all who manufacture or sell them. Raytheon valves . . . especially designed for hearing-aids, and noted the world over for their sturdy long life and rugged construction . . . are available for immediate shipment.

These are the world's most widely-used valves for hearing-aids. They give maximum performance for minimum battery drain. They are proven favorites with engineers, manufacturers and users alike.

Ask for complete information. Address your inquiry to Submarine Signal Company (London) Ltd., Artillery House, Artillery Row, London E.C. 2, England or to:

**RAYTHEON MANUFACTURING COMPANY**  
International Division,  
60 East 42nd Street, New York 17, N. Y., U. S. A.

**RAYTHEON**

*Excellence in Electronics*



**B.I.**  
*Callender's*  
**WORLD SERVICE  
TO INDUSTRY**

As the world's largest group of cable manufacturing companies, the B.I. Callender organisation has built up a chain of branch offices and agents in this country, in the Empire and overseas from Northern Europe to Argentina. This organisation has been developed over more than sixty years to provide buyers of the group's many electrical products with the services of electrical engineers who know the country, the climate and the special conditions under which cables, machines and electrical equipment will operate.

**BRITISH INSULATED CALLENDER'S CABLES LIMITED**  
NORFOLK HOUSE, NORFOLK STREET, LONDON W.C.2

**RADIO IN EVERY ROOM**

with these  
**NEW & BETTER  
EXTENSION SPEAKERS**

Are you enjoying the pleasure and convenience of having your radio instantly available in any room? These moderately priced Stentorian extension speakers, with their handsome acoustically designed wooden cabinets, give such superb quality of reproduction that you will be amazed at the difference a Stentorian makes to your receiver.

Ask your dealer for a demonstration.



**SENIOR MODEL**  
Type SC with Universal Transformer **£5.15.6**  
" SX minus **£5.2.6**  
Walnut Veneered wooden Cabinet, P.M. Unit  
9" diameter, Handling Capacity 7 watts.  
Magnet Flux density 12,000 lines/sq.cm.

**JUNIOR MODEL**  
Type JC with Universal Transformer **£5.0.0**  
" JX minus **£4.10.6**  
Walnut Veneered wooden Cabinet, P.M. Unit  
8" diameter, Handling capacity 6 watts.  
Magnet Flux density 10,000 lines/sq.cm.



**Stentorian**

THE FINEST EXTRA SPEAKER FOR ANY SET

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

*Miniature or Midget*

ACTUAL SIZE

XY 1-4A

XW 0-75A

**HIVAC**

NEW TYPES FOR  
MIDGET RECEIVERS  
HEARING AIDS  
METEOROLOGICAL  
INSTRUMENTS  
ETC.

THE SCIENTIFIC  
VALVE  
BRITISH MADE

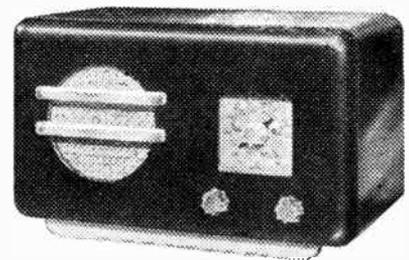
**HIVAC LIMITED** Greenhill Crescent, Phone HARROW  
Harrow on the Hill, Middx. 0895

**"PETER PAN"**  
**MIDGET ELECTRIC RADIO**

**YOU CAN BUILD IN THREE HOURS**  
The "Peter Pan" model 461U is an entirely new conception of home constructor's kit. When completed the constructor has a receiver of the highest performance and appearance of the best factory-built model. Designed by experts for ease of assembly and wiring.

**TECHNICAL SPECIFICATION:**

- H.P. AMPLIFIER. A 6K7G valve is used as variable MU pentode giving maximum sensitivity.
- DETECTOR. A 6J7 or (KT263) valve being used as an anode bend detector which in conjunction with specially designed high "Q" coils gives excellent sensitivity.
- OUTPUT STAGE. A 25A6G valve is used which with careful matching, gives approximately 2 watts undistorted output.
- RECTIFIER. A half-wave rectifier U31 is employed.
- WAVE RANGES 200-550 metres, 1,000 to 2,000 metres.



**Price 9 Guineas  
plus Tax (£2 - 0 - 7)**

DESCRIPTIVE CATALOGUE IN COLOUR ON RECEIPT OF 2½d. STAMP.

- MAINS SUPPLY. 200-250 volts AC or DC mains.
  - OVERALL SIZE. Height 7". Width 12½". Depth 6½".
  - CABINET. Black and white plastic of modern styling, giving a very attractive finish to the completed receiver.
- An up-to-the-minute luxury radio receiver at less than factory price  
**DELIVERY PER RETURN**

**H. P. RADIO SERVICES LTD.**  
Tel.: Aintree 1445 55, County Road, Liverpool, 4 Estab. 1935

# METALLISED CERAMICS

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



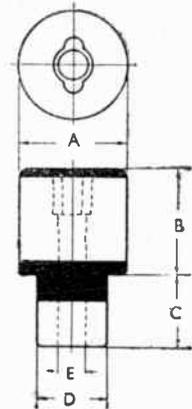
R.50650

R.50764

★ R.50844

★ R.50855

TYPE	A mms.	B mms.	C mms.	D mms.	E mms.
R.50650	9.5	9.5	6.4	6.25	2.75
R.50764	9.5	16.7	6.4	6.25	2.75
★ R.50844	9.5	12.7	9.5	6.25	2.75
★ R.50855	12.7	22.2	12.7	9.5	3.9



★ Recent additions to the range

For full information and prices please write to :

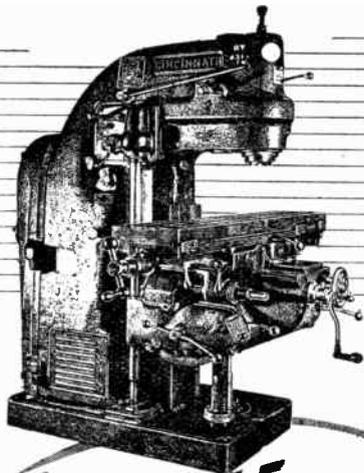
**STEATITE & PORCELAIN PRODUCTS LTD.**

STOURPORT-ON-SEVERN, WORCS. Telephone: Stourport III. Telegrams: Steatite, Stourport.



S.P.43

MORE THAN  
1,500 DIFFERENT TYPES  
**machine  
tools**



**AVAILABLE  
NOW!**

Government Surplus machine tools available NOW at attractive prices. YOUR opportunity to get better equipment and increase production.

**DISPOSAL CENTRES**, where records of all machines available may be inspected, are open to the public for enquiries from 10 a.m. to 4 p.m. Monday to Friday inclusive:—

**BIRMINGHAM** C.M.L. Buildings, Great Charles Street.

**BRISTOL** 8/9 Elmdale Road, Bristol 8.

**CARDIFF** Imperial Buildings, Mount Stuart Square.

**GLASGOW** 21 Glassford Street.

**LEEDS** 10 Bank Street, off Boar Lane.

**LONDON** Room 0088, Ground Floor, Thames House North, Millbank, S.W.1.

**MANCHESTER** Britannia House, Fountain Street.

ISSUED BY THE MINISTRY OF SUPPLY



Ardente have the most modern Public Address systems—fixed or mobile—for EVERY purpose, indoor or out. Combining technical quality with attractive appearance, the wide range available represents the very finest P.A. equipment obtainable to-day. Simple to operate; easy to instal.

by **Ardente**



● Write for trade terms direct to Sales Dept. TW.

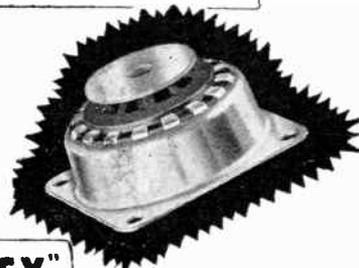
**ARDENTE ACOUSTIC LABORATORIES LTD.**

London Office: 309, Oxford St., W.1. Mayfair 7917-8.

Works: GUILDFORD, SURREY. Guildford 3278-9.

**ISOLATION FROM VIBRATION**

**NEW  
VIBRATION  
ELIMINATORS**



**"EQUIFLEX"**  
PATENTED AND FOREIGN PATENTS PENDING  
MOUNTINGS

AN **AV** PRODUCT

electrical apparatus, motors, etc., and wherever elimination of vibration and shock is required.

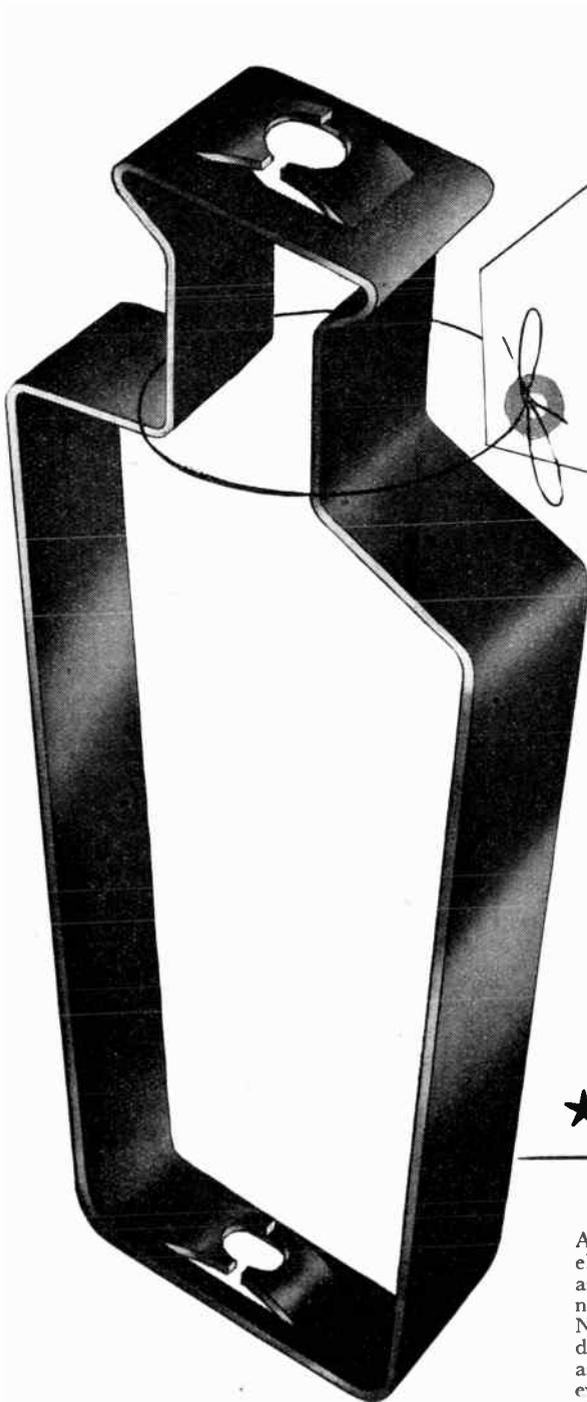
**SPECIAL FEATURES**

Flexible in all directions at an equal deflection. Can be loaded on any side, thus eliminating vibration in Vertical, Horizontal and Longitudinal planes employing best quality natural rubber spring elements and complete with snubbing device. Special Fittings made to suit customers' requirements.

Also available as previously advertised, the ALL-METAL construction comprising an ingenious Damped Spring System.

Write for illustrated brochure, and send us details of your requirements.

A. WELLS & CO. LTD. (Dept. W.W.),  
STIRLING ROAD, WALTHAMSTOW, LONDON, E.17  
\*Phone: Larkswood 2691



*Shake  
vigorously*  
(NOTHING HAPPENS)

Shake as much as you like and as long as you like. You won't shake a Spire fixing loose—it's double-locked. When the screw or bolt is screwed into the Spire Fix the two prongs close and grip the thread. Then the arched base is compressed making a self-energised spring lock which still further tightens the grip on the thread. A Spire Fix holds just as tightly on an unthreaded stud. Spire fixings are light and simple but they are strong medicine. Can we make up a "prescription" for any of your light assembly problems?

**Spire**  
Regd.

★ A BETTER way of fixing

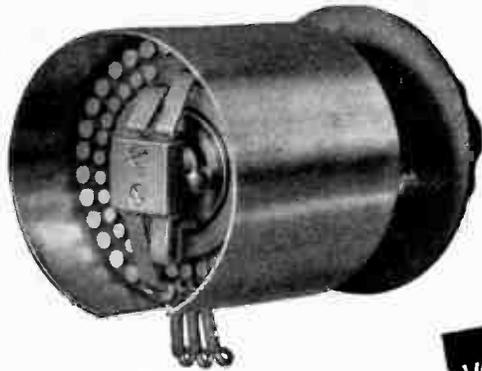
**THAT'S fixed THAT!**

A Boiler maker uses this Spire fixing.  $\frac{3}{16}$ " studs are electrically welded to the exterior of boiler plates; asbestos sheets are pierced and placed over the pins; next a mild steel washer, and then the Spire Fix No. SV1628 is pushed quickly down the stud to make a snug assembly which will hold for ever and a day but is sufficiently elastic to ensure that the asbestos sheets do not crack. All assembly is carried out from the exterior—a material saving in time and cost.



SIMMONDS AEROCESSORIES, LIMITED

C.R.C.10



... another famous production from

*The House*

*of*

**VOICE FREQUENCY FADERS,  
LOW FREQUENCY AND HIGH  
FREQUENCY ATTENUATORS**

We shall be happy to supply the fullest information.



PAINTON & COMPANY LIMITED  
KINGSTHORPE NORTHAMPTON  
Telephone : Northampton 2820



**FOR THE  
RADIO SERVICEMAN  
DEALER AND OWNER**

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

Write to the I.C.S. Advisory Dept. stating your requirements. Our advice is free and places you under no obligation.

-----You may use this coupon-----

**INTERNATIONAL CORRESPONDENCE SCHOOLS Ltd.**

DEPT. 38, INTERNATIONAL BUILDINGS, KINGSWAY, LONDON, W.6.2

Please explain fully about your instruction in the subject marked X

Complete Radio Engineering      Radio Service Engineering  
Elementary Radio

And the following Radio Examinations:—

British Institution of Radio Engineers  
P.M.G. Certificates for Wireless Operators  
City and Guilds Telecommunications  
Wireless Operators and Wireless Mechanics, R.A.F.

Name .....

Age .....

Address: .....



**5 mmf/ft**

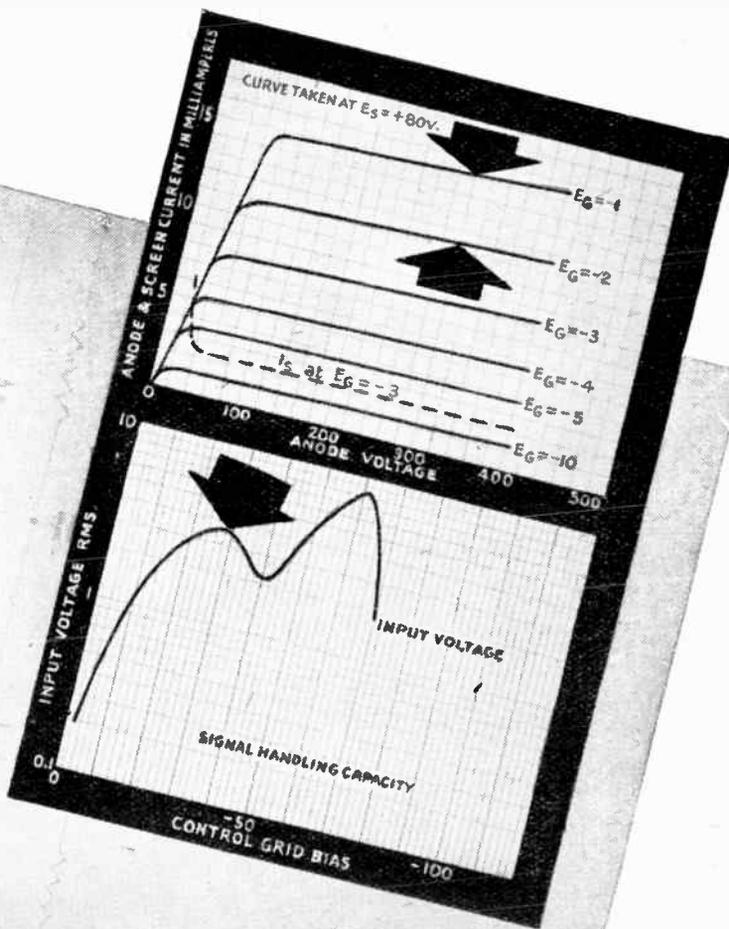
NEW LOW LEVELS in capacity and attenuation of CO-AX Cables mean new possibilities in electronic equipment design both for the war effort and for the post-war electronic age.

Write for characteristics

**BASICALLY BETTER  
AIR-SPACED**

**CO-AX LOW LOSS CABLES**

**TRANSRADIO LTD 16 THE HIGHWAY BEACONSFIELD 4 BUCKS**



# POINTERS FOR DESIGNERS

## THE KTW61

A screened tetrode with suppressor plates and with variable-mu characteristics, the OSRAM KTW61 is specially suitable for use as an R.F. or I.F. amplifier in superhet receivers. Its outstanding features include:—

- ▶ High order of mutual conductance (2.9 mA/Volt) combined with low leakage capacitance (0.0025  $\mu\mu F$ ), which facilitates high stage gain.
- ▶ Negligible distortion with the maximum signal likely to be encountered in practice. Conditions of use — as an I.F. amplifier with screen dropping resistance, and in conjunction with OSRAM frequency changer X61M.
- ▶ Marked improvement in signal to noise ratio, particularly on the short waves, when used as an R.F. amplifier with fixed screen voltage.

A detailed technical data sheet is available on request.

**Osram**  
PHOTO CELLS

**S.E.C.**  
CATHODE RAY TUBES

**Osram**  
VALVES

# A NEW OSCILLOSCOPE



TYPE 1684B

## PRINCIPAL FEATURES

★ TUBE 3½ ins. diam. Blue or green screen.

★ SHIFTS. D.C. thus Instantaneous on both axes.

★ AMPLIFIERS X and Y amplifiers are similar. D.C. to 3 Mc/s 24 mV. r.m.s. per c.m. or D.C. to 1 Mc/s 8 mV. r.m.s. per c.m.

★ TIME BASE 0.2 c/s to 150 Kc/s. Variable through X amplifier 0.2 to 5 screen diameters. Single sweep available

The Oscilloscope Type 1684B has proved an invaluable instrument for applications ranging from Servo Development, where signal frequencies may be as low as 0.1 c/s, to Television Research. The Oscilloscope is equipped with high gain d.c. coupled amplifiers having a frequency response from d.c. to 3 Mc/s. These amplifiers will handle symmetrical and asymmetrical input. In general the instantaneous shifts, semi-automatic synch, steadiness of image and general ease of operation are features which appeal to all engineers.

Price £100

**FHL FURZEHILL LABORATORIES LTD**  
 TELEPHONE BOREHAM WOOD  
 ELSTREE HERTS  
 1137

# SPHERE INSTRUMENTS



## Introducing the ALL WAVE SIGNAL GENERATOR TYPE 505

A portable Signal Generator for A.C. Mains operation. Specially developed by SPHERE as a high class instrument, for general Laboratory and Workshop use, it is the ideal instrument for the aligning and testing of radio receivers and amplifiers.

This is a specially designed Generator embodying several new and unique features and improvements, which radio engineers will find invaluable.

All "SPHERE" Test-instruments are entirely British made with highest quality materials and workmanship and carry a SIX Months' guarantee.

- Continuous Frequency coverage from 110 Kilocycles to 56 Megacycles, in six bands.
- Exclusive "SPHERE" "SEE AT A GLANCE" Band and Attenuator indicators.
- Built in ladder attenuator, with fine control, giving 1 Volt maximum, in five steps, in multiples of 10 Microvolts.
- Radio and Audio Frequency Voltages can be switched via single Test-lead.

- Variable control of 400 C.P.S. audio, from 0 to 1 Volt.

FOR RADIO SERVICE, RADIO ENGINEERING AND LABORATORY USE.

Write for List No. 505 S.G.

## SPHERE RADIO LIMITED

Radio Instrument Manufacturers

HEATH LANE, WEST BROMWICH

Here at last!  
**A REAL GEM**

## KILLICK'S Sapphox REPRODUCING INSTRUMENT

PRO. PATENT NO. 20214/45



Gives high fidelity Reproduction and is guaranteed through Laboratory Tests to play 2,000 Records before needing replacement.

This scientifically designed Patent Sapphox Instrument cannot touch the bottom of the groove, thus leaving it undamaged.

**KILLICK & COMPANY, 118 FLEET STREET, E.C.4**

Telephone: CENTRAL 3807

Manufacturers of Scientific Recording Instruments, Amplifiers, Radiograms, Cutting Stylus, Discs, Playback Sapphires, etc.



# LONDON CENTRAL RADIO STORES

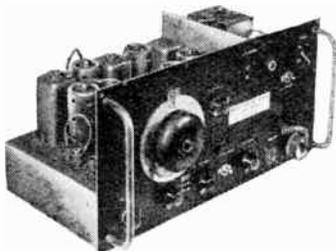
## Special Offer of Ex-Govt. Receivers, etc.

**Type R103 Mk. 2.**  
**7-VALVE SHORT-WAVE RECEIVER**  
Range 1.7—7.5 megacycles.



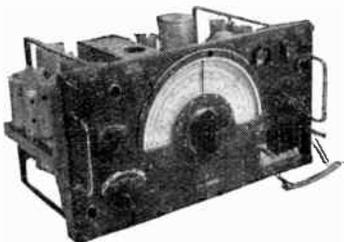
These receivers were originally designed for use in cars and can be converted into car radios. I.F.s 465 Kc/s. No power pack. In black metal cabinet 12 x 7 x 7in. Complete with Valves ..... **£7.0.0**

**Type R103A**  
**7-VALVE SHORT-WAVE RECEIVER**  
Range 1.7—7.5 megacycles



A.C. Mains or Battery operated. Valves 6C5G, 6Q7G, 6K7G(2), 6K80, ARP30 and 0Z4. In metal Cabinet ..... **£10.0.0**

**Type R1155**  
**10-VALVE COMMUNICATION RECEIVER**



These sets are equal to new, need only a power pack for immediate use (see "W.W." July, 1946). Freq. range, 7.5 mcs. or 1,500 kc/s., complete with 10 valves, including magic eye. Enclosed in strong metal box. **£17.10.0**  
Each receiver is aerial tested. ....  
Carriage and packing 7/6 extra. No G.O.D.

**POWER PACK 220-250 v. A.C. for above is available to CALLERS ONLY.**

**OSCILLATOR UNITS. Type 217.**

These units contain very useful components: two EF50 Valves, three P.O. type Relays, numerous Condensers including two 25v 25mf.d. Electrolytics, Resistors Potentiometers etc. Bargain price ..... **£1.12.6**

**RADAR VIEWING UNITS**

Consisting of 6in. diameter Electrostatic C.R. tube, 7 valves including four EF50, potentiometers, resistances and other associated components. In metal cabinet 18 x 8 x 7 1/2in. Bargain price ..... **£3.7.6**

**Type R1147B**  
**7-VALVE U.H.F. RECEIVER**  
Range approx. 200 megacycles



**A Real Opportunity!**

Beautifully constructed and fitted with micro-condenser drive. Valve type two EF50, two EF35, one each EBC33, RL7, RL16. In black metal case 8 x 7 x 6in. Set, complete with valves ..... **£2.7.6**

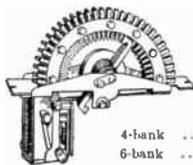
**SMALL BRUSH TYPE ELECTRIC MOTORS.**

24 volt size 2 1/2in. diam., 5in. overall length. Spindle 1/4in. diam. NEW ..... **19/6**

**Super Quality Heavy Duty TWIN-ELEMENT SLIDING RESISTANCES**

5.4 ohm at 20 amp. ....	47/6
12 ohm at 10 amp. ....	39/6
70 ohm at 5 amp. ....	35/-
Single Element 14 ohm at 5 amp. ....	13/6

**TELEPHONE LINE or UNISELECTOR SWITCHES**



4- or 6-bank, 26 constants. Have various applications including automatic tuning, circuit selection, etc. Operates on 25-50v.

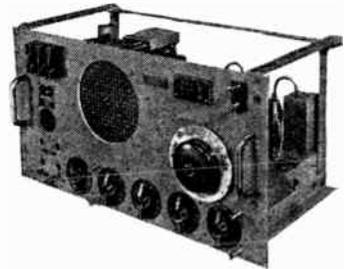
4-bank .....	28/6
6-bank .....	30/-

**The items advertised in May issue are still available.**

**Closed Thursday 1 p.m. Open all day Saturday.**

**Type R208**

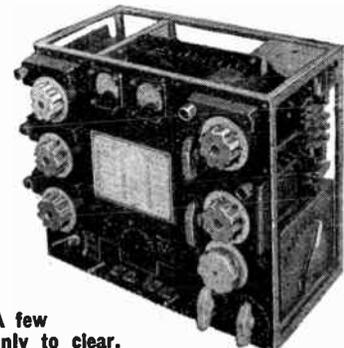
**6-VALVE SHORT-WAVE RECEIVER**  
Precision-built Communication Type  
Range 10—60 megacycles



Suitable for AC 100-250 v. or 6-v. battery operation. Meta rectifiers, B.F.O., Built-in Speaker, Super Slow motion dial. Provision for phones etc. A real super job in grey metal cabinet. Complete with Valves and Vibrator ready to use ..... **£18.0.0**

**Type 1145**

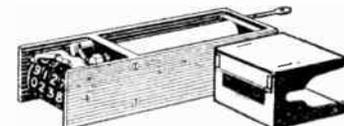
**AIRBORNE G.P. TRANSMITTERS**



**A few only to clear.**

Complete with 4 valves. Frequency coverage: 500 kc/s, 200 kc/s, 10 mc/s, 3 mc/s, 2.35 mc/s, 8 mc/s, 2.5 mc/s. Power input 1,200 v., 200 m/a. H.T. 6 v. 4 amp. L.T. Chassis size, 15in. x 13 in. x 8 1/2in. In metal cabinet. Supplied in strong wood case, with metal bonded covers and carrying handles, easily adapted for Amateur use. Less Power Pack ..... **£5.17.6**

**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., many industrial and domestic applications **5/6**

## LONDON CENTRAL RADIO STORES, 23, LISLE ST. (GERrard 2969) LONDON, W.C.2



SERIES 100  
MULTI-RANGE  
TEST SET by

**PULLIN**

A Service Engineers' Universal Testing Set with a sensitivity of 10,000 Ohms per Volt. The Instrument is housed in a strong metal case with carrying handle, and is complete with one pair of leads having detachable bull-dog clips and test prods.

- Ranges : AC/DC Volts : 10, 25, 100, 250, 500, 1000  
 D.C. Milliamps : 2.5, 10, 25, 100, 500.  
 AC/DC Microamps : 100 Microamps on the 10V range.  
 Resistance ranges : 0-1 Meg. (13,500 Ohms mid scale). 0/10,000 Ohms (135 Ohms mid scale).
- Frequency Range : 15 to 20,000 Cycles per second.
- Accuracy : 3% on D.C. Ranges.  
 4% on A.C. Ranges (for sinusoidal waveforms).  
 5% on Resistance Ranges (Compensated for normal variation of cell voltage).
- Size : 9" x 5 1/2" x 4".
- Terminals : Socket head type.



Address all enquiries to Dept. J, Electrin Works, Winchester Street, Acton, London, W.3. Telephone : Acorn 4651-4



**BIRMINGHAM SOUND REPRODUCERS LTD**

CLAREMONT WORKS, OLD HILL, STAFFS. TEL: CRADLEY HEATH 6212/3

LONDON OFFICE: 115 GOWER STREET, W.C.1. TEL: EUSTON 7515

M-W 88



113, CHARING CROSS ROAD, LONDON, W.C.2



MAKE SURE YOU USE

**"IVALEK"**

Matched T.R.F. dual range coils  
WHEN SET BUILDING

200-550 metres. 1,000-2,000 metres

A fine precision job. PRICE 9/- per pair.

Sent Post Free. Complete with circuit, components for which can also be supplied.

Write for particulars of full range of Radio, Television, Electronic, Electrical Instruments and components. M. ALLEN (Radio) Ltd., 113, Charing Cross Rd., London, W.C.2. Tel. : Gerrard 8734.

**THE  
COSSOR  
HIGH VACUUM  
DOUBLE BEAM  
OSCILLOGRAPH**

*giving*

VISUAL TWO - DIMENSIONAL  
delineation of any recurrent law.

●  
RELATIVE TIMING OF EVENTS  
and other comparative measurements  
with extreme accuracy.

●  
PHOTOGRAPHIC RECORDING  
of transient phenomena

*and*

SIMULTANEOUS INDICATION  
of two variables on a common time axis.

Completely embracing all the above  
functions, of which the last is unique,  
the Cossor Double Beam Oscillograph  
is inherently applicable to all prob-  
lems arising in

RECORDING, INDICATING & MONITORING  
when the effects examined can be  
made available as a voltage.

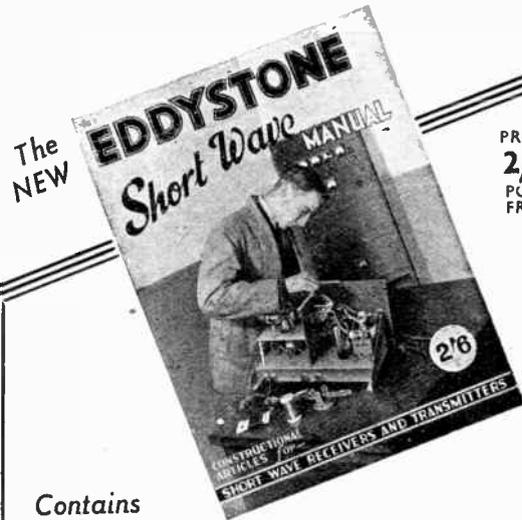
**A. C. COSSOR LTD.,  
INSTRUMENT DEPT.,  
HIGHBURY, LONDON, N.5**

Phone: CA Nonbury 1234 (30 lines)  
Grams: Amplifiers, Phone, London



**WEBB'S**  
*Radio*

Of interest to  
**ALL experimenters...**



PRICE  
**2/6**  
POST  
FREE

Contains  
Articles on:

**BAND-SPREAD ALL-DRY RECEIVER  
V.H. FREQUENCY METER**

★ **FIVE & TEN METRE CONVERTER  
TWO VALVE PRE-SELECTOR**

**FIVE & TEN METRE TRANSMITTERS, etc.**

★ The really efficient 5 & 10 metre Converter  
described therein is available ready-built at  
WEBB'S. Uses new valves EF54-RL7, EC52-  
RL16, EF50. Price .. £13 : 10 : 11.

All  
EDDYSTONE Components  
are available from

**WEBB'S RADIO**

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

Phone: GERard 2089.

Shop hours: 9 a.m.—5.30 p.m. Sats. 9 a.m.—1 p.m.



THE S. S. WHITE COMPANY, BRITANNIA WORKS  
 ST. PANCRAS WAY · CAMDEN TOWN LONDON N.W.1.  
 Cable Address: WHICODENTA, WESDO, PHONE, LONDON  
 Telephone: EUSTON 4758-4759

Robert Sharp & Partners

WT 35

**LABGEAR**

**LOW CAPACITY VALVE VOLTMETER**

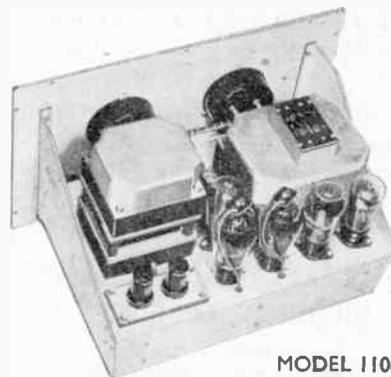


- Three ranges—0-1 volt, 0-5 volts, 0-50 volts.
- Input capacity 5.4pf (average)
- Input impedance—at 4.5 Mc/s >5 Megohms. At 75 Mc/s 80,000 ohms.
- Acorn valve probe unit.
- Stabilised power supply unit.
- Full meter protection provided.
- Negligible zero drift.
- Reasonably priced.

'Phone: 2494 (8 lines) *Labgear* 'Grams: Labgear, Cambridge

**WILLOW PLACE, CAMBRIDGE, ENGLAND**

**ALL-POWER**  
 Constant Voltage Power Supplies



MODEL 1108-S  
 One of our low-priced industrial units.

LET ELECTRONIC STABILIZATION SOLVE YOUR POWER SUPPLY PROBLEMS

**ALL-POWER TRANSFORMERS LTD.**

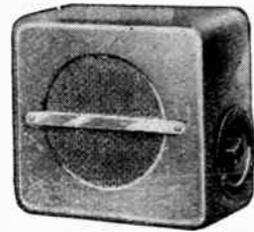
8a Gladstone Rd., Wimbledon, S.W.19

Telephone: LIBerty 3303

# Wharfedale Tyny

## Extension Speaker

*The little speaker  
with the big voice*



7½" x 7" x 3½"

Fitted with "TRUQUAL" Volume Control and sensitive 5" Unit. Finished in Cream and Chromium. Ideal for Kitchen or Bedroom.

**PRICE 50/-** (Without Transformer)

Supplies  
are being  
sent to  
usual Factors  
as available

Made and Guaranteed by

**WHARFEDALE WIRELESS WORKS**

BRADFORD ROAD - IDLE - BRADFORD

Telephone : IDLE 461 - Telegrams : Wharfedel, Idle, Bradford

## A WITCH DOCTOR MIGHT AS WELL TRY

A witch doctor might just as well try to find certain faults in a defective wireless set as a skilled engineer without a good test instrument. A Weston Model E772 Analyser will help you to find radio faults in the easiest and quickest way. This instrument will save you time, trouble and money, and you will find it universally useful for a wide range of measurements. Features of the instrument are high sensitivity—20,000 ohms per volt on all D.C. ranges—simplified controls, robust construction, accuracy and dependability.



ANALYSE SYSTEMATICALLY WITH A

# WESTON

SANGAMO WESTON LTD. ENFIELD, MIDDX.

Telephone: Enfield 3434 & 1242

A WIDE RANGE OF  
**OKERIN**  
WAX DI-ELECTRICS

—created in our own laboratories and manufactured in our own works—supplies almost every requirement of Electrical Industry. Grades have been designed for operation under the most severe and varied conditions, and many are resistant to mould and fungus growth.



Special types are evolved as new demands arise, and technical discussion on manufacturers' problems is welcomed.

Telephone : Temple Bar 5927

**ASTOR BOISSELER  
& LAWRENCE LTD.**

Sales Dept. : Norfolk House,  
Norfolk Street, London, W.C.2

**M. R. SUPPLIES Ltd.**

make the following special offers of PUBLIC ADDRESS and ELECTRICAL material, etc., all brand new, for immediate delivery from stock.

**PUBLIC ADDRESS SPEAKERS.** Exceptional offer of the very efficient **Beal Reflected Horn Projector Speakers**, with 10-watt P.M. M/Coil Unit, 15-ohms Imp. Flare only 12in. long and 14in. diameter. On swivel bracket with wheel-bolts for clamping at any angle. Completely storm-proof and ideal for all outdoor and mobile P.A. The perfect unit for roof of car or van. With long weather-proof lead, brand new, £5/17/6 (desp. 5/-). **NOTE:** In conjunction with Current-fed Microphone (details on request) these make first class Loud Hailer for small craft, etc., no amplifier being required. Other P.A. SPEAKERS in stock : Vitavox 10-watt P.M. M/Coil Proj. Unit on 30in. all-metal square Proj. Horn, £9/10/0 ; on 42in. all-metal Expon. Horn, £11/5/0 (desp. either 5/-). **G.E.C. Omni-diffusion Speakers**, the popular radial type with octagonal flare 21in. diameter, handling 12-watt at good quality. Fitted multi-match line transformer. Ideal for dance-halls, public rooms, factories, etc., (Listed £14) A few brand new at only £8/8/0 (despatch 5/-). **Speaker Cabinets**, strongly constructed in wood, sprayed brown, with top compartment for leads, Front 17in. square, depth 6in., diameter of opening 8½in., fitted spring-loaded handle, 32/6 (desp. 2/-).

**MEASURING INSTRUMENTS**, some special fully-guaranteed types : Milliammeters, M/Coil 0/1 m.a. 2½in. in desk mount with top terminals, res. 100 ohms, Weston 3½in. Milliammeters, m/coil 0/1 m.a. with blank scale for individual calibration, flush panel mount, 57/6. Pocket type Voltmeters, m/coil, 0/15 and 0/250 v. on each, with test prods, dia. 2½in., 345 ohms/volt, 27/6, with webbing carrier. Weston Thermo-couple Ammeters for high and low frequency currents, 0/4 amps, in 3½in. by 2½in. housing with circuit and shunting switches, 27/6. High-voltage Meters (BPL) each reading 3,000 and 10,000 volts, with lead, clips and polarity reversing switch, in desk mount, 6in. high, £9/7/6 ; (m/coil-1000 ohms/volt) BPL Fluorescent Tube Testers with light cell, calibrated "Bad-Fair-Good," indispensable for checking large installations, £9/7/6. Evershed "Wee-Megger," the robust, portable Insulation Tester, 500-volt, 0/20 megohms and infinity, with hand and log books, £11.

**RECTIFIERS (S.T.C.-Selenium) EHT types**, tubular, 1000 v., 4 m.a., 15/6 ; 2000 v., 4 m.a., 25/- ; 1000 v., 10 m.a., 47/6. New Midget instrument types, 2 m.a., and 5 m.a., either, 10/- ; Battery Charging types, all for charging up to 12 v., 1.5 amp., 12/6 (a), 4 amps 22/6 (b), 6/8 amps, 35/6 (c), 10/12 amps, 45/6 (d). The letters refer to the associated Mains Transformers, all with tapped prim., £00/220/240 v., (a) 7, 11 and 15 v. at 2 amps, 22/- ; (b) 6, 8 and 14 v. at 4 amps, 32/6 ; (c) 6, 12 and 17 v. at 6 amps, 51/6 ; (d) 7, 8 and 16 v. at 12 amps, 77/6 (des. P. Train, 2/6). **Steel Cases**, suitable for housing the 4-amp Rectifier and Transformer, etc., 10½in. by 6½in. by 5½in., 7/6.

**H.V. CONDENSERS**, (Ex-Govt., brand new). 1.5 mfd., 4000 v. D.C. working, with insulated terminals, 12/6.

**MINIATURE COMMUNICATIONS RECEIVERS**, (M.C.R.1), 5-valve superhet, in metal case, 9in. by 3in. A.C.D.C. Power Pack in same size case, two HT/LT Batteries (one spare), phones, serial, etc., complete, £10 (des. 4/6).

**EXTRACTOR FANS** (Vent-Axia), New, maker-guaranteed, again in stock for immediate delivery. The "Silent 6," 6 in. impeller, 26/6/0 ; "Silent 9," 9-inch impeller, £11/4/0 ; both for 200/260 v. A.C., complete assembly with outside cowling, ready for easy fixing.

For Callers Only : Ex-Govt. Signal Generators, USW, by Marconi Instruments, range 3/150 Mc/s, 230 v. A.C. operated, fine condition, perfect, £32/10/0. Class D. Wave meters, £5/17/6.

All prices nett. Please include sufficient for packing and despatch.

**M. R. SUPPLIES Ltd., 68, New Oxford Street, London, W.C.1.**

Telephone : MUSEum 2958

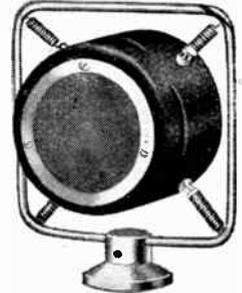
**CLARITY**



**PERSONIFIED**

WITH THIS SENSITIVE  
GRAMPIAN MIKE

The Grampian M.C.R. Type Microphone reproduces voices with that crystal clearness which gives full value to every word and accentuates the "personality" of the speaker. Those who still have "make do" microphones on their P. A. Systems should take advantage of this up-to-date, highly sensitive model which Grampian are now in a position to supply. The M.C.R. is mounted in a spring suspension frame with the Unit Assembly housed in cast metal case. In crinkled black and nickel standard finish. Write for details now.



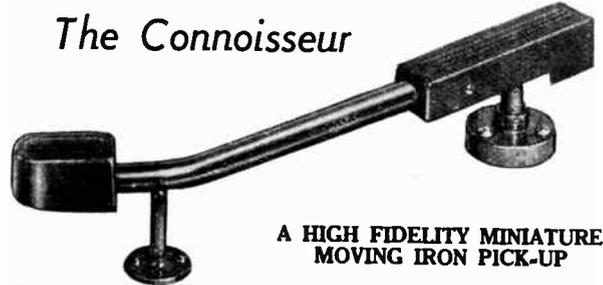
Type M. C. R. Frequency Range 80-7,500 cycles. Sensitivity Minus 45 d.b. Impedance 20 ohms. Size 2½ ins. by 3½ ins. frame, 6 ins square with Base Adaptor threaded ½ ins. B.S.F. weight ¾ lbs. List £5-0-0

**GRAMPIAN**  
LOUDSPEAKERS

GRAMPIAN REPRODUCERS LTD. Hanworth Trading Estate, Feltham,  
Phone : Feltham 2657 Telegrams : Reamp, Feltham. Middlesex

Scientific G12

*The Connoisseur*



**A HIGH FIDELITY MINIATURE  
MOVING IRON PICK-UP**

Faithful reproduction of all recordings from 12,000 c.p.s. to 30 c.p.s. will win many new friends for the CONNOISSEUR miniature moving iron Pick-up in 1947.

The CONNOISSEUR reveals a wide range of notes and instruments that has hitherto been hidden by bass and treble resonance. The CONNOISSEUR will reproduce every sound on the record. Try it and prove it.

Note new prices. Pick-up 54/- plus 11/8½ P. tax  
Transformer 13/- nett

Apply to

Albion Electric Stores, 125, Albion Street, Leeds 1

or to

Lawton Bros. (Sales) Ltd., Henry Square, Ashton-under-Lyne

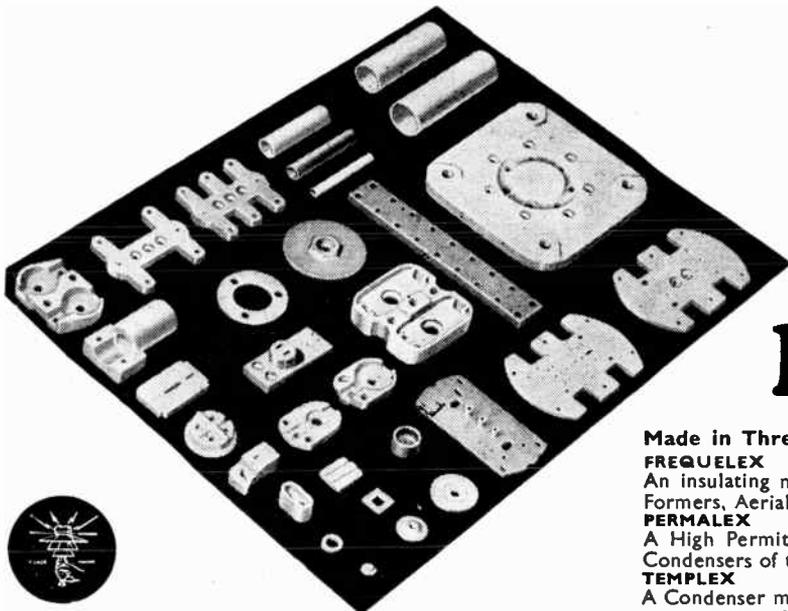
Made by

A. R. SUGDEN & Co, (Engineers) Ltd., Brighouse, Yorks

# INTRICATE PARTS

but not too intricate for

# Bullers



**BULLERS LOW LOSS CERAMICS**

Made in Three Principal Materials

**FREQUELEX**

An insulating material of Low Di-electric Loss, for Coil Formers, Aerial Insulators, Valve Holders, etc.

**PERMALEX**

A High Permittivity Material. For the construction of Condensers of the smallest possible dimensions.

**TEMPLEX**

A Condenser material of medium permittivity. For the construction of Condensers having a constant capacity at all temperatures.

**BULLERS LTD.**, 6, Laurence Pountney Hill, London, E.C.4

Phone : Mansion House 9971 (3 lines)

Telegrams : "Bullers, Cannon, London"



**MODEL 120A TAYLOR JUNIOR**

Now reduced to £7 10s., this sturdy accurate pocket size instrument is of real interest to the Radio Engineer. Only 4 7/8" x 3 1/2" x 1.15/16" deep, the pocket size Universal Taylormeter has 21 ranges controlled by one switch covering all A.C. and D.C. Voltages and Currents normally found in Radio and Television. The Resistance ranges cover from 0.5 to 200,000 ohms with internal battery and up to 20 megohms with external battery. The sensitivity on all A.C. and D.C. Volt ranges is 1,000 ohms per volt.

For further particulars please write for leaflet. Now available for immediate delivery.

made to **MEASURE** —

**Верста**

Verst to you—  
is the Russian mile,  
(3,500 English Feet.)



In the land of the droshky and the troika, they measure their vodka by the tcharkas and their caviare in poods, but when it comes to electrical measurements, Russians rely on the international volt, ampere, and ohm. Even the most intransigent national could not help respecting the accuracy associated with every electrical measuring instrument that is

— **TAYLOR** made

Full particulars of Taylor Instruments and Meters from your usual Factors or direct from:

**TAYLOR ELECTRICAL INSTRUMENTS LTD.**

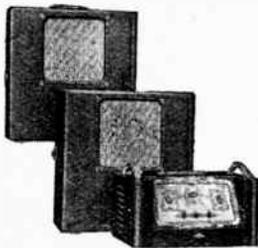
419-424 Montrose Avenue, SLOUGH, BUCKS.

Phones: Slough 21381 (4 lines)

# from WHISPERING to SHOUTING . . . .

## The R.S. TYPE 12 ABLY AND FAITHFULLY REPRODUCES

... what do you care whether he whispers with nervousness, or shouts with excitement into your Microphone, when you know that your R.S. Amplifier Type 12 will ably and faithfully 'put over' even the squeak of the mouse or the trumpet of the elephant, without loss of timbre or intonation. No more fearful moments for you with 'mike-unconscious' people or music which will 'blare'... the R.S. Type 12 takes care of all that. This amplifier is only a part of the R.S. completely new series of advanced Sound Equipment which you should know about... write to-day for full information.



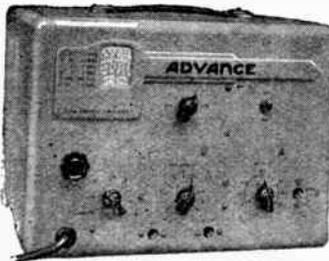
MICROPHONES RADIOGRAMS  
RADIO LOUDSPEAKERS  
AMPLIFIERS  
PORTABLE EQUIPMENT

R.S. Amplifiers Ltd., Reynolds Road, Acton Lane, London, W.4.  
Telephone: CHISWICK 1011-3

## "Laboratory" INSTRUMENT... but NOT "Laboratory" Price!

The newest addition to the "Advance" range of Signal Generators places an instrument of laboratory class within the financial scope of every radio service engineer and experimenter.

The discerning engineer will appreciate its accuracy and stability, its exceptionally wide range which covers all frequencies required for radio and television receivers, and its accurate attenuating system which enables sensitivity measurements to be made on highly sensitive receivers up to 60 Mc/s. Send for fully descriptive pamphlet.



Price 19 Gns

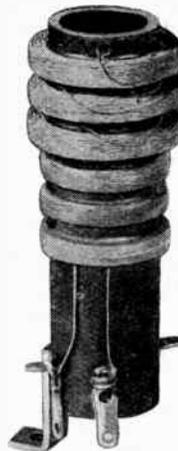
Range: 100 Kc/s—60 Mc/s on fundamentals (up to 120 Mc/s on Second Harmonic).  
Accuracy: Guaranteed within  $\pm 1\%$ .  
Attenuation: Constant impedance system embodying a matched 75 ohms transmission line.  
Stray Field: Less than 3 microvolts at 60 mc. cycles.  
Illuminated Dial:  
Total scale length 30".  
Power Supply: 110-210-230-250 volts.  
Dimensions: 13" x 10 1/2" x 7 1/2" deep.  
Weight: 15 lbs.

The New

# Advance TYPE E Signal Generator

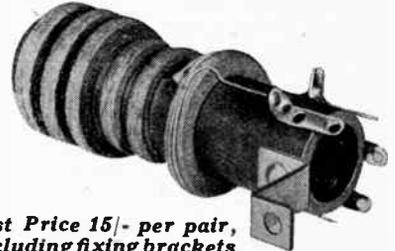
ADVANCE COMPONENTS, LTD., Back Road, Sthernhall Street, Walthamstow, London, E.17. Telephone: LARKSWOOD 4366, 7

# RM



## HIGH PEAK PRIMARY COILS, Q100.

### TYPE T.R.F. 34/35.



List Price 15/- per pair, including fixing brackets

Designed specially for midget T.R.F. receivers. They are small in physical size yet have High Q.

**R. M. ELECTRIC LTD.**  
**TEAM VALLEY, GATESHEAD. 11.**



Manufacturers  
of  
LOUDSPEAKERS  
•  
LAMINATIONS  
•  
SCREENS  
In  
RADIOMETAL  
•  
PERMALLOY  
•  
SILICONALLOYS

**ELECTRICAL SOUND & TELEVISION PATENTS LTD.**  
12, Pembroke Street, London, N.1. Terminus 4355  
2/4, Manor Way, Boreham Wood, Herts Elstree 2138

# TELCON RADIO FREQUENCY CABLES

ARE SPECIFIED IN

## Decca Navigator

TRANSMITTER & RECEIVER INSTALLATIONS



TELCON R.F. CABLES have been used for land, sea and air installations of DECCA Navigator Equipment. The range of Telcon Cables available has successfully met all Decca requirements which have ranged from trunk feeders for transmitter control circuits to flexible cables for receivers. For unfailing service under all conditions you can confidently specify R.F. Cables by Telcon. Full details on request.



**THE TELEGRAPH CONSTRUCTION & MAINTENANCE CO. LTD.**

Founded 1864

Head Office: 22 OLD BROAD ST., LONDON, E.C.2

Telephone: LONDON Wall 3141

Enquiries to: TELCON WORKS, GREENWICH, S.E.10

Telephone: Greenwich 1040



*The* **PIFCO**  
ALL-IN-ONE  
**RADIOMETER**

*tests everything electrical*  
**RADIO, HOUSEHOLD APPLIANCES  
& MOTOR CAR LIGHTING ETC!**

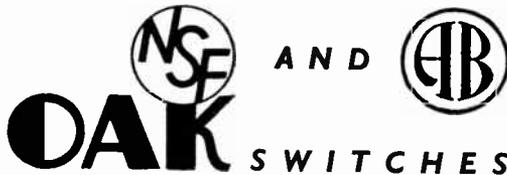
**25/-**

Ask your local Factor to show you one of these remarkable instruments and to put your name down on his waiting list.

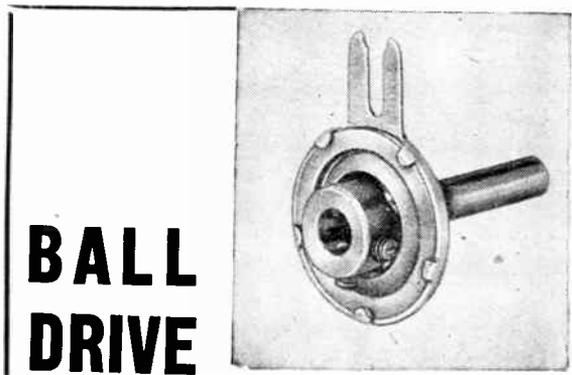
*Which Switch  
is the right switch?*

... is it Rotary or Pushbutton or Slider? Is it wanted for circuit selection, band selection, tap switching? Is it for a new design or in quantities for a well proved circuit?

Whatever it is—the answer is always OAK! The basic design of all Oak switches is one of strength and efficient functioning, including such exclusive features as the double-contact clip and the floating rotor, ensuring self-alignment of each section.



**BRITISH N.S.F. CO. LTD.**, Keighley, Yorkshire  
(Sole Licensees of OAK Manufacturing Co., Chicago)  
**A.B. METAL PRODUCTS LTD.**, Feltham, Middx.  
(Sub-Licensees of N.S.F.)  
The only Manufacturers of OAK Switches under Patent Nos. 478391 & 478392



**BALL  
DRIVE**

- SMOOTH, RELIABLE & VERY POWERFUL
- Epicyclic friction drive, ratio 6 : 1
- May be used to increase ratios on other drives or attached direct to component spindle ( $\frac{1}{4}$ " shaft).

PRICE 3/3 RETAIL



**JACKSON**  
**BROS (LONDON) LIMITED**  
KINGSWAY · WADDON · SURREY  
TELEPHONE: CROYDON 2754-5  
TELEGRAMS: WALFILCO, PHONE, LONDON

**RECEIVERS, CONVERTERS, AMPLIFIERS, ETC.**

- TYPE R1147/A 2-METRE BK** (easily converted to 5 metres by changing coils) VR138 (RL7) Mixer, VR137 (RL16) Oscillator 2—VR91 (EF50) I.F. s (25 Mc/s) 2—VR55 (EF35) 2nd Det. and L.F. Amp. VR65 (EBC33) B.F.O. 7" x 8" x 6". All aluminium case with top and bottom hinged. 80-1 Slow Motion Drive. Only require 6 v. L.T. and 200/250 H.T. for immediate use. A magnificent Receiver, worth £25 ..... **£6 0 0**
- TYPE R1147B** ditto, but 955 and 954 "Acorns" in R.F. and L.F. stages ... **£6 0 0**  
5/- Extra for transit case (necessary for post orders).
- ROTARY CONVERTERS.** Double Output type, 300 v. 70 mA and 12 v. 2 a. 19 v. input ..... **£1 0 0**
- 9 v. INPUT** 450 v. 50 mA output. Will run on 12 v. input and deliver 400 v. 80/100 mA. For intermittent amateur use. Post free ..... **10 0**
- A1368 2-VALVE MIC. AMPLIFIERS** for use with 1154 and TR9 Tx. VR21 (210 LF) and VR35 (PD220) Q.P.P. output. Brand new and contain 4 transformers. Can also be used as 2-stage amplifier for any-purpose .... **£1 5 0**
- VALVEHOLDERS.** International Octal Amphenol type with metal fixing plate, 6d.; 4-pin English ditto, 6d.; large 7-pin U.X. ditto (for 6A6, RK34, etc.), 9d.; 9-pin English pasolin (for EF50, etc.), 9d.
- SWITCHES.** Double pole 6-way. Ideal meter or multi-band switches, 2/6; three-pole 3 way 2 wafer, 3/6; single pole 6 way 3 wafer assembly, 3/6; 3 wafer assembly, 1 wafer double pole 4 way, 3/6; 2 wafer single pole 4 way 3/6.
- THERMO AMMETERS.** Brand new 2" square cased, .5 amps., 10/6; 2" round cased flush 350 mA, 10/6; 2" round cased 2.5 amps., 15/-.
- 3" 0.1 mA METERS** scaled 0-10 volts. At present connected for A.C. (with internal rectifier). In polished wood case with recessed lid. Case 5" x 6 1/2" x 5" Ideal for making into test sets ..... **£2 10 0**
- L.F. CHOKES.** High inductance 2 winding L.F. Choke. D.C. resistance, 1,500 ohms each half. Inductance at full load of 10 mA 200 henries approx. .... **10 6**

**Q.C.C. and SALFORD (G.E.C.) CRYSTALS.** Available in 1.7, 3.5 and 7 meg. band and 100 kcs. and 465 kcs. units stocked. Also S.T.C. 14 meg Crystals, 7 meg. and 14 meg. Suitable for 58 meg. band, included in above stocks.

**RADIOMART**  
GSMI (SHAMI) LTD.

**48 HOLLOWAY HEAD, BIRMINGHAM, 1**

**THE  
ROBERTS PORTABLE**



**VALVE & CIRCUIT ANALYSER**

- Tests Valves for Current, any Electrode, A.C & D.C. 11 Ranges 0—2.5 Amps.
- Tests Electrodes for Volts, any Electrode, A.C & D.C. 17 Ranges 0—1000 Volts.
- Checks Resistance any Electrode. Valve to Valve or Chassis. 3 Ranges 0—1 meg.
- Can be used as Universal Meter 2000 Ohms. per volt.
- Invaluable for testing A.C.—D.C Radio Receivers.

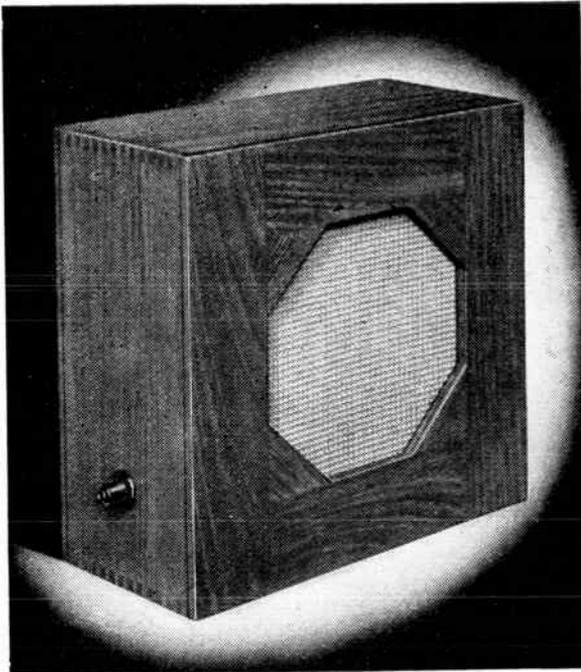
**NO NEED TO REMOVE CHASSIS  
FROM CABINET FOR TESTING**

Best materials and workmanship. Guaranteed for 12 months.  
Dimens.: 12 x 12 x 6 ins., weight 11 lbs. Manufactured by:—  
**LONDON SOUND LABORATORIES LTD.,**  
40, South Molton Lane, Bond Street, London, W.1.

Sole Distributors:



**WARTON RD., STRATFORD,  
LONDON — E.15**  
And all Branches.



Dimensions : 17 $\frac{1}{4}$ " x 17 $\frac{1}{4}$ " x 8 $\frac{3}{8}$ ". Unit : 12" P.M. Type T2/1205/15.  
 Nett Weight : 23 lbs. 12 ozs. Max. Power Input : 12-watts peak A.C.

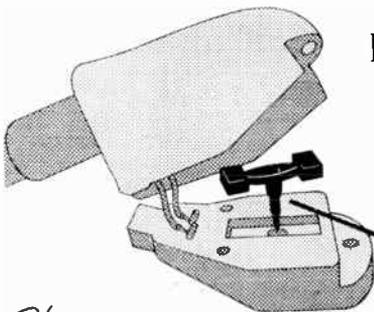
**GOODMANS**  
*Public Address*  
**CABINET LOUDSPEAKER**  
 TYPE AL/5

THIS well-known unit is now available again in a strongly made cabinet of natural polished seasoned mahogany, with locked corners, for use in halls, theatres and factories, and on all indoor installations where high power and fidelity are required. Rugged construction and excellent appearance render it ideal for permanent installations and for short term hire work involving constant handling. Portability and adequate bass response are noteworthy features. Nominally of 15-ohms impedance, a suitable line transformer can be fitted internally to present any required impedance at the socket connection.

FIDELITY  
  
 EFFICIENCY

**GOODMANS**  
*Loudspeakers*

GOODMANS INDUSTRIES, LTD.,  
 LANCELOT ROAD · WEMBLEY · MIDDX.



## DELICATE PRECISION BONDING *of* RUBBER to METAL

*The*  
**STYLUS UNIT** *of the*  
**NEW DECCA frr pick-up**  
*incorporated in the*  
**"DECOLA" de luxe**  
 ELECTRIC RECORD REPRODUCER

THIS is a particularly interesting example of the science of rubber-bonding to metal. It is the delicate STYLUS unit of the new Decca frr pick-up which is carried by two rubber parts, enabling the steel holder with its sapphire point to float and freely transmit to the amplifier of the Decola the full range of frequencies impressed on the record.

Rubber bonded to metal is the answer to a great variety of engineering problems. Have you one for us ?

*Have you a copy of the new "Short Review" ?*



**RUBBER BONDERS LIMITED**  
 ENGINEERS IN RUBBER BONDED TO METAL  
**FLEXILANT WORKS · DUNSTABLE · BEDS.**  
 TELEPHONE: DUNSTABLE 80345

Robert Sharp & Partners

RB.62

The **ROTHERMEL** Crystal  
SILENT PILLOW LOUDSPEAKER



ENJOY your own particular choice of programme without causing interference to others. This unique instrument can be used under a pillow or cushion, and the broadcast clearly heard while the room remains quiet. It can be used on existing installations, and eliminates the discomfort of wearing headphones over long periods—or when lying down. A beautifully finished product in black plastic

PRICE 42/-.

★ Now ready. A full range of ROTHERMEL Crystal and other products in loose leaf catalogue form. Obtainable on request. Price 6d.

**R. A. ROTHERMEL LTD.,**  
Rothermel House, Canterbury Road, Kilburn,  
London, N.W.6.

Telephone:  
Maida Vale  
6066.

Remember-



RADIO  
STAMPINGS

RADIO  
CHASSIS

RADIO  
PRESSINGS

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



When  
**SENSITIVITY**  
is  
**VITAL!**



Type "A"

Time and again lives have depended upon the sensitivity of a pair of Headphones.

The enthusiastic radio amateur, experimenter and serviceman using headphones of just average sensitivity should make sure that the next pair they purchase are of the utmost sensitivity as well as capable of giving true quality reproduction.

The famous S. G. Brown Type "A" Headphones give highest possible efficiency; this is attained by the Adjustable Reed Movement which replaces the usual flat diaphragm.

Your local dealer can supply  
**S. G. BROWN TYPE "A"**  
**HEADPHONES**  
Price 60/- per pair.

Details of all types of S. G. Brown headphones priced from 25/- to 105/- are given in Brochure "W.W." Free on request.

'Phone  
ACOrn  
5021

**S. G. Brown, Ltd.**

VICTORIA ROAD, NORTH ACTON, LONDON, W.3

**AERIALS**

**"EXSTAT"**  
SHORT-WAVE  
TELEVISION  
CAR RADIO

STOCKED BY ALL THE  
LEADING DEALERS

**ANTIFERRENCE**  
LIMITED

67, Bryanston St., Marble Arch, London, W.1

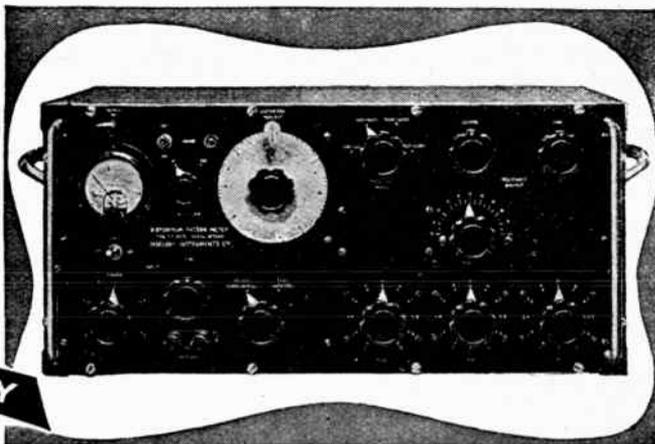
Telephone: Paddington 7253/4.

MARCONI INSTRUMENTS LTD

Masters of Measurement  
in Communications  
can now supply their

# DISTORTION FACTOR METER

TYPE TF 142E



**DELIVERY**  
**FOR IMMEDIATE**

Evolved for investigating distortion in AF amplifiers, the instrument directly measures the total harmonic content of voltage wave forms.

Meticulous workmanship ensures accuracy and trouble-free performance. Full specifications available on request.



## MARCONI INSTRUMENTS LTD

ST. ALBANS, HERTS. Telephone: St. Albans 43236

Northern Office: 30, ALBION STREET, HULL. Hull 16144

Western Office: 10, PORTVIEW ROAD, AVONMOUTH. Avonmouth 438.

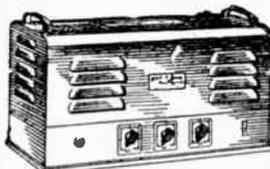
Southern Office: 109, EATON SQUARE, S.W.1. Sloane 8615



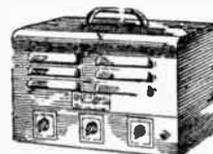
### THE GREEKS HAD A WORD FOR IT

but we prefer to call it "AUDIOSCOPE"

"Audioscope"—maybe we have invented a new word, but the meaning, when applied to WODEN AMPLIFIERS, is that their "audioscope" embraces not only perfected reproduction of any sound but such excellent amplification that it will reach the widest audience in hall or open space without the loss of the slightest undertone or the distortion of music's highest C. Designed for a long life of trouble-free service and built in the WODEN belief that Finest Materials + Expert Craftsmanship must = Quality. Now it's up to you to send us your name and address for further particulars . . . why not do so TO-DAY ?



**60 WATT "CLASSIC" AMPLIFIER**  
Mains supply 200-250 v. A.C. 50 cps. Transformer tapped at 0, 8, 15 and 200 ohms. Response 50-10,000 cycles  $\pm$  2 db. Undistorted output of 60 watts. Finished in Light Grey Stove Enamel and Chromium. Retail Price £47.10.0.



**20 WATT "JUNIOR" AMPLIFIER**  
Undistorted output of 20 watts. Transformer tapped at 0, 8 and 15 ohms. Flat from 50-10,000 cycles  $\pm$  1 db. Controls consist of Mic. and Gram. Feeders and Tone. Finished in Light Grey Stove Enamel and Chromium. Retail Price £27.10.0.

# WODEN AMPLIFIERS

BUILT FOR THOSE WHO KNOW

WODEN TRANSFORMER COMPANY LIMITED

MOXLEY ROAD, BILSTON, STAFFS.

TELEPHONE BILSTON 41959

**— PYROBIT —  
ELECTRIC SOLDERING IRONS**

FULL RANGE OF MODELS FOR  
VOLTAGES FROM 6—250 VOLTS.

DELIVERY  
FROM  
STOCK.



INSTRUMENT MODEL ILLUSTRATED  
OPERATES LIKE A PENCIL.

**THE ACRU ELECTRIC TOOL CO. LTD.,**  
123, HYDE ROAD, MANCHESTER, 12  
Tel. : ARD 4284

The result of long experience and precision watch-making standards which give a finely constructed instrument.

# Lexington

**MOVING COIL PICK-UPS**

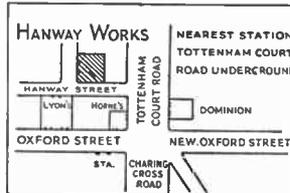
**DE LUXE MODEL.** Robust design. Accidental dropping on record will not damage Pick-up. Extremely low moment of inertia (80 milligrams total weight of movement). Pure sine wave with no harmonic distortion. Automatic needle or sapphire changing opens new fidelity field to the amateur. Can be used with normal record changer without fear of damage. Price (without sapphire) £5. 10. 0 plus 24/6 P.T.

**JUNIOR MODEL.** Identical in design and workmanship to the De Luxe, the only difference being that it is not equipped with the Automatic Sapphire needle inserter and Extractor device and metal sole plate. Made to take standard steel and fibre needles this model enables every music lover to enjoy the fine reproduction which only a moving coil pick-up can give. £3. 9. 3 plus 15/5 P.T.

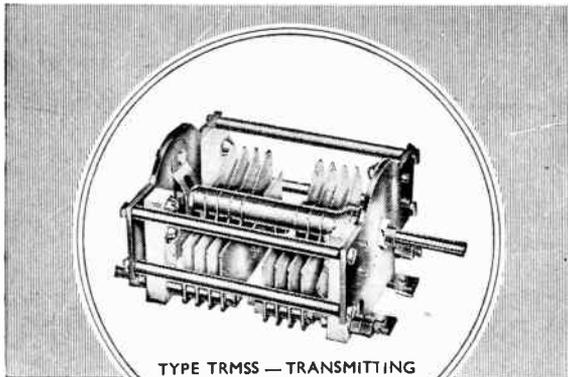
**PLUG-IN HEADS.** Available in both Junior and De Luxe types to fit Collaro and Garrard arms, thus providing easy change-over from Magnetic types. Input conversion may be required. (See our Technical Brochure.)

Price 49/6, plus 11/-P.T. Separate Ejector for De Luxe type 30/10 plus 6/10 P.T. **PRE-AMPLIFIERS** having an inverse of the recording characteristic incorporated are available for use with pick-ups. These are necessary with some amplifiers.

Price, Complete with Valve and Input Transformer £6. 1. 0  
**Illustrated Technical Brochure** upon request.  
Export and Trade Enquiries invited.



**COOPER**  
MANUFACTURING CO.  
HANWAY WORKS,  
HANWAY ST., LONDON, W.1  
Telephone : MUSeum 9779  
**SALES OFFICES—Top Floor**



*"Cyldon"*  
**TRANSMITTING Capacitors**

**SYDNEY S. BIRD & SONS, LTD.**  
CAMBRIDGE ARTERIAL ROAD, ENFIELD, MIDDX.  
Phone : Enfield 2071/2. "Grams : "Capacity, Enfield."

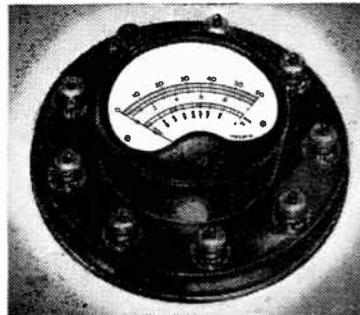


**EX-R.A.F.**

Transmitter receiver for short waves 20-40 metres. Provision for crystal control. Uses standard headphones and microphone. Battery operated, requiring standard 120 volts h.t. and 2 volts l.t. Includes 9 valves standard English types. Six valves in receiver and three in

transmitter. Circuit RX, 2r.f., det., 2 Audio and Power. TX Osc. P.A. and Modulator. **PAID . . . £6**

**THE STAMFORD RADIO CO.**  
199 Stamford Street, Ashton-u-Lyne, Lancs  
Telephone: ASHton 1964.



**SIFAM**  
RADIO SERVICING  
D.C. TEST SET  
Type RT.10.

- 12 D.C. Ranges
- No switches to go wrong.
- Long clear scales.
- Positive push-button selection.
- Accurate in any position.
- Made to stand heavy overload.
- 1,000 Ω per v.

22  
Years  
Specialised  
Experience

**RANGES :**  
100 MV. 2, 6, 120, 300 volts D.C. 1, 6,  
600 MA. 6 amperes D.C., 50 000 ohms,  
2,000 ohms at mid-scale.

**SIFAM ELECTRICAL  
INSTRUMENT CO. Ltd.**  
TORQUAY, DEVON.

## The Problem

The directional response characteristic of single unit loudspeakers is very pronounced at the higher audio frequencies which are audible only in a comparatively narrow channel directly in front of the reproducer with a corresponding lack of intelligibility and brilliance elsewhere.

This feature is particularly troublesome when high quality sound reproduction is required in public halls, theatres and small cinemas where the size and expense of a large dual channel loudspeaker system is often not justified.

## The Solution

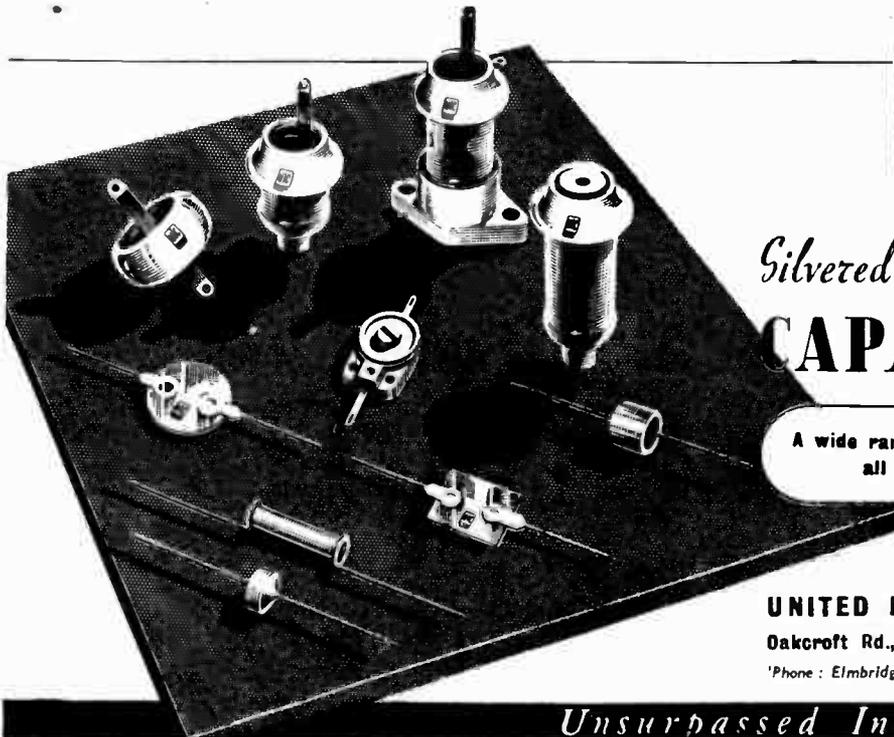
It is for such installations that the Vitavox Bitone Reproducer has been designed. High frequency reproduction in this instrument is handled by a small multicellular horn and moving coil pressure unit, this assembly providing adequate coverage and at the same time because of its high efficiency, a rising high note characteristic which is an advantage in auditorium reproduction. A 12" moving coil cone type loudspeaker operating in a vented enclosure reproduces low frequencies and a cross-over filter network is fitted to divide the frequency spectrum correctly between the two units. The whole assembly is mounted in a polished Walnut finished cabinet as standard, Oak and Mahogany veneered models being available to special order, and can be relied upon for applications where quality of performance rather than first cost is the main consideration.

### SPECIFICATION AND PRICES

Power Handling Capacity: Model 610—10 watts; Model 620—20 watts. Size: 32" x 21" x 20". Terminating Impedance: 7.5 ohms. Filler Attenuation: 12 d.b. per octave. H. F. Distribution (approx): 60° x 40°.

MODEL 610 — £42 0 0  
MODEL 620 — £50 0 0

VITAVOX LTD., WESTMORELAND ROAD, LONDON, N.W.9. TEL: COLINDALE 8671-3



# U.I.C.

*Silvered Mica & Ceramic*  
**CAPACITORS**

A wide range of types for  
all purposes

**UNITED INSULATOR CO. LTD.**

Oakcroft Rd., Tolworth, Surbiton, Surrey

Phone: Elmbridge 5241 Grams: Colanel, Surbiton

*Unsurpassed In Ceramics*



## THE STANDARD OF TECHNICAL EXCELLENCE QUALITY AND RELIABILITY

Dubilier Capacitors have been known and selected by Radio Engineers since the early days of radio. The development and extension of their range during the years has proceeded step by step with, and often in anticipation of, the progress of radio and electronics. The result is that today Dubilier Capacitors cover, with the highest degree of efficiency, the entire field in which Capacitors are used.

With the rapid growth of scientific knowledge during the past few years, important internal improvements have been effected in the Dubilier range of Capacitors. Many of these improvements are not always apparent until the Capacitors are actually in use, but their excellent performance gives final proof of the essential quality of these improvements.

MAKERS OF THE WORLD'S  
FINEST CAPACITORS

# DUBILIER

CONDENSER CO. (1925) LTD.

DUBILIER CONDENSER CO. (1925) LTD., DUCON WORKS, VICTORIA ROAD, NORTH ACTON, W.3  
Phone: Acorn 2241 Grams: Hivalton, Phone, London. Cables: Hivalton, London. Marconi International Code.

# Wireless World

Radio and Electronics

37th YEAR OF PUBLICATION

JUNE 1947

Proprietors:  
ILIFFE & SONS LTD.

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

Editor:  
H. F. SMITH

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

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

△  
PUBLISHED  
MONTHLY

Price: 1/6

(Publication date 26th  
of preceding month)

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

MONTHLY COMMENTARY .. .. .	195
PHYSICAL SOCIETY'S EXHIBITION .. .. .	196
DESIGNING AN F.M. RECEIVER—2 By Thomas Roddam .. .. .	203
TELEVISION E.H.T. SUPPLY. By W. T. Cocking	207
RECEIVER REMOTE CONTROL. By J. F. O. Vaughan .. .. .	212
COLONIAL BROADCASTING .. .. .	214
WORLD OF WIRELESS .. .. .	215
LETTERS TO THE EDITOR.. .. .	219
MODERN MARINE RADIO. By D. F. Bowers and E. F. Cranston .. .. .	221
CHANNELS OF COMMUNICATION. By "Cathode Ray" .. .. .	223
PROJECTION TELEVISION .. .. .	227
NEW RECEIVING VALVES .. .. .	228
UNBIASED. By Free Grid .. .. .	230
SHORT-WAVE RADIATIONS. By "Diallist" .. .. .	231
SHORT-WAVE CONDITIONS. By T. W. Benning- ton .. .. .	232
RECENT INVENTIONS .. .. .	234

Branch Offices:

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

BIRMINGHAM:  
King Edward House,  
New Street, 2.  
Telephone:  
Midland 7191 (7 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."

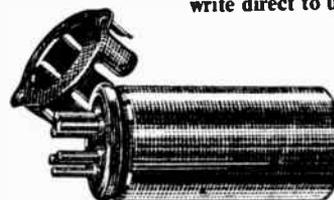
△

*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.*



## REPLACEMENT VIBRATORS FOR CAR RADIO

Send new life coursing through your car  
radio. Put a STRATOSIL Vibrator into circuit  
... it defies all climatic conditions  
and operates efficiently—anywhere.  
Your dealer can supply—in case of difficulty  
write direct to us





# VALVES AND THEIR APPLICATIONS

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

## No. 6: Mullard MERCURY VAPOUR RECTIFIER RG1-240A

**G**ENERALLY speaking, vacuum rectifiers are suitable for domestic receivers, and mercury-vapour for transmitters and high-power amplifiers. The dividing line is in the region of 100 watts; perhaps higher if the load is constant, or lower if it is variable.

The vacuum rectifier is simple and foolproof. But owing to its high resistance it is unduly large, expensive, and wasteful for high-power units. And output voltage varies considerably with current — i.e., it has bad regulation, as shown at A in Fig. 1.

The drop across the mercury rectifier is steady at about 15 V even when passing heavy current, so anode dissipation is slight and quite a small valve serves for d.c. of the kilowatt order. And, as shown at B, regulation is excellent over a wide range of current.

Although one of the suitable circuits (Fig. 2) is, except for the absence of reservoir condenser, identical with the usual vacuum rectifier arrangement, it works differently and requires quite different components and design. Omitting the reservoir condenser is not optional; in the interests of valve life it must never be used, nor must the first smoothing capacitance exceed the valve-makers' limit. The choke is particularly important, because regulation is good only so long as its reactance is sufficient, relative to load resistance, to maintain current through itself uninterrupted. The critical ratio is about 2:3.

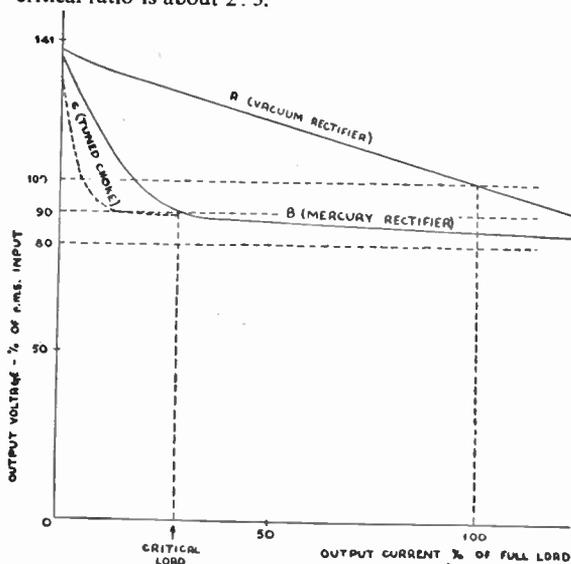


FIG. 1. POWER UNIT REGULATION, USING TYPICAL COMPONENTS.

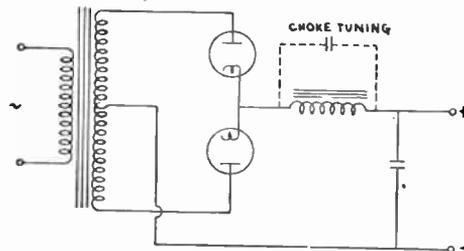


FIG. 2. FULL-WAVE CHOKE INPUT CIRCUIT.

For example, the maximum output rating of two RG1-204A rectifiers in Fig. 2 is 500 mA at 1,500 V — a load resistance of 3,000 ohms. So the choke reactance should be at least 2,000 ohms. With 50 c/s supply, ripple is mainly 100 c/s, and the minimum inductance at full load is  $2,000/200\pi = 3.2H$ . (To allow a margin, the valve makers advise 4.5H).

If less current is drawn (i.e., load resistance increased), inductance should rise in proportion. Another requirement is low choke resistance. These characteristics are promoted by using no air gap. Ideally, if the undesirable voltage rise shown by curve B is to be avoided, the reactance at zero current should increase to infinity. This being impossible, the load circuit should be arranged to ensure that its resistance never falls below the critical value. One way of extending the permissible load ratio is to tune the choke to the ripple frequency (curve C).

Another thing; the peak voltage across the choke is of the same order as the output, so the winding must be insulated to suit.

If a 3-phase supply is available, six RG1-240A valves can be arranged to give 3.35 kW d.c. at 4,470V, with a r.m.s. input of only 1,920 V per phase and a choke of 1H.

There is no room here for more, but further notes on how to get the best from mercury rectifiers are obtainable from the makers.

This is the sixth of a series written by M. G. Scroggie, B.Sc., M.I.E.E., the well-known Consulting Radio Engineer. Reprints for schools and technical colleges may be obtained free of charge from:



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

(M.V.T.207)

# Wireless World

Radio and Electronics

Vol. LIII. No. 6

JUNE, 1947

Price 1s. 6d.

## Monthly Commentary

### *Marconi Jubilee*

WE are in the midst of celebrating the fiftieth anniversary of the inception of wireless telegraphy as a practical means of communication. On 13th May, 1897, the culmination of a series of successful transmission tests across the Bristol Channel convinced Sir William Preece, Engineer-in-Chief of the Post Office, that official encouragement could be given to the young Marconi and to his "system" of wireless telegraphy. As a result, the Wireless Telegraph and Signal Company was formed on 20th July of the same year; the title was changed three years later to Marconi's Wireless Telegraph Company. To this great company—"the only wireless firm in existence formed in the reign of Queen Victoria"—*Wireless World* offers sincere congratulations and expresses its hopes for success in the task of carrying on the torch that was lighted by its illustrious founder.

#### *Making it Work*

Marconi's first great technical contribution to the art was his addition of an elevated aerial and an earth connection to the oscillator evolved by Hertz a few years earlier. But that contribution, fundamental as it was, sinks into insignificance as compared with Marconi's single-purposed devotion to the idea of using Hertzian waves for long-distance communication. That idea, commonplace to us, but a brand-new conception in the years immediately following the publication of Hertz's work in 1888, was not seized upon wholeheartedly by other early workers. Hertz himself belittled the idea when it was propounded to him by the German engineer Huber. Popov and Tesla tended to dissipate their energies by following relatively profitless fields; Popov used his apparatus for the investigation of atmospheric disturbances and Tesla was largely interested in the transmission of power without wires. It is not on record that Marconi demonstrated true wireless telegraphy earlier than Popov, but it now seems certain that to him is the credit for taking it out

of the lecture theatre and proving to the world that mankind had at its disposal a new means of exchanging intelligence, unfettered by the need for metallic connections or other tangible links. Marconi was the first to "make it work" on a sufficiently large and impressive scale. In a few short years he convinced all but the most sceptical that the new method of communication had far-reaching potentialities.

#### *World-wide Communication*

This principle of "making it work" and keeping the practical end always in sight has remained as the animating force of the Marconi Company. As each successive extension of wireless technology has loomed up, the company's development engineers have worked steadily to translate ideas into practical working methods and apparatus. Of their many achievements perhaps the most outstanding has been the evolution of the short-wave beam system, by which the dreams of the pioneers were turned into reality. But, in recalling this fact, we must not forget the more academic Marconi research work in short-wave propagation that formed part of this development.

This journal takes particular pleasure in recording the Marconi jubilee, and on this special occasion we may be permitted to glance back over our own past. We have an almost filial interest in Marconi progress, as *Wireless World* started life as *The Marconigraph*. Though we began our career as house organ of the company we had from the first a certain limited outside circulation, which rose to quite a considerable figure as interest in wireless increased. Since we discarded our parent's leading strings and ventured out into the world as an independent public journal our progress has been steady, and we have now achieved the largest circulation of any comparable publication. And, even if we are still some 14 years short of our half-century, we can at least claim to be by far the oldest wireless journal of any kind in the world.

# PHYSICAL SOCIETY'S EXHIBITION

## Testing and Measuring Equipment on Show

THE second post-war Exhibition of the Physical Society, held from April 9th-12th in London, was on a somewhat larger scale than in 1946. There were 118 trade stands; while the Research Section, which will be dealt with first in this report, had been considerably enlarged.

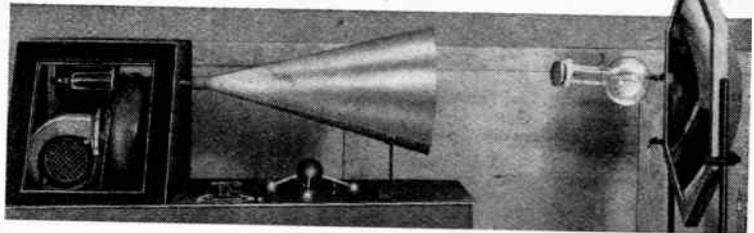
### Research Section

This year's exhibits demonstrated still more strikingly how methods and tools that used to be considered characteristically "wireless" are now common to all branches of scientific research.

For instance, building research might seem to be a rather remote branch of investigation; yet variations of strain in large structures are observed by the changes in modulation frequency of a radio transmitter placed at the position being studied. Modulation is by a valve-maintained vibrating wire, the tension of which, and hence the frequency of vibration, is controlled by the strain under observation. Weather data in the upper atmosphere are observed in a similar manner, using "radio-sonde" balloons. Abstract mathe-

cathode-ray tube is ubiquitous, as, for example, in measuring camera shutter speeds, in atomic research, and in mathematical investigation.

G.E.C. set-up for detecting mm waves using an ammonia filled flask.



There is a tendency, in fact, for all branches of science to use identical or closely analogous methods. The apparatus that was

shown by Metropolitan - Vickers for measuring acoustic impedance was remarkably like that shown by the Admiralty for measuring electro-magnetic impedance. Each consists of a metal pipe, excited by a suitable generator, with means for observing the standing wave ratio when the pipe is terminated by the impedance to be measured. The similarity extends even to the use of the Smith circle diagram in both systems, for working out the results.

Another close parallel between

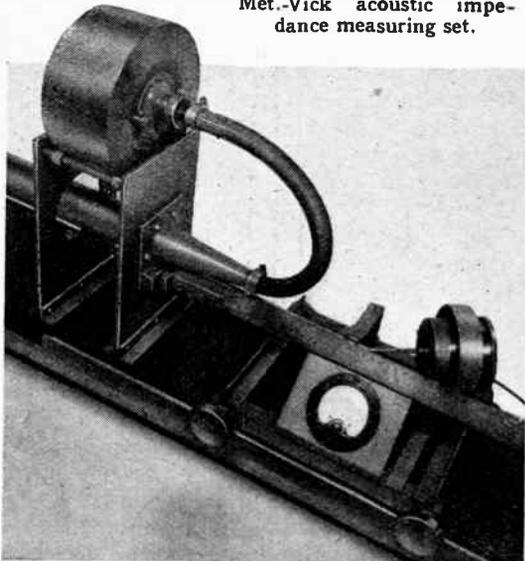
radio and acoustic devices could be seen on the stand of T.R.E., famous for its developments in radar. It had been found that the thickness of many airfield runways, hurriedly laid during the war, was unknown. To avoid having to hack them up to find out, a system is being developed which is analogous to radar, using supersonic sound waves. As in radar, confusion of echoes is minimized by narrowing the radiated

beam and shortening the pulse. This is done, in the apparatus that was shown, by the use of a magnetostriction generator.

The gap between radio and heat waves is continually being reduced. Bolometers, in which the change in resistance of one arm of a bridge is observed when under the influence of the current or radiation to be measured, were shown both for infra-red and for millimetre waves.

One of the factors that limits the frequency which can be usefully employed for radio communication is atmospheric absorption. The N.P.L. exhibited apparatus for measuring the absorption and reflection of 12-mm waves by water, and so arriving at its complex dielectric characteristic. A striking demonstration of absorption of 12-mm waves by an atmosphere of ammonia was staged by the G.E.C. A flask containing ammonia gas was placed at the focus of a mirror receiving a powerful beam of waves, modulated at an audible frequency. The heating and consequent expansion of the contents, due to absorption, therefore also varied

Met.-Vick acoustic impedance measuring set.



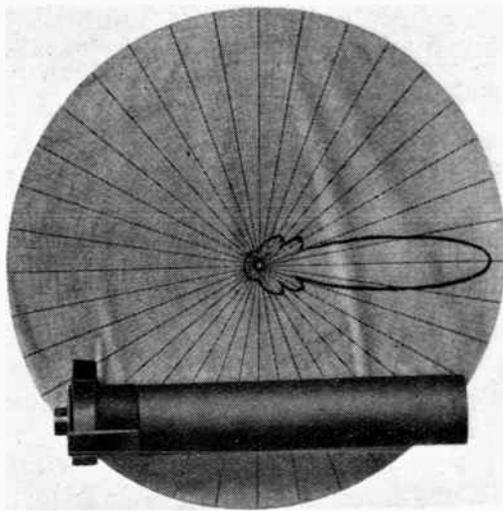
mathematical calculations are carried out by assemblies consisting largely of ordinary "volume controls." And, of course, the

at audible frequency, as could be confirmed by placing the ear to the mouth of the flask, which was covered by a rubber diaphragm: wireless reception without a receiver.

An outstanding wartime radio technique was the revival of the obsolete crystal rectifier, in vastly improved form, as the most effective detector of centimetre waves. The crystal, once the apotheosis of unreliability and variable performance, is now reaching the stage of being incorporated in measuring instruments. A.C. meters using metal rectifiers are generally limited to about 10 kc/s; but the B.T.-H. Co. were showing 10,000-ohm-per-volt A.C. voltmeters, using silicon crystal rectifiers, useful up to 1,000 Mc/s. The possibilities of germanium rectifiers were suggested by a G.E.C. display. With a forward resistance of 50  $\Omega$  and a backward resistance of 0.2 M $\Omega$ , they promise to displace the much less convenient diode valves from all but high-impedance and high-voltage circuits. Their negative resistance properties may also find uses.

The notable development of electrical methods for mathematical computation and research has been mentioned. Some of the techniques employed are: counting, by triggering flip-flop or similar circuits by pulses; measuring time intervals, either by counting cycles of a standard frequency or by condenser discharge (integrating) methods; adding and multiplying by potentiometer networks. R.A.E. showed a time and frequency rack using the counting system, to a scale of 2. The potentiometer technique was exemplified by a simple assembly shown by De Havilland Propellers, capable of solving four simultaneous equations. This company will no doubt receive

many enquiries from the upper forms of schools! The calculator



Admiralty experimental cardboard tube radiator with its polar diagram.

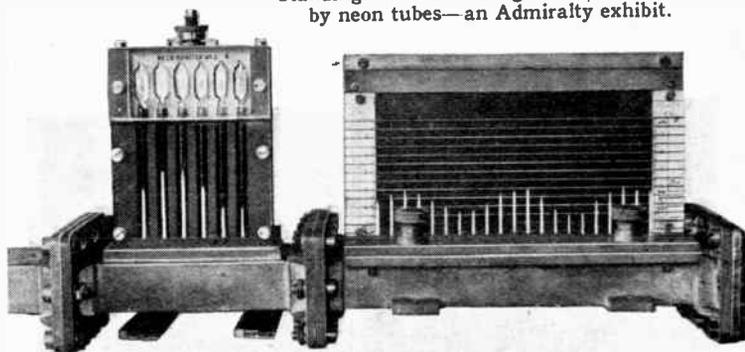
shown is a try-out for a 12-order equation solver, for tackling certain problems in propeller design. An elaborate apparatus was that demonstrated by Dr. Rymer, of Reading University, for harmonic analysis and synthesis. It is based on the method of selected ordinates. Taking ordinates at 10° intervals necessitates a 36-pole 36-way switch. This rather formidable requirement has been

pins," which normally clear the parallel wires. Pulling a strip forward causes one set of these hairpins to be brought into good contact with the parallel wires.

An example of another technique was the polar diagram computer shown by Standard Telephones. Partly mechanical and partly electrical, using stationary selsyn motors as transformers, it enables the radiation diagram of an array of up to five unit aerials to be determined, given their spacing and electrical and spatial angular relationships.

A more abstruse type of equipment was the Fourier transformer, by the Ferranti research department in conjunction with Edinburgh University. This is not a transformer in the electrical sense, but a cathode-ray apparatus for performing the class of mathematical operation known as a Fourier transformation. To illustrate by an example in our own field: a pulse—say a television synchronizing signal—can be represented diagrammatically either by its waveform (an amplitude/time graph) or by its frequency spectrum (an amplitude/frequency graph). Time and frequency are, of course, reciprocal; and given the data in either form the other can be derived. To do so by calculation is often tedious; but by placing the waveform in the Ferranti instrument as a

Standing waves on waveguide demonstrated by neon tubes—an Admiralty exhibit.



neatly met by a compact frame containing 36 pairs of stationary parallel silver-plated brass wires, each pair constituting one of the "poles." At right angles to them are mounted 36 strips of insulation, each controlling 36 silver-plated beryllium copper wire "hair-

transparency, the spectrum instantly appears on the cathode-ray screen. It is also possible to determine the distortion of a signal by a network of known amplitude/frequency characteristic, or conversely.

Outstanding for variety were

### Physical Society's Exhibition—

the exhibits on the Admiralty Experimental Establishment's stand. Only some of them can be mentioned, and that briefly. An awkward problem is the accurate attenuator calibration of standard signal generators, especially at very high frequencies and low microvoltages. A simple solution was demonstrated, in which the generator output was heterodyned, using a diode frequency-changer followed by a cathode follower feeding an attenuator and 200-kc/s I.F. amplifier. By performing all measurements at this comparatively low frequency, the usual difficulties largely disappear.

A demonstration of high-speed facsimile, or "slow television," using the Skiatron dark trace cathode-ray tube, suggested interesting possibilities. The definition was 500-line, and owing to the characteristics of the screen the effective focus was very much finer than the beam focus, and the line structure could only just be seen by very close scrutiny. The frame frequency was 0.1 c/s; in other words, a picture or diagram was completely "painted" on the screen in 10 seconds, after which it would persist in moderate light or be quickly erased by bright light. The use of a trace of aluminium in the screen coating was responsible for improved decay speed.

Not the least interesting and thought-provoking of a number of narrow-beam centimetre-wave aerials was an ordinary cardboard mailing tube excited by a dipole. Notwithstanding the presumably high loss of this material at 10,000 Mc/s, its polar diagram showed a good 25° beam with little side-lobe radiation.

Other centimetre gear included a 1-cm spectrometer, in which a resonant cavity was tuned cyclically over the band to be analyzed by means of a loud-speaker drive.

A naval 10-cm transmitter was used to provide Prof. Randall with radiation for demonstrating reflection, refraction and all the usual optical phenomena. This equipment was interesting for its multiple neon tube monitor. The tubes stood in a row along a section of the wave guide, and by

the respective heights of glow indicated the output power and standing wave ratio. Some interesting research has been carried out on the pulse excitation of these tubes.

One of the troubles of modern mariners was displayed. Apparently the numerous signalling frequencies used on naval vessels are liable to cross-modulation by

rusty bolts in the ship. Not only does this annoy by causing local interference in the receivers, but the difference frequency produced from, say, 100 Mc/s and 120 Mc/s may actually be detected by an enemy at a greater range than either of the primary frequencies. The need for surveying vessels for rusty bolts, as well as for resonant structures, was illustrated.

## Trade Section

**Materials.**—A ceramic semi-conducting material known as "Varite" has been introduced by Mullard. It has a marked negative temperature coefficient of resistance, and has been used for the series heater resistance in A.C./D.C. receivers where the thermal time delay provides protection for valves and pilot lamps. It differs from silicon carbide in having a negligible voltage coefficient, the resistance depending solely upon physical dimensions and temperature. Ceramic dielectric materials of high permittivity with a wide range of properties including zero and negative temperature coefficients are also being produced by Mullard under the name of "Kaymax."

Muirhead non-reactive wire-wound resistor.



A non-conducting magnetic material known as "Caslox" has been introduced by the Plessey Co. It consists of a mixture of cobalt and iron oxide powder in a plastic matrix and can be conveniently moulded by conventional

methods. It has a high coercive force and is very suitable for applications in which an open-circuit magnet of large area and short length is required.

The technique of powder metallurgy in making sintered magnets of awkward shape in hard and brittle alloys was well exemplified by the exhibit of Murex who specialize in this class of work.

Alloys for transformer cores, shown by Transformer Steels, Ltd., included "Crystalloy" in which a fine crystalline structure, oriented in the direction of the magnetic field, is produced by cold rolling. The material is available as continuous strip and can be cut and made up into conventional core shapes with overlapping joints.

Alternatively the core may be wound as a continuous spiral and then cut for fitting into pre-formed windings; in this case the flux traverses the length of the strip at all parts of the circuit and losses in turning corners are avoided. The alloy can be worked at a much higher flux density with consequent economy in weight and overall dimensions. An example of a transformer with a wound "Crystalloy" strip core, made by Johnson and Phillips, was shown in which the working flux density was 17,500 lines/cm<sup>2</sup>. The loss at B=10,000 at 50 c/s is 0.32 watt per lb.

The joint exhibit of Mond Nickel and Henry Wiggin afforded many examples of the use of nickel in electrical alloys including "Nilo K" for glass-to-metal seals and alloys for magnetostriction. An alloy known as 5,000Z with a practically rectangular hysteresis loop was shown by the Telegraph Construction and Maintenance Co. This has been used for the construction of heavy current rectifiers.

**Components.**—Most of the recent developments in receiver components has already been covered in the report of the R.C.M.F. Exhibition in our last issue, but one or two new items were noted, primarily of interest to makers of test and measuring instruments.

Muirhead were showing wire-wound non-reactive standard resistances, hermetically sealed in ceramic tubes. Covering a range of 1Ω to 57 kΩ they are available with a rating of ½ watt with an accuracy of 0.1 per cent or 1 watt at 0.5 per cent. Sullivan were also showing tubular non-reactive resistors with an accuracy of 0.1 per cent and a temperature coefficient of 0.0025 per cent per deg. C. These resistances are also available in decade units.

Salford have produced a new decade switch of substantial construction. It has a laminated phosphor bronze rotor and studs spaced at 30 deg in the moulded body. The same firm were also showing a 44:1 ratio slow-motion dial with epicyclic friction drive giving 350 deg. rota-

tion. An alternative version of the Muirhead slow-motion dial is now in production in which the scale is detachable for calibration.

A quartz crystal standard with thermostatically controlled oven is now made by Salford as a compact plug-in unit very little larger than a standard vibrator unit. Muirhead were showing a low temperature coefficient tuning fork of small dimensions with a constancy of two parts per million over a range of temperatures from 14 to 26 deg. C. Temperature compensation for tuned circuits by means of a bi-metal controlled condenser of 2 pF was shown by Sullivan. This unit has been recently redesigned to give improved accuracy under cyclic conditions.

Relays are components of a wide variety of equipments for industrial control and automatic adjustment. The Type T.D.R.O. made by Elec-

Electro Methods  
miniature polar-  
ized relay.



tro Methods for switching the anode circuits of gas-filled valves incorporated a thermal delay mechanism in conjunction with an electromagnetic relay. The load is carried by both elements and the circuit is not completed until the thermal switch has cooled and reset itself. Faults occurring during the combined delay period cannot cause damage, as they might with the conventional thermal delay switch. A compact polarized relay weighing only 1½ oz and measuring ½ in × ½ in × ⅞ in was also shown by this firm. The operating power is of the order of 10 microwatts and the relay is mechanically balanced to withstand vibration. Shock tests of 500g have been successfully completed.

A wide range of relay equipment was shown by Londex, including process timers and photoelectric control equipment, and L. A. Steiner were demonstrating the application of electronic relay to a number of industrial control problems.

**Industrial Electronics.**—The "Radyne" series of R.F. heaters

made by Radio Heaters, Wokingham covers a wide range of applications and is notable for the compact design of the heater and H.T. units. Models are available with outputs up to 6.5 kW, and silica envelope valves are used in which a new filament can be fitted and the valve evacuated for half the cost of a new valve. The guaranteed life is 1,500 hours. The models designed for plasticising and moisture evaporation are fitted with ovens on top of the cabinet and may be adapted to work with a conveyor belt.

In addition to a seam welder for thermoplastic sheet Radio Heaters also produce an R. F. moisture tester in which the loss of weight from evaporation in the sample is indicated by a calibrated spring balance.

Moisture meters depending on measurement of change of dielectric properties in the sample were shown by the Baldwin Instrument Co., Mullard, and Marconi Instruments. The Marconi Type TF818 continuous moisture recorder for grain sampling depends on the flow of grain falling between the electrodes of a condenser and works in conjunction with a disc-type pen recorder.

The portable battery-operated strain gauge Type D-423-A, made by Muirhead, employs valve maintained stretched steel wires. The strain to be measured alters the frequency of one of the wires and produces beats with a standard which are indicated either by a rectifier meter or in headphones. Adjustment of the standard by means of a calibrated tension spring to zero beat, gives a measure of the strain. The instrument is capable of indicating strains of the order of one part in a million.

Ultrasonic methods of testing materials, preparing emulsions, etc., seem to be attracting more attention. The crack detector shown last year by Henry Hughes is now available in portable form, and Salford Instruments were showing a recently developed general-purpose ultrasonic generator with a range of 14 to 1,200 kc/s and a power output of 30 watts.

**Valves.**—The new pressed-glass base type valves were shown in wide ranges by the M-O Valve Co. in both directly and indirectly heated types. The triode-hexodes are claimed to be effective at frequencies as high as 300 Mc/s and the types include variable- $\mu$  R.F. pentodes, duo-diode-triodes, output tetodes and H.T. rectifiers.

Among the miniature glass-base types a television-type RF pentode

is of particular interest. It is the Z77 with a mutual conductance of 7.5 mA/V.

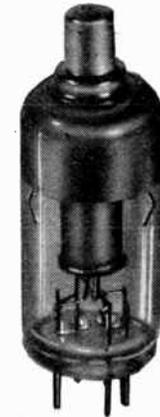


M.O. Valve  
Co. Types  
KT81 and  
Z77.

Ferranti have a high-voltage rectifier with this same base but with a top-cap anode connector. The H.R.1 is designed for television E.H.T. supplies derived from the line flyback and the filament takes only 55 mA at 0.65 V. It is rated for a peak inverse of 12.5 kV and a mean output current of 50  $\mu$ A.

International Television Corporation showed the Nagard F.M.1 frequency multiplier. This is a deflection valve giving a frequency multiplication of 2, 4, 6, 8 or 10 times without tuned circuits. Similar in general form to a C.R. tube, the deflection voltage sweeps an electron beam across a number of spaced bars. Each time the beam

crosses a bar a pulse is generated in the output circuit. With a triangular input wave, 10 output pulses are generated for each input cycle. By reducing the input voltage the number of bars swept is reduced and hence the degree of multiplication.



Ferranti HR1 high-voltage rectifier.

**Cathode Ray Equipment.**—With each succeeding year the C.R. oscilloscope becomes more and more a precision instrument, and the synchronizing is now so improved that perfectly steady pictures are easily obtained.

### Physical Society's Exhibition—

The Cossor model 1035 has a double-beam tube with a two-valve amplifier having a 7-range directly calibrated voltage scale with an accuracy of  $\pm 10$  per cent. The frequency response drops by 10 per cent at 7 Mc/s for an amplification of 3 times and at 60 kc/s for an



Cossor 1035 oscillograph.

amplification of 3,000 times. The time base provides sweeps of duration ranging from 15  $\mu$ sec to 150 msec and can be used repetitive, triggered or single stroke. There is switch selection of synchronizing from either a positive or negative input.

The Furzehill Laboratories Type 1684B oscilloscope, with a 3 $\frac{1}{2}$ -in tube, has a deflection sensitivity of 24 mV R.M.S. per cm with the amplifier adjusted for a response of zero to 3 Mc/s or 8 mV per cm with it adjusted for a response to 1 Mc/s. Direct-coupled amplifiers are used with either balanced or unbalanced inputs. A sweep expansion of 0.2 to 5 screen diameters is provided; since it operates on the X-amplifier it does not affect the synchronizing.

A smaller oscilloscope made by the same firm is the Type 1936 with a 2 $\frac{3}{4}$ -in tube. This has an amplifier covering 1 c/s to 15 kc/s. There is sweep expansion and the saw-tooth voltage is generated by a thyatron with a linearizing pentode. The sync input is fed through a limiter.

The Nagard Type 1025 oscilloscope, shown by International Television Corp., differs from normal design in that it uses the Nagard SC1 signal converter for generating the saw-tooth voltage. This is a deflection-modulated valve.<sup>1</sup> The tube is of the 5 $\frac{1}{2}$ -in type and reliable synchronization with frequencies up to 1.5 Mc/s is claimed or 6 Mc/s if the input is modulated. The

Y-amplifier response is -4 db at 2 c/s and 3 Mc/s with a deflection sensitivity of 0.36 mm/mV. The maximum writing speed is 10 mm/ $\mu$ sec and voltage measurements of 0.01-200 V with an accuracy of 2 per cent are claimed.

Taylor Electrical Instruments have a model using a 3 $\frac{1}{2}$ -in tube with a time-base covering 10-10,000 c/s. A Y-amplifier is included. Mullard have two models—the E800 and the E805—designed respectively for very low and high frequencies. The L.F. model has an amplifier with a response of -2db at 0.1 c/s, whereas the H.F. model amplifier is usable up to 5 Mc/s.

Perhaps the smallest oscilloscope is the G.E.C. Miniscope with a 1 $\frac{1}{2}$ -in tube and measuring 8 $\frac{1}{2}$ in  $\times$  6 $\frac{3}{8}$ in  $\times$  2 $\frac{1}{4}$ in overall. A Y-amplifier is included and the time-base covers 30 c/s to 80 kc/s.

Apart from the oscilloscope the C.R. tube is widely used in measuring equipment. For instance, Southern Instruments make an instrument for measuring force, pressure, strains and so on in which the component to be measured is made to frequency-modulate an oscillator covering 0-20 kc/s and the C.R. tube is used to measure the frequency change.

An electronic clock-timer was shown by Furzehill Laboratories. The "tick" is picked up by a microphone and can be listened to via a loudspeaker. It also gener-



Furzehill Laboratories Type 1936 oscilloscope.

ates pulses which are compared with the output of a crystal oscillator and are used to brighten the trace of a circular time-base. An incorrect rate for a clock is shown by the movement of the brightened spot around the trace.

The bad effects of a rapid sweep in a "wobulated" signal genera-

tor are well shown by the Plessey I.F. Alignment Oscillator. Basically of conventional type with a frequency-modulated oscillator and cathode-ray presentation of the receiver response curve, it is most unusual in having a tube with a long-persistence screen and an F.M. rate variable from 50 c/s down to zero. It is thus possible to sweep slowly enough to get a true picture of even the sharpest response curve.

**Signal Generators.**—The wide difference that at one time existed between the so-called serviceman's type of test equipment and other varieties has now largely disappeared and one range of test sets is provided for both purposes. For example, really effective attenuators are fitted in even the relatively inexpensive type of signal generators and this one feature alone has necessitated better screening of the R.F. circuits.

Exemplifying this new trend in design is the Type E signal generator made by Advance Components. With a fundamental frequency coverage of 100 kc/s to 60 Mc/s it caters for radio servicing needs in most fields.

The attenuator gives a signal output of 1  $\mu$ V to 100 mV with optional internal modulation at 400 c/s. The frequency coverage can be extended to 120 Mc/s by using harmonics of the 30 to 60 Mc/s range.

A comprehensive receiver test set—Type TF888—is one of a new range of equipments developed by Marconi Instruments. It comprises three entirely separate instruments, a signal generator, output meter and a crystal frequency calibrator; thanks to the judicious use of miniature components the whole is contained in a case measuring only 15in  $\times$  11in  $\times$  6in. The signal generator covers 70 kc/s to 50 Mc/s in eight bands with a scale accuracy of 2 per cent. Since it includes a dual crystal oscillator on either 500 kc/s or 5 Mc/s having an accuracy of two parts in 10<sup>4</sup> the accuracy of the instrument is effectively raised to this order on spot frequencies, and these are available as a separate output in addition to checking the calibration of the variable oscillator. The output meter, which is also used as a monitor for the attenuator input, provides three ranges with full-scale readings of 10 mW, 100 mW and 1 W respectively. Internal modulation is at 1,000 c/s and mains or battery operation is optional.

A new signal generator has also been introduced this year by Avo; while Standard Telephones now have a new V.H.F. model, the Type QD1 covering 90 to 160 Mc/s in one range.

<sup>1</sup> *Wireless Engineer*, June, 1943, Vol. 20, p. 273; September and October, 1945, Vol. 22, p. 29 and p. 489.

Crystal controlled calibrators, generally including two crystals, are obtainable from several makers for use as generators of spot frequencies and, for checking the calibration of R.F. oscillators. The calibrator made by Pye has a long-period stability of  $\pm 1$  part in  $10^6$  and is fitted with 100-kc/s and 1-Mc crystals. Other examples are included in the products of Furzehill Laboratories, Standard Telephones and Salford, the last mentioned being a really miniature model.

A frequency standard having a Hartley oscillator as the R.F. signal source has been added to the Sullivan range of laboratory type instruments. It has plug-in coils and a feature of its design is that each coil serves for two ranges, a dual condenser with a switch connecting one or both sections in parallel being fitted. The coverage is 30 kc/s to 24 Mc/s and the calibra-

instruments were as much in evidence as hitherto and of the new models now available mention should be made of the Turner high-voltage electrostatic models in  $3\frac{1}{2}$ -in and 6-in sizes for A.C. voltage measurements up to 10kV and 15 kV respectively. This style takes negligible current and is ideal for the E.H.T. measurements in television sets.

Very low consumption, incidentally, is now a feature of most of the latest multi-range test instruments, sensitive movements taking only  $50^{\circ}\mu\text{A}$  for full-scale deflection and thereby giving a voltmeter resistance of  $20\text{ k}\Omega/\text{V}$  being commonly used.

The new Ferranti model, Taylor 70A and Weston S75 meters all provide these facilities. But delicate instruments of this kind, and also those of the  $1\text{ k}\Omega/\text{V}$  class, are easily damaged by overload. Thus considerable attention has been given to protecting devices, some taking the form of quick-acting overload cutouts which isolate the meter before the current can attain a damaging magnitude. Avo, G.E.C. and Weston meters all incorporate a device of this kind.

#### A.F. Oscillators.

—For the generation of audio frequencies both the beat-frequency principle and the resistance capacity coupled oscillator are still being used. Marconi Instruments still favour the former type, their TF894 A.F. oscillator having a frequency range of 50 to 12,000 c/s and a maximum output of 300 mW.



Marconi Instruments TF888 receiver test set.

tion accuracy is better than 1 per cent.

**Multi-range Meters.**—Many new multi-range test meters have become available this year, the general idea being to make them as versatile as possible, at the same time keeping to a reasonable size. G.E.C. has one known as the Selectest, providing 34 ranges of A.C. and D.C. volts and current; it is also an ohmmeter. Super Ranger is the title of the new 28-range model produced by British Physical Laboratories, which, in addition to the usual A.C., D.C. and ohms ranges, is calibrated for use as a rectifier-type output meter reading 0 to -60 db.

Among the other firms making this class of instrument can be mentioned Avo, Ferranti and Weston (whose Model S75 has 54 ranges) and Taylor.

Panel and bench type pointer

A ladder attenuator with a  $600\Omega$  output is incorporated and the sig-



British Physical Labs. 28 range test set.

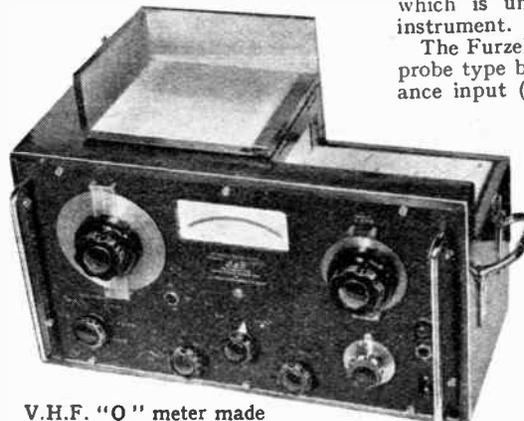
nal is monitored by a bridge-connected rectifier output meter which can be used separately.

The British Physical Laboratories A.F. generator is an R.C. pattern with a range of 30 to 33,000 c/s. Again the output is at  $600\Omega$  impedance and a calibrated attenuator gives an output range of 4 mV to 40 V.

**Valve Voltmeters.**—The probe type of valve voltmeter has now become the predominant pattern and the majority have one of the miniature diodes fitted in the exploring head with a D.C. amplifier, or its equivalent, in the main instrument.

Langham Thompson make one of this pattern having a diode head with an input impedance of  $7\text{ M}\Omega$  and a capacity of 5.5 pF. It is a four-range meter, the lowest being 0-3 V and the highest 0-100 V and it incorporates an overload relay which is unusual in this class of instrument.

The Furzehill Model 378A is not a probe type but it has a high impedance input ( $2\text{ M}\Omega$ ) and incorporates a two-stage amplifier feeding a bridge-connected diode rectifier, the indicating meter reading the D.C. output of the rectifier. Its normal working range of frequencies is 50 c/s to 250 kc/s and the lowest voltage range is 0-1 mV while the highest is 0-100 V. This firm also have a probe model for R.F. operation



V.H.F. "Q" meter made by Salford.

### Physical Society's Exhibition—

which is effective up to 250 Mc/s.

Marconi Instruments make a self-contained valve voltmeter capable of operation up to 300 Mc/s and further examples were shown by Dawe.

**Bridges.**—As usual, measuring bridges took a variety of forms. There were the high-precision instruments shown by Sullivan, Pye and Gambrell and in addition there were a number of production testing equipments. There were two "Q" meters shown by Salford. One, the BW424, covers a frequency range of 25 kc/s to 50 Mc/s; the other, type BW431, is a V.H.F. instrument for frequencies of from 15 Mc/s to 150 Mc/s. Both have the same "Q" ranges, 0-250 and 0-500 respectively.

A comprehensive inductance bridge was included in the exhibit of British Physical Laboratories. Described as an inductance and "K" bridge it gives coil inductance measurements of from 1  $\mu$ H to 1 H and "K" (coupling coefficients)



Baldwin Logohm resistance bridge.

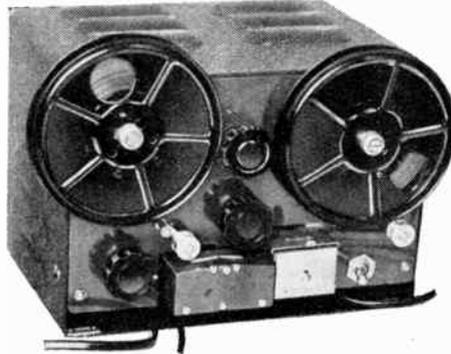
from 0.001 to 999. A feature of this instrument is that coils can be measured *in situ* even if they are shunted by capacitance, provided the resonant frequency of the circuit under test is not less than eight times the measuring frequency, which for this bridge is 20 kc/s.

A universal-type bridge covering inductance, capacitance, "Q" and resistance is included in the new range of test sets made by Marconi Instruments.

Among the Baldwin Instruments was a new resistance bridge described as Logohm, having a range of 0.05  $\Omega$  to 5 M $\Omega$  in four bands. It is a wheatstone bridge type and includes a galvanometer in which the pole pieces are shaped to give high sensitivity in the vicinity of the centre zero and low sensitivity at maximum deflection,

thus providing a form of meter protection.

**Miscellaneous.**—A magnetic tape recorder for speech, using oxide coated plastic tape, was shown by Plessey. The instrument is portable and measures 8in x 7in x 6in. A



Plessey magnetic tape recorder.

3-in loudspeaker serves also as the microphone, and the three-stage amplifier is mains operated. The tape spools are 4in in diameter and give a recording time of five minutes.

The direct recording electroencephalograph now produced in commercial form by the Edison Swan Electric Co. is based on the design of the Burden Neurological Institute and is a fine example of the contribution of electronic methods to medical research. Con-

tinuous records of the electrical activity of the human brain can be made from six or more pairs of electrodes and a high discrimination is provided against outside electrical interference. Associated with this instrument is a wave analyser with 24 interchangeable plug-in selectors covering 1.5 c/s to 30 c/s and operating on the principle of the feedback R.C. oscillator. The selectors are followed by integrators which alternate over periods of 10 seconds and record the frequency distribution of the energy. A third integrator is available for periods longer than 10 seconds.

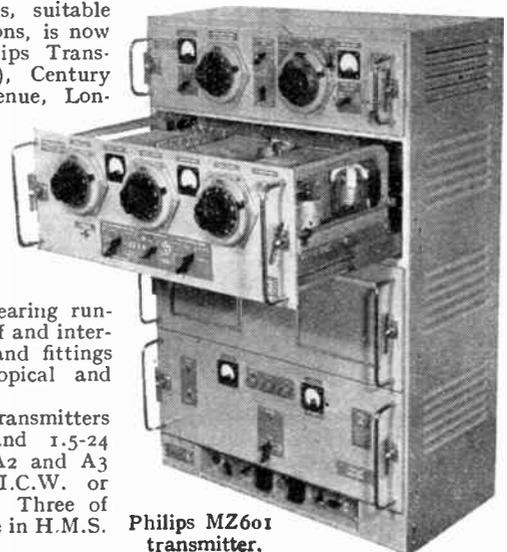
Two interesting examples of loudspeaker permanent magnet design were seen. Mullard were showing a "Ticonal" magnet produced for the Lowther

Manufacturing Co. having an average flux density of 22,000 lines/cm<sup>2</sup>, and a double loudspeaker unit for cinema use with centre-pole "Alcomax" magnets was among the examples exhibited by the Permanent Magnet Association. This magnet energizes a tweeter, the throat of which is formed in white metal through the centre core of both magnets. The low-frequency cone has a gap 3in in diameter, 0.08in wide and 0.5in deep. Average fluxes are 17,000 lines/cm<sup>2</sup> in the tweeter and 10,000 lines/cm<sup>2</sup> in the large-diameter unit.

## PHILIPS TRANSMITTERS

A RANGE of transmitters known as the MZ600 series, suitable for fixed or mobile stations, is now being produced by Philips Transmission (Philips Lamps), Century House, Shaftesbury Avenue, London, W.C.2. Unit construction has been adopted and the driving circuits of the high powered transmitters can be used as complete low-powered transmitters. The smaller units are readily accessible on extending ball-bearing runners and may be lifted off and interchanged. Components and fittings are proofed against tropical and arctic conditions.

In all there are five transmitters covering 200-500 kc/s and 1.5-24 Mc/s, suitable for A<sub>1</sub>, A<sub>2</sub> and A<sub>3</sub> communication (C.W., I.C.W. or M.C.M. and telephony). Three of the transmitters are in use in H.M.S. Vanguard.



Philips MZ601 transmitter.

# DESIGNING AN F.M. RECEIVER

## 2.—Limiter and Discriminator Circuits

**I**N the first part of this article the problems associated with the construction of a receiver for the experimental B.B.C. transmissions of frequency modulation were discussed. Only the "ordinary" part of the receiver was considered, and it was assumed that the reader was not

By **THOMAS RODDAM**

the job of making sure that the input to the discriminator is absolutely constant. It does not matter that in doing so it works in a non-linear fashion which would cause hopeless distortion with an amplitude-modulated signal: indeed the limiter's job is to distort any amplitude modulation out of existence. The discriminator is con-

properly, it is quite a straightforward job. If you are trying to save a valve, or to eliminate one resistance costing 1½d, you can spend a lot of time on limiter design, and the commercial set makers will no doubt produce some very pretty tricks. For my part I prefer to use brute force at this point. With the amplifier described last month it should be possible to get about 10 volts applied to the grid of the limiter, and an EF50 or EF54 valve with low anode and screen volts and a high resistance in the grid will drive from cut-off to grid limiting on a lot less than this. The circuit is shown in Fig. 1 and the values shown should be regarded as indicating the sort of thing needed. If a lower H.T. voltage than 300 is used, rather lower resistances are permissible. With this circuit the grid-stopping effect is not really sufficiently marked, and one of the two circuits shown in Fig. 2 may be tried: Fig. 2(a) seems attractive, but I have not

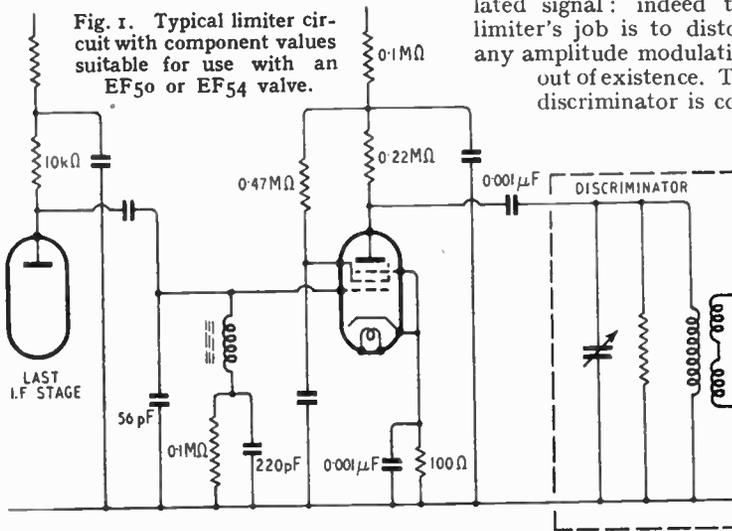


Fig. 1. Typical limiter circuit with component values suitable for use with an EF50 or EF54 valve.

going to embark on the job of building a frequency-modulation receiver unless he was familiar with the difficulties of constructing a receiver for very short waves. It is true that there is nothing to it once you know how, but a little experience is needed before it becomes automatic to remember that an inch of wire is not a direct connection, but a finite impedance. Only an unstable amplifier can teach the constructor which points are really critical and what liberties can safely be taken with decoupling and screening. Fortunately it does not take very long to reconstruct one of these amplifiers. Incidentally, through a draughtsman's error, coupling condensers between anode and grid circuits in Fig. 3, Part 1 were omitted. These should be assigned a value of the order of 0.001μF.

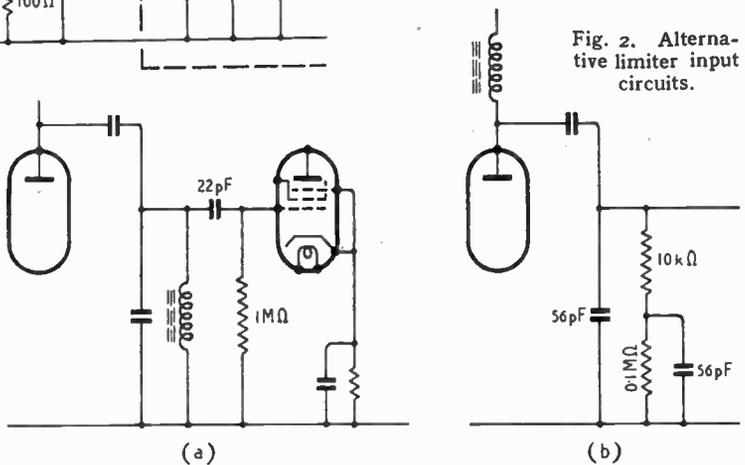
• This article is devoted to the heart of an F.M. receiver, the limiter and discriminator. As we saw last month, the limiter has

sequently provided with a pure frequency-modulated signal, and provides at its output the required audio frequencies resulting from F.M. "detection."

For the ordinary home constructor there is not very much difficulty about limiters. "Hit it hard and stop it dead" is the rule, and so long as plenty of gain is provided to drive the limiter

yet tried it. Both circuits provide the required 10kΩ damping for the anode coil which tunes with the valve capacitances, at the same time giving a higher resistance for the flow of grid current. The screen of the valve may, if preferred, be fed by a voltage divider circuit: the important thing is that the valve should drive well beyond cut-off, not just

Fig. 2. Alternative limiter input circuits.



**Designing an F.M. Receiver—**

down the tail of the characteristic. It is surprising what high values of screen resistance can be tolerated in a circuit of this kind.

The discriminator is, of course, the really interesting part of the circuit. Properly speaking the discriminator converts a frequency-modulated R.F. (or I.F.) signal into an amplitude-modulated signal, but it is usual to include the diode detectors which provide the audio output in the design. This we shall do here.

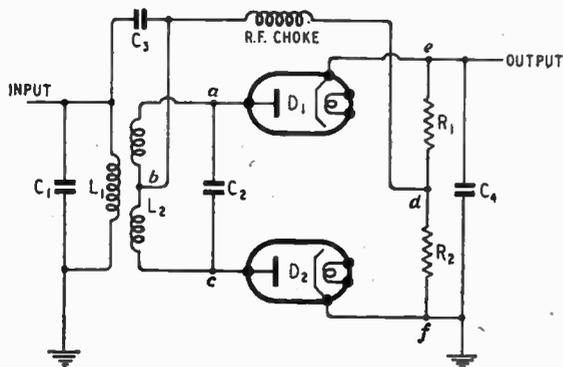


Fig. 3. Basic discriminator circuit.

The "phase discriminator" circuit has been described elsewhere by Sturley and the circuit is shown in Fig. 3. A full mathematical description is available for those who want it in reference (1), but here we shall give only the basic ideas about how the circuit works and how to calculate the circuit values. Fundamentally the circuit is made up

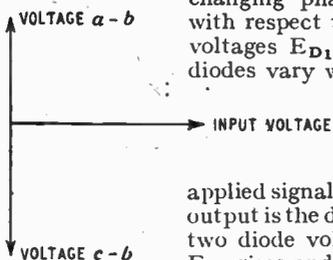


Fig. 4. Phases of voltages in coupled circuits at middle of pass band.

of a tuned coupled circuit arrangement like an ordinary I.F. transformer,  $C_1L_1$  and  $C_2L_2$ , followed by a pair of diodes. In the actual construction of the circuit two things must be remembered: it is an ordinary coupled circuit in principle, and the secondary is balanced with respect to earth. When  $C_3$  is left out, the voltages appearing across the two halves of  $L_2$  are, as shown in Fig. 4,  $180^\circ$  out of phase with

each other, and  $\pm 90^\circ$  out of phase with the voltage across the primary. This, of course, is at the middle of the pass band of the circuit. As the frequency is increased, the voltages  $a-b$  and  $c-b$  remain  $180^\circ$  apart, but are no longer  $\pm 90^\circ$  out of phase with the primary voltage: the state of affairs is shown in Fig. 5 by the solid line; the dotted line shows the phases for a frequency below the mid-band frequency. When we apply our frequency-modulated signal to the primary circuit,

therefore, the phase of the voltages across the halves of  $L_2$  varies backwards and forwards, the amplitude remaining constant ( $C_3$  is still disconnected). The diodes shown in Fig. 3 are connected in such a way that under these circumstances there would be no rectified output, for  $e$  and  $f$  would

each be driven positive by the same amount, so that the resultant voltage  $e-f$  would be zero.

When  $C_3$  is connected to the mid-point  $b$  of  $L_2$ , the voltage vectors become as shown in Fig. 6.  $E_{bd}$  is constant, and so are  $E_{ab}$  and  $E_{cb}$ , but owing to the changing phase of  $E_{ab}$  and  $E_{cb}$  with respect to  $E_{bd}$ , the resultant voltages  $E_{D1}$   $E_{D2}$  applied to the diodes vary with the phase variations of  $E_{ab}$  and  $E_{cb}$ , and thus follow the frequency variations of the

applied signal. As we have seen the output is the difference between the two diode voltages, so that when  $E_{D1}$  rises and  $E_{D2}$  falls, a positive output appears across  $R_1$  and  $R_2$ , and when  $E_{D1}$  falls and  $E_{D2}$  rises, there is a negative voltage across  $R_1R_2$ . This output voltage is dependent on the secondary phase, which depends on the primary frequency, and the circuit is therefore a detector of frequency modulation. The resulting characteristic is shown in Fig. 7.

It is not easy to get an absolutely linear characteristic of volts against frequency, such as is

shown in the region between  $f_1$  and  $f_2$ . The curvature of the characteristic is reduced by careful choice of the double-humping

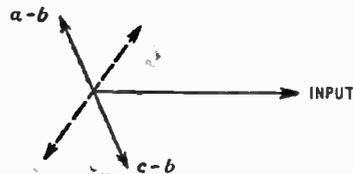


Fig. 5. Phases of voltages at a frequency above mid-band.

of the transformer and the design below makes provision for this. If the primary and secondary circuit Q's are not equal, the response is skewed, as shown in Fig. 8.

In building a discriminator, the design formulae given by Sturley were used. It seems worthwhile to use the conditions for maximum linearity, because the loss of gain is only about 4db and this is easily made up in the amplifiers.

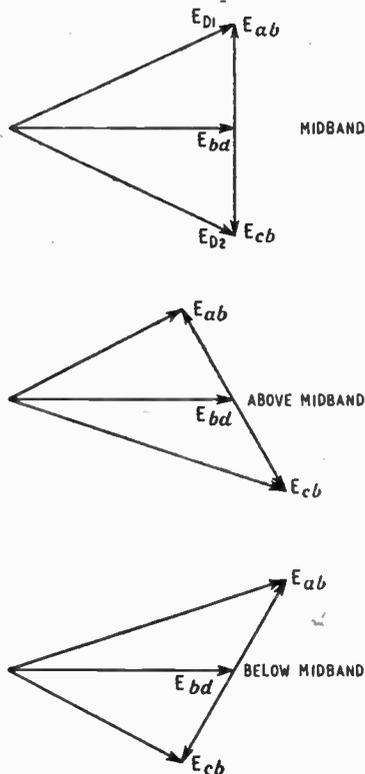


Fig. 6. Voltage vectors in phase discriminator.

The quantities involved are :

- $f_m$ , the mid-band frequency
- $L_1, L_2$ , the coupled circuit self-inductances
- $k$ , the coefficient of coupling
- $Q$ , the ratio of shunt resistance to reactance at mid-band frequency
- $\Delta f$ , the frequency off-tune from  $f_m$  ( $= f - f_m$  at any frequency  $f$ )
- $F$ , the normalized off-tune frequency (twice the "fractional de-tuning")  
 $= 2\Delta f/f_m$

For maximum linearity, Sturley gives  $L_2/L_1 = 1.414$  and  $Qk = 2$ . Under these conditions the system is linear up to a value of  $QF = 0.8$  from  $QF = 0$ . Applying these

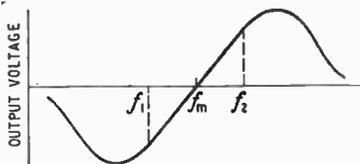


Fig. 7. Ideal discriminator characteristic.

criteria to our problem: we are working at an intermediate frequency of  $10\text{Mc/s}$ ,  $f_m = 10 \times 10^6$ , we should make the discriminator linear over a range of about  $\pm 100\text{kc/s}$  to allow for tuning drift, and so we shall take  $\Delta f = 100 \times 10^3$  when  $F = 0.8$ . This gives us  $Q = 0.8f_m/2\Delta f = 40$ . As  $Qk = 2$ ,  $k = 0.05$ .

To determine  $L_2$  we need to choose  $C_2$ . Small air condensers of the concentric cylinder type are very suitable and a mid-value of  $20\text{pF}$  may be chosen. This gives  $L_2 = 1/4\pi^2 f_m^2 C_2 = 12.5\mu\text{H}$ . As  $L_2/L_1 = 1.414$ ,  $L_1 = 8.8\mu\text{H}$ .

The total primary capacitance is given immediately by the conditions  $L_2/L_1 = 1.414$  and  $L_1 C_1 = L_2 C_2$ , as  $C_1 = 1.414 C_2 = 28\text{pF}$ . This includes the limiter output capacitance.

It is now necessary to determine the damping resistance. The actual value of shunt resistance required is given by the formula  $R = 2\pi f_m L Q$ , and on substitution this becomes  $R = 2/10\pi \Delta f \cdot C = 2/\pi \cdot 10^6 C$ , when  $\Delta f = 100\text{kc/s}$ . As  $C_2 = 20\text{pF}$ ,  $R_s = 31,000$  ohms,  $C_1 = 28\text{pF}$ ,  $R_p = 22,000$  ohms.

We cannot just connect these resistances in the circuit. Part of the damping is provided by the losses in the coils themselves and part by the resistances  $R_1$  and  $R_2$  which form the diode loads. The anode resistance of the limiter valve will also add to the damping if the discriminator is shunt-fed. Sturley assumes values for  $R_1$  and  $R_2$ , but here we shall find what values of  $R_1$  and  $R_2$  may be used if all the primary damping is to be provided by the diode loads. It can be shown that the apparent resistance presented by two equal resistances  $R$  forming the loads of  $D_1$  and  $D_2$  is  $R/6$  at the primary. To get the required damping of  $22,000$  ohms, therefore, we require  $R$  to be  $132,000$  ohms. As we shall need to adjust the damping in lining up the circuit, the value chosen is  $220,000$  ohms: the coil losses will represent about  $50,000$  ohms across the primary and an additional resistance of this order should be used for trimming.

On the secondary side, the diode load resistances  $R_1 R_2$  contribute their actual value to the damping, so that most of the  $31,000$  ohms

30 turns of 40 S.W.G. wire will give the  $8.8\mu\text{H}$ , and about 36 turns the  $12.5\mu\text{H}$ . The exact inductance

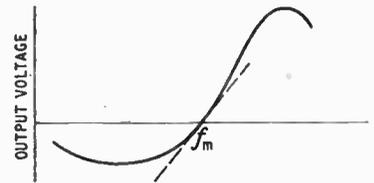


Fig. 8. Discriminator characteristic when primary and secondary  $Q$  values are not equal.

obtained depends on the way the winding is put on, but these figures will provide a good first shot. To get the coefficient of coupling required, the two coils should be mounted on separate formers held back-to-back by means of threaded rod: the spacing between coils will be about  $\frac{1}{2}$  inch, and if the cores do not pass through the coils, the coupling will not be greatly affected by movement of the cores, so that the inductance can be adjusted by the cores, and the coupling by the spacing, without very much

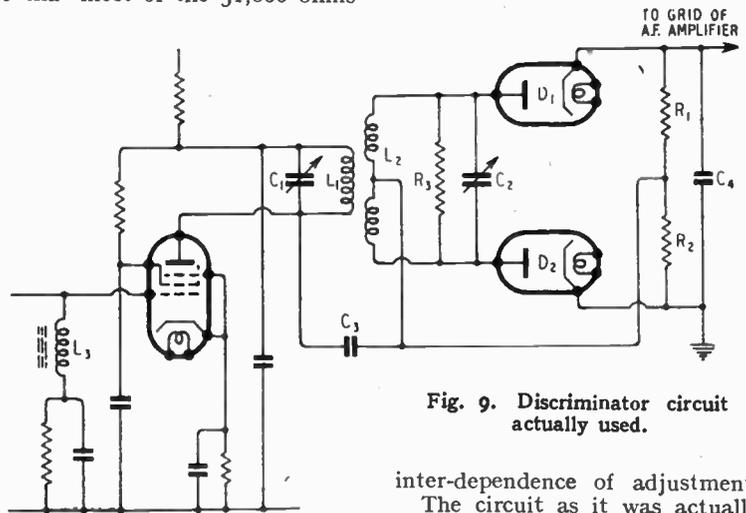


Fig. 9. Discriminator circuit actually used.

required must be provided by a separate resistance. It is fairly safe to start off with  $47,000$  ohms across  $L_2$ .

The coil inductances are  $8.8\mu\text{H}$ . On the formers with dust cores used for the I.F. coils in Part 1 these inductances are best obtained by using small polystyrene bobbins which fit over the formers. About

inter-dependence of adjustment.

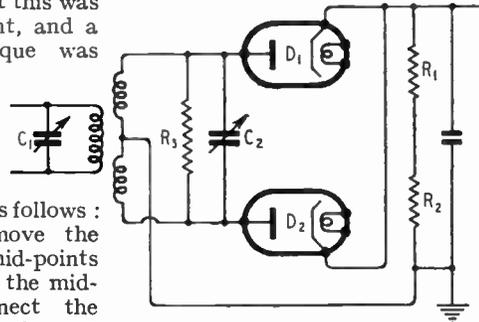
The circuit as it was actually used is shown in Fig. 9.  $L_1$  has been put in the anode of the limiter valve, although this has the disadvantage that  $C_1$  is connected to the H.T. supply. As  $R_1 R_2$  are large, the R.F. choke shown in Fig. 3 has been omitted. Suitable values for  $C_3$  and  $C_4$  are  $47\text{pF}$ ; both must present low impedance to the signal frequency, but high impedance to the modulation fre-

**Designing an F.M. Receiver—**

quency.  $C_4$ , of course, can be larger, as it can play a part in providing de-emphasis.

Lining up the discriminator is rather tricky. Sturley's method involves reducing the coupling to well below critical, but this was found to be inconvenient, and a rather different technique was

Fig. 10. Rearrangement of circuit for initial alignment.



used. The procedure is as follows : disconnect  $C_3$  and remove the connection between the mid-points of  $L_2$  and  $R_1R_2$ . Earth the mid-point of  $L_2$ . Disconnect the cathode of  $D_2$  from earth, and connect it to the cathode of  $D_1$ . This gives the circuit shown in Fig. 10. The values of  $C_1$ ,  $C_2$  are then adjusted in the usual way with tuned transformers to give the double-humped characteristic shown in Fig. 11, with humps equally spaced about 240kc/s away from  $f_m$  and the voltage across  $R_1R_2$  rising by 9db ( $\times 2.8$ ) at the humps compared with mid-band. After adjustment of tuning and coupling, the circuit is restored to its normal form.

Final trimming is now needed. Looking back to Fig. 7, we see that the output for an input of constant frequency  $f_m$  should be zero. A carrier of  $f_m$  is applied to the input of the receiver, and  $C_2$  adjusted until there is no output

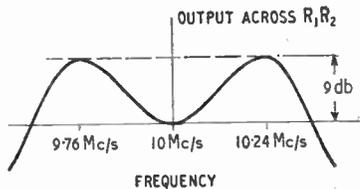


Fig. 11. Response of circuit of Fig. 10.

across  $R_1R_2$ . The input frequency should then be changed alternately to  $f_m + 100kc/s$  and  $f_m - 100kc/s$ , and  $C_1$  adjusted to give equal but opposite voltages across  $R_1R_2$  under these two conditions. A final correction of  $C_2$  may then be needed. The overall response curve should then be plotted in terms of output voltage across  $R_1R_2$  against fre-

quency, making sure that the input level is high enough to keep the limiter in action. If there is any asymmetry, the damping resistance may be altered until a completely symmetrical curve with

a linear mid-portion is obtained.

The average D.C. output from the discriminator circuit is a measure of the amount of detuning of the circuit. It can therefore be smoothed and applied to an A.F.C. system in just the same way as the detector output in an amplitude-modulated receiver is applied to the A.V.C. line. Elaborations of this kind

are best left until a satisfactory receiver design has been achieved.

These notes on the construction of an F.M. receiver are based upon experience with a rather special receiver which, by reason of its frequency and bandwidth, presented awkward problems not encountered in building a receiver for broadcast transmissions. The chief difficulties were, however, not those caused by the frequency modulation, but the ordinary troubles which are always encountered at the high frequencies involved. I should recommend any reader who wants to start in this field to build himself a receiver for the television sound channel first of all, to get the feel of V.H.F. working. After he has produced a straight R.F. and detector receiver and a superhet for this, he will be quite prepared to break into F.M.

**BIBLIOGRAPHY.**

1. K. R. Sturley, *Wireless Engineer*, Vol. 21, p. 72 (Feb. 1944).
2. H. Roder, *Proc. I.R.E.*, Vol. 26, p. 590 (May 1938).
3. K. R. Sturley, *J.I.E.E.*, Vol. 92, Pt. III No. 19, p. 212 (Sept. 1945), (for list of reference on F.M.).

**NEW DOMESTIC RECEIVERS**

**I**N the Murphy Type A104R radio-gramophone an interesting "acoustic tube" is employed to suppress radiation from the back of the loudspeaker diaphragm and thus to eliminate interference effects which curtail bass response. A number of tubes each 1/10th inch in diameter and 20 inches long are formed in parallel by a block of corrugated cardboard sheets, and sound is attenuated in the interstices without reflecting an excessive load on the loudspeaker diaphragm. A 10-inch permanent magnet unit with high-note diffuser provides the drive. The record changer plays up to eight 10in or 12in records and is fitted with a light-weight pick-up using miniature steel needles. On the radio side the specification is similar to the A104 reviewed in our Dec., 1946 issue. The price of the radio-gramophone version is £75 plus £16 13s 4d purchase tax. Makers: Murphy Radio, Welwyn Garden City, Herts.

The G.E.C. "Compact" receiver is a four-valve superhet plus rectifier and barretter for A.C. or D.C. supplies. It is housed in a moulded black and ivory cabinet measuring 12in x 7 3/4in x 7 3/4in and weighs 10 1/2lb.

Short, medium and long waves are covered and the price is £14 14s plus £3 3s 3d purchase tax. Makers: The General Electric Co., Magnet House, Kingsway, London, W.C.2.

A table model (M.A.S. 305) for A.C. mains in a moulded cabinet with internal plate aerial is announced by the Mullard Wireless Service Co., Century House, Shaftesbury Avenue, London, W.C.2. It is a superheterodyne (three valves + rectifier) and covers 16.2 to 52 metres, 170-560 metres and 708-2,000 metres. The price is £18 18s plus purchase tax £4 1s 4d.

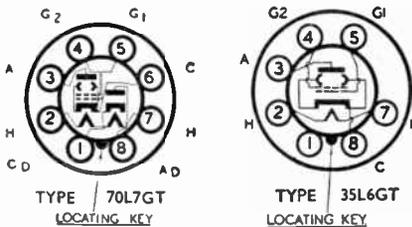
The Model SC70 portable introduced by the Rees Mace Manufacturing Co., 40, Welbeck Street, London, W.1, takes the place of the Model AD70 described in our Feb., 1947, issue. It will make use of 2-volt valves with a Varley dry accumulator and Ever-Ready "Batrymax" H.T. battery.

A midget A.C./D.C. superhet (medium and short waves only) is announced by the Dulci Co., Villiers Road, Willesden, London, N.W.2. This is housed in a bakelite cabinet 7 3/4in x 6in x 5 1/4in and is available in a variety of colours. The price is £13 13s (purchase tax extra).

# Short of a 70L7GT? - then **\*BRIMARIZE!**

70L7GT

—change to a BRIMAR 35L6GT. This valve is similar in characteristics to the 70L7GT and both are Octal types so that the necessary alterations are straight forward. The principal change is the substitution of a metal rectifier for the rectifier section of the 70L7GT. Wherever possible this rectifier should be mounted horizontally in order to ensure adequate cooling, and it is advisable to check the total rectified current. If it is above 40 mA a series resistance should be inserted in the smoothing circuit.



RATED CHARACTERISTICS		
	35L6GT	70L7GT
Heater Volts	35V	70V
Heater Current	0.15A	0.15A
Anode Volts	110V	110V
Anode Current	40mA	40mA
Screen Volts	110V	110V
Grid Bias	-7.5V	-7.5V
Output	1.5W	1.7W

PUNCH HOLES HERE

TYPE	CHANGE SOCKET		CHANGE CONNECTIONS		OTHER WORK NECESSARY
	FROM	TO	FROM OLD SOCKET	TO NEW SOCKET	
35L6GT	INT/OCTAL	NO CHANGE	PIN 1 " 2 " 3 " 4 " 5 " 6 " 7 " 8	+ VE RECT PIN 2 " 3 " 4 " 5 " 8 " 7 - VE RECT	Increase line cord resistance by 175 ohms. Sen TerCel miniature rectifier TYPE SB2 (2½" x 3½" overall) may be fitted to chassis or cabinet. <b>Please Note—Supplies to be obtained through Wholesalers who should now order from S. T. &amp; C. LTD. Brimar Valve Works, Footscray, Kent. LIST PRICE 9/- complete with arms and including packing and postage.</b>

NOTE that in the case of the 70L7GT the cathode of the tetrode section is connected to Pin 6 instead of the more usual Pin 8 and that, owing to the lower heater voltage of the 35L6GT an alteration in line cord resistance is essential.

## BRIMAR

### RADIO VALVES

**\* OPERATION BRIMARIZE — a manoeuvre executed by qualified radio engineers in order to effect the widest possible use of available BRIMAR VALVES.**

**STANDARD TELEPHONES AND CABLES LIMITED, FOOTSCRAY, SIDCUP, KENT.**

**WATCH FOR THE NEXT OF THIS SERIES**

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

**3**

# PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD.

ALL POST ORDERS to 167 LOWER CLAPTON RD., LONDON, E.5. 'Phone: Amherst 4723  
ALL CALLERS to 169 FLEET STREET, LONDON, E.C.4. 'Phone: Central 2833

Send 2½d. stamp for our September, 1946 list

Terms of Business: Cash with order or C.O.D. over £1

**MIDGET RADIO KIT.** Build your own Midget Radio. A complete set of parts, including valves, loudspeaker and instructions. In fact, everything except cabinet necessary to build 4-valve Medium and Long Wave T.R.F. Radio operating on 200-250 v. Mains, A/C or D/C. Valve line-up, 6K7, 6J7, 25A6, 25Y5. Wave-lengths covered 200-557 and 700-2,000. Size 10 x 6 x 6 in. Completely drilled chassis. Price, including tax, £7/7/6. An attractive bakelite cabinet can be supplied at 25/- extra or wired and tested in cabinet. Price £10/10/6.

**SUPERHET MIDGET RADIO KIT.** A complete kit of parts for a 5-valve superhet. Covers 16-50 and 200-557 metres. A/C/D/C 200-250 v. 6K8, 6J7, 25A6, 25Y5. Size: 10 x 6 x 6 in. Completely drilled chassis. Price, including tax, £8/5/-. An attractive bakelite cabinet can be supplied at 25/- extra.

**1947 MODEL COLLARO MICROGRAM.** A super quality 3½-watt amplifier contained in a neat leatherette-covered portable carrying case, with a quality Electric Motor, Pick-up and Loudspeaker incorporated. Just the thing for quality record reproduction. Price, £20/10/8.

**DEWOO G.T.I. TURBETS.** Completely wired and aligned tuning packs, complete with tuning condenser. 16-50, 200-550, 800-2,000 metres. Available for 1.6 m/c or 465 k/c. Price 55/-.

**MANSBRIDGE TYPE CONDENSERS.** Huge purchase of Military Surplus Paper Condensers. Super quality, oil filled.

Capacity	Working Voltage	Size H	Price	Per Doz.
2 mf.	1,000	4½ x 1½ x 1	2/6	20/-
2 mf.	600	3½ x 1½ x 1	1/9	14/-

**MAINS TRANSFORMERS.** Government surplus, super quality. All 230 volts input.  
Type 3.—500-0-500, 150 m/a, 4 v. 2½ a., 4 v. 10 a., 4 v. 5 a. 35/-.

Type 4.—865-0-865 v. Tapped at 760 and 690 v. 500 milliamperes. Complete with I.T. trans. for rect. heaters, 4 v. 3-8A twice. Price, £5.

Type 5.—450-0-450. Tapped at 300 v. 150 m/a, 4 v. 3-5 a., 4 v. 3-5 a., 30/-.

Type 7.—6.3 v. 1-2 a., 4 v. 10 a., 4 v. 10 a., 4 v. 10 a., 10/-.

**SHORT-WAVE CONDENSERS.** High-grade Ceramic Insulation. Super Midget type. Single gangs available in 10, 20, 50, 75, 100 P.F. (75 P.F. has double spindle for ganging). Price 2/6.

**2-GANG.** In 4.8, 9.6, 27.1, 50, 75 P.F. Price 5/-.

**2-GANG.** Full size, 100 P.F. Price 5/-.

**CYLINDR 2-GANG.** 50-50 P.F. Price 5/-.

**AIR-DIELECTRIC CERAMIC TRIMMERS.** 25, 50, 100 P.F. Price 1/-. Each.

**PHILLIPS AIR DIELECTRIC CONCENTRIC TRIMMERS** 8 P.F. and 30 P.F. 1/- each.

**WAVE CHANGE SWITCHES.** Available with any of following Wavers. 2-pole, 3-way; 3-pole, 5-way; 4-pole, 2-way; 2-pole, 4-way; 1-pole, 4-way with shorting bar; 2-pole, 5-way. 1-GANG, 4/-; 2-GANG, 5/6; 3-GANG, 7/-.

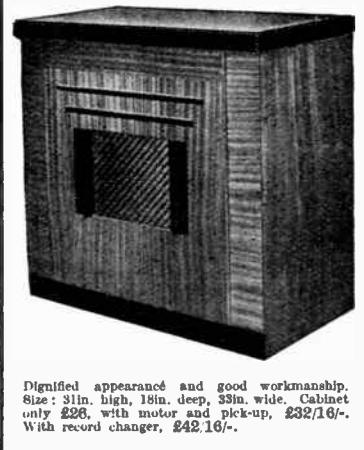
**SUPERHET TUNING PACES.** Completely wired and aligned. 13-40, 40-120, 190-570 metres. R.F. stage, 465 k/c; 8 connections only. Complete with 3-gang Condenser, calibrated, engraved Perplex dial, and 8M/d meter. Litz wound polystyrene insulation permeability tuned I.F.'s, 7 k/c bandwidth. Price complete, £3/17/6.

**FIVE 5-VALVE SUPERHET RADIO.** Employ CCH85, EF39, EB35, C133, CY31 valves; operate on 100-250 volts A/C/D/C mains. Cover 13-40, 40-100, 200-550 metres. Gram position on wavechange switch. EXT L/S terminals, 8-inch energised speaker; dial aperture 12 x 4 in.; enamelled steel cabinet, 18 in. high x 15 in. wide x 9 in. deep. Manufactured by Portogram Ltd. for Navy Welfare Centres. A fortunate purchase enables us to offer these fine sets at £15/15/-, including Purchase Tax. Packing and carriage 10/- extra. Strongly recommended as a Radiogram Chassis in conjunction with Cabinet, illustrated above.

**ALUMINIUM CHASSIS.**—Substantially made of bright aluminium, with four sides, 10 in. x 8 in. x 2½ in. 7/-; 12 in. x 8 in. x 2½ in. 7/9; 16 in. x 8 in. x 2½ in. 8/6; 20 in. x 8 in. x 2½ in. 10/6; 22 in. x 10 in. x 2½ in. 13/4.

**TYPE 103.** Rotary Transformer. Normal rating is 19 v. D/C input. Output 300 volts 30 m/a and 6.5 volts 3 a. D/C. By applying between 200 and 250 volts D/C to the H/T output side, the two low-tension windings may be used to charge accumulators. The 19-volt side will charge a 6-volt accumulator at 2-3 amperes, the 6.5 side a 2-volt accumulator at 1-2. With a 12-volt input to the 19-volt side, 180 v. at 30 m/a, and 4 v. at 3 a. may be obtained. With a 6-volt input to the 6.5 side, 160 v. at 30 m/a may

## RADIOGRAM CABINETS



Dignified appearance and good workmanship. Size: 31 in. high, 18 in. deep, 33 in. wide. Cabinet only £28, with motor and pick-up, £32/16/-. With record changer, £42/16/-.

be obtained. By extending the spindle which is flush with the frame and applying 200 to 250 v. D/C mains to the 300 v. side, the unit becomes a powerful high-speed electric motor, suitable for small drilling machines, etc. Similarly, it may be used with 6 or 12 v. input to the 6.5-v. or 19-v. side. It employs a powerful ring magnet and is of substantial construction costing originally over £5. A fortunate purchase enables us to offer these fine units at 10/-.

**PHILLIPS' AMPLIFIERS.** Military surplus, sealed condition, consist of Metal Case containing complete output stage for Mobile Amplifier, Push-Pull EL35 (similar 6L6) valves, Vibrator Pack giving 220 v. 80 m/a incorporated, includes Output Transformer. Only requires addition of pre-amplifier; no circuit available. Can be supplied for 6 or 12-volt operation, price 35/-, or with two EL35 and one 0Z4, 70/-. Also available with ECO 31 Phase Inverter Stage, 45/-, or with 4 valves, 92/6.

**2-VALVE SHORT-WAVE BATTERY KIT.** A complete kit of parts for a 2-valve receiver, covering 16-600 metres, including valves, coils, drilled chassis, H.T. and L.T. dry batteries to last approximately 6 to 12 months. A pair of double headphones and full instructions. Price £3/10/-. An extra coil can be supplied, covering 600-1,900 metres at 4/-.

**PERMANENT MAGNET HORN LOUD-SPEAKERS.** Handle 8 watts. Weatherproof. Complete with spring bracket, horn mouth, 35 x 13½, 35 in. deep. Solved but unused. Usual price £12. To clear at £3/10/-.

**500 MICROAMP METERS.** Moving-coil. 2 in. diameter flush mounting. Available by the following manufacturers. Met-Vick 500 ohms, Ferranti 79 ohms, Weston 116 ohms. Either type, 21/-. Special quotations for quantities. The following accessories are available to convert the above meter into a multimeter. Set of 6 multipliers plus/minus 2½% to read 10 v., 50 v., 100 v., 250 v., 1,000 v., 7/6 the set. Bridge Type Meter Rectifier 10/-.

Separate 0-10,000 ohms scale chart, 1,000 ohm Preset Resistance and Fixed Resistor to convert meter into ohm-meter with 1½ v. battery, 3/6.

**VIBRATOR POWER PACES.** Type 301. Input 12 v. D.C., output 250 v. 50 cycles 30 w/a. In steel case with complete noise suppression. Price 45/-.

Type 302. Input 6 volts, output 150 v. 25 m/a. In steel case, with complete smoothing. 40/-.

Type 303. Input 12 volts, output 300 v. 100 m/a. In steel case, with noise suppression, no smoothing. Price 42/6.

Type 308. 12 v. input, output 150 v. 40 m/a. In steel case, combined with single valve amplifier (no valve supplied). Price 35/-.

**MAINS TRANSFORMERS.** Government surplus. All 230 v. input. Type 8. 6 v. 10 a. and 4 v. 10 a., 10,000 v.

insulation, 15/-.

Type 9. 1,500 v. 10 m/a., 1,500 v. 10 m/a., 2 v. 2 a., 2 v. 2 a., 4 v. 2-3 a., 25/-.

Half-wave Rectifiers for same (two required).

**1947 MODEL A/C/D/C AMPLIFIERS.** 5 watts output. Super quality three stage push-pull. Suitable for mike or pick-up. In steel cabinet, £8/6/-.

**GRAMPHONE PICK-UPS.**

Rothermel Senior Crystal Pick-up, £2/16/3.

Cosmocord Crystal Pick-up, £1/17/-.

Goldring Magnetic Pick-up, £1/10/6.

**CRYSTAL SETS.** With permanent detector in neat bakelite case, complete with aerial wire and 'phones, £1/-.

**SPECIAL OFFER.** P.M. Loudspeakers. 6 in., 15/-; 6½ in., 17/6; 8 in., 20/-; 10 in., 30/-.

**OUTPUT TRANSFORMERS** for any of above, 5/-.

**I.F. TRANSFORMERS.**—Iron core. Htz wound, with or without flying lead, 460/465 k/c., 7/6 each. Miniature type, 1 in. x 1 in. x 2 in., 8/9.

**PREMIER MAINS TRANSFORMERS.** All primaries are tapped for 200-230-250 v. mains 40-100 cycles. All primaries are screened. All LTBs are centre tapped.

List No.	Output.	Price
SP.175A.	175-0-175 v. 50 m/a. 6.3 v. 2-3 a. 5 v. 2 a.	25/-
SP.175B.	175-0-175 v. 50 m/a. 4 v. 1 a. 4 v. 2-3 a.	25/-
SP.250A.	250-0-250 v. 60 m/a. 6.3 v. 2-3 a. 5 v. 2 a.	25/-
SP.250B.	250-0-250 v. 60 m/a. 4 v. 1-2 a., 4 v. 3-5 a.	25/-
SP.300A.	300-0-300 v. 60 m/a. 6.3 v. 2-3 a., 5 v. 2 a.	25/-
SP.300B.	300-0-300 v. 60 m/a. 4 v. 2-3 a., 4 v. 3-5 a., 4 v. 1-2 a.	25/-
SP.301A.	300-0-300 v. 120 m/a. 5 v. 2-3 a., 6.3 v. 3-4 a.	28/-
SP.301B.	300-0-300 v. 120 m/a. 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-5 a.	28/-
SP.350A.	350-0-350 v. 100 m/a. 5 v. 2-3 a., 6.3 v. 2-3 a.	29/-
SP.350B.	350-0-350 v. 100 m/a. 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-5 a.	29/-
SP.351.	350-0-350 v. 150 m/a. 4 v. 1-2 a., 4 v. 3-5 a., 4 v. 1-2 a., 4 v. 1-2 a.	36/-
SP.351A.	350-0-350 v. 150 m/a. 4 v. 2-3 a., 4 v. 3-6 a., 4 v. 1-2 a., 4 v. 1-2 a.	39/-
SP.352.	350-0-350 v. 150 m/a. 5 v. 2-3 a., 6.3 v. 2-3 a., 6.3 v. 2-3 a.	36/-
SP.375A.	375-0-375 v. 250 m/a. 6.3 v. 2-3 a., 6.3 v. 3-5 a., 5 v. 2-3 a.	46/-
SP.375B.	375-0-375 v. 250 m/a. 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-6 a.	46/-
SP.425A.	425-0-425 v. 200 m/a. 6.3 v. 2-3 a., 6.3 v. 2-5 a., 5 v. 2-3 a.	47/-
SP.425B.	425-0-425 v. 200 m/a. 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-6 a.	47/-
SP.501.	500-0-500 v. 150 m/a. 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-5 a.	47/-
SP.501A.	500-0-500 v. 150 m/a. 5 v. 2-3 a., 6.3 v. 2-3 a., 6.3 v. 2-3 a.	50/-
SP.503.	500-0-500 v. 250 m/a. 5 v. 2-3 a., 6.3 v. 2-3 a., 6.3 v. 3-5 a.	65/-

**BATTERY CHARGE KITS.** All incorporate metal rectifiers, input 200-250 v. AC. 40/100 cycles.

To charge 2 v. accumulator at 1 amp.	15/-
" " 6 v. " " 1 amp.	17/8
" " 12 v. " " 1 amp.	22/6
" " 6 or 12 v. " " 4 amp.	22/6
Complete with variable resistance and meter	£3/10/0
To charge 6 or 12 v. Accumulator at 6 amps. ditto	£5/0/0

**CIRCLE CUTTER.** Used with ordinary hand brace will cut circles between ½ in. and 3½ in. in diameter in aluminium or steel up to 16 gage. 4/6.

**CO-AXIAL CABLE.** Super quality cable, consisting of a centre copper core (stranded), a Low-Loss Ribbed polyvinyl resin type insulation, a flexible screen, a weatherproof P.V.C. outer cover.

Used with the thing for television lead-in, super mike cable, etc., 80 ohms impedance, 6d. per foot.

**TWIN, DIODE, 1/- per foot.**

**2-VALVE SHORT WAVE BATTERY KIT.** A complete Kit of Parts for a 2-valve receiver, covering 16-600 metres, including valves, coils, drilled chassis, H.T. and L.T. dry batteries to last approximately 6 to 12 months. A pair of Double Headphones and full instructions. Price £3/10/0.

An Extra Coil can be supplied, covering 600-1900 metres at 4/-.

# TELEVISION E.H.T. SUPPLY

## Use of Line-Deflection Fly-Back

By

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

WHEN electromagnetic deflection is used the anode of the valve which feeds the line-deflector coils has a peak potential of several thousand volts developed on it. This is an unavoidable by-product of deflection and the voltage arises because the current must necessarily change rapidly on the fly-back and the circuit is inductive. Normally, this voltage serves no useful purpose but it so

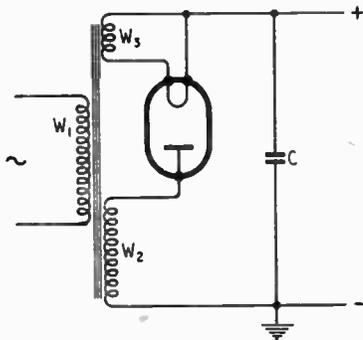


Fig. 1. Conventional half-wave rectifier for E.H.T. supply from a sine-wave input voltage such as the mains.

happens that the C.R. tube requires a steady voltage of the same order of magnitude for its dial anode and it is possible to derive this from the fly-back voltage.

There are several advantages in so doing. The conventional E.H.T. (extra-high tension) supply has a circuit like that shown in Fig. 1 whereas with a supply from the line fly-back an arrangement such as that of Fig. 2 can be employed. Here only  $V_2$ , C and the winding  $W_3$  are additional to the line-scan circuit. The mains transformer of Fig. 1 is saved and on account of the much higher operating frequency the reservoir capacitance C need have only 1/200 of the value required with a mains supply. This not only reduces the cost, but makes for increased safety, because the quantity of electricity stored in C is proportional to its capacitance.

The rectifier in Fig. 2 works

with an input of pulse waveform and the peak voltage across it when it is non-conducting is but little greater than the output voltage across C. With a rectifier fed from a sine-wave input as in Fig. 1, however, the peak inverse voltage on the rectifier is about twice the output voltage. Because of this the circuit of Fig. 2 enables a lower-voltage rectifier to be used for a given output and also, in some cases, eases the insulation problem in the transformer.

In these days of shortages, the saving of copper and iron effected by deriving the E.H.T. supply from the line fly-back is of considerable importance. However, simple though the circuit of Fig. 2 may appear, it requires very careful design if satisfactory results are to be obtained, and there is a very definite limit to the maximum voltage economically to be obtained from it.

The difficulties which arise are not in connection with the rectifier circuit but lie in the transformer. They arise because the voltage inevitably occurring on the anode of  $V_1$  is rarely much more than one-half of that needed for E.H.T. Because of this the winding  $W_3$  is added to give a step-up of voltage for the rectifier. The windings  $W_1$  and  $W_3$  act as an auto-transformer of ratio  $(W_1 + W_3)/W_1$ .

The rectifier circuit, as such, does not appreciably load the scanning circuit because the output power needed by the C.R. tube is exceedingly small. It is an experimental fact that if the scanning waveform is observed on an oscilloscope, the connection and disconnection of the rectifier causes no observable change in the amplitude or waveform of the scan.

The practical difficulties in using the circuit of Fig. 2 all lie in the circuit capacitance of which the transformer self-capacitance is the

major item. The importance of this capacitance was stressed in an earlier article<sup>1</sup> dealing with the amplifier but it is much more important here because the transformer ratio between the whole primary  $W_1 + W_3$  and the secondary  $W_2$  is greater than in an amplifier. The latter would not have  $W_3$  and the ratio would be  $W_1$  to  $W_2$  only.

The self-capacitance of a transformer winding does not vary very much with the number of turns. If an increase of turns results in an increase in the number of layers or sections, then the capacitance will fall as the turns increase. In general, however, if the form of construction remains the same the self-capacitance falls quite slowly as the turns increase. This is especially so when the primary and secondary windings are interleaved, for then quite a large part of the self-capacitance is interwinding capacitance.

Now if a 2 : 1 step-up is needed for E.H.T.  $W_1$  and  $W_3$  will have equal turns and  $W_1$  and  $W_2$  will be the same as if  $W_3$  were absent. If the total self-capacitance

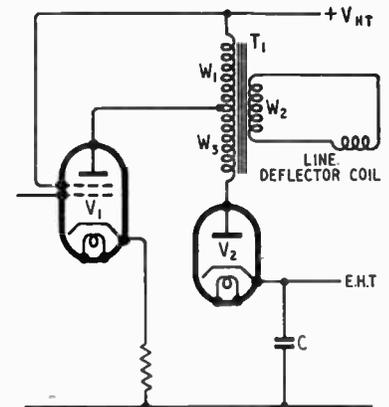


Fig. 2. The basic arrangement for obtaining E.H.T. from the line time base involves the addition of  $W_3$ ,  $V_2$  and C to the time base.

measured across  $W_1$  and  $W_3$  is the same as that across  $W_1$  alone

<sup>1</sup> "Electromagnetic Deflection," by W. T. Cocking, *Wireless World*, July, 1946, Vol. 52, p. 217.

**Television E.H.T. Supply—**

when  $W_3$  is absent, then the capacitance effectively across  $W_1$  with  $W_3$  present is four times as great. If we consider an amplifier circuit which produces across  $W_1$  a peak voltage of one-half the required value of E.H.T. and the capacitance has the maximum permissible value for the required fly-back time, then when  $W_3$  is added to produce the required voltage the transformer must be re-designed so that the total capacitance across  $W_1 + W_3$  is one-quarter of its previous value.

It is this capacitance which, in practice, proves the only real limitation on taking the E.H.T. supply economically from the line fly-back voltage. Most of the relevant circuit equations were given in an appendix to the article already referred to, but some of them were not in the best form for the present purpose. In particular, it is necessary to take into account the fact that while the E.H.T. voltage is directly proportional to the deflector-coil current, the current required for a given deflection is proportional to the square root of the E.H.T. voltage.

Unless it is properly allowed for, this is liable to cause confusion in design, for while there is little or no tolerance on the deflection there is usually considerable latitude in the E.H.T. voltage. An increase in the latter from 5 kV to 6 kV, for instance, results

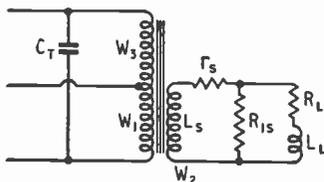


Fig. 3. The equivalent circuit of Fig. 2;  $R_L$  and  $L_L$  are the constants of the deflector coil.

in quite a small improvement in picture brightness and definition; but reduces the picture width from 7.5 in to 6.8 in which is very noticeable. Picture width must be maintained, but in economical design it is often permissible to adopt a value of E.H.T. rather different from the original target figure.

All the equations necessary for the design of an amplifier providing

E.H.T. and scan are given in the appendix and are based on the equivalent circuit of Fig. 3. Equation (1) gives a value for the transformer secondary inductance which will give an adequately linear scan provided that the current supplied to the trans-

former by the valve is itself linear. In practice, valve and transformer distortion are inverse and a lower value for  $L_S$  is then permissible. This is especially the case if negative-current feed-back from the transformer secondary is used;  $L_S$  can then be as low as three times the deflector-coil inductance without introducing excessive non-linearity.

As far as  $E_{HT}$  is concerned equation (14) clearly shows the fundamental limitations. It is instructive to take an actual case with typical circuit values such as, those listed in Table 1. Taking the rectifier voltage efficiency  $\eta$  as 0.95 for the half-wave rectifier of Fig. 2, and inserting values in equation (14) we get  $E_{HT} = 75,000/C_T$ . A typical value of  $C_T$  is 50 pF, for which  $V_{HT} = 1,500$  V.

The values taken are typical of a reasonably good transformer; that is, reasonably good from the scanning point of view. Its efficiency is given by (13) as  $\eta_T = 0.65$ . This means that the valve must provide  $1/0.65 = 1.54$  times more volt-mA than are actually needed in the deflector coil itself.

With a given tube and deflector coil assembly there are three ways only of increasing  $E_{HT}$ . The first is to reduce  $C_T$ . If  $E_{HT}$  is to be 5.5 kV,  $C_T$  must be reduced to about 15 pF only; as possibly up to 10 pF of the total is provided by elements outside the transformer this really means reducing the self-capacitance of this component from 40 pF to 5 pF, which is almost impossible.

The second method is to increase the factor  $a$  which means increasing the transformer secondary inductance  $L_S$  or reducing  $k$  or both so that the leakage inductance is increased. To obtain 5.5 kV with

$C_T = 50$  pF, we must increase  $a$  to some 3.9 and then  $\eta_T$  drops to 0.13 for the same value of  $L_S$ . The provision of E.H.T. has involved an increase in the volt-mA supplied by the valve of  $0.63/0.13 = 4.85$  times. As it is usually quite

difficult to obtain sufficient output for the scan alone, one cannot view with equanimity the need for providing such an enormous increase.

It is to be noted that the first and second methods would, in practice, be applied simultaneously. The transformer windings would be arranged for the minimum possible self-capacitance and some reduction of the coupling coefficient would be helpful in achieving this. By reducing capacitance and transformer efficiency together a practicable compromise can be reached. Some increase in the secondary inductance  $L_S$  will also be helpful, but the transformer efficiency is still below that obtainable when E.H.T. is not taken from the fly-back.

There is a third possibility, however, which has very much to commend it. This is the use of a voltage-multiplying rectifier circuit. With a voltage-doubler, for instance, the voltage efficiency of the rectifier,  $\eta$  becomes 1.8 instead of 0.95 and the immediate result is that the permissible capacitance is increased by  $(1.8/0.95)^2 = 3.6$  times. With a capacitance of 50 pF and other values as before the maximum value of  $E_{HT}$  becomes 5,400 V.

It is to be noted that this is not an ideal theoretical figure. The values adopted in computing it are typical ones derived from the measurement of actual components and, in practice, the writer has had no difficulty in securing measured outputs up to 8 kV. More could no doubt have been obtained, but as the voltage ratings of some of the components in use were already being exceeded it was considered wiser not to attempt it!

Using the voltage-doubler  $W_3$  in Fig. 2 is usually unnecessary; a 1:1 ratio between the valve and the E.H.T. circuit, or even a step-down ratio, is used.

TABLE I.

$L_L = 8.9$ mH; $k = 0.98$
$L_S = 33$ mH; $k_1 = 1.53$
$R_L = 15 \Omega$ ; $k_2 = 1.08$
$r_s = 8 \Omega$ ; $a = 1.148$
$d = 7.5$ in; $1/T_L = 1.68$

The equations in the appendix contain all the information needed to determine approximate circuit values for both the E.H.T. and deflector parts of the circuit. They are derived on the assumption that the circuit will be damped mainly by a resistance in shunt with the transformer primary or secondary. However, it is found that the scanning efficiency can be increased by something like 20 per cent if a capacitance is inserted in series with the damping resistor. This modifies the shape of the fly-back somewhat and so effects the peak voltage. The value of E.H.T. obtained with this method of damping is of the order of 10 per cent less, so that

needed to give a convenient deflection with any convenient tube voltage;  $k_2$  is then determined from equation (2). In the case being considered it has the value 1.08. With the above values  $1/T_L = 1.68$  and so from equations (2), (3a) and (11) we have  $I = 600$  mA p-p,  $E_L = 68$  V and deflection V-mA = 40,800.

Before we can proceed further it is necessary to know  $a$  and to determine this we must know the transformer secondary inductance  $L_S$  and the coupling coefficient  $k$ . It will often be necessary to try a number of different values and afterwards to see whether it is possible to build a transformer which possesses them. It is here that experience of transformer design is most helpful.

For the purpose of this example we shall take  $L_S = 33$  mH and  $k = 0.98$  with  $r_S = 8\Omega$ , all as in Table I. The results of working through the equations is shown in Table II for two different values of  $\eta$ , 0.95 and 1.8 corresponding to half-wave and voltage-doubler rectifiers respectively.

With the former  $C_T$  comes out at 14.7 pF only and it is almost certainly impracticable to achieve such a low value. With the voltage-doubler, however,  $C_T$  is 52 pF and it is by no means difficult to achieve this.

The remaining equations enable the transformer ratio  $n_1$  to be calculated. This depends on the operating conditions of the amplifier valve and will vary according to whether it is more convenient to operate at high current and low voltage or vice versa. It is quite independent of the E.H.T. circuit and is exactly the same if E.H.T. is taken directly from the mains instead of from the fly-back.

Suppose the amplifier H.T. supply is fixed at 350 volts and  $E_a$  is 70 V, then  $\Delta E_a = 280$  volts and from (7)  $n_1 = 3.5$ . From (12)  $\Delta i_a$  is 224 mA p-p. It might, however, be more convenient to operate with a lower current—say  $\Delta i_a = 150$  mA.

In this case we should have from (12)  $\Delta E_a = 418$  V and so with  $E_a = 70$  V, (15) gives

$V_{HT} = 488$  V and (7) gives  $n_1 = 5.24$ . With this ratio it is necessary to check from (9a) that it results in a practicable value of  $C_T$ ; it works out at  $C_T = 30.5$  pF and there will be great difficulty in achieving it.

TABLE II.	
Values of Table I	$E_{HT} = 5.5$ kV.
By equation—	
(2)	$I = 600$ mA
(3a)	$E_L = 68$ V.
(11)	Deflection V-mA = 40,800
(4a)	$E = 80$ V
(5a)	$V = 765$ V
(13)	$\eta_T = 0.65$
(12)	Amplifier Output = 62,600 V-mA.
With $\eta = 0.95$	
By equation—	
(6)	$n_2 = 7.55$
(9a)	$C_T = 14.7$ pF.
(10)	$R_{1s} = 2.71$ k $\Omega$
With $\eta = 1.8$	
By equation—	
(6)	$n_2 = 4$
(9a)	$C_T = 52$ pF.
(10)	$R_{1s} = 2.71$ k $\Omega$

when it is used the transformer ratio  $n_2$  should be about 10 per cent greater than the calculated value. An exact design procedure with this method of damping is quite difficult, for the equations become very involved.

The proper procedure is to regard the design equations as enabling good approximations to the final values to be obtained, but it will usually be necessary to make some experimental adjustment to them.

As an example of their use, suppose that it is desired to operate a 9-in tube at 5.5 kV and to have a deflection of 7.5 in with a deflector coil having  $L_L = 8.9$  mH and  $R_L = 15\Omega$ . It is necessary to know the factor  $k_2$  and this can be determined by setting up the tube and deflector coil and measuring the current

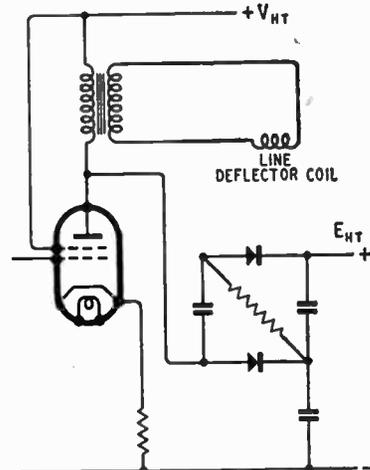


Fig. 4. Voltage-doubler rectifier circuit which greatly eases transformer design.

In most practical cases  $\Delta i_a$  is of the order of 200 mA and  $V_{HT}$  is around 400 V. This usually leads to a transformer ratio of the order of 4 for  $n_1$  and rather less for  $n_2$ . The circuit takes the form shown in Fig. 4 where metal rectifiers are used in place of valves since no cathode-heating supply is required.

As this voltage-doubler circuit adopted is not well known some explanation of its operation may be advisable, and it is more easily understood from Fig. 5 in which valve rectifiers are shown.

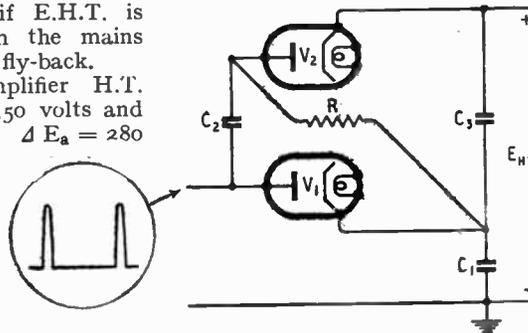


Fig. 5. The basic voltage-doubler circuit.

The input waveform consists of a series of pulses, as shown in

**Television E.H.T. Supply—**

Fig. 5. First of all, consider  $V_1$  and  $C_1$  alone. In effect,  $V_1$  acts as a switch which closes when its anode becomes more positive than its cathode on a pulse, and opens when it becomes negative. The pulse, therefore, makes  $V_1$  conductive and charges  $C_1$  through it. At the end of a pulse the input terminal returns to a potential close to that of earth and remains there during the scan stroke of the time-base. The cathode of  $V_1$ , however, is held positive by the charge accumulated on  $C_1$  so that  $V_1$  is non-conductive.

The load circuit draws current from  $C_1$  and it consequently loses charge; during the scan period, therefore, the voltage across it falls. The amount of the fall of voltage depends on the capacitance, the load current, and the scanning period, and it can be made very small by making the capacitance sufficiently large;  $0.001 \mu\text{F}$  is usually sufficient.

The other components  $C_2$ ,  $C_3$ ,  $R$ , and  $V_2$  must now be considered. Assume that at the end of the fly-back  $C_2$  and  $C_3$  are charged to equal voltages which are less than the voltage on  $C_1$ . Then when  $V_1$  becomes non-conductive  $V_2$  does so also, for since the voltages on  $C_2$  and  $C_3$  are equal and there is no input, its cathode is positive with respect to its anode by the voltage on  $C_1$ .

Since the voltage on  $C_2$  is less than that on  $C_1$ , during the scanning period  $C_2$  charges from  $C_1$  through  $R$ , so that the voltage across  $C_2$  rises during this period. At the same time  $C_1$  and  $C_3$  act in series to supply the load current and the output voltage is the sum of their individual voltages. The voltages across both  $C_1$  and  $C_3$  fall during the scan; that on  $C_3$  falls because it supplies current to the load and that on  $C_1$  because it supplies both load current and the charging current for  $C_2$ .

On the fly-back pulse,  $V_1$  becomes conductive, as before, and  $C_1$  is charged by the pulse. Also with  $V_1$  conductive  $C_2$  is virtually joined to the junction of  $C_1$  and  $C_3$ . But the voltage on  $C_2$  is now greater than that on  $C_3$ , for they were initially equal and the one capacitor has been charging and the other has been discharging. Therefore,  $V_2$

becomes conductive and  $C_2$  and  $C_3$  are virtually in parallel. There is then a redistribution of charge between them and the voltages across them become nearly equal, the voltage across  $C_2$  falling and that across  $C_3$  rising.

Briefly, the action is:  $C_1$  charges from the source during fly-back and  $C_3$  is charged from  $C_2$ . During the scan,  $C_2$  charges from  $C_1$ , and  $C_1$  and  $C_3$  act in series to supply the load current.

It has been found experimentally that the output voltage is about 1.8 times the peak input voltage with the normal load current of a cathode-ray tube. All capacitors can be of  $0.001 \mu\text{F}$  capacitance with a resistor  $R$  of  $2 \text{ M}\Omega$ . No component is subjected to a voltage of much more than one-half the output voltage. The voltage on  $V_1$  and  $C_1$  is actually at 55 per cent of the output.

One practical difficulty which arises with the circuit of Fig. 5 is the need for two well-insulated windings for the heaters of  $V_1$  and  $V_2$ . That for  $V_2$  must withstand the full output voltage and that for  $V_1$  about one-half of it. This is very easily overcome, however, by using metal rectifiers. The circuit then has the form shown attached to the scanning circuit in Fig. 4 and the writer has found it to function extremely well.

Before concluding it may be as well to list a number of the more important fundamental facts about the scanning circuits which the writer has found particularly helpful in experimental work.

1. If the transformer ratio between amplifier and E.H.T. circuits is maintained constant and if the current ( $\Delta i_a$ ) supplied by the amplifier is also kept constant, then changing the transformer ratio ( $n_1$ ) between amplifier and deflector coil has no effect on the picture width, but the E.H.T. voltage varies as the square of the transformer ratio and the amplifier H.T. voltage needed varies nearly as the square of the ratio.

Thus, suppose that with  $n_1 = 3$ , the full scan is obtained with 4 kV for E.H.T., the amplifier H.T. supply is 300 volts, and it is desired to operate at 6 kV. The valve is presumed to be working at its maximum current output.

By making  $n_1 = 3\sqrt{6/4} = 3.67$  and increasing the H.T. supply to  $300 \times 6/4 = 450 \text{ V}$ , about, the required output can be secured.

2. For a constant amplifier H.T. supply and for constant E.H.T. an increase of deflection beyond the maximum obtainable with a given transformer ratio  $n_1$  necessitates a change of transformer ratio inversely proportional to the deflection and an increase of current proportional to the square of the deflection.

Thus, to take a common example, suppose that the scan obtainable is 6 in only and  $7\frac{1}{2}$  in is required, the H.T. supply to the amplifier cannot be altered. What is to be done?

Reduce the transformer ratio to  $6/7.5 = 0.8$  of its present value and increase the current supplied to it by  $(7.5/6)^2 = 1.56$  times.

This applies whether or not E.H.T. is taken from the fly-back. In the former case it is still unchanged if the transformer ratio between the amplifier and the E.H.T. circuit is kept the same.

3. If E.H.T. is taken from the fly-back and all the transformer ratios are kept constant the deflection volt-amps needed are proportional to the fourth power of the deflection.

Thus, if a 7.5 in picture is required and only 7 in is obtained and the transformer ratios cannot be altered it is necessary to increase the output of the valve by  $(7.5/7)^4 = 1.32$  times. This will demand an increase of current and H.T. voltage of  $(7.5/7)^2 = 1.15$  times each.

4. For a constant scan/fly-back ratio, the deflection volt-amperes needed are proportional to the number of scanning lines per second.

Thus a change in the transmission from 405 lines to 1,000 lines would need an increase in the deflection volt-mA of  $1,000/405 = 2.47$  times, which is not inconsiderable.

5. When E.H.T. is taken from the fly-back, the voltage obtainable for a given deflection, tube and deflector coil assembly is inversely proportional to the circuit capacitance and directly proportional to the transformer leakage inductance and to the square of the E.H.T. rectifier voltage efficiency.

APPENDIX.

Symbols.

- $a = 1 + 2(1 - k) L_8 / L_L$
- $C_T$  = total effective capacitance in shunt with the whole primary.
- $d$  = total deflection on screen of C.R. tube.
- $E$  = maximum voltage developed across  $L_1$  on scan.
- $E_a$  = minimum permissible anode-cathode voltage of amplifier valve on scan.
- $\Delta E_a = n_1 E$  = maximum voltage developed across  $L_p$  on scan.
- $E_{HT}$  = final anode operating voltage of C.R. tube.
- $E_L$  = maximum voltage developed across  $L_L$  on scan.
- $I$  = current (peak-to-peak) through  $L_L$ .
- $i = I/n_1$  = current (p-p) in  $L_p$ .
- $i_a$  = mean anode current of amplifier valve.
- $\Delta i_a$  = saw-tooth current (p-p) supplied by amplifier valve.
- $k$  = coupling coefficient of transformer =  $M/\sqrt{L_p L_8}$
- $k_1 = 1 + r_8/R_L$
- $k_2$  = deflection efficiency factor (see below).
- $L_L$  = deflector-coil inductance.
- $L_p$  = transformer primary inductance.
- $L_8$  = transformer secondary inductance.
- $L_1 = L_L + 2L_8(1 - k)$ .
- $M$  = mutual inductance between primary and secondary.
- $n$  = turns ratio (whole primary)/(whole secondary  $W_2$ ).
- $n_1$  = turns ratio (amplifier winding)/(whole secondary  $W_2$ ).
- $n_2$  = turns ratio (E.H.T. primary)/(whole secondary  $W_2$ ).
- $R_{18}$  = Shunt damping resistance across secondary  $W_2$ .
- $R_L$  = deflector-coil resistance.
- $R_8 = R_L + r_8$  total secondary circuit resistance.
- $r_8$  = transformer secondary winding resistance (Note: the value to be used is double the measured value to allow approximately for the primary winding resistance which is otherwise neglected).
- $T_1$  = total scan time.
- $T_2$  = total fly-back time.
- $T_L = L_L/R_L$  = time constant of deflector coil.
- $V$  = maximum peak voltage on fly-back across  $L_1$ .
- $V_a = n_1 V$  = maximum peak voltage on fly-back on amplifier anode.

$V_{HT}$  = H.T. voltage of amplifier.  
 $\eta$  = E.H.T. rectifier voltage efficiency.  
 $\eta_T$  = transformer efficiency.

The factor  $k_2$  is determined for a given C.R. tube and deflector-coil assembly by measuring the current  $I'$  needed to produce a deflection  $d'$  when operating at a voltage  $E'_{HT}$ .  
 then  $k_2 = \frac{I'}{d' \sqrt{E'_{HT}}}$

It is to be noted that  $L_L, T_L$  and  $k_2$  are not independent variables. In general,  $L_L$  cannot be changed without affecting the current needed for a given deflection and, so, without affecting the value of  $k_2$ . Throughout the following equations  $L_L, T_L$  and  $k_2$  are to be treated as constants specifying the characteristics of the tube and deflector coil in combination. The units are: volts, mA,  $\Omega$ , mH,  $\mu$ sec, pF, in.

$L_8$	= $4.2 R_8 \dots \dots \dots$	(1)
$I$	= $dk_2 \sqrt{E_{HT}} \dots \dots \dots$	(2)
$E_L$	= $\frac{IL_L}{T_1} \left[ 1 + 0.001 \frac{T_1}{2T_L} \right] \dots \dots \dots$	(3)
	= $0.0119 IL_L [1 + 0.042/T_L] \dots \dots \dots$	(3a)
	when $T_1 = 84.5 \mu$ sec.	
$E$	= $\frac{IL_L}{T_1} \left[ a + 0.001 k_1 \frac{T_1}{2T_L} \right] \dots \dots \dots$	(4)
	= $0.0119 IL_L [a + 0.042 k_1/T_L] \dots \dots \dots$	(4a)
	when $T_1 = 84.5 \mu$ sec.	
$V$	= $1.8 a IL_L/T_2 \dots \dots \dots$	(5)
	= $0.122 a IL_L \dots \dots \dots$	(5a)
	when $T_2 = 14.8 \mu$ sec.	
$E_{HT}$	= $n_2 \eta V \dots \dots \dots$	(6)
$\Delta E_a$	= $n_1 E \dots \dots \dots$	(7)
$\Delta i_a$	= $\frac{I}{n_1} \left[ 1 + a \frac{L_L}{L_8} + \frac{R_8}{R_{18}} \right] \dots \dots \dots$	(8)
	$\approx \frac{I}{n_1} \left[ 1 + a \frac{L_L}{L_8} \right] \dots \dots \dots$	(8a)
$n$	= $6.2 T_2 / \sqrt{a L_L C_T} \dots \dots \dots$	(9)
	= $92.4 / \sqrt{a L_L C_T} \dots \dots \dots$	(9a)
	when $T_2 = 14.8 \mu$ sec.	
$R_{18}$	$\approx 2.25 \times 10^8 / (n^2 C_T) \dots \dots \dots$	(10)
Deflection Volt-mA = $E_L I = I^2 \frac{L_L}{T_1} \left[ 1 + 0.0005 \frac{T_1}{T_L} \right] \dots \dots \dots$ (11)		
Volt-mA supplied by valve		
	= $\Delta E_a \Delta i_a = I^2 \frac{L_L}{T_1} \left[ a + 0.0005 k_1 \frac{T_1}{T_L} \right] \left[ 1 + a \frac{L_L}{L_8} \right] = E_L I / \eta_T$ (12)	
	$\eta_T = \frac{1}{(a + 0.0005 k_1 T_1 / T_L)(1 + a L_L / L_8)}$ (13)	
Combining (2), (5), (6) and (9),		
$E_{HT}$	= $125 (\eta d k_2)^2 a L_L / C_T \dots \dots \dots$	(14)
$V_{HT}$	= $E_a + \Delta E_a \dots \dots \dots$	(15)
By expanding (13) in terms of $L_L/L_8$ and $k$ , differentiating and equating to zero a relation between $L_L/L_8$ and $k$ which makes $\eta_T$ a maximum can be found. It is:—		
$\frac{L_L}{L_8}$	= $\sqrt{\frac{2(1-k)(1+2(1-k))}{1+0.0005 k_1 T_1 / T_L}} \dots \dots \dots$	(16)
and with this value		
$a$	= $1 + \sqrt{\frac{2(1-k)(1+0.0005 k_1 T_1 / T_L)}{1+2(1-k)}} \dots \dots \dots$	(17)
and then the optimum efficiency is		
$\eta_T$	= $\frac{1 + 0.0005 T_1 / T_L}{[\sqrt{2(1-k)} + \sqrt{(1+0.0005 k_1 T_1 / T_L)(1+2(1-k))}]^2} \dots \dots \dots$	(18)

# RECEIVER REMOTE CONTROL

## Use of the Extension Loudspeaker Leads

By J. F. O. VAUGHAN,  
Grad.I.E.E.

THE extension loudspeaker is a familiar sight in homes today, and in many instances it offers a cheap and satisfactory alternative to a second receiver. Some kind of volume control is often fitted to it, but it is very rare indeed to find that any provision is made for switching the set on or off from the remote point. This is a serious disadvantage but one which is not difficult to overcome. The facility is provided by the remote control system described in this article, and it does it without requiring any additional wires between the receiver and the extension loudspeaker. The writer has had the system in use since 1942, and it has needed negligible maintenance.

The basic circuit is shown in Fig. 1, and it will be seen that blocking capacitors are inserted in one extension loudspeaker lead; one at the receiver end and the other at the loudspeaker. The extension leads can then be used to carry a unidirectional control current as well as the speech currents. The insertion of the capacitors theoretically introduces some loss of bass which depends on their capacitance and on the output impedance of the receiver. In the writer's case, the set had a pentode output valve with-

were found to be adequate, the loss of bass being barely perceptible.

In the case of an output stage with negative voltage feedback, or one employing triodes, the circuit impedance is low, and in the limit when the set impedance is zero, an effective capacitance of  $50 \mu\text{F}$  causes a loss of 18 db at 100 cycles. In such cases the value of the capacitors will have to be greatly increased. It is sug-

high impedance, with the usual  $1\frac{1}{2}$  to 3 ohms extension loudspeaker, not appreciably to bypass the audio signals. The writer has tried inserting a low-resistance choke in series with the relay, and by-passing the latter with an electrolytic capacitor. This helps, but is not necessary unless a very high audio output is required from the extension loudspeaker. The trouble then is not the attenuation caused by the

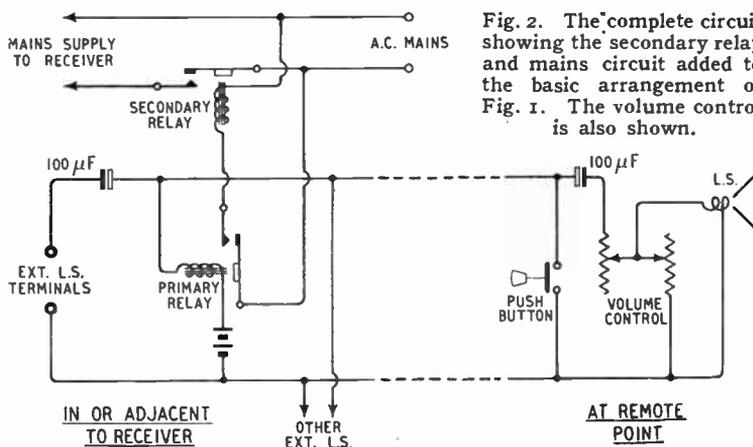


Fig. 2. The complete circuit showing the secondary relay and mains circuit added to the basic arrangement of Fig. 1. The volume control is also shown.

gested, however, that the aural test should be the deciding factor.

Referring to Fig. 1, in normal use the push-button contacts are open, the battery merely maintains a polarizing voltage across the two capacitors, and the audio signal from the radio set passes through them to the loudspeaker.

The relay is of the type which

relay but the fact that low signal frequencies rattle the relay, which may consequently send false signals to the controlled circuits. For normal levels, such a refinement is not needed.

The use of a battery is open to criticism, but the alternatives are complicated and wasteful of power. An ordinary twin-cell cycle-lamp battery usually lasts more than twelve months, and is cheap and easy to replace. The contacts at the loudspeaker are only closed when the actual operation of switching on or off is being performed; no power is taken from the battery at other times.

The relay shown in Fig. 1 is not used to carry out the actual switching operation itself, but to control another relay which performs this function. This secondary relay must alternately make and break a circuit at successive

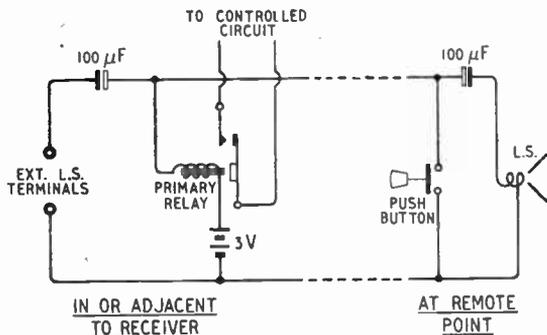


Fig. 1.—The basic remote-control circuit. Closing the push-button switch energizes the primary relay and so closes its contacts.

out negative feedback. The impedance in this case being high, two capacitors of  $100 \mu\text{F}$  each

requires not more than, say, 60 mA to operate it, at 3 volts, and is therefore of sufficiently

operations. The photographs below show the construction. The core is built up of U-shaped laminations  $\frac{1}{2}$  in wide, and outside dimensions  $1\frac{1}{4}$  in by  $1\frac{1}{4}$  in, stacked

which to plug the set's mains leads, and flexible leads can be arranged to plug into the "External L.S." terminals on the set and into the power point and "External L.S." sockets in the skirting.

Assuming everything to be off to start with, the sequence of operation is as follows. The act of pressing the push-button

short-circuits the loudspeaker leads and completes the circuit from the battery through the primary relay, the contacts of which close and cause the secondary relay to be energized from the mains. The switch on the secondary relay closes, and remains closed even after the push-button has been released, and the relays de-energized. The set is thus switched on, and the volume can be controlled at the remote loudspeaker. To switch the set off, the button is pressed again, the sequence of events is repeated,

by the battery, but as the force required to operate the push-on push-off type switch is considerable, it cannot merely replace the primary relay. To obtain say six watts from a three-volt battery (which is possible under pulse conditions) the circuit resistance must be kept down to about  $1\frac{1}{2}$  ohms. This means a very low impedance relay which would noticeably attenuate the audio signals. Also the resistance of the loudspeaker extension wires would be important. Even if the primary relay is retained, however, if D.C. is required, a better plan is to supply the secondary relay from the mains through a half-wave rectifier and limiting resistance, as otherwise the battery life will be very much reduced. The coil should then be designed for high-voltage working. The rectifier and resistance, however, need not be designed to carry the required operating current continuously, as the duty cycle is very short; something like one second in an hour or more. The rectifier must, however, be designed to stand the

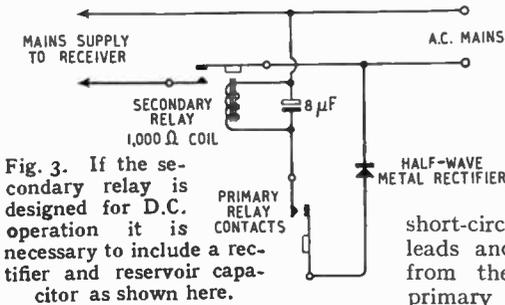


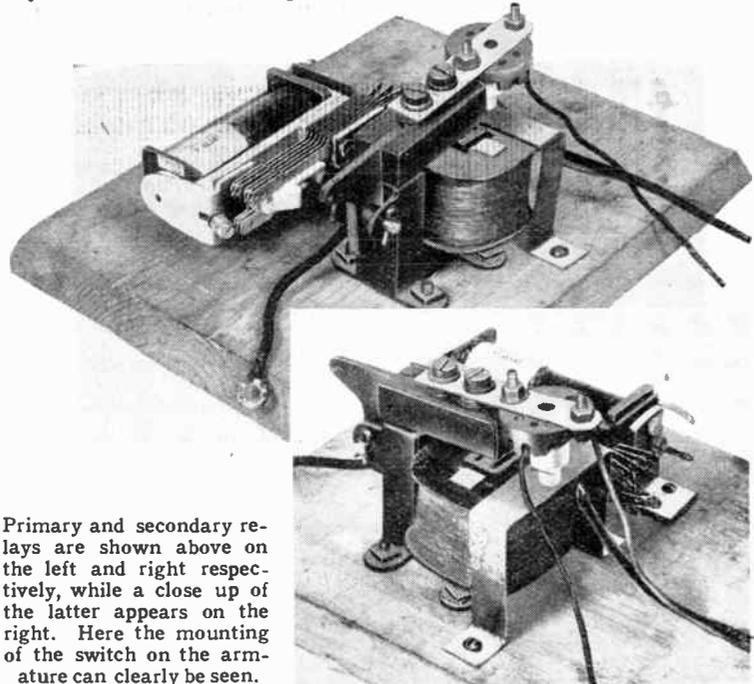
Fig. 3. If the secondary relay is designed for D.C. operation it is necessary to include a rectifier and reservoir capacitor as shown here.

to a depth of  $\frac{1}{32}$  in. The coil, which is intended to operate on 230 V 50 c/s, consists of 7,000 turns of 38 S.W.G. enamelled-copper wire, and is placed over one limb of the core. It has a resistance of  $750\ \Omega$  and an inductance, with the armature attracted, of 2 henrys. This value depends, of course, on the air-gap, which has been taken as  $\frac{1}{32}$  in. The armature is also laminated, and has the same cross-section as the core. It is hinged to the latter by means of a bracket fixed to its outside limb.

An extension on the armature carries a switch, the plunger of which is arranged to bear against a bridge mounted over the coil. This switch, of the type found on reading lamps, closes a circuit at one operation and opens it at the next. It is wired in one of the mains leads to the receiver, the mains switch on the set being left on, the set tuned to the required station, and its volume control set to the required level. Fig. 2 shows the complete circuit.

The volume control on the extension loudspeaker is of the constant-impedance type, so that its operation does not affect the volume at the set speaker, or at any other extension loudspeakers which may be in circuit. These latter, of course, must be fitted with blocking capacitors, but the volume control and push-button will not necessarily be fitted to them all.

The "local" unit, consisting of the two relays, the battery and  $100\text{-}\mu\text{F}$  capacitor can be a separate small unit near the receiver. Sockets can be provided into



Primary and secondary relays are shown above on the left and right respectively, while a close up of the latter appears on the right. Here the mounting of the switch on the armature can clearly be seen.

and the switch operated by the secondary relay is moved to the off position.

If the device which is used as the secondary relay happens to be D.C. operated, it can be powered

peak inverse voltage; i.e., the peak mains voltage plus the unidirectional voltage developed across the relay coil. This coil should be shunted by an electrolytic capacitor of  $8\ \mu\text{F}$  or more to

**Receiver Remote Control—** prevent rattle. The arrangement is shown in Fig. 3.

The resistance of the extension leads is in series with the primary relay, but with normal wiring this is small in comparison with the resistance of the relay coil and has little effect on the available current.

Care must be taken to ensure that the voltage across the electrolytic capacitor in the remote loudspeaker is of the correct polarity. Some loudspeaker extension systems employ non-reversible plugs and sockets. This will prevent accidental reversal of polarity in the event of the loudspeaker's being temporarily disconnected. Non-reversible plugs and sockets are not fool-proof, however, as the connections between one room and another may be crossed. It is, therefore, necessary to check the polarity at all the sockets and make them uniform. This can easily be done by connecting a battery across one socket, and testing at the others with a voltmeter. If the plugs are reversible, and the chance of wrong connection cannot be avoided, reversible electrolytics can be used, but are not so readily obtainable as the polarized type.

The secondary relay current is

about 0.3 A and so the contacts of the primary relay are required to make and break 230 volts A.C. at this current. The telegraph type of relay, which is the natural choice for this purpose, is usually fitted with rather light contacts, but the writer has found that perfectly reliable operation can be obtained if a relay with two pairs of "make" contacts is used, and the contacts wired in series so as to present a double gap when the contacts open. The G.P.O. "3000" type is suitable (see photo), and is available now in many radio shops as Government surplus. One with the required contact arrangement, and a coil resistance of 50 ohms should be selected.

In order to get the full benefit from the remote volume control, it is preferable to arrange for the audio output from the set to be just too loud for normal listening. It is particularly irritating to find that the control on the extension speaker is "flat out," but that the sound level is still not high enough.

For this reason it is desirable to fit a similar volume control to the built-in loudspeaker on the set, so that listeners at both points may adjust the volume to the required level, without affecting each other.

transmitters are at present operating on reduced power and the re-establishment of the S.W. service is being considered.

The Palestine Broadcasting Service, started in 1936, was originally part of the Department of Posts and Telegraphs, but in June, 1945, became a separate department of the Palestine Government. There are now two 20-kW medium-wave transmitters at Ramallah, some 20 miles north of Jerusalem, serving the 78,000 licensed listeners.

The Bahama Islands possess a complete telecommunications organization which is controlled by the Government and provides all internal and external radio and telephone services. There is a 5-kW M.W. transmitter and a 600-watt S.W. transmitter for broadcasting to the 1,200 set owners. About 28 community receivers are in use in the outer islands. A weather observation and reporting service is conducted in the islands for the U.S. Weather Bureau. The islands' broadcasting service is utilized for one of radio's primary purposes—the saving of life—for it is the only means available for issuing hurricane warnings to the isolated communities.

In Fiji a M.W. and a S.W. transmitter are operated by Amalgamated Wireless (Australasia) under a Government licence which, after 12 years, expires this year.

Ceylon's 11,000 listeners (1942 figure) are served by a 5-kW medium-wave transmitter and a 7½-kW short-wave transmitter owned and operated by the Government. In addition a powerful S.W. transmitter is operated by the British Army's South-East Asia Command.

Cable and Wireless, Ltd., operates Kenya's four low-power medium- and short-wave transmitters in Nairobi where there are some 7,000 licensed listeners and an ever-growing number of community sets. Public address systems are installed in Mombasa and Nairobi.

It is not possible in our limited space to deal with all the areas covered by Mr. Burrows' survey. In a number of them where there is no broadcasting service a rediffusion system is operated. It is perhaps of interest to note that the number of licensed listeners in some of the areas in which there is not a broadcasting service is considerable. For instance there are some 10,000 in Malta, 8,000 in Trinidad and Tobago and 5,000 in Cyprus.

The majority of the areas covered by the report are populated by peoples whose unaided resources are generally insufficient to enable them to buy receivers for themselves and, moreover, many lack an electricity supply.

## COLONIAL BROADCASTING

### *Extracts from an Interesting Survey*

**I**NFORMATION on the history and development of broadcasting in the Colonies and Protectorates, not readily available from any one source, has been collected by A. R. Burrows and published in the *Bulletin* of the International Broadcasting Union.

The author, who was secretary general of the Union for many years prior to the war, will be remembered by some readers as "Uncle Arthur" of the early days of the B.B.C.

Some of the technical difficulties associated with colonial broadcasting have been discussed in *Wireless World* from time to time, but, as stated in the *Bulletin*, the greatest problems are largely economic.

We give below a few extracts from the considerable amount of information contained in the article.

Prior to the Japanese invasion the broadcasting service in Malaya was

operated by the Malayan Broadcasting Corporation, set up in 1941 on the lines of the B.B.C. At the cessation of hostilities it was conducted by the British Military Administration and was later taken over by the Government's Malayan Broadcasting Department. There are medium-wave transmitters in five towns, which are temporarily operating low-power equipment. They will later be equipped with 10-kW transmitters. This service is supplemented by three S.W. transmitters. There are also daily transmissions by four 7.5-kW S.W. transmitters in Singapore operated by the British Far Eastern Broadcasting Service.

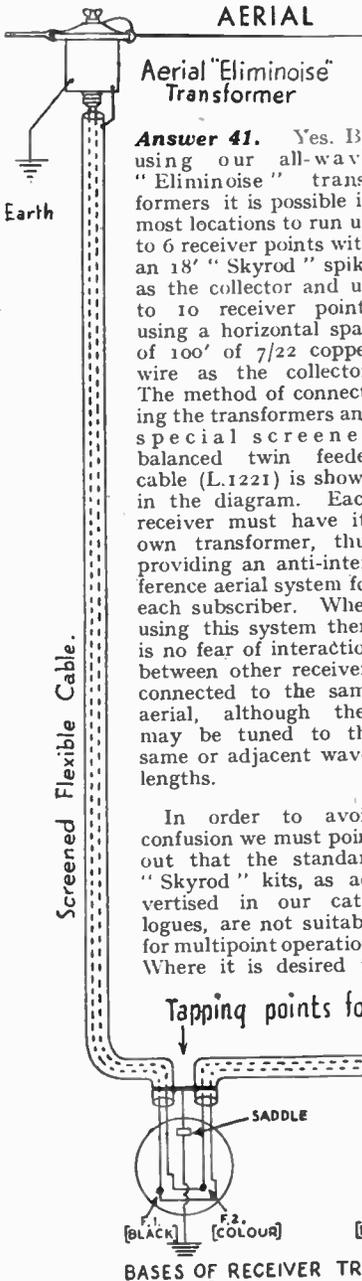
The broadcasting service in Hong-Kong is controlled and operated by the Government. Before the Japanese invasion there were three transmitters in the Colony—one S.W. and two M.W. The M.W.

# BELLING-LEE QUIZ (No. 12)

Answers to questions we are often asked by letter and telephone

**Question 41.** Can I run more than one broadcast receiver from a "Skyrod"\*<sub>1</sub> or horizontal "Eliminoise"\*<sub>2</sub> aerial system

## The "ELIMINOISE" ALL-WAVE ANTI-INTERFERENCE SYSTEM



Aerial "Eliminoise" Transformer

**Answer 41.** Yes. By using our all-wave "Eliminoise" transformers it is possible in most locations to run up to 6 receiver points with an 18' "Skyrod" spike as the collector and up to 10 receiver points using a horizontal span of 100' of 7/22 copper wire as the collector. The method of connecting the transformers and special screened balanced twin feeder cable (L.1221) is shown in the diagram. Each receiver must have its own transformer, thus providing an anti-interference aerial system for each subscriber. When using this system there is no fear of interaction between other receivers connected to the same aerial, although they may be tuned to the same or adjacent wavelengths.

In order to avoid confusion we must point out that the standard "Skyrod" kits, as advertised in our catalogues, are not suitable for multipoint operation. Where it is desired to

use the "Skyrod" as the collector, the following items of equipment are required (assuming the usual chimney fixing method):—

- 1 S.A.1765 Skyrod 18' collector
- 2 S.A.1767 Clamps
- 1 S.A.1498 Stirrup bracket
- 2 S.A.1774 Chimney lashings
- 1 L.306/T Aerial transformer
- 1 L.307/T Receiver transformers one for each set
- L.1221 Screened twin feeder cable (as required)
- 1 PP.1607/60 Insulated earth wire
- 1 wooden mast 18' x 2 1/2" diam.

**Question 42.** How many television receivers can I run from one aerial? \*3

**Answer 42.** This depends upon certain important factors:—

- (i) Signal strength in the locality
- (ii) Gain of receivers
- (iii) Length of feeder cable involved.

Item (i) above is the main deciding factor and really should be stated as the voltage received from the aerial. If the voltage available is sufficient, it is possible that four or five television receivers could be fed from the common aerial. In this case, however, it would be necessary to insert padder units in the main feeder line to prevent interaction between receivers and to terminate the main feeder correctly at the far end.

One point, therefore, is fairly obvious. Before deciding how many receivers can be fed from a common

aerial, it is essential that the aerial be erected (temporarily if necessary) and the vision input voltage measured. Once this figure is known the number of receivers can be determined, and the resistor values calculated for the padder units.

Our installation department would be pleased to advise you on this problem and undertake multi-point installations where conditions are suitable.

### ERRATUM

In the May issue of the "Wireless World," centre column, sub-heading 2, 6db should read: minus 6db.

\*1 Skyrod (Regd. Trade Mark).

Types L.355/CK 12' collector, down-lead, 2 transformers, pole clamps, and earth wire £7 7 0  
 L.355/LK with chimney lashings and brackets in addition £8 8 0  
 L.370/LK with chimney lashings for 2" mast in addition to L.355/CK £8 17 6

Also supplied with 18' collector.

\*2 "Eliminoise" (Regd. Trade Mark).  
 Anti-Interference Aerials. (U.K. Patents 477218, 479118.)

L.307/T. Receiver Transformer  
 Price £2 0 0

\*L.306/T. Aerial Transformer  
 Price £2 10 0

\*L/308/T. Pair of Transformers  
 Price £4 10 0

\*L/308/K. Complete kit with 60' Aerial, 50' screened feeder. L.1221  
 Price £6 6 0

L.1221 Screened Feeder  
 per yard 1 9

\* Complete with L350 lightning arrester.

\*3 Viewrod (Regd. Trade Mark).  
 Dipole, reflector and cross arm with chimney lashings, L.502/L.  
 each £5 12 6

Supplied also without reflector and/or chimney lashing .. from £2 7 6

TO BE CONTINUED



# Vortexion

## "SUPER FIFTY WATT" AMPLIFIER

This **AMPLIFIER** has a response of 30 cps. to 25,000 cps., within 1 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.

As Illustrated. Price **36½ Gns.**

### A.D. 47 10-valve Triode Cathode Follower Amplifier.

For this recording and play-back amplifier we claim an overall distortion of only 0.01% as measured on a distortion factor meter at middle frequencies for a 10 watt output. The output transformer can be switched from 15 ohms to 2,000 ohms, for recording purposes, the measured damping factor being 40 times in each case. Full details on request.



### C.P. 20A 15 watt Amplifier for 12 volt battery and A.C. Mains operation.

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

Price **£28**

# VORTEXION LTD.

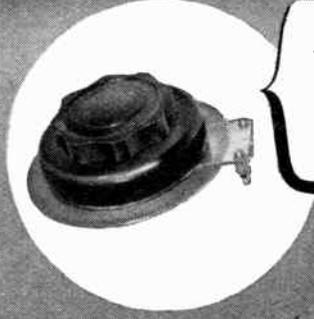
257-261 THE BROADWAY, WIMBLEDON, S.W.19

Telephones: L1Berty 2814 and 6242/3

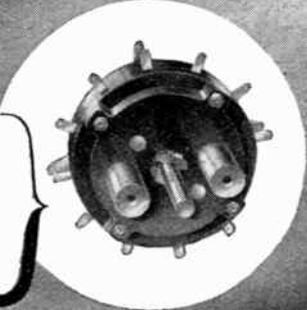
Telegrams: VORTEXION, WIMBLE, LONDON

# PRECISION CONTROLS

for COMMUNICATIONS AND MEASURING EQUIPMENT



**SLOW-MOTION DRIVE**  
 A Unique Control giving complete 360° rotation  
 Double friction epicyclic mechanism — enclosed in dust-proof bakelite housing.  
 Torque — 12 inch-ounces before slipping  
 Ratio — 44 to 1 approximately  
 Supplied with dials up to 6 inches diameter — any engraving.  
 PRICES ON APPLICATION



**DECADE SWITCH**  
 A Precision Component embodying all the best design features  
 Very low contact resistance. Positive location. Sturdy action. Twelve positions — providing two extra contacts — 30° angular spacing simplifies dial calibration. Two types available — 416A (Shorting) and 416B (Non-Shorting).  
 Can also be supplied in ganged units of two or more switches  
 PRICES ON APPLICATION

## SALFORD ELECTRICAL INSTRUMENTS LTD.

PEEL WORKS, SALFORD 3

Telephones: BLAckfriars 6688 (6 lines).

Telegrams and Cables: "SPARKLESS, MANCHESTER"

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

# World of Wireless

## MARINE NAVIGATION

AMONG the papers presented at the second meeting on Radio Aids to Marine Navigation, which opened in New York on April 28th was one by Capt. R. W. Ravenhill, R.N., Director of Navigation and Direction at the Admiralty, reviewing the mariners' navigational requirements. He stated that in pilotage and coastal waters they were best met by a combination of radar and Decca. So far as an ocean aid was concerned he doubted if the requirements were strong enough to warrant the expense and suggested that they might be met by the use of Consol stations, established primarily for aircraft, which require only an ordinary receiver.

A paper on Decca was presented by W. Ross, Principal Scientific Officer at the Ministry of Transport. To solve the difficulty which would arise should there be a break in transmission or reception a system of lane identification had, he said, been successfully demonstrated. It was achieved by exchanging the frequencies of one or more of the transmitters for a short interval.

The number of ships already fitted with Decca is 74.

## TELEVISION RELAY STATIONS

IT emerged from the recent controversy in the House of Commons on the proposed erection of a relay station on the Berkshire Downs that the Post Office is undertaking experiments in relaying television to Bristol and Cardiff by radio link.

It has since been announced by the P.M.G. that the proposed station will be erected elsewhere.

## R.C.M.F. REPORT

THE component manufacturer's part in the industrial drive of last year is indicated by the figures given in the annual report of the Radio Component Manufacturers' Federation. Production reached a level during the year of over 20,000,000 components and accessories a month. Some 75 to 80 per cent of the demand placed on the industry was for domestic receivers.

Whilst the value of exports during the year "give grounds for satisfaction" it is pointed out in the report that, owing to the considerable increase in prices, if exports are interpreted in volume of goods rather than value they are not so impressive.

The present membership of the

Federation is 118 which brings it very close to its target of 100 per cent representation of component manufacturers.

## EXPORT TELEVISION

CONSIDERABLE progress has been made in the development of television transmitters and receivers for the overseas market. E.M.I. is developing 605-line equipment and has prepared specifications for complete transmitting stations with this definition. It is stressed that this equipment is for "export only."

## JUBILEES AND ANNIVERSARIES

APART from the Marconi jubilee which is referred to elsewhere in this issue a number of notable anniversaries occur this year.

It was on April 30th, 1897, that Prof. J. J. Thomson (later Sir Joseph Thomson) made his announcement of the existence of the electron. To mark this jubilee the Institute of Physics and the Physical Society, in collaboration with the I.E.E., is arranging a series of lectures in London on Sept. 25th and 26th and an exhibition at the Science Museum which will remain open for about three months.

The silver jubilee of both regular broadcasting in this country and the national radio exhibition will be celebrated this year. The first radio exhibition was held in October, 1922, and the first regular broadcast was radiated in November of the same year.

We are reminded of a number of communications anniversaries by John Young of Cable & Wireless. It is 40 years ago this October that Marconi's opened the long-wave Great Britain-Canadian service. The first phototelegraph service was opened (with New York) in May, 1926—to-day fourteen services are in use. This year is the twentieth anniversary of the opening of the beam services between Britain and Australia (April 8th), South Africa (July 5th) and India (Sept. 6th).

## I.E.E. AND INTERFERENCE

IN the section of the I.E.E. annual report dealing with technical investigations reference is made to the work on Codes of Practice.

Among the Codes being prepared are three on the abatement of radio interference from:—

- (a) electro-medical and high-frequency industrial equipment,
- (b) motor vehicles and internal combustion engines,
- (c) neon signs or electric discharge lamps.

The final version of the Code on interference caused by motor vehicles will be published shortly.

The report of the I.E.E. Committee on Radio Interference on means whereby the substantial control of interference could best be brought about has been submitted to the Postmaster-General.

## CIVIL AVIATION

THE final report of the first session of the Special Radio Technical Division of P.I.C.A.O. has been issued in English, French and Spanish from the offices of P.I.C.A.O., Montreal. The recommendations contained in the report will be considered by the Council of the organization which will decide upon acceptance in whole or in part.

The report covers the meeting of 180 representatives of 29 nations in Montreal last November which, it will be recalled, was preceded by displays of equipment in this country, the United States and Canada.

The largest section of this 84-page book is Section VIII which deals with radio aids for navigation, communications and radar for search and rescue purposes.

Copies, which cost 3s 9d, may be obtained from E. M. Lewis, P.I.C.A.O. Representative, 7, Fitzwilliam Place, Dublin, Ireland.

## AIR OPERATORS' EXAMS

DURING the second half of this year monthly examinations for civil aircraft radio operators' licences will be held in London and Liverpool. Details and application forms, M.C.A. 182 and 183, are obtainable from the Secretary, Ministry of Civil Aviation, Directorate of Telecommunications (Tels 4b), Cornwall House, Stamford Street, London, S.E.1.

Two licences are obtainable—radiotelephony and combined radio-

## OUR COVER

This month's illustration is from a photograph of Marconi, taken in 1896 with the original demonstration apparatus he brought from Italy to England. On the left is a 1½-metre oscillator and on the right the companion receiver, comprising a copper-strip dipole aerial and (inside the box) a coherer, tapper and relay.

### World of Wireless—

telegraphy and telephony. For the first the examination lasts approximately  $2\frac{1}{2}$  hours and for the second  $3\frac{1}{2}$  hours.

In general the last date for acceptance of applications is the first of the month in which the applicant wishes to sit the examination.

### BOY SCOUTS AND RADIO

**A**RRANGEMENTS have been made by the Postmaster-General whereby up to twenty transmitting licences may be issued to scout groups.

These licences will permit the use of apparatus with a dummy aerial, within a building, for instructional purposes, and portable sets for use at camps and for training schemes, over a radius of ten miles from the radio headquarters shown in the licence.

The licensee will be a responsible Scouter (officer), who need not be technical, but the licence will bear the name and address of at least one qualified operator of the sets, which may be as many as ten.

Transmissions are limited to morse in the 58.5 to 60 Mc/s band. The same frequency must be used for control and mobile sets in any one licensed group.

The total D.C. power input to the anode circuit of the valve or valves energizing the aerial must not exceed 1 watt, apart from one (control) set per group, with which 5 watts may be used.

The provisional licence fee is 10s with which a maximum of ten sets may be used. The arrangement is an experiment for one year.

### RAILWAY RADIO

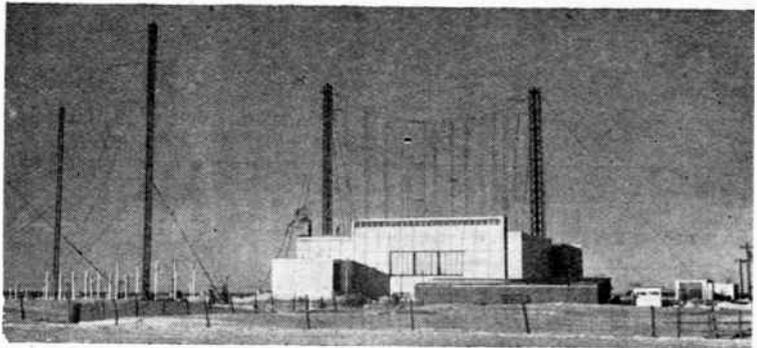
**W**HEN asked in the House of Commons when he would be able to allocate frequencies to the railways in order that they might undertake trials in radiocommunication, the Assistant Postmaster-General stated that some frequencies would be made available within a few weeks.

It was pointed out, however, that the wavelengths would be liable to alteration as a result of the forthcoming international telecommunications conference.

### THIRD PARTY MESSAGES

**T**HE Postmaster-General has asked the R.S.G.B. to draw the attention of amateur transmitters to Condition 8 of their licences whereby they are permitted to send or receive only messages relating to their own or their correspondent's private affairs and prohibited from sending or receiving other messages.

The sending or receiving of



**MEASUREMENTS** made by the B.B.C. of the transmissions from the international short-wave station of the Canadian Broadcasting Corporation in the 15-Mc/s band show an average signal strength of 400 mV/m. One of the three aerial arrays of the station at Sackville, New Brunswick, which provide six directional beams, is shown in this photograph. The two 50-kW. transmitters are linked to the studios in Montreal by 600 miles of land line. Monthly schedules of the C.B.C. International Service, which was inaugurated two years ago, are sent to listeners sending reports.

messages originated by or about the affairs of third parties, whether for payment or not, is, therefore, a breach of the conditions attaching to the licence and renders it liable to cancellation.

### AMATEUR FREQUENCIES

**S**OME of the proposals for frequency allocations being made at the International Telecommunications Conference meeting in Atlantic City were announced just prior to the delegates leaving this country.

In order to give readers an opportunity of comparing the G.P.O. proposals for amateur frequency bands with those put forward by the R.S.G.B., we give below the two lists (Mc/s). The G.P.O. proposals were formulated and substantially agreed to at the recent conference in Paris attended by delegates from the U.K., France, and the U.S.S.R.

G.P.O.	R.S.G.B.
1.715— 2.00 shared	1.715— 2.00
3.50 — 3.60 exclusive	3.50 — 3.80
7.00 — 7.20 "	7.00 — 7.30
14.00 —14.40 "	14.00 —14.40
21.25 —21.45 "	21.00 —21.50
28.00 —29.70 "	28.00 —30.00
	50.00 —54.00 or
	58.50 —60.00 or
	66.00 —67.50
168— 170 exclusive	168— 170
	220— 225
400— 415 shared	400— 430
1,215— 1,295 exclusive	1,200— 1,300
2,300— 2,450 "	2,300— 2,450
5,650— 5,850 "	5,600— 6,000
10,000—10,500 "	10,000—10,500
20,500—22,000 "	20,500—22,000

Commenting in the April issue of the *R.S.G.B. Bulletin* on the G.P.O. proposals, the Society states that it has lodged the strongest possible protests with the G.P.O. regarding the 3.5- and 7-Mc/s bands and also the omission of a band around 60 Mc/s.

It will be recalled that S. K. Lewer and John Clarricoats, presi-

dent and general secretary, respectively, of the R.S.G.B., are attending the Atlantic City conference as delegates of the International Amateur Radio Union.

### B.B.C. YEAR BOOK

**D**ISCUSSING the problem of improving the coverage of the Third Programme, Sir William Haley, B.B.C. Director General, writing in the B.B.C. Year Book, 1947, states that the Corporation envisages a chain of F.M. stations to make the programme available to some 96 per cent of the population. A 25-kW experimental transmitter is being built in Kent to serve the south-east.

Among the many interesting articles in the Year Book, which is obtainable by post from the B.B.C. Publications Department, Scarle Road, Wembley, Middx, price 2s 6d, is one by G. Darnley-Smith, R.I.C. chairman, on the radio industry.

### PERSONALITIES

**Sir Edward Appleton** has recently been awarded the honorary degree of D.Sc., by the University of Brussels and has also been elected an honorary member of the Royal Belgian Society of Engineers and Industrialists.

**Wilfred Paling** has succeeded as Postmaster-General Lord Listowel, who is now Secretary of State for India and Burma. Mr. Paling is Labour M.P. for the Wentworth Division of Yorkshire.

**J. H. Cotton, M.B.E.**, has joined the Board of the Dubilier Condenser Co. (1925) as works director. He joined the Dubilier organization in 1930 and has served on several Government missions to the U.S.A. and the Continent during and since the war.

**G. D. Deuchars** has been appointed United Kingdom Civil Aviation Telecommunications Representative, Cairo.

He succeeds Air Comdre. W. E. G. Mann, who is now responsible for overseas telecommunications developments in the Ministry of Civil Aviation.

H. R. Denne has been appointed Television Outside-Service Engineer for E. K. Cole and will operate from Somerton Works, Southend-on-Sea.

H. de A. Donisthorpe was elected chairman of the Radio Industries Club for the eleventh successive year at the first meeting of the new committee. Guy R. Fountain is vice-chairman.

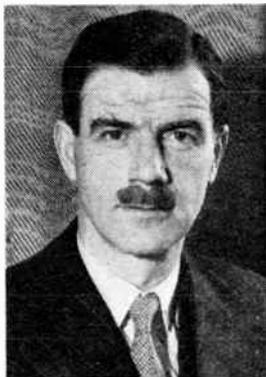
C. W. Goyder, C.B.E., who relinquished his appointment as chief engineer of All-India Radio last year, has rejoined the B.B.C. as assistant head of the Overseas and Engineering Information Department.

Major Gen. L. B. Nicholls, a director of Cable and Wireless, is visiting the Middle and Far East to plan the development of civil communications. During the war General Nicholls was General Eisenhower's Chief Signal Officer.

Major L. H. Peter, M.C., has been appointed chief development engineer of the Westinghouse Brake and Signal Co. L. E. Thompson, B.Sc., A.R.C.S., has been appointed chief electrical engineer and K. H. Leech, B.Sc., chief design engineer.

Andrew Reid has been appointed Press Officer for the Olympia radio exhibition (October 1st-11th). His address is 11, Garrick Street, London, W.C.2. (Tel.: Temple Bar 4844.)

J. H. Williams was elected president of the Radio Industries Club, in succession to Leslie C. Gamage, at the sixteenth annual general meeting of the club.



**AIR COMDRE. C. S. CADELL, C.B.E., M.A., A.M.I.E.E.,** who during the war was R.A.F. Director of Telecommunications and Signals, has been appointed managing director of International Aeradio Ltd. This non-profit-making company was recently formed by the three State-owned British airline corporations to install and maintain radio navigational and telecommunications equipment on the world air routes.

## IN BRIEF

A record total of approximately 10,780,400 broadcasting receiving licences were in force in Great Britain and Northern Ireland at the end of March. This is an increase of only 2,400 during the first three months of the year. The March total includes 14,550 television licences.

Receiving Licences in force in British India totalled 232,368 at the end of 1946. There was an increase of almost 30,000 during the year.

German Listeners. According to the latest figures available from the International Broadcasting Organization there were 7,686,825 licensed listeners in Germany at the beginning of February. The zonal figures are:—British, 2,886,825; Soviet, 2,500,000; American, 1,800,000; and French, 500,000.

Amateur Exhibition.—The R.S.G.B. is arranging to hold an exhibition of short-wave equipment at the Royal Hotel, Woburn Place, London, W.C.1, from November 18th-21st. A similar exhibition was arranged for 1939, but had to be cancelled on the outbreak of war.

Acoustics.—The proposed Acoustics Group of the Physical Society, to which reference was made in our February issue, has now been formed with H. L. Kirke as chairman and Dr. A. Wood as vice-chairman. Membership of the Group is not confined to members of the Physical Society. Particulars are available from the joint-secretaries, W. A. Allen and A. T. Pickles, The Physical Society, 1, Lowther Gardens, London, S.W.7.

Canadian Loran.—The Canadian Government has announced its intention to build two Loran stations in the Far North this summer for marine and air navigation. A third station is to be built next year.

F.M. in Canada.—By the end of the year it is expected that twelve F.M. stations will be in operation in the Dominion. Three—one in Toronto and two in Montreal—are already operating, with a fourth at Kingston ready to start. The frequency band used for F.M. in Canada is 88-108 Mc/s.

"Wireless World" Index.—Copies of the index to Vol. LII, January-December, 1946, are still available from our Publisher, price 1s 1½d, including postage. Binding cases are also obtainable which, complete with index, cost 5s 10d by post. Our Publisher is able to arrange for the binding of readers' own copies at a cost of 13s 3d, including postage on the return of the volume.

Railway Radar.—Radiolocation is being developed in the Soviet Union for use on railway engines to facilitate driving at night and in fog.

I.S.W.L.—Among the facilities provided by the International Short-Wave League for its members—at present some 600—are a translation service, broadcast station schedule service and a QSL bureau. Details of membership are obtainable from the headquarters, 57, Maida Vale, London, W.9.

I.E.E. Radio Section.—At the Annual Dinner, held in London on April 30th, Prof. Willis Jackson, Section Chairman, announced that the secretaryship of the Section was being taken over by K. W. T. Brown from H. J. Nunn. A presentation was made to Mr. Nunn, who has held the office for 15 years, and has 40 years' service with the I.E.E. The formation of local radio groups has resulted in a noticeable increase in the membership of the Radio Section of the Institution, which is now 3,311.



**ERIC E. JONES, manager of the Communications Division of the Mullard Wireless Service Co.,** which will market the products developed and manufactured by the new company—Electronic Transmission Equipment Ltd., referred to on the next page.

"Proc. R.S.G.B."—The Radio Society of Great Britain is to publish three times a year a new periodical, *Proceedings of the R.S.G.B.* Each issue will contain at least two of the papers read at meetings of the Society.

Engineering Centre.—The I.E.E. and the Brit.I.R.E. are among the bodies sponsoring the formation of the Engineering Centre which will establish branches in various parts of the country. The first will be opened in Glasgow this year. The aims of the organization include the provision of permanent exhibitions of modern engineering products and advice bureaux. The headquarters of the Engineering Centre, Ltd., is 351, Sauchiehall Street, Glasgow, C.2.

High-power F.M.—Permission has been granted to Eitel McCullough, the American valve manufacturers, to establish an experimental 50-kW F.M. transmitter at their works at San Bruno, California. It is planned to erect the station eventually at the summit of the 3,800ft Mount Diablo, near San Francisco.

Jubilee.—To mark the "fiftieth anniversary of the discovery of radio by Marconi" the Italian National Council of Research has organized an international congress to be held in Rome from September 28th-October 5th. The congress is planned to provide a complete picture of the present develop-

**World of Wireless—**

ment of radio in the technical, scientific and industrial fields. Invitations have been extended to many countries to participate in the congress.

**An American Book.** "Music and Sound Systems in Industry," by Barbara Elna Benson, is the first to attempt to survey in a comprehensive manner the origin, development and present-day applications of "music while you work." Published by McGraw-Hill, price 9s, it includes a 41-page "discography"—classified list of records.

"Research and the Smaller Firm" is the title of the report of the conference on this subject held in Manchester last October under the auspices of the Manchester Joint Research Council. Copies of this 100-page report are available from the M.J.R.C., (Chamber of Commerce, Ship Canal House, King Street, Manchester, 2, at 2s 6d, plus postage.

**INDUSTRIAL NEWS**

**Flat-ended C.R. tubes** are being produced by the G.E.C. and are a feature of their new table model television receiver which incorporates a gin tube giving a picture of about 8in×6½in. These tubes employ pressed screen ends of 1,000 mm radius of curvature.

**Radio Industries Club.**—The annual report of the club, presented at the sixteenth annual general meeting, shows that membership of the parent club (London) has grown to 645—an increase of 43 during the year. Membership of the two affiliated clubs is: Scotland, 198; Wales and Monmouthshire, 88.

**R.C.M.F. Council.**—At the first meeting of the new council of the Radio Component Manufacturers' Federation, A. F. Bulgin was elected chairman, and W. A. Jackson, vice-chairman.

**Engineering and Marine Exhibition.**—Among the radio manufacturers exhibiting at this show at Olympia (August 28th—September 13th) are: Ardente, Automatic Coil Winder, B.I. Callenders, B.T.H., S. G. Brown, Cossor, Ekco, Magneta Time Co., Met-Vick and Redifusion.

**E.M.A. Representatives** to the B.S.I. Sub-Committee on Radio Equipment and Components are A. S. Williams (Felgate Radio) and C. Lunt (Central Equipment). R. C. Hitch (New Era) is deputy.

**Plessey Co.** is the only radio manufacturer exhibiting in the *St. Merriel* floating exhibition visiting South America.

**Radio Industries Ball.**—During the period of the Radio Exhibition the Radio Industries Club will be holding a ball at the Royal Albert Hall.

**Electronic Transmission Equipment, Ltd.**, is the name adopted by a new company formed by Mullards for the development and manufacture of communications apparatus. It will take over the present communications activities of Radio Transmission Equipment, Ltd. Laboratories and works are at Brathway Road, Wandsworth,

London, S.W.18. Equipment will be marketed by the Communications Division of Mullard. Directors of E.T.E. include Air Comdr. A. V. Harvey, C.B.E., M.P., and T. E. Goldup.

**Stratton and Co.** recently presented the R.S.G.B. with an Eddystone 640 communication receiver for use at the Society's headquarters' station.

**S.I.M.A.**—An official catalogue of the members of the Electronic Section of the Scientific Instrument Manufacturers' Association who were exhibiting at the B.I.F. was produced by the Association for distribution at the exhibition. The brochure includes a list of members and details of their products.

**Mullard** has opened a new factory at Gillingham, Kent, for the assembly of the component parts of miniature valves. The sub-assemblies are transported from Gillingham to Mitcham, where the filaments are inserted and the complete assembly sealed into the bulb.

**Philips.**—A new Philips factory is being built at Hamilton, Lanarkshire, Scotland. It will ultimately employ some 2,500 workers on the production of receivers and components.

**B.I. Callender's Cables.**—Due to the delay in building the company's new factory on the Kirkby Trading Estate, Liverpool, B.I. Callender's have taken over a factory covering 9½ acres at Melling, near Liverpool, for the production of telecommunication equipment.

**Ekco.**—The address of E. K. Cole's Scottish Service Depot is now Ekco Works, Duchess Road, Rutherglen, Lanarkshire. (Tel.: Rutherglen 2240/3.)

**Moreton Cheyney Co.** has moved to new premises in Darkhouse Lane, Deepfields, Bilston, Staffs. (Tel.: Bilston 41778.)

**Welwyn Electrical Laboratories, Ltd.**, have moved their factory and head office to Links Road, Blyth, Northumberland (Tel.: Blyth 668/9). A branch office will be maintained at the old address—70, Bridge Road East, Welwyn Garden City, Herts.

**G.W.B. Electric Furnaces, Ltd.**—It was inadvertently stated in our April issue that this company's Birmingham office was at 21, Steelhouse Lane, which is the new address of Wild-Barfield Electric Furnaces, Ltd. The address of G.W.B. Electric Furnaces remains unchanged.

**CLUBS**

**Birkenhead.**—Meetings of the Wirral Amateur Radio Society (formerly the Wirral Amateur Transmitting and Short-wave Club), which has a membership of over 60, are held twice a month on Wednesdays at the Y.M.C.A., Whetstone Lane, Birkenhead. June meetings will be held on the 11th and 25th. Sec.: B. O'Brien, G2AMV, 26, Coombe Road, Irby, Heswall, Cheshire.

**Birmingham.**—Details of the meetings of the recently formed South

Birmingham group of the R.S.G.B., which are held on the first Sunday of each month at 10.30 a.m. and the third Monday at 7.0 at Stirchley Institute, Stirchley, are obtainable from I. Higgins, G8JI, 391, Rednal Road, Northfield, Birmingham, 31.

**Birmingham.**—Employees of I.C.I. (Metals), Ltd., Kynoch Works, Witton, Birmingham, have formed the Kynoch Radio and Television Society. They hope eventually to establish their own station and laboratory. Membership is not confined to I.C.I. employees. Sec.: J. W. Harris, Kynoch Works, Witton, Birmingham, 6.

**Brighton.**—At the meeting of the Brighton and Hove Group of the R.S.G.B. at the Golden Cross Hotel, Western Road, on June 16th at 7.30 a representative of the Automatic Coil Winder and Electrical Equipment Co. will speak on "Test Equipment." Town Representative: Lt. Cdr. J. R. D. Sainsbury, G8HV, 80, Lansdowne Place, Hove, 2, Sussex.

**Cheadle.**—The Cheadle (Staffs) and District Amateur Radio Society claims the distinction of having a higher ratio of amateur transmitters to the town's population than any other—one to 680. Sec.: V. Hughes, G3AVG, Abbots-Haye, Cheadle, Stoke-on-Trent, Staffs.

**Harrogate.**—The recently formed Harrogate and District Short-wave Radio Society meets on alternate Wednesdays at 7.30 at the Y.M.C.A., Victoria Avenue, Harrogate. The next meeting will be on June 11th. Sec.: K. B. Moore, Spinney Cottage, 2a, Wayside Crescent, Harrogate, Yorks.

**Manchester.**—Amateurs in the Manchester, Prestwich, Whitefield and Bury districts are invited to the meetings of the Whitefield and District Radio Society held on Mondays at 7.30 at the Stand Grammar School for Girls, Higher Lane, Whitefield. Morse classes and a short-wave listener section have been started. Sec.: E. Fearn, 4, Partington Street, Newton Heath, Manchester, 10.

**Kingston-on-Thames.**—Originally formed in 1935 and reorganized last October, the Kingston and District Amateur Radio Society has been meeting twice a month at the Three Fishes Hotel, Kingston, but has now to find other accommodation. Members will be notified when alternative arrangements have been made. Sec.: A. W. Knight, G2LP, 132, Elgar Avenue, Tolworth, Surbiton.

**MEETINGS****Institution of Electrical Engineers**

**Southern Centre.**—"Colonial Telecommunication Systems," by C. Lawton and V. H. Winson, B.Sc. (Eng.), on June 4th at 7.0 at 110, High Street, Portsmouth.

"Frequency Modulation," by K. R. Sturley, Ph.D., B.Sc., on June 18th at 7.0 at the Royal Aircraft Establishment, Farnborough.

**British Sound Recording Association**  
"Sound on Film and the Amateur," by D. O. Roy, B.Sc., on May 30th at 7.0 at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2.



**Letters to the Editor—**

settings of controls are then less critical. E. J. B. WILLEY.  
London, S.W.5.

**Thyratron Action**

IN your February issue "Cathode Ray" may have added to existing confusion by his description of the action of ions and electrons in thyratrons.

He implied that electrons leave the cathode in "ones" and release so many electrons by collision and ionization that they enter the anode in "hundreds." In fact, he said that "such a crowd would need an enormous cathode to yield it by thermal emission alone."

That this description is very misleading may be seen easily if one enquires where the electrons get to in the circuit and where they continue to come from in the valve.

Obviously in a sustained discharge, such as occurs in a thyratron, as many electrons must leave the external circuit at the valve cathode as enter at the anode. Also, over a period of time as many electrons must enter the valve at the cathode as leave at the anode. Thus the cathode must release, by thermal emission, the entire current the valve is capable of handling. This is an unfortunate fact, since much power must be wasted in heating the cathode.

The only advantage of having a gas, or vapour, filling in the valve is that the ionized molecules neutralize the space charge effect so that a 10—20-volt drop between anode and cathode can force electrons to cross the valve at a rate of many amperes, whereas in a similar vacuum valve hundreds or even thousands of volts would be required. Since the ionization reduces the anode dissipation of the valve and increases the efficiency of the circuit, it is worth while and is widely used, not only for large currents, but also for low-current precision control equipment.

WM. H. P. LESLIE.

North Farnborough, Hants.

[*"Cathode Ray's" comments on this letter are given below.—Ed.*]

I am grateful to Mr. Leslie for pointing out that my description of conduction in mercury vapour rectifiers and similar valves was misleading in one respect, in that it implied that the electrons emitted from the cathode were only a part of the total electronic current. It is true that the emitted electrons release very many more from the gas molecules, and since all electrons are alike it might seem that those attracted to the anode would be more numerous than those emitted from the cathode. In actual fact, however,

ionization takes place a very short distance from the cathode, so that the whole of the remaining space between cathode and anode is filled with a cloud of electrons and ions. This cloud is electrically neutral and is therefore subject to very little potential difference during conduction. It is almost as if, during the conducting phase, a metallic conductor extended from the anode to within a very short distance of the cathode, confining the negative space-charge to a thin layer, across which only a few volts are needed to sustain the process.

The electrons removed from this cloud by the anode are replaced in equal numbers by the cathode. Although it is true to say that a gas-filled valve can carry a given current with less (though not enormously less) cathode-heating power than a vacuum valve, this is due to circumstances other than the one I mentioned. I believe that, except for the question of cathode emission, my original brief description of what is quite a complicated process was, so far as it went, in agreement with Mr. Leslie and authorities generally; and I hope that the above further remarks, in conjunction with his letter, will make the matter clear.

"CATHODE RAY."

**"Careers in Radio"**

WITH reference to the above article, published in the April *Wireless World*, your readers may be interested to know that, although the school conducted by this company originally catered for those intending to enter aircraft radio engineering, it was extended some months ago to cover all branches of radio engineering and we now train students for any of the recognized professional examinations in radio engineering, including special training in radar theory and technique.

R. J. WOODHAMS,

Air Service Training, Ltd.

Hamble, Southampton.

**Television Synchronization**

HAVING recently carried out an exhaustive investigation of the circuit aspects of frame time-base synchronization I found W. T. Cocking's particularly lucid and helpful contribution to the subject of considerable interest.

While the various factors causing imperfect interlacing are well known to circuit engineers there is little unanimity among them as to the relative importance of these causes. In this respect it is my own conviction that insufficient attention has been given to the waveform irregularity mentioned by Mr. Cocking; viz., the difference between alternate frames in the dura-

tion of the interval between the last line synchronizing pulse and the first pulse of the framing signal. It is significant that this difficulty was taken into account by the formulators of the current American R.M.A. standard transmission in which the irregularity is eliminated by the insertion of a group of equalizing pulses between the last active line and the first framing pulse and of a similar group between the last framing pulse and the first of the unmodulated (i.e., black) lines commencing the following frame. As a result U.S. synchronizing circuits are particularly simple, and there is little other evidence that their designers are obsessed by the interlacing problem.

An additional factor in favour of a framing signal centrally disposed between two similar equalizing pulse trains is its greater suitability to the flywheel method of frame time-base synchronization particularly when automatic frequency and phase control is desired.

I would suggest, therefore, that the use of equalizing pulse trains would be worthy of attention when the time comes to revise transmission standards. A. W. KEEN.

Harrow-on-the-Hill,  
Middx.

**A.R.R.L. 1947 HANDBOOK**

THIS annual publication of the American Radio Relay League has acquired a well-deserved reputation as a standard manual of amateur radio communication. Theory and practice are nicely proportioned, with some nine chapters devoted to each and covering, on the theoretical side, such subjects as fundamental principles, valves, transmitter and receiver design, keying, modulating technique and, finally, wave propagation and aerials. The authors have contrived to explain these matters lucidly and adequately without mathematics.

As in previous editions considerable space is given to valve data and in the 1947 edition some fifty pages are devoted to tabulated operating conditions and characteristics of over 1,000 valves.

A selection of miscellaneous formulae, charts and tables gives an appropriate finish to this useful storehouse of radio information.

The handbook is obtainable from A. F. Bird, 66, Chandos Place, London, W.C.2, the price being 12s 6d plus 8d postage. Alternatively, orders for delivery direct from the U.S.A. can be placed with the Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1. Price 11s 6d, inclusive of postage.

Indoor Suspension Loudspeaker—Type LS/T/10C. Fitted with two 8" units and covers a wide area.

# cabinet Speakers...



5" Single Cone Loudspeaker—Type LS/30C. Totally enclosed. wall mounting.

12" Single Cone Loudspeaker—Type LS/10/C. OPEN BOTH SIDES and suitable for centre hanging in Hall or Workshop.

Single Unit Loudspeaker—Type LS/5C. Ideal for medium power Public Address.

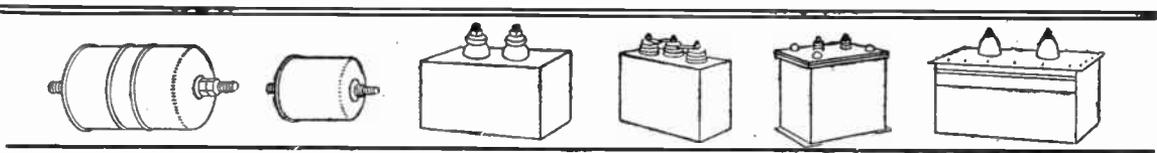
Dual Unit Loudspeaker—Type LS/HF/10C. A medium capacity general purpose speaker 'or wall mounting.

Dual Unit Loudspeaker—Type LS/HF/5C. Designed for mounting on wall or across a corner.

'TANNOY' offers a wide range of Cabinet Speakers—different in size, shape and power output—each type (or combination of several) being just right for a particular purpose or location.  
For music or speech, small dance hall or large ballroom, private social gathering or big convention, TANNOY Sound Equipment always fits the occasion.

**"TANNOY"**  
"THE SOUND PEOPLE"  
**GUY R. FOUNTAIN, LTD.**  
WEST NORWOOD, S.E.27 (GIPsy Hill 1131)  
Branches throughout the British Isles.  
**ARE YOU A TANNOY STOCKIST?**  
Write for details to Dept. "D."

'TANNOY' is the Registered Trade Mark of Equipment manufactured by **GUY R. FOUNTAIN, LTD.** The Largest organisation in Great Britain specialising SOLELY in Sound Equipment.

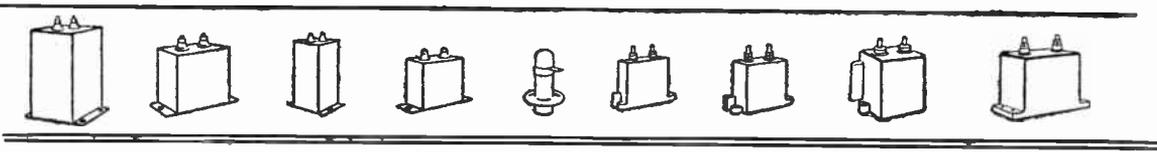


# Wego CAPACITORS

★ CALCULATED TO ANSWER  
THE MOST EXACTING DEMANDS

★ FOR ALL RADIO  
AND ELECTRONIC PURPOSES

WEGO CONDENSER CO LTD · BIDEFORD AVE · PERIVALE · GREENFORD · MIDDX · Tel. PERIVALE 4277



*Let Britain's Leading Electronic Experts train  
you for a Career in Electronics*

★ There is vast scope for ambitious men and women in the new fields opened up by Electronic Science. The Correspondence and College Courses provided by E.M.I. Institutes which cover recognised diplomas and include a wide variety of sets are written and supervised by E.M.I. scientists who are specialists in Electronic Science. Here are some of the subjects in which you can be trained:

- SERVICE ENGINEERING
- 
- OPERATING
- 
- DESIGN AND DEVELOPMENT
- 
- TECHNICAL SALESMANSHIP

- TELEVISION and RADIO.
- COMMUNICATION ENGINEERING—Land, Sea and Air.
- RADAR.
- NAVIGATIONAL AIDS.
- INDUSTRIAL ELECTRONIC APPLICATIONS.
- MEDICAL EQUIPMENT.
- AUDIO FREQUENCY, INCLUDING FILMS, etc.

Also Popular Courses for Executives, Amateurs, Schoolboys, etc.  
For full details apply to your local H.M.V. Radio dealer or direct to:—  
PROFESSOR H. F. TREWMAN, M.A. (Cantab), M.I.E.E., M.I.Mech.E.  
Principal . . .



## E.M.I. INSTITUTES LTD.

Dept.16, 43 GROVE PARK ROAD, CHISWICK, LONDON, W.4

The E.M.I. Group includes H.M.V., Marconiphone and other important electronic interests.

# MODERN MARINE RADIO

## Standardized Marconi Equipment for Merchant Ships

By D. F. BOWERS and E. F. CRANSTON

**T**O meet the demand for radio equipment created by the intensive shipbuilding programme since the war, the Marconi Company has standardized two types of installation, built on the unit system so that they can be readily fitted in cabins of diverse shapes. Each installation consists of a transmitter, communication receiver, automatic alarm device, and direction finder. The "Trader" transmitter is for medium-frequency working only,

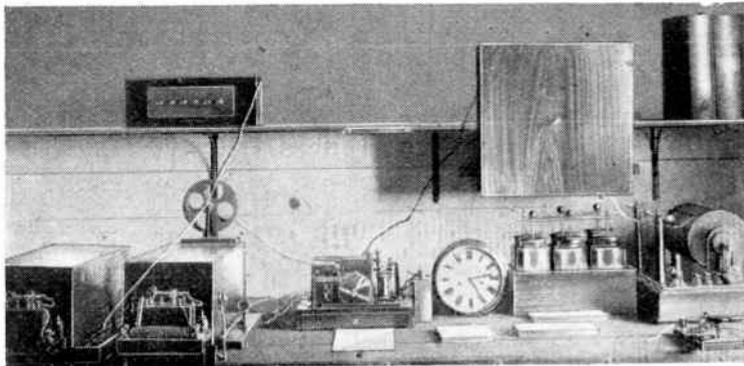
out into an accessible position with power on, so that inspection or performance checks may be effected. The "Oceanspan" and "Trader" radio-frequency units are interchangeable, the remaining units being common to both equipments.

At medium frequencies the "Oceanspan" transmitter covers 365-540 kc/s and delivers an

ing a total of thirty radiated frequencies, the H.F. marine bands being harmonically related. Separate aerial matching circuits are used for medium- and high-frequency operation, both being capable of coupling to the wide range of aerial characteristics met with on different classes of ships. The circuits are designed to give low harmonic radiation, this being essential to prevent interference on other marine bands.

Colour-coded tuning controls are fitted to simplify operation, and the use of "click" spot-frequency selectors enables predetermined settings to be rapidly and accurately found. For high-frequency operation it is possible to switch from the calling to the working frequency without retuning the transmitter. The circuits and performance of the "Trader" transmitter are identical with those of the "Oceanspan" transmitter on medium frequencies.

An overload trip circuit protects the transmitter against damage due to breakage or short-circuiting



THEN—The Marconi Company is now celebrating the fiftieth anniversary of its foundation. In the photograph above is seen one of the earliest marine installations: that fitted aboard the S.S. *Philadelphia* in 1902, and used by Marconi for experimental work.

—AND NOW →

a typical Marconi installation of 1947 built on the unit system and adaptable to different shapes of cabin. The units shown are (from left to right) "Oceanspan" transmitter, auto alarm device, communication receiver and D.F. receiver.

but the "Oceanspan" covers both medium- and high-frequency marine bands.

A robust cabinet houses the transmitter together with the aerial switching, transmitter supplies, vibrator supply units for all receivers, battery charging and control circuits. The various units in the cabinet slide in on runners and connect with the cabinet wiring by special spring contacts. Access to the units is obtained by the removal of the front cover, which is interlocked to prevent accidental contact with high potentials. To assist in maintenance and servicing, test jigs supplied with each equipment make it possible to bring any unit

aerial current of 4.0 to 5.5 amps on C.W., or 4.5 to 6.0 amps on M.C.W. into an average ship's aerial. In the high-frequency marine bands (between 3.0 and 23.0 Mc/s) the power radiated is 100 watts on C.W. or 110 watts on M.C.W.

The transmitter employs a negative-resistance type oscillator for medium frequencies and a crystal oscillator for high frequencies. Provision is made on the latter for fitting up to ten crystals, giv-



of the aerial, failure of drive or mistuning of the final stage.

About 60 watts at 1,000 c/s is developed by a tone oscillator valve acting directly as an anode modulator. The depth of modulation is 80 per cent (100 per cent for M.C.W. operation).

### Modern Marine Radio—

The transmitter is keyed by the front contact of the telegraph key, the back contact being used to desensitize the associated receiver for "break-in" operation. No keying relay is used.

The equipment is normally fed from the ship's D.C. supply at 110 or 220 volts. Alternatively, by the operation of a switch, the equipment can be supplied from emergency batteries while still giving the same aerial output. Under this condition the duration of transmission and reception more than complies with statutory requirements for emergency operation.

The "Yeoman" superheterodyne receiver covers continuously a frequency range of 15 kc/s to 25 Mc/s. Gaps in the frequency range are avoided by selecting, according to the signal frequency, either of two intermediate frequencies, i.e., 570 kc/s or 98 kc/s. The receiver employs eight valves including one signal-frequency, and two I.F. stages. A crystal oscillator with a frequency of 690 kc/s (a sub-harmonic of the marine high-frequency calling frequencies), can be used as a calibrator when desired. Four passbands are available, the narrowest (100 c/s) being obtained by means of an audio-frequency filter. A logging scale is fitted in addition to the usual frequency calibrated scales. Plugging headphones into one of the jacks provided automatically cuts out the built-in loudspeaker. For "break-in" operation the gain of the receiver is drastically reduced by applying a biasing voltage to the signal frequency and first I.F. valves in the "key down" condition. The degree of desensitizing can be adjusted to suit operating conditions.

The "Vigilant" automatic alarm device provides for the reception of the international alarm signal and by the subsequent actuation of alarm bells indicates the reception of a distress call. The apparatus consists of a receiver which responds to M.C.W. signals on any frequency between 512 and 487 kc/s, and a selector unit which discriminates between the correctly coded distress call and other signals or static. A calibrated oscillator is incorporated

for testing both receiver and selector.

The "Lodestone" direction finder covers a frequency band of 250-546 kc/s. The goniometer and superhet receiver are built into a single unit used in conjunction with Bellini-Tosi fixed loops and a separate sense aerial. The receiver employs five valves including one signal-frequency stage and one stage of intermediate-frequency amplification.

Since these equipments have been fitted, reports have been re-

ceived from the operators regarding general performance and the ranges obtained. These reports state that on medium frequencies (375 to 500 kc/s) ranges up to 900 miles by day and 2,000 miles by night were achieved. At high frequencies world-wide communication was obtained. It has been found that the simplicity and rapidity of band changing and the ability to switch rapidly from calling to working frequencies has materially assisted in the expeditious handling of traffic.

## BOOK REVIEW

**Principles of Radar** (Second Edition). By Members of the Radar School, Massachusetts Institute of Technology. McGraw-Hill Publishing Co., Ltd., Aldwych House, Aldwych, London, W.C.2. Price 25s.

**EXPERIENCE** with large books composed of the contributions of many writers has not always been entirely happy, and in the present case one may be additionally prejudiced by the facsimile typescript, associated with rush war jobs. So it is a pleasant surprise, on examining "Principles of Radar" more closely, to find a work combining consistency with thoroughness in every part. More remarkable still is the way in which it combines two other qualities that so seldom meet as to seem almost incompatible: this volume is as informative as an advanced work, and as approachable as an elementary one. And these primary qualities are further combined with exceptional accuracy and consistency in presentation. There may be slips or misprints, but in a fairly close examination the reviewer failed to find a single one in the book itself; a result which as far as he can remember is quite unprecedented! It is true that the dust-cover bears a reference to a non-existent Chapter XIII, but it is unlikely that the authors can be blamed for that, and in any case the following extract from the same cover is so true as to be worth quoting:—

"Expositions of circuits and devices provide an unusual combination of technically thorough and accurate treatments with minimum dependence upon mathematics. Emphasis in the treatment of circuits is upon quantitative analysis directly from tube characteristics and physical principles."

The method adopted in explaining each circuit—say a differentiating or oscillator circuit—is to reduce it to its basic equivalent, which is

generally familiar. This is admirable, because in contrast to blind-alley memorizing, it gives the student a thorough grasp of underlying principles, combined with the ability to apply them to new situations. The favourite reducing tool is Thevenin's Theorem, which ought to come much earlier in technical instruction than it usually does—or did.

The authors confine themselves to radar in its strictest sense, and wartime radar at that; yet the book can be thoroughly recommended to readers who are not even concerned with radar at all, for its thorough explanations of circuit action with non-sinusoidal waveforms, waveform spectrums and bandwidth, practical design of transmitters and feeders, and theory of lines and cavity resonators, to mention only a few things.

It is no doubt a result of intensive experience in teaching this new science to thousands of mainly non-technical entrants, that almost every possible cause of misunderstanding has been anticipated and guarded against. The uses of symbols and conventions are clearly explained and scrupulously adhered to. To exclude any uncertainty about what is meant when descriptions of circuit action refer to a current or voltage being positive or negative, the positive condition is marked on each diagram concerned—a very helpful convention.

Although the emphasis is on principles, typical values and quantities are given. For example, not only are the usually obscure principles of dipole reflectors and directors clearly and concisely given in a way that enables particular cases to be worked out, but the effect of variables on their performance is shown diagrammatically.

"Principles of Radar" is a model of how to teach theory for practical application.

M. G. S.

# CHANNELS OF COMMUNICATION

## Why and How They Require Bands of Frequency

IT is interesting to notice how the emphasis shifts during the development of a new art.

When the brothers Wright were attempting to fly, their thoughts were no doubt more concerned with getting their contraption into the air than with the fear that lack of international air traffic regulations might increase the risk of their bumping into some other aviator.

Similarly, fifty years ago the achievement of sending wireless messages at all was too absorbing to leave much time for considering what might happen when overcrowding set in. But when wireless caught on and spark transmitters were installed wholesale, it was soon clear that the risk of one "bumping into" another was far from negligible. The word "jamming" dates from this period. Messages were generally quite brief, however, and a number of ships (for example) could share the same wavelength—or *channel*. If it was completely jammed it was just a case of waiting one's turn.

But when some stations' trans-

By "CATHODE RAY"

as they became more numerous the problem arose of packing the channels more and more closely in order to have enough to go round.

At first the solution appeared to be just a matter of making receivers more and more selective. It was true that certain theorists had talked learnedly about "sidebands," but these were dismissed by others as mathematical fictions, devoid of any practical reality or significance. This question came to a head in the great Stenode controversy of 1929-1932. The reality and non-reality of sidebands were both stoutly defended to influential circles, and things got to such a pass that a Government-sponsored investigation was put in hand. Its report settled any lingering doubts about the physical reality of sidebands and the inescapable necessity for spacing transmitters apart by a frequency which depended on the frequency of the "information" they carried.

Meanwhile the growth in the

tion of this one-time highbrow scientific controversy. On the one hand the need for a wide frequency channel in order to transmit speech and music faithfully had been established; on the other, all the nations wanted to grab as many channels as they could, and were not always content with frequencies that limited effective range to their own frontiers. And, of course, all sorts of other radio services kept on joining the competition, so the conflict between the irresistible force of commercial and political radio development and the immovable object of necessary channel width gets worse day by day.

But is the channel difficulty so immovable? What exactly is the difficulty?

In the first place, it may be as well to realize that it is not an exclusive radio problem. If the "information"—morse, speech, music, pictures, etc.—were sent over a line channel instead of by radio it would still occupy a frequency band. For the reproduction of reasonably clear speech it is necessary to include all fre-

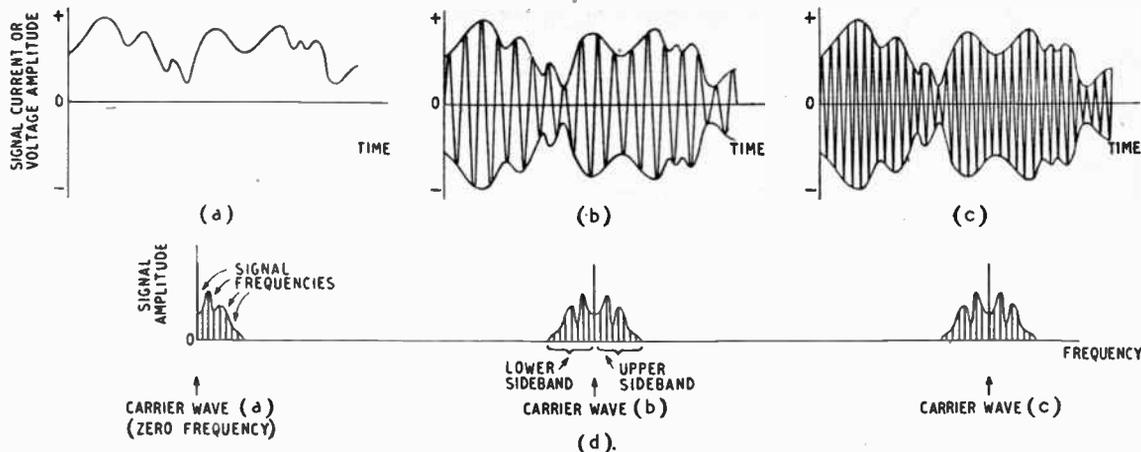


Fig. 1. (a) is a sample of audio-frequency programme; a mixture of a number of frequencies. These frequencies can be individually represented on a frequency scale, as at the left of (d). When (a) is used to modulate a carrier wave, the result is shown on time and frequency scales by (b) and the middle of (d) respectively. (c) and the right-hand end of (d) represent an alternative carrier wave, of higher frequency. (a) can be regarded as having a zero-frequency carrier wave. In all cases the programme is fully communicated by one sideband only. (a)—(c) and (d) are two different ways of graphing signals.

missions came to be more or less continuous, they had to be given exclusive rights to channels. And

number of transmitters, broadcasting and otherwise, was making an acute international situa-

quencies from, say, 100 to 3,000 c/s. That is a frequency band of 2,900 c/s. Sent directly over a

### Channels of Communication—

line, this band would occupy the position 100-3,000 c/s in the frequency scale (for what that means, see later).

The modulator in a radio transmitter is just a device for shifting this same band into a region of frequencies that can be radiated effectively. If the carrier wave is, say, 1,000,000 c/s, amplitude modulation causes sidebands to appear, from 997,000 to 999,900 c/s and 1,000,100 to 1,003,000 c/s; a total band of 6,000 c/s (including the small gaps extending for 100 c/s each side of the carrier wave). This is more than double the original 2,900 c/s; but it need not be. One sideband and the carrier wave can be suppressed, whereupon what is left occupies exactly the same frequency band as the original. Given a suitable receiver, no more is needed. The difficulty is that this sort of receiver costs more and is much more difficult to tune than the sort that deals with transmissions consisting of carrier wave and both sidebands. So, in broadcasting, where the number of receivers is enormous, it is an unfortunate practical necessity for transmitters to occupy a channel more than twice as wide as in line communication. For point-to-point radio, the extra trouble and cost of single-sideband working is relatively small, and well worth it for the saving in channels.

Whatever carrier-wave frequency is used, the frequency band occupied by the information is, of course, exactly the same. In fact, the original band, 100-3,000 c/s, can be regarded as a sideband of a zero-frequency carrier wave; see Fig. 1.

What is meant by "occupying" a 100-3,000 c/s frequency band? It can hardly mean that there is a signal going on all the time at every frequency from 100 c/s to 3,000 c/s, because the number of such frequencies is infinitely large. (However closely together you number them, somebody can always come along with another decimal place to the right and stick nine more in between every pair of yours!) The nearest approach to complete occupation is "fluctuation noise" caused by the restless movements of electrons, in which the probability is

that something will happen sometimes however narrow a frequency band you select. In practice, however, there is no sense in dividing the frequency scale into narrower units than one can select by the sharpest tuning circuits or filters. The band 100-3,000 c/s covers a good many such units, and can be said to be occupied if there is a chance that all the units may be needed some of the time. In any particular spoken message

terms of the height of a vertical line on a cathode-ray tube, just as in Fig. 1d. With a variable signal such as speech or music these lines keep popping up and down all the time. This type of display is an alternative to the ordinary time-base oscilloscope, which shows Fig. 1a-c.

The next question is whether it is possible to reduce the frequency bands occupied, so as to make room for more channels. 2,900

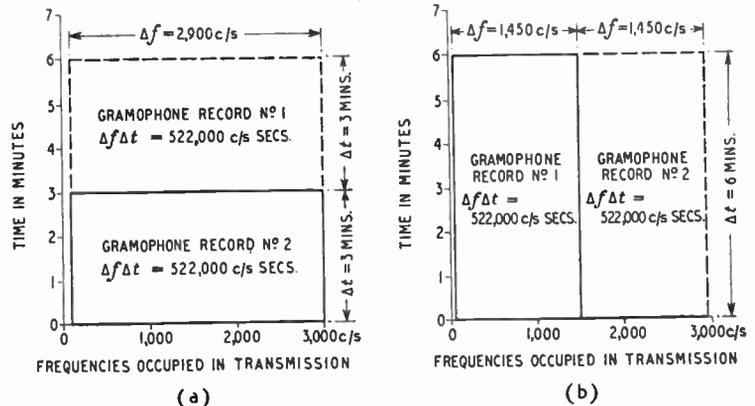


Fig. 2. If a transmission channel 2900 c/s wide is available, two recorded speeches, each lasting 3 minutes, would together occupy it for 6 minutes (a). By running the records at half-speed, each occupies only half the band width, and by means of modulators, band-pass filters, etc., both could be transmitted simultaneously along a 2900 c/s channel (b); but as each takes twice as long, there is no net advantage, and the process is technically much more difficult. In practice a frequency gap would have to be allowed between the two channels.

or musical programme, some of them may go unused all the time, but you never know. Renting a communication channel is rather like renting an hotel. You have to pay for the whole place all the time, even though some of the rooms may not always be full. In speech or music, the hotel guests are very much of the type referred to in America as "transients." (The U.S.A. must have known I was going to use this analogy!)

Incidentally, a frequency-occupation diagram, such as Fig. 1d, is often called a spectrum, as it is, in fact, the extreme low-frequency end of the same thing as is shown by an optical spectro-scope. One type of communication-frequency spectro-scope consists of an array of filters or resonators, between them covering the whole band of frequencies involved, with an arrangement for showing the response of each in

c/s for speech is already some reduction, because the frequencies actually present in the voice extend considerably higher. It is possible to cut off still more, but in doing so one runs an increasing risk of losing important and perhaps vital parts of the information.

Instead of sacrificing some of the frequencies completely, it is possible to lower them all. By recording the speech and running the record into the transmitter at half-speed, the resulting frequency band (50-1,500 c/s) is half what it was; and by re-recording at the receiving end and reproducing at twice the speed it is restored to 100-3,000 c/s. But although it would be possible in this way to transmit two speech messages simultaneously in a frequency band normally occupied by one, each would take twice as long to transmit, so the arrangement would show no advantage over

the much simpler process of sending the two messages straightforwardly one after the other along the full-width channel. This is shown in Fig. 2, where frequency band-widths are denoted by  $\Delta f$  and time periods occupied by  $\Delta t$ . (The Greek capital  $\Delta$ , stands for *difference* between two boundary frequencies or times.)

It seems, then, that what determines the quantity of information that can be transmitted along a channel—line or radio—is not just the width of the channel,  $\Delta f$ , but the width multiplied by the time,  $\Delta t$ , during which it is available. This  $\Delta f \Delta t$  is represented on a diagram of the Fig. 2 type by an area. A given message can—*theoretically*—at any rate—be transmitted in a short time along a wide channel, or in a proportionately longer time along a narrower channel. The unit of the amount of information that can be transmitted might be said to be one cycle per second multiplied by one second, viz., one cycle.

Before this statement can be regarded as fully buttoned-up it is necessary to establish a more definite relationship between information and cycles. This is difficult, because "information" is not readily measurable. Hartley, of oscillator fame, discussed it in America in 1928, and arrived at what has since been named the Hartley Law, which is more or less what we have just said—"the total amount of information which may be transmitted is proportional to the product of frequency range which is transmitted and the time which is available for transmission." Even his fairly advanced argument didn't get the length of fixing a numerical rate of exchange between information and  $\Delta f \Delta t$ . Not long ago Dr. Gabor tackled this part of the problem.<sup>1</sup> But before going on to his results, is it true that the unit of  $\Delta f \Delta t$  is the cycle? It may seem to fit nicely into the Hartley Law, because it is a plausible idea that one cycle is a sort of elementary signal, like a morse dot perhaps; so a whole message can be built up from a suitable number of cycles. A pity, but it is a fallacy. Try sending even a simple mes-

sage with identical cycles, as many as you want! An infinitely large number would be insufficient.

"How absurd!" you may say. "Give me an audio oscillator and a morse key and I'll soon crack off the message." Yes, but I said *identical* cycles. If you interrupt the flow of cycles you are modulating it, and that creates sidebands, which consist of cycles of other frequencies and therefore not identical.

Whatever one may do in order to convey information necessitates some sort of choice or selection of alternatives, such as the choice of letters in written words, or sequence of dots and dashes in morse or of sounds in speech, and that means variation or *modulation*. And that, as has been proved mathematically and by experiment, spreads out the frequencies, so that it is impossible to send a message with a single frequency. The cycle, as a unit of message capacity, won't do; it is the cycle per second frequency band width multiplied by the second.

So now perhaps the Hartley Law looks less obvious, and the abstruse reasoning behind it more necessary. (This reminds me of the professor who suddenly interrupted his lecture at the words "... from which it is obvious that ...," and saying, "Excuse me, gentlemen," retired into his study for deep and prolonged thought. At length, emerging into the now empty classroom he beamingly announced, "Yes, gentlemen, it is obvious!")

After people realized that signalling by *amplitude* modulation necessitated a channel at least as wide as the highest modulation frequency, every now and then some of them who didn't know about the Hartley Law, or didn't believe it, rubbed their hands with glee and said, "Ha! We can get round this by using *frequency* modulation. We have only to keep the depth of modulation down to, say, 100c/s each side of the carrier wave, and we'll be able to send speech over a 200c/s-wide channel!" Well, of course, that is too good to be true, but there was some excuse for not realizing it at first—the mathematics this time was beyond all

And now—  
A.C./D.C.

**20-25-WATT UNIVERSAL AMPLIFIER—U885**

Gives considerably greater power output than usually expected from A.C./D.C. equipment. Constructed on the same lines as our 30-watt A.C. model and fitted with latest control panel carrying microphone, gramophone and tone controls, mains switch and pilot lamp and special 3-position switch providing either change-over or mixer circuit for gramophone and microphone. Three-stage high-gain type having four valves in parallel push-pull in output stage, a total of 10 valves. Output for high and low impedance speaker circuits.

Full details of this and other models sent on request.



**TRIX**  
Quality  
SOUND EQUIPMENT

**THE TRIX ELECTRICAL CO. LTD.**  
1-5 MAPLE PLACE—TOTTENHAM COURT ROAD—LONDON, W.1  
TELEPHONE: MUSEUM 5817 GRAMM & CABLES: TRIXRADIO, WESDO, LONDON.

<sup>1</sup> *Journal I.E.E.*, Part III, Nov. 1946, pp. 429-457.

**Channels of Communication—** but a select few, of whom J. R. Carson was the first to prove that the sidebands with F.M. were even wider than with A.M., however narrow the frequency deviation.

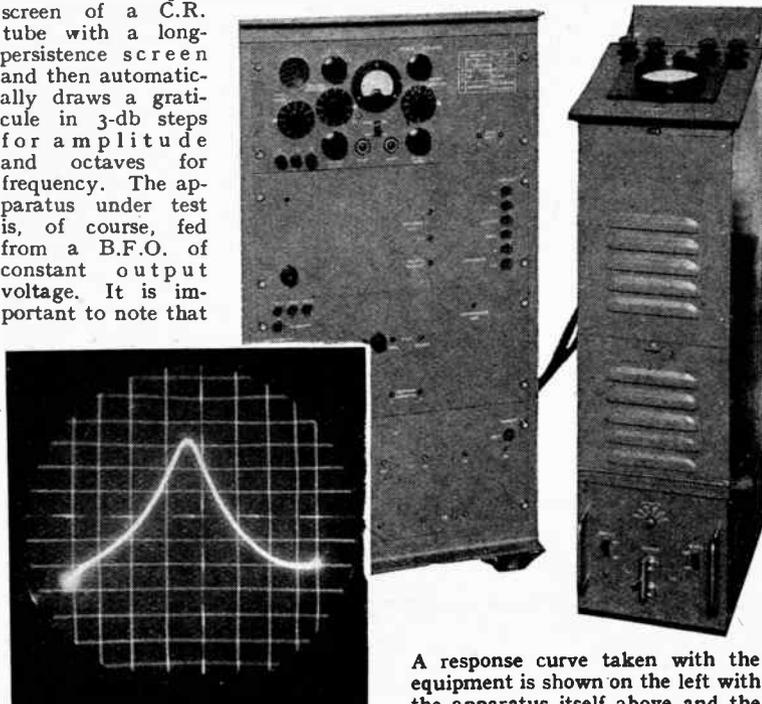
The pursuit after some way of dodging the Hartley Law seems to be as fruitless as the search for Perpetual Motion; but that is not to say there is no scope at all for progress. A deep, clear, rounded voice is not likely to need quite such a wide frequency band as a very high, squeaky one delivering the same message in the same time. The high voice is less efficient in its use of a transmission channel. On the other hand, the same words can be sent as quickly by high-speed morse through an even narrower channel than the deep voice, and telegraphy is, therefore, more efficient in this re-

spect than telephony, at least if only the mere words are counted as "information." An interesting question is: What is the smallest signal—that is, the smallest time + frequency-band—that is capable of transmitting one elementary item of information? That is the problem Dr. Gabor investigated, and to do so he had to invoke mathematics of many terrifying kinds, and used an analogy with quantum mechanics to make it easier—so you may know! But it is not too difficult to follow the gist of it. In doing so one gets some light on the sort of ideas that are coming into an increasing number of papers on communication nowadays. As the Cathode-Ray screen is just about filled up, however, the shining of that light will have to wait until next month, when we will discuss some of the possibilities.

## RESPONSE CURVE TRACER

**REDIFFUSION, LTD.**, of Broomhill Road, London, S.W.18, have produced an automatic curve-tracer of unusual type. Fed with the output of the filter, transmission line or loudspeaker under test it draws the response curve on the screen of a C.R. tube with a long-persistence screen and then automatically draws a graticule in 3-db steps for a amplitude and octaves for frequency. The apparatus under test is, of course, fed from a B.F.O. of constant output voltage. It is important to note that

no synchronization of the apparatus with the B.F.O. is needed nor any communication channel but the apparatus under test. The frequency range is 39 c/s to 11,000 c/s. The apparatus is known as Redifon Response Curve Tracer, Model M.33.

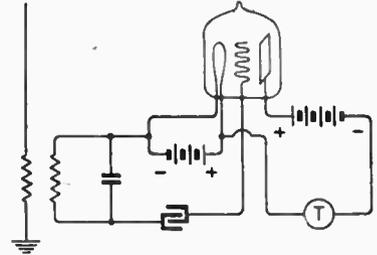


A response curve taken with the equipment is shown on the left with the apparatus itself above and the C.R. unit on the right.

## 40 YEARS AFTER

**I**T was in January, 1907, that Lee de Forest filed the patent on the insertion of the grid in the valve.

Dr. de Forest, America's "Father of Radio," addressing the U.S. National Association of Broadcasters, in a letter in a Chicago newspaper, asks, "What have you gentlemen done with my child? He was conceived as a potent instrumentality for culture, fine music, the uplifting of America's mass intelligence. You have debased this



This diagram from de Forest's 1907 patent specification "might—except for the absence of a grid leak—be dated 1943."

child . . . you have made him a laughing stock of intelligence."

In a special de Forest anniversary number of our New York contemporary, *Radio Craft*, the inventor, now 73 years old, contributes an article on "How the audion was invented." Describing the building of the first valve containing a platinum plate and carbon filament he writes: "The plate was connected to the positive side of the dry battery; the negative terminal to the filament. In series was a telephone receiver. This device was *not* the Fleming valve. It has always been quite impossible for me to understand the confused idea, in the minds of some otherwise keen thinkers, that the audion differed from the Fleming valve merely by the insertion of a third electrode. *Without the use of the B-battery the valve would be nothing but a rectifier with one too many electrodes.* The employment of the local battery in the plate circuit is just as necessary an element to the success of the device as the grid."

Writing on "Early Radio Inventions" in our sister journal, *Wireless Engineer* (November, 1943), Professor G. W. O. Howe, said of de Forest's insertion of the grid in the valve, "This will surely rank for all time as one of the greatest inventions of radio telegraphy."

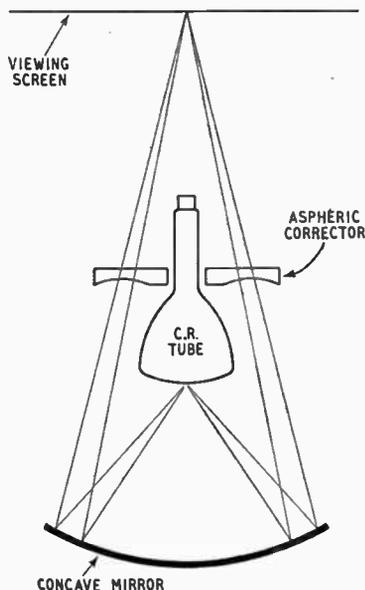
In recognition of the 40th anniversary of his invention, de Forest was awarded the Edison Medal by the American I.E.E.

# PROJECTION TELEVISION

## Advantages of Plastics for Optical Equipment

THERE is no doubt that the attainment of larger television pictures must depend very largely on projection technique, if only because the convenient maximum in size for a directly-viewed cathode-ray tube has already been reached. The most widely used tube to-day has a screen diameter of 9in and an overall length of about 18in and produces a picture 7½in by 6in; 12in tubes are used and are proportionately bigger in every way. Anything much larger than this becomes impracticable for home use.

It is an attractive idea to produce a small and very bright picture on a small tube and to project it optically on to a viewing



Layout of the Schmidt optical system for projecting television pictures on a screen.

screen. By optical magnification any required size of picture can be obtained and the physical dimensions of the apparatus can be kept within reasonable limits. Moreover, the picture can be obtained on a flat surface instead of the rounded end of the tube.

Projection television is by no means new and sets embodying this principle were on the market before the war. However, there have always been certain difficulties which have hitherto prevented it from becoming at all widely used. These have lain in the attainment of adequate brightness and definition.

The brightness required at the tube itself, of course, varies as the square of the linear dimension of the final picture and there is nothing that can be done about this. There is also a loss in the optical system as compared with direct viewing and it is here that serious difficulties have been encountered.

For efficiency an optical system of very large aperture is needed, but with the conventional glass lenses and mirrors a large aperture demands the use of spherical surfaces if the manufacturing cost is not to be prohibitive. Now spherical surfaces result in spherical aberration and a loss of definition and contrast in the final picture. As a result a compromise is adopted between aperture, aberration and cost and the loss of light is quite considerable.

During the war great strides were made in the development of plastic, instead of glass, lenses for optical equipment and this technique is now being applied to television projection. The great advantage of plastic over glass is that it becomes economically possible to adopt surfaces other than spherical and so a large aperture system free from aberration becomes possible. It is true that a suitable mould has to be made and that this is quite as difficult as making a glass lens of the same shape, but one mould can be used for many plastic lenses and with bulk production its proportionate cost per lens is small.

The technique of making plastic optical equipment was discussed recently by D. Starkie in a paper read before the Institute of Physics in which he referred to

SPECIAL  
INSTALLATION FOR

# DEAF SCHOOLS

Before the War, Multitone supplied most of the Schools for the Deaf in this country and many abroad with group hearing aid installations. Our new equipment of this type has now been installed in all the L.C.C. Special Schools. It consists of a sound cell crystal microphone, special amplifier, radio tuning unit and magnetic earphones with suitable control boxes for each pupil. The amplifier incorporates volume compression circuit and two channel output; one channel provides level modification, the other high pass. The pupil's phone box is provided with two volume controls for mixing the two outputs to suit each individual. The power supply is A.C. Mains, 110-250, and a monitor loud-speaker is incorporated in the tuning unit. Delivery approximately 6 weeks.

## MULTITONE

ELECTRIC COMPANY LIMITED  
92, New Cavendish St., London, W.1.

Signatories to the National  
Institute for the Deaf Agreement

### Projection Television—

the work of Imperial Chemical Industries. Two suitable materials are available and are known as Transpex 1 and 2; they are respectively especially pure grades of Perspex and polystyrene. They have refractive indexes of 1.49 and 1.59 and the softening temperature is 120° C.

For television purposes the Schmidt optical system is used as sketched in Fig. 1. Two models were shown at the lecture. One used a 2½-in C.R. tube with an 8-in diameter optical system giving a magnification of 8.5 times at a throw distance of 40in. The other had a 3½-in tube with a 14-in optical system and a magnification of 7.5 times at a throw distance of 69in. The resolution is claimed to be adequate for a 1,000-line television system.

As shown in Fig. 1, the C.R. tube on which the picture is formed faces a concave mirror. This is made of Transpex with a surface layer of aluminium deposited in a vacuum chamber. The aperture is  $f/0.75$  and would in itself be sufficient to focus an enlarged picture on the viewing screen if it were not that it introduces spherical aberration. The effects of this are overcome by the aspheric corrector plate mounted around the tube. It is this component of the system which would be so difficult to manufacture if glass were used.

### Heavy Duty Converter

DESIGNED for use with television as well as radio receivers the Valradio Model 230/200 vibrator converter operates from D.C. mains and supplies 200VA at 200/250 V A.C.

The vibrator is of the heavy-duty type having contacts ¼in in diameter. It is spring-suspended to reduce mechanical noise and housed, together with its transformer and R.F. filter circuits, in a ventilated steel case measuring 13in x 6in x 6in.

Frequencies of 50, 65 and 75 c/s can be supplied, and the latter is recommended for television as it avoids any shadow or flicker due to residual hum in the receiver.

The price of the converter is £12 and the makers are Valradio, 57, Fortress Road, Kentish Town, London, N.W.5.

## NEW RECEIVING VALVES

### First Details of Mazda and Mullard Ranges

**M**OST of the new types announced by Mazda will be on the B.V.A. type B8A base described in our issue of last November. The A.C./D.C. series, already in production, has a standard heater current rating of 100mA and includes the following types. Unless otherwise stated the bulb diameter is 20 mm.

**10C1.** Triode-heptode frequency changer. Performance equivalent to that of the Mazda TH233.

**10F9.** Pentode R.F. amplifier primarily designed to work in the I.F. stage of a receiver: working mutual conductance, 2.4 mA/V. Similar to the VP133, but is designed to work with the same operating potentials on input grid and screen grid as the 10C1. This enables the number of resistors and condensers in the receiver to be reduced.

**10LD11.** Double-diode-triode, the triode section of which has a voltage amplification factor of 30.

**10P13.** Beam power output pentode intended primarily for use in receivers where the saving of space is of the first importance. The 10P13 has been especially designed to enable resistance smoothing to be employed in anode and screen circuits. With 180 volts on the anode and 165 volts on the screen it has a power output of 2.5 watts.

**10P14.** Beam power output pentode with greater power-handling capacity than the 10P13. It is fitted with an international octal base and has a bulb 28.5 mm in diameter. Typical operating voltages are 165 volts on the anode and 175 volts on the screen, under which conditions the power-handling capacity is 3.3 watts.

**U404.** Half-wave rectifier designed for input voltages up to 250 volts R.M.S. D.C. output 90 mA.

In the forthcoming A.C. range, 6.3-volt heaters with reduced current consumption will be standardized, and small-bulb construction will be used wherever

possible. The types which will be available are as follows:—

**6C9.** Triode-hexode frequency changer similar to the TH41.

**6F15.** Variable- $\mu$  R.F. pentode designed for operation in conjunction with the 6C9 using common A.V.C. bias and coupled screens.

**6LD20.** Double-diode-triode; amplification factor of triode section 30.

**6P25.** Beam power output pentode; with 250 volts on the anode and screen, gives a power output of 5.8 watts. It is fitted with an international octal base and has a bulb diameter of 45 mm.

**6F13.** High-gain screened R.F. pentode for wide-band reception, e.g., in television.

**6L18.** Triode designed primarily for use as the local oscillator in superhet television receivers. It is an efficient oscillator up to 150 Mc/s.

The new range of Mullard valves to be released later in the year will be fitted with the spigotless version of the B.V.A. type B8A base and will be made by a new low-tem-



The spigotless type B8A base has been adopted for the new "U40" range of Mullard valves.

perature sealing process in which a special cement is used to join the bulb to the glass base. Advantages claimed for the method are that softening and distortion of the base are avoided and hard connecting pins can be used. There is also less risk of "poisoning" the cathode.

The new valves will have a diameter of 22 mm and lengths ranging from 66 to 84 mm. The heater current will be 100 mA and

the following details of representative types have been received.

**UAF41.** Single-diode-pentode: only one diode is included in order to avoid interaction between the diodes in a circuit where two diodes are required. By using two UAF41 valves in a receiver, the diode section of the I.F. valve can be used for detection and the diode section of the A.F. amplifier for A.V.C. In this way the delay voltage of the A.V.C. valve will not be affected by the control of the I.F. amplifier. The slope of the UAF41 is 1.8 mA/V and the anode-grid capacitance is less than 0.002 pF.

**UCH41.** Triode-hexode: The third hexode grid is connected internally to the triode grid and the valve can therefore be used only as a frequency changer. The heater consumption is only 1.4 watts and the characteristics of the UCH41 are approximately the same as those of the earlier CCH35.

**UL41.** Output pentode: This valve has a mutual conductance of 9.5 mA/V, and is capable of delivering 4.2 watts of A.F. power into a 3,000-ohm load when operated at anode and screen voltages of 165 V, and with a signal input of 6.2 V. The valve is so designed that, with the obvious exception of the resistance in the heater circuit, the circuit constants, i.e., cathode and screen resistances and anode load are substantially independent of the supply voltage.

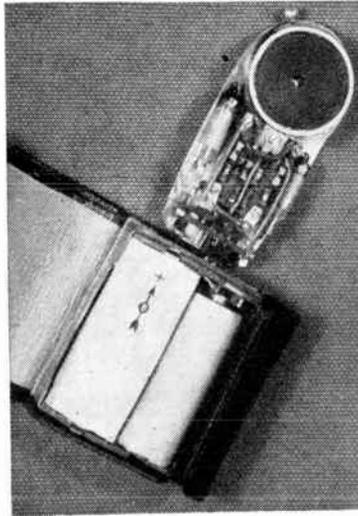
**UY41.** Half-wave rectifier: This valve is designed for input voltages up to 250 V R.M.S. and gives a rectified output current up to 90 mA.

## HEARING AID MINIATURE

### The Multitone Type MT3

NOWHERE is the cult of "miniaturization" pursued with greater justification than in the production of hearing aids for the deaf. In the latest Multitone design a three-stage amplifier and crystal microphone have been compressed into a case  $3\frac{1}{4}$  in long,  $1\frac{1}{2}$  in wide and  $\frac{1}{2}$  to  $\frac{1}{4}$  in thick. A wide variety of battery supply units is available

the smallest of which plugs into the base of the amplifier unit and serves as a carrying handle. Clips of the fountain pen type enable the unit



Multitone miniature hearing aid, type MT3.

to be attached to the person in a variety of ways. The weight of the unit is  $2\frac{1}{2}$  oz; with the smallest battery pack,  $6\frac{1}{2}$  oz. Running costs range from 1d per hour to 1d for 13 hours, depending on the degree of amplification required, and the type of battery chosen.

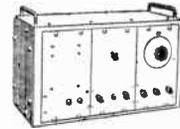
The circuit consists of a two-stage R-C coupled voltage amplifier employing a Raytheon type CK510AX double tetrode, followed by a CK506AX pentode output valve, feeding a miniature magnetic earpiece or bone conductor. When a crystal earpiece is used the output valve is connected as a triode, the necessary circuit changes being effected by differences in the wiring of the 3-socket earpiece connector.

Volume is controlled by negative feedback through a differential condenser arranged, when an inductive load is used, to attenuate high frequencies as volume is decreased. The effect of this is to reduce extraneous noise at low volume levels.

The instrument has provision for the connection of an inductive pick-up coil in place of the microphone, so that it can be used in theatres, cinemas, etc., equipped with the "Telesonic" system.

The price of the MT3 with magnetic earpiece is 29 guineas, with crystal miniature earpiece 30 guineas and with bone conductor 31 guineas. The "Telesonic" coil is 2 guineas extra. Makers: Multitone Electric Co., 223/227, St. John Street, Clerkenwell, London, E.C.1.

## SOME EQUIPMENT towards BETTER P.A.



### U. Series AMPLIFIER

Interchangeable units so as to provide "tailor-made" equipment for any installation.



### M.B. 31 AMPLIFIER

30 watts mains and battery operated. Designed for Dealers' P.A. work. M.31 as M.B. 31 but mains only.



### S.H. 15 REPRODUCER

Open-air reproducer with response from 90—9000 c.p.s. over a 90° arc.



### S.L. 15 LOUDSPEAKER

Labyrinth Loudspeaker of new design giving correct bass pitch.

Other equipment includes 12 watt high fidelity amplifier for laboratory—recording— or home use. Mixers—matching units— output meters—microphones—gramophone units, etc. Comprehensive details of any models gladly sent on request.



# ACOUSTICAL

MANUFACTURING COMPANY LTD.,  
HUNTINGDON. Telephone 361.

# UNBIASED

By *FREE GRID*

## Radiagnosis

SOME of you may have heard of the famous "Abrams box" invented about 1920 by the late Dr. Albert Abrams, of San Francisco. It was sometimes known as the Oscilloclast or E.R.A. ("Electronic Reactions of Abrams"). The doctor claimed to relieve a very large number of the ills to which the flesh is heir, ranging from gin-drinker's liver to housemaid's knee—both of which, by the way, are exceedingly painful conditions and no matter for ribald jesting. Claiming, as he did, to bring about his cures by "electronic reactions" his methods naturally had some interest to those of us moving in electronic circles.

The reason why I am raising the question of "Abrams box" now is that it, or at any rate a modern and very much more electronic counterpart of it, appears to be coming into action again. The main difference is that the new version—like the encephalograph—is more of a diagnostic apparatus than a curative instrument. According to what I have been reading about it, the instrument depends for its effect upon its reactions to the human aura.

No doubt there are many of you who are not quite certain what the human aura is. I am not at all sure that I am myself after all the contradictory statements I have read about it. It is said to be a sort of vapoury or "etheric" cloud surrounding the



Marked and indelicate attention.

body, and more especially the head, rather in the fashion of the halos depicted on paintings and stained-glass windows. People, like Mrs. Free Grid, who possess the necessary psychic gifts claim to be able to see it and they state that it varies in colour being darker in those parts adjacent to any organs of the body

which are below par. Hence the expression "off colour" to denote a feeling of ill health. I must confess that although I have always been a sceptic concerning it I invariably feel distinctly uncomfortable when the offensive females who constitute Mrs. Free Grid's psychic circle have directed marked and indelicate attention to the region of my liver, presumably in an endeavour to discover signs of incipient cirrhosis.

Now, however, all this has been changed and the whole thing set upon a scientific basis by the discovery that radio waves of a certain length are affected by the aura. There is a kind of radar effect, the degree of which depends on the condition of any particular part of the aura or in other words upon the health or otherwise of the adjacent bodily organ. This new diagnostic method has, I understand, advanced so far that certain police forces in the U.S.A. are seriously considering its use as a test for sobriety.

## Science and Art United

NEXT October when the radio exhibition opens at Olympia we shall be celebrating the silver jubilee of radio exhibitions; the very first exhibition was held at the Horticultural Hall in October, 1922. That year also saw the birth of regular broadcasting—November 14th, 1922, was the exact date—and so we shall be celebrating the silver jubilee of that too.

However, it is not about silver jubilees that I want to talk but about the exhibits which we shall see at Olympia. At the risk of being shouted down by totalitarian technical partisans I am going to take up the challenge implicit in the contemptuous remark made recently by one of them to the effect that he hoped it would not be merely another furniture show. Speaking personally I sincerely hope that the various manufacturers will choose their furniture designer with as much care as they choose their technical designer, for radio has

suffered too long from the ugly brown box complex.

Twenty-five years ago a broadcast receiver was a mass of protruberant knobs and valves and quite rightly so, for it was purely and simply a scientific novelty. Nobody in 1922 who had not the clear-sighted vision of myself and a few other pioneers dreamt that it would grow up to the ubiquitous and indispensable home entertainer that it is today. Women in particular were "agin it," and I well recollect Mrs. Free Grid's vain efforts to cleanse the Augean stables which a wireless



Spring cleaning run riot.

set inevitably made of any room in which it was installed. I make no apology for reproducing a photograph, taken in a much later epoch, showing the result of Mrs. F. G. having cleared my room of a much-cherished accumulation, hoarded for many years, of receivers and other apparatus of the period.

Some time after this kindergarten stage, broadcast receiver design seemed to enter into the doldrums of the 2-V-2 era in which the two valves in front of the detector were prevented from active opposition and made into quite docile passengers by the application of positive grid bias. This state of affairs lasted for some time and many manufacturers tried to conceal the poverty of the land in the matter of technical design by over elaborate cabinet work.

Now, however, the broadcast receiver is as much grown up as the automobile, and both innards and outards deserve equal attention from the hands of their respective craftsmen. Some manufacturers have obviously realized this but others quite clearly farm out their cabinet designing to the local undertaker with his somewhat one-track mind. The time will, of course, eventually come when the wireless set is banished to the cellar with the electric light meter, and its functions radio-controlled by a small portable push-button unit.

# RANDOM RADIATIONS

By "DIALLIST"

## Symbols

IT is growing increasingly difficult to keep pace with the changes in wireless symbols. Take stage gain. In the early days S was often used as the symbol for this. Then we seemed to have settled down to A. But in the February number of *Wireless World* I notice that S. W. Amos uses M. If this is now correct, it is a pity, one feels, for M seemed to have become established as the symbol for mutual inductance—to say nothing of the hard work it puts in as the abbreviation for mega—in MΩ, Mc/s and so on. Talking of symbols, "Cathode-Ray" had something to say recently about the overworking of  $\mu$ . I am eagerly expecting the appearance of  $\mu$ -phone in some American publication. It has not come my way yet, but I feel sure that it will one of these days. American publications are pretty bad offenders in their disregard of internationally accepted symbols. One still comes across "mfd" quite often in them. They seem almost to have standardized  $\mu$  for  $\mu$  presumably because few typewriters have a  $\mu$ ;  $\mu$  is used instead and it saves time not to bother about adding the extra stroke when correcting a typescript. More curious is  $w$ , which one finds even in text books such as Terman in place of small omega as the symbol for ohm.

□ □ □

## Television Grouzers

FROM time to time one comes across disgruntled folk who are more than a little bitter about the proportion of the B.B.C.'s total revenue that is spent on television. There are not, they argue, more than 7,000-8,000 genuine viewers (private owners, that is, who use their televisions solely for entertainment purposes) amongst the 12,000-odd licencees\* who live within the service area of the Alexandra Palace. A good many other people, they point out, who hold television licences live in places so far from A.P. that their interest in the matter must be in the experimental rather than in the entertainment side. They contend that of the 12,000 a very considerable number have no more than a professional or trading interest in television: every concern manufacturing televisions must hold several licences for its

own laboratories and for its research workers in their homes: all stores or radio shops dealing in television sets must take out licences. The number, then, of those who own and use televisions at the present time purely for entertainment purposes is very small indeed; how can an expenditure running well into six figures be justified? Is not every holder of a television receiving licence getting many times what he pays for and being heavily subsidized by the holders of "sound" receiving licences?

## Wrongs and Rights

Those who hold such views are barking simultaneously up several wrong trees. In the first place the £1 "sound" receiving licence gives no specific undertaking that entertainment programmes will be provided for those who hold it; it does no more than authorize the ownership and use of a wireless set, just as the 10s gun licence authorizes the ownership and use of a gun but does not bind the Government to supply suitable targets. In point of fact a large percentage of the wireless licence revenue is allotted to the provision of broadcasting and there is a kind of gentlemen's agreement that this shall be done. So far as television is concerned, there can be no doubt that it will become in time a major form of home entertainment. It is the clear duty of the authorities to foster its development, even though it may have to run for some time at a loss. My own view is that it is now being subsidized not too heavily, but far too meagrely. Two of the chief reasons why people don't rush to install televisions in their homes are that the transmissions occupy so few hours each day, and that, for sheer lack of funds, the programmes have now to contain such a large proportion of matter that is of little real entertainment value.

## More Money Needed

It isn't always realized how costly a business it may be to put on a television item such as a play. In "sound" broadcasting the actors and actresses can read their parts; they needn't be in costume; movements, gestures and facial expressions are of no importance. For a "vision" broadcast matters are very different. Costumes and scenery are necessary and thorough training and rehearsal are required to ensure that everyone is not only

## RE-ENTRANT HORN TYPE 42 REH



The new 42REH has advantages of complete weather-proofness, smaller overall length, better weight distribution and consequently greater ease in handling, which make this one of the most popular of the new F.I. loud-speakers. The horn is designed for use with the standard F.I. L.S.7 Unit and allows for this unit to be driven to 12 watts input. A spun aluminium cover over the unit has room for housing a suitable matching transformer.

The construction has been designed so that the whole unit is assembled and held together with ONE LARGE NUT only. This construction enables a number of units to be packed for export in a space which is a fraction of that normally required; assembly is a matter of a few minutes unskilled labour. This unique feature will recommend itself to all export buyers particularly.

The 42REH is not of the "loud-hailer" type of speaker, but is designed to cover a range of frequencies considerably greater than those needed for purely "announcing" purposes: i.e., it is suitable for all normal requirements of high power reproduction of music as well as speech.

Dimensions assembled ...	22in. dia. x 24in.
Bell diameter ...	22in.
Cut-off frequency ...	175
Effective Air Column ...	42in.
Weight Horn only ...	8 lbs.
Shipping space ...	One—23in. x 23in. x 18in. 12—33in. x 33in. x 27in.

**F.I. for P.A.**  
**FILM INDUSTRIES LTD.**  
60, PADDINGTON ST., W.1  
Telephone: WELbeck 2385

\* According to figures published since this was written, the present total is 14,550.—E.D.

### Random Radiations—

word-perfect, but also movement-perfect and expression-perfect. It costs, therefore, many times as much to televise a play as to broadcast it by sound only. Further, a "sound" broadcast may be recorded and repeated at will for a trifling expenditure; the only way of repeating a television broadcast (unless you film it and televise the film) is to do it all over again. Because the money for an absolutely first-rate service is not there, a great deal of unsuitable matter has to be televised. Who, for example, is going to switch on the television receiver in order to see an orchestra, a pianist or a singer? I've always thought that one of the greatest boons of "sound" broadcast reception is that you can hear singers without seeing their far from beautiful facial contortions!

If the television service is given a lot more money, we shall have better programmes and "televueing" will soon become popular. But if television funds are to be rationed now according to the number of licences, we shall find ourselves involved in the vicious circle: few licences mean small grants; small grants mean poor programmes; poor programmes mean few licences. . . .

### Not Very Likely

The chairman of a manufacturing concern recently raised what, to my mind, is a completely imaginary scare by issuing a warning that, if we didn't pull up our socks we should find our markets inundated with cheap televisions of American make, once the present import restrictions were lifted. I can think of few things more unlikely for four pretty good reasons: (1) You can't profitably dump goods in a foreign country unless they're the left-overs of large home sales; (2) sales in America are not large; (3) American sets would be of no use here (unless extensively modified) since the American systems use 525 lines as compared with our 405 and their modulation is the exact opposite of ours; (4) television prices in the U.S.A. are very much higher than they are here. Dumping, then, seems unlikely. Almost equally incomprehensible to me is the statement of another chairman that television sets could form one of our major exports. To whom are we going to export them? At the moment the only other country in which there are yet any kind of regular television services is the U.S.A. For reasons already given we have no possible market there. Television can flourish (owing to the restricted service area of U.S.W.

stations) only in countries where there are many densely populated areas. As there is no crystal-set equivalent of the television the inhabitants of such areas must be prosperous and well paid as well as numerous. How many countries can you name which fulfil these requirements and are therefore suitable targets for a television export drive!

□ □ □

### Shorthand Circuits

THOUGH I intended to refer last month to A. W. Keen's interesting article on "Shorthand Circuit Symbols," I didn't leave myself space enough to do so. Most of us, I imagine, who have had to take notes of lectures on wireless or electricity in general have had in self-defence to invent shorthand systems of our own. You may hold your own pretty well with ordinary symbols if the lecturer draws his circuits on the blackboard; but you're apt to be sunk if he unrolls

a wall diagram, all ready drawn, rushes through the explanations of it and then passes on to another of the same kind. Good though Keen's system is in its way, I've a good many criticisms of it to make. First of all resistors and inductors. If resistors are represented just by one "saw-tooth" and inductors by a single curve, you're very apt to make the signs for the two difficult to distinguish when working fast. I make my resistors with two saw-teeth like a capital M, right-way up or sideways according to circumstances, and my inductors with two major curves joined by a little loop (like a copybook capital W). I don't quite like the short straight line for a capacitor—apt to be overlooked. My symbol is a capital X, with its middle point on the lead. Then valves. Keen's idea is attractive; he shows them as polygons with one side per electrode. But can you draw at note-taking pace a hexagon or a heptagon which is unmistakably what it is meant to be?

## SHORT-WAVE CONDITIONS

### Expectations for June

By T. W. BENNINGTON (Engineering Division, B.B.C.)

MAXIMUM usable frequencies for this latitude decreased very considerably during the daytime during April, and increased somewhat during the night. This was according to the normal seasonal trend, and these variations should continue until about the end of June.

There was a considerable amount of ionosphere storminess during the month, though April was less disturbed than March. The most severe disturbances occurred during the periods 4th-6th and 17th-19th, the Aurora Borealis being seen in England and in many parts of Northern Europe on the night of 17th. Other disturbed periods were 2nd, 8th-9th, 12th, 15th and 26th-27th.

**Forecast.**—During June the daytime M.U.F.s should continue to decrease towards their lowest seasonal value, which should be reached towards the end of the month. The night-time M.U.F.s should be higher than they were during May.

Working frequencies for long distance transmission paths should therefore be somewhat lower by day and, except for those to high latitudes in the Southern Hemisphere, somewhat higher by night. Communication on exceptionally high frequencies (like the 28-Mc/s

amateur band) is not likely to be very frequent. Daytime frequencies will, of course, remain of use for longer periods than at present—for example, 17 Mc/s should be regularly usable on many circuits till well after midnight. 15 Mc/s may remain usable the night through over some circuits.

For medium distance transmission—up to about 1,800 miles—the E or F<sub>1</sub> layers will control transmission for considerable periods during the day, and in these cases daytime as well as night-time frequencies should be higher than at present.

Sporadic E is likely to be particularly prevalent, and so on many occasions—which are, however, unpredictable—communication over distances up to 1,400 miles may be possible by way of this medium on frequencies far above the M.U.F.s for the regular E or F layers.

Below are given, in terms of the broadcast bands, the working frequencies which should be regularly usable during June for four long-distance circuits running in different directions from this country. In addition a figure in brackets is given for the use of those whose primary interest is the exploitation of certain frequency bands, and this indicates the highest frequency likely to

be usable for about 25 per cent of the time during the month for communication by way of the regular layers:—

<b>Montreal :</b>	0000	15 Mc/s	(22 Mc/s)
	0300	11 "	(19 "
	0800	15 "	(22 "
	1300	17 "	(24 "
<b>Buenos Aires :</b>	0000	17 "	(24 "
	0100	15 "	(22 "
	0700	11 "	(20 "
	0900	15 "	(23 "
	1000	17 "	(26 "
	1400	21 "	(29 "
<b>Cape Town :</b>	0000	15 "	(22 "
	0200	11 "	(18 "
	0500	15 "	(23 "
	0700	21 "	(30 "
	1400	26 "	(34 "
	1700	21 "	(32 "
	1900	17 "	(26 "
	2100	15 "	(23 "
<b>Chungking :</b>	0000	15 "	(20 "
	0800	17 "	(23 "
	2000	15 "	(21 "

Ionosphere storms are not usually very troublesome during June and relatively stable radio conditions may be expected. At the time of writing it would appear that if any storms do occur they are more likely during the periods 2nd, 8th, 10th-12th, 19th-20th, 25th-27th and 30th than on the other days of the month.

**Footnote.**—Three items of interest—two of which will answer some queries received—are given below in condensed form.

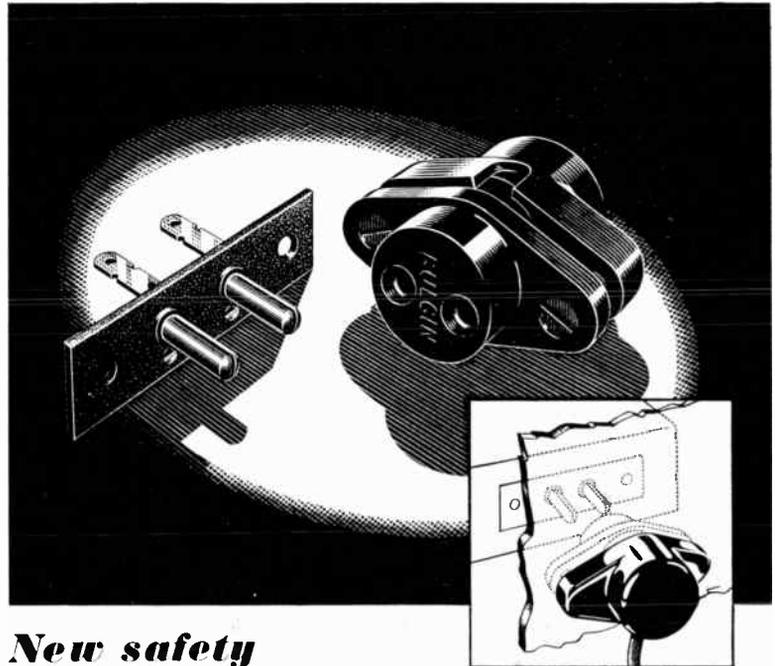
(1) Newspaper report from Capetown states that at 1430 local time during the afternoon of 26th March H. Rieder, of Three Anchor Bay, picked up amateur PAOUN, Eindhoven, Holland on 6 metres. His test and call sign were heard, signals being "loud and clear."

(2) When signals come in from a direction other than that in which the transmitting station is known to be, it most probably indicates that the working frequency is above the M.U.F. for the path. Over the Great Circle path propagation cannot be sustained by the ionosphere, but energy can still be "scattered" towards the receiver from ionospheric points "off" the Great Circle path.

(3) Summer prospects for long distance communication on the higher frequency bands:—

**28Mc/s :** Not much good in east/west directions till about mid-September except on isolated days. Improving rapidly after that. Fair, but not so good as lately, for communication in southerly directions.

**50 Mc/s :** No prospects in east/west directions till about October, when the best possibilities for years should open up, reaching a peak in November. Even then, do not expect regular contacts on this frequency.



## New safety

## 2-pole mains connector

This new Bulgin 2-pole plug and socket will be of particular interest to engineers in many fields of the electrical and radio industry. It is especially designed for cabinet-back attachment and is eminently suitable for apparatus where, on removal of the back, it is required to break the mains supply.

The P.200 is non-reversible when fixed.

**Amps. rating per pole :** At 6 volts, 8 amps., 250 volts, 3-4 amps., and 500 volts, 1 amp.

For attaching to panels up to ¼" thick, the fixing of the male or apparatus member requires 2 × 4BA clearance holes at 1½" centres with central aperture 1" × ⅝" approx. Fixing of cabinet back member, 2 × 5/16" Ø holes at 1 5/16" centres with central 15/16" Ø hole. A special feature of this attachment is the provision of "float," for ease of location with male member. This high efficiency, reliable plug and socket Type P.200 is but one of a comprehensive range designed to the high standards of all Bulgin products.

"The choice

# BULGIN

of critics"

A. F. BULGIN & CO. LTD. · BYE-PASS-RO. · BARKING

Telephone : RIPpleway 3474 (5 lines).

# RECENT INVENTIONS

## A Selection of the More Interesting Radio Developments

### RADIO-VISION

**D**ISTANT objects are detected and observed by a method which combines the principles of radiolocation with those of television.

Exploring pulses of frequency-modulated centimetre waves are projected through a refracting prism, say of ammonia gas, or of pitch, from which they emerge as a "spectrum," in which the component frequencies are differently dispersed to provide a "static scanning line" of the field under observation. A third dimension of scanning may be added by mechanically moving the beam. Reflected echo signals derived from the different frequency bands are separately detected by receivers which are cyclically tuned. The resulting signals are passed through delay and "coincidence" circuits to give a final image, which may be stereoscopic, of any object located at a given distance from the transmitter. The distance being found by known radiolocation methods.

*J. Forman and Pye, Ltd. Application date September 30th and November 21st, 1941. No. 579813.*

### RADIO COURSE INDICATORS

**I**N a blind approach system, the correct course is defined by the receipt of equal signals from both beams, the indicator then showing a null or zero reading. The same indication would, of course, be given in the absence of all signals, so that it is usual to provide a separate fault indicator, such as a neon lamp, which ceases to glow if there is any defect in the equipment, or if by an oversight the beams have not been switched on.

According to the invention, the same cathode ray tube is made to serve both as a course and "breakdown" indicator. The received signals invariably contain an appreciable fraction of unfiltered ripple voltage from the 500-cycle tone-modulator. This is diverted, through a suitable bypass circuit, from the first A.F. amplifier on to the X-plates of the C.R. tube. The Y-plates are fed with the amplified signal from the second A.F. stage, from which the ripple is excluded by the intensive coupling. The ripple voltage will then expand the normal "spot" indication into a corresponding "line" trace, so long as the course-marking signals are coming through.

*Standard Telephones & Cables, Ltd. and H. P. Williams. Application date May 11th, 1944. No. 579900.*

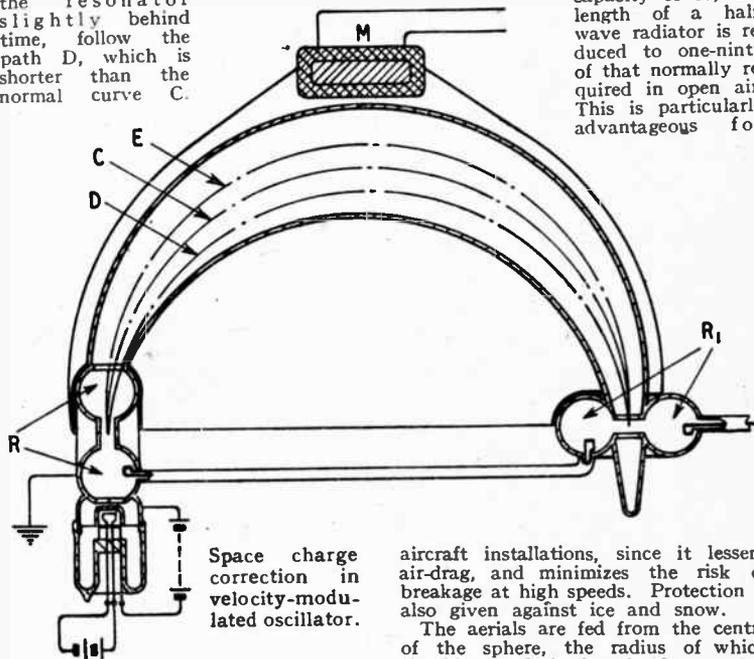
### S.W. OSCILLATORS

**I**N short-wave generators of the velocity-modulating type, the concentration of electrons in the space, following the first resonator, tends to create space-charges which adversely affect the operation of the device.

The electrons in the arrangement

shown are passed from the bunching resonator R to the second or load resonator R<sub>1</sub> through a crescent-shaped channel under the control of the transverse field from a magnet M.

The R.F. field between the narrow walls of the centre portion of the resonator R imposes on the electron beam a slight lateral vibration, in addition to producing the usual bunching effect. This side-to-side deflection shifts the radius of curvature of the paths taken by the electrons under the influence of the magnet M, so that those swung to the right, and leaving the resonator slightly behind time, follow the path D, which is shorter than the normal curve C.



Similarly, when the beam is swung to the left, those emerging first take the longer path E. The correct bunching of the stream is thus preserved until it reaches the delivery or load resonator R<sub>1</sub>, whilst undue overcrowding in transit is avoided.

*Westinghouse Electric International Co. Convention date (U.S.A.) Aug. 20th, 1941. No. 578588.*

### DIRECTION FINDERS

**T**O facilitate D.F. operation all transmitters within a given frequency band are first indicated simultaneously on the dial of a cathode-ray tube. A particular transmitter is then selected and bearings are taken on it.

Initially the receiver is coupled to a non-directional aerial, whilst a motor continuously swings the tuning over the given frequency range. All incoming signals appear on the dial as separate

radial deflections, against a time base which is derived from a circular potentiometer rotated synchronously with the tuning control.

To take bearings on a particular transmitter, the set is switched over to a directive aerial, and the circuits are tuned manually to the frequency indicated on the C.R. tube. The aerial is then rotated into the zero position, this orientation being ascertained by the fact that the original deflection no longer appears on the indicator dial.

*Standard Telephones and Cables, Ltd. (Communicated by International Standard Electrical Corp.) Application date 31st July, 1942. No. 578301.*

### AERIALS

**R**ADIATING elements, such as rods, cones or cylinders, are arranged radially inside a sphere or hemisphere of insulating material. Assuming the latter to have a specific inductive capacity of 80, the length of a half-wave radiator is reduced to one-ninth of that normally required in open air. This is particularly advantageous for

aircraft installations, since it lessens air-drag, and minimizes the risk of breakage at high speeds. Protection is also given against ice and snow.

The aerials are fed from the centre of the sphere, the radius of which should exceed the length of a quarter-wave radiator by an odd number of quarter wavelengths, as measured in the dielectric.

Alternatively, radiation may take place from a half-wave slot cut symmetrically about the centre of a sheet of metal laid over the base of a hemisphere of half-wave radius, the slot being excited at opposite points, at the centre of each edge.

*Standard Telephones and Cables, Ltd., and E. O. Willoughby. Application date April 21st, 1944.*

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.



**ERIE**

*Electronic Component Products*

**RESISTORS · CERAMICONS · Ni-K CERAMICONS**

**SUPPRESSORS · POTENTIOMETERS**

**VITREOUS ENAMELLED WIRE-WOUND RESISTORS**

**ERIE RESISTOR LIMITED**

**CARLISLE ROAD · THE HYDE · LONDON · N.W.9 · ENGLAND**  
 TELEPHONE: COLINDALE 8011-4      TELEGRAMS: RESISTOR, PHONE, LONDON      CABLES: RESISTOR, LONDON  
 FACTORIES: LONDON, ENGLAND · TORONTO, CANADA · ERIE, PA., U.S.A.

**"You're CERTAIN to get it at ARTHURS!"**

★ **VALVES** : We have probably the largest stock of valves in the Country. Let us know your requirements.

**AVOMETERS. NOW IN STOCK.**

- AVOMETER, Model 7 .....£19 10 0
- AVOMETER, Model 40 .....£17 10 0
- VALVE TESTER (Complete) .....£16 10 0
- TEST BRIDGE .....£11 0 0
- AVOMINOR, Universal Model .... £8 10 0
- AVOMINOR, D.C. Model ..... £4 4 0

All orders sent by return of Post. Terms C.O.D.  
**London's Oldest Leading Radio Dealers.**

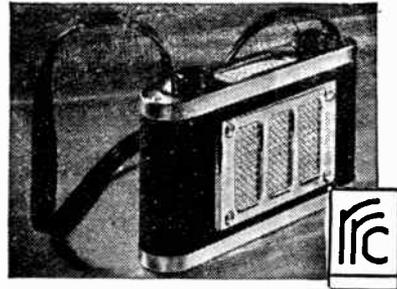
*Arthur's* EST. 1919  
 PROPS: ARTHUR GRAY, LTD.

**ELECTRICAL, TELEVISION & RADIO ENGINEERS.**

Gray House, 150, Charing Cross Rd., London, W.C.2  
 Telephone: TEMple Bar 5833/4.

OUR FIRST POST-WAR PRODUCT  
**THE ROMAC 106**  
**"Personal" RECEIVER**

£14 14 0 Complete, Plus P.T. £3 6 0



This Receiver was selected as an Exhibit at the "BRITAIN CAN MAKE IT" Exhibition.

Home and Export enquiries should be directed to :

**ROMAC RADIO CORPN. LTD.**  
 THE HYDE · HENDON · LONDON, N.W.9.

**10 VALVE**

**V.H.F. TRANSMITTER-RECEIVER UNITS**

(RADAR I.F.F. UNITS) MADE IN U.S.A.

COMPLETE WITH 13 VALVES (U.S.A. metal and glass types) and self-contained power supply. Overall size approx. 12" x 12" x 9". Double decker chassis. Frequency coverage 158-186 Mcs. Models available with either 12 or 24 v. D.C. Input Motor Generator. Cash with Order only. Carriage and packing 5/-. Only **39/6**

**20 WATT POWER UNITS**

Comprising Motor Generator 12 v. D.C. input, 480 v. 40 m/a Output with reduction gearing and FULLY SMOOTHED. Self-contained in metal case. Brand new and unused. Carriage and packing 2/6. **35/-**

**M.O.S.**

MAIL ORDER SUPPLY Stepney Green  
 24 New Rd., London, E.1. 2760 & 3906



Resistors produced by the cracked carbon process remain stable to  $\pm 1\%$  of initial value.

★ Tolerances  $\pm 1\%$   
 $\pm 2\% \pm 5\%$

Low temperature co-efficient.

**Welwyn** carbon resistor

WELWYN ELECTRICAL LABORATORIES LTD.  
 Welwyn Garden City, Herts. Telephone: Welwyn Garden 3816-8

**Varley** REGD. TRADE MARK  
**THERMAL DELAY SWITCHES**  
*Protect Your Radio Equipment*

4 VOLT · 5 VOLT · 6·3 VOLT HEATERS

**OLIVER PELL CONTROL LTD**

Telephone - WOOLWICH 1422  
 CAMBRIDGE ROW · WOOLWICH S·E·18

In an age of insistence on high quality reproduction, the choice rests increasingly on



Brit. Pat. No. 556137

**MOVING-COIL MICROPHONES**

★ For transmitting, recording, and all P.A. requirements, where dependability is essential. Write "Ref. W.W. 647" for detailed literature.

LUSTRAPHONE LTD., 84 BELSIZE LANE, LONDON, N.W.3  
 Hampstead 5369 : 5515

No. 2

**POINTS OF LOW CONTACT RESISTANCE IN  
CIRCUIT DESIGN OF MINIATURE RECEIVERS**

**CLIX**  
RADIO & TELEVISION  
COMPONENTS . . .

. . . ARE USED BY  
ALL THE LEADING SET MANUFACTURERS

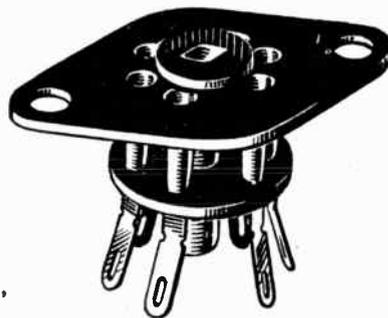
**BRITISH MECHANICAL PRODUCTIONS LTD.**  
**21 BRUTON ST., LONDON, W.1**

Telephone : MAYfair 5543

**Foremost in Valveholder design**

**B7G MINIATURE  
LAMINATED  
VALVEHOLDER**

For use with  
1T4, 1R5, etc.,



Designed with 7 special sockets giving extremely low contact resistance and ensuring positive location of pins. Tags and centre screen pre-tinned. Fixing centres .875, Hole Dia. .100.

PLATE DIMENSIONS  
Major axis 1.093  
Minor axis .680

for mounting either above or below chassis.



**THE COMPLETE SERVICE  
FOR SOUND RECORDING  
AND REPRODUCTION**

- ★ Mobile, static and specialised recording units.
- ★ Complete Wire Recorders, Recording and Wipe-off Units.
- ★ Recording Amplifiers.
- ★ Moving Coil and Crystal Microphones.
- ★ Sapphire cutting and reproducing stylii.
- ★ Blank recording discs from 5in. to 17in., Single or Double sided.
- ★ Lightweight, moving iron, permanent sapphire and moving coil pick-ups.
- ★ A comprehensive range of accessories to meet every requirement of the sound recording engineer.
- ★★ And our latest development (of special interest to users of sapphire and delicate pick-ups)—THE SIMTROL. This is a controlled micro-movement easily fitted for use with any type of pick-up.



Portable Dual Channel  
Recording and Replay Outfit.

**OUR WELL-EQUIPPED WORKSHOPS ARE AVAILABLE FOR  
THE DEVELOPMENT OF EQUIPMENT TO MEET SPECIAL NEEDS.**

**SIMON SOUND SERVICE, Recorder House, 48/50, George St., Portman Square, London, W.1.**

CABLES : Simsale, London.

TELEGRAMS : Simsale, Wesdo, London.

TELEPHONE : Welbeck 237-12.

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: July 1947 issue. First post Friday, June 6th. No responsibility accepted for errors.

## WARNING

Readers are warned that Government surplus components which may be offered for sale through our columns carry no manufacturer's guarantee. Many of these components will have been designed for special purposes making them unsuitable for civilian use, or may have deteriorated as a result of the conditions under which they have been stored. We cannot undertake to deal with any complaints regarding any such components purchased.

### NEW RECEIVERS AND AMPLIFIERS

**R**107 communication receiver, brand new, very heavy and massive job, excellent performance; £30.—Box 8514. [7502]

**C**OMMUNICATION receivers.—As soon as a civilian supplies reconnaissance we shall be at your service.—A.C.S. Radio, 44, Widmore Rd., Bromley, Kent. [4528]

**S**EMI-MIDGET a.c. main 3-waveband superhet receivers; in mahogany wood cabinet; retail price, £14/3/6, plus £3/3 tax; trade and export enquiries invited.

**P**ARKER Radio Manufacturing Co., 756, Harrow Rd., N.W.10, Ladbroke 446. [7254]

**A**MPLIFIERS, 6 watts push-pull output, complete with 10in speaker, for use on a.c. mains, good quality job, tone control, etc.; call and hear one or send for descriptive leaflet "W".

**C**HARLES BRITAIN (RADIO), Ltd., 2, Wilson St., London, E.C.2. [6835]

**D**EGALLIER'S, Ltd., announcement.—When token imports American receivers is permitted we shall have these; information will be in this column when available, please watch future issues. [7541]

**O**SMOR A.C.-D.C. 3-wave 5v superhet receivers, excellent reproduction and sensitivity, attractive cabinet, early delivery, shipping waveband if required; write for literature; trade enquiries invited.—Morgan, Osborne & Co. Ltd., Southview Rd., Warringham, Surrey. [7286]

**O**SMOR A.C.-D.C. 5v 3-wave superhet radio heart, includes (fully assembled) chassis, coil pack, calibrated dial, 2-gang, I.F.S., V.C. choke, 8-16, dropper, circuit diagrams, small resistances and condensers only required, cabinets available; trade enquiries invited.—Morgan Osborne & Co. Ltd., Southview Rd., Warringham, Surrey. [7287]

**B**AKER'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, also with realistic reproduction or public address; 2/6d stamp for parties, prices, etc.—Baker's Selhurst Radio, 75, Sussex Rd., S. Croydon. Croydon 4226.

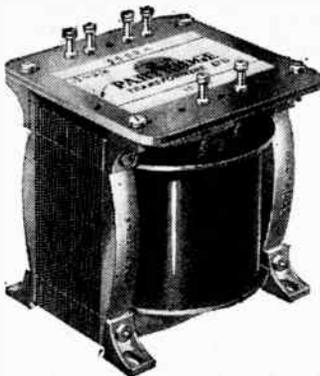
**C**HARLES AMPLIFIERS.—Announcing a new version of their famous HFA1 amplifier—the HFA3 incorporating a pre-amplifier to enable the use of moving coil pick-ups direct; this amplifier in conjunction with the Lexington moving coil pick-up and the B.A.E.C. twin cone speaker provides the highest obtainable fidelity of reproduction; the complete range now comprises amplifier HFA1 7watt cathode follower output for crystal pick-ups; HFA2 single-ended 3 watt for crystal pick-up; the HFA3 for moving coil pick-ups; full constructional blueprints, 2/6 each; full kits or separate components available or supplied ready assembled; stamp for comprehensive catalogue.—Charles Amplifiers, 18, Palace Gate, Kensington, W.8.

**E**X-R.A.F. radar identification Friend or Foe "W" transmitter-receivers, operates between 155-185 megacycles, and easily convertible for amateur use, complete with 10 valves, 2 type RK34, 1 type EF50, 4 type SP41, 3 type D1, and 20 watts motor generator, only 79/6 (carriage 4/-); Canadian type 58 Mk. 1 "Star" transmitter-receivers, complete with 8 valves, 2 sets of headphones and microphones, 3 aeriels, Battle battery, etc., etc., and instruction books, all brand new, in original manufacturer's cartons, complete and ready to switch on, only £10/10 (carriage 5/-); illustrated leaflet available on application; also refer to our advertisement under "Test Equipment" offering ex-Army wavers.—U.E.I. Corpn., 32, St. Gabriela Rd., London, N.W.2. [7373]

**R**ECEIVERS, AMPLIFIERS—SECOND-HAND  
**P**HILIPS portable radio, nearly new, perfect; £10.—97, Midhurst Rd., W.13. [7309]

**F**OR sale, Vortexion AD47 amplifier, new and unused; offers.—Box 8148. [7416]

## Partridge News



### INDIVIDUAL DESIGN

PARTRIDGE Precision Built TRANSFORMERS wound to suit individual requirements now incorporate:—Silver plated turret terminals giving a low potential drop and carrying up to 15 amps. Adequate room on each for easy soldering of several external circuit wires.

Firm clamping of the laminations by means of scientifically designed pressure die-castings.

Interlocked fixing feet providing alternative mounting.

Illustrated above is mounting style "DN" which can be employed if desired on all components wound to special requirements.

### AVAILABLE STOCK

A comprehensive range of mains and audio components is now available from stock, and we can despatch small quantities of these per return. We would stress that before ordering you send for our list detailing these components. Our stock range now covers almost all normal requirements, and by availing yourself of this service you will save the inevitable delay in the production of a special component.

### CATALOGUE

A new catalogue illustrating various mounting styles is now available. This incorporates full data on our components, including fixing dimensions, weight, method of termination, etc. You are invited to send for a copy, issued free of charge.

Telephone:



Abbey 2244

**PARTRIDGE**  
**TRANSFORMERS LTD**

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

**R**1155 R.A.F. receivers, excellent condition, £16 to 4,000 metres; £15.

**I**N nearly new condition, realigned and calibrated, guaranteed working order; £17/10.

**C**AN be supplied with output stage/power pack and loudspeaker; £27/10.

**F**ULLY modified, as follows, becomes an all-round super set with high quality output D.F. parts removed, new front panel, bass and treble boost with separate tone controls, R.C. coupled push-pull output (2-PX4s), gram input, other refinements, complete with loudspeaker; £35.—Write for details.

**R**1155s already purchased, modified and serviced and power packs supplied.—R.T.S. Ltd., 8, Gladstone Rd., Wimbledon, S.W.19. Tel. Lib. 3303. [7003]

**T**ELEVISION table model, 9in screen; £55.—Sly, 16, Buckland Av., Slough. [7545]

**B**AIRD T20C televisor, pre-amp and aerial, perfect order; offers.—Box 7745. [7306]

**N**ATIONAL com. rec., 300kcs 17mcs, as new; £50.—9, Merlin Cres., Willington Quay.

**T**WO R1155 communication receivers, excellent condition; £11 ea.—Box 8553. [7530]

**E**XPERIMENTAL television set, £25.—49, Rathcoole Gardens, Hornsey, London, N.8.

**H**RO-M speaker and power pack, 1.7-30mcs bandspread, excellent condition; £60 or offers.—Box 8517. [7511]

**R**1155 receiver, not modified; offers over £10.—M. Stratford, 8, Coxwell St., Cirencester, Glos. [7336]

**M**MURPHY A78C, perfect condition; £85.—Wills, 114, Northampton Rd., Wellingborough. Tel. 2925. [7553]

**H**ALLICRAFTER 838, 1946 model, 110/230 ac/dc, am/cw, send/receive switch, etc.—Offers to Box 8516. [7510]

**H**ALLICRAFTER'S latest 8-39A communication receiver, new condition; £32.—14, Common Rd., Evesham. [7552]

**B**EST quality 8-watt amplifier, straight through built by professional, with straight tuner; £18.—26, Eland Rd., S.W.11. [7521]

**E**DDYSTONE 358, as new, separate power pack, 9 coils, no speaker; £35, or exchange television.—Box 8550. [7526]

**V**55R communications receiver, as new, complete with loudspeaker unit, perfect, cost £32; what offers?—Box 8615. [7545]

**S**-VALVE double superhet, 6 wavebands, complete speaker, cabinet, ex. condition (tropical), ac; £15.—Box 8552. [7529]

**R**1155 revr., aligned and calib., with plug circuit and details; £12/10.—Stephens, North Union St., Cupar File. [7343]

**E**X-R.A.F. 1155 comm. recr., built-in mains supplies, speaker and 6V6 output, all one unit; £18/10, offers.—Box 8434. [7481]

**A**MBASSADOR 10watt radio and p.a. amplifier, working order; £12.—T. E. C. The Outings, Aspatria, Cumberland. [7493]

**E**CHOPHONE receiver, model E.C.1, 545kc to 30.5mc, as new, nearest offer £18.—Free, 62, Mawson Rd., Cambridge. [7531]

**1946** qual. amp. PX25s, neg. feed back, ind. bass and treble, 1946 Baker 12in P.M.F. speaker; £20.—Box 8612. [7548]

**R**A.F. 1155 new front panel built-in power pack and speaker, good performance; £30.—1, Hanway Place, W.1. Mus. 1027. [7455]

**R**1155 receiver (new), power pack and output, m.c. speaker, phones and spares, Avometer model 40; £25.—Box 8610. [7546]

**N**ATIONAL H.E.O. type M 9-valve power pack, 9 coils, 50 kc/s to 30 mc/s, no sprk.; £55.—29, Pickwick Rd., Corsham, Wilts.

**R**C.A. 8-valve comm. receiver less power pack, crystal filter, B.F.O. 18mc-200kc coverage, brand new; price £12/12.—Box 8347.

**W**IRELESS World quality amplifier, recvr., sprk., £12/10; Murphy 1947 television, perfect, guaranteed, cost £68; offers.—Box 8136.

**H**ALLICRAFTER Defiant, minus meter and crystal, otherwise standard, demonstration; £29.—Bannister, 68, South St., Bridport.

**H**ALLICRAFTER'S Super Skyriver SX28, in perfect condition, with speaker and spare valves; what offers?—Woodall, 17, Holly Lane, Smeethwick. [7456]

**H**AMMARLUND HQ-129-X receiver with matched speaker, as brand new, in maker's packing carton; £95 or nearest; buyer collects.—Tel. Sale 5475. 55, Derbyshire Rd. South, Sale, Manchester. [7663]

**N**ATIONAL H.R.O. 9 coils, National p. pack, cabinet sprk., ex. condn., £45 or best offer; unused valves, 9003 (10) 12/6, 9002 (3) 10/5, 955 (3) 15/-. 70L7 15/-, 956 (3) 20/-. ECR30 £2/10, etc.; used valves and components.—10, Bristol Rd., Southsea. [7355]

**W** 12watt amplifier, Magnavox 66 ac speaker, Baker auditorium p.m. speaker, in baffle cabinet, Lexington m/c sensor pickup with transformer and sapphire, Meico m/c mic on chrome floor stand, ac gram motor (H.M.V.) with pick-up, Avo model 7, Avo oscillator ac, all as new; nearest offer £90 the lot.—King, Robroy, Jaywick Lane, Clacton. [7514]

**32 WATT** amplifier, R.A.F. 11555 receiver working to amplifier, 3 speakers, playing desk, crystal pickup, Ard-ne microphone floor and table stands.—Box 8143. [7403]

**B.S.R. P.A.20** amplifier, Romac 25/II/11 B radio amplifier, 3 G.E.C. expo speakers, 2 Meico mics., 1 Lustraphone mic., all in good condition; £90 or offers, with separate.—Bonham, 40, Salisbury Ave., Coventry. [7457]

**EDDYSTONE** e.c.r., with 12in. speaker, perfect condition, just overhauled at Eddystones, £43; R.M.E. 69 with speaker and spare valves, £45; R1132A v.h.f. receiver, modified for 45-90mc., complete power pack and speaker, £15.—135, Lichfield Rd., Four Oaks, Warwickshire. [7517]

**BROADCAST**, 40 watt amplifier, 61.6s, perfect, rack mounting, in wooden carrying case, £15; 20 watt chassis, P.X.25s, complete with 12in. Baker Sellhurst P.M. felt hinge speaker; £9; 230 dc-220 ac 0.525 amp rotary, just reconditioned, with suppressor unit and silence cabinet; £12.—Box 7744. [7305]

**HAMMARLUND** Super Pro, 1.25-40 mc/s., power supply and speaker, excellent noise limiter, calibrated bandspread, really sensitive, £95; I.C.O. Senior, all 9 coils, power hand, £80; Hallcrafters SX28, 0.55-42 mc/s., £75, offers considered; recent ex-laboratory models, all below cost, amateur selling up; condition like new and perfect, picked jobs, thoroughly vetted; inspection London if desired.—Box 8397. [7477]

**EX-GOV'T.** radio units at a fraction of original cost: Ex-Admiralty type No. M.36.1 communication receivers, 4-valve T.R.F. 100 to 4,300kc/s., in steel case measuring 13x11x15in. 12in. in, these sets have been used but guaranteed serviceable, complete with valves; to clear, £5 each, carr. fwd. Ex-U.S. Navy Dept. 6-valve T.R.F. aircraft receivers type C.W.46048d, less coils but with 3 type 78 valves, 2 type 77 valves, 1 type 28333 valves, these sets contain following components: 1 4-gang tuning condenser with micrometer Vernier drive, 1 pre-set condenser, 14 various fixed condensers, 25 various resistances, 6 valves, unused equipment in maker's sealed cartons, offered at less than retail price of valves; 75/-, carr. paid.

**WIRELESS INSTRUMENTS (LEEDS), LTD.**, 54-56, The Headrow, Leeds, Tel. 2262.

**TEST EQUIPMENT INSTRUMENTS.**

**MOST** makes in stock, some on easy terms.—Write for details and proposal forms to The Instrument Co., 244, Harrow Rd., London, W.2. [7470]

**DUMONT** scope, little used, perfect, spare C.R.T.; offers.—Box 8611. [7547]

**WESTON** E772 analyzer, as new; £20 (London address).—Box 8154. [7459]

**TAYLOR** meter, little used, perfect condition; price £11.—Box 8145. [7405]

**C.A. Junior** valve voltmeter, perfect; £15 (Newman).—Denmark Villas, Hove.

**MARCONI** instruments, T.F.144, 85kc to 25mc., Avometer 36, both perfect.—Offers to Box 8518. [7513]

**BRIDGE**, Hunt's, new cond.; £12.—W.A. 1, Acre Way, Northwood, Middlesex. [7524]

**TAYLOR** resistance and capacitance bridge meter, new; £12.—"Siggers," London Rd., Bracknell, Berks. [7391]

**DILLIPS** oscilloscope, type GM3152, £35, T.B. 2-150,000cs. ampl. x1600.—45, Lee Road Way, N.W.10. [7568]

**ROSS** D beam scope, g'teed practically unused, genuine reason for disposal.—Watkins, 23, Gladstone Av., Liverpool, 16.

**A.C.** battery charger, Op. 2 and 4v 10amp, £10; signal tracer, £10; C and R bridge, £3/10.—49, Rathcoole Gardens, Hornsey, N.8.

**OSCILLOSCOPE**, Cossor 339 double beam and ganging oscillator 343, perfect, almost unused; offers over £65.—"Roza," Reading Rd., Yateley, Hants. [7662]

**MILLI-RANGE** meter, 6in. mirror scale, 45m.v., 3, 15, 150 volts, 1.5, 1.5, 15 amp; price £7, or exchange 1amp ac motor. Harwick, 28, Fern St., Colne, Lancs. [7533]

**WEE-MEGGERS**, brand new, ex Gov't., 250-volt, complete in leather case; list price £12, our price £28 post free.—Auto Collections, Ltd., 126, St. Albans Av., Bedford Park, W.4, Tel. Chiswick 1601. [7483]

**METERS**—Taylor 90, £11; Avo 47A, £14; M Universal Avometer, £6; or exchange for Weemegger, panel fixing 500  $\mu$ A; two thermocouples, 1A and 4A R.F., 25/- each; R1155 modified power pack, output and speaker, £18.—Box 8609. [7533]

**OFFERS**—Voltomyst Junior, Taylor 45A valve tester, Taylor 425 milliammeter 0-1, Taylor 65B signal generator, Avometer Universal, Cosmocord Xstal A.C. playing desk, Baker 15-watt Quality amplifier and 12in. P.M. speaker, Mullard G.M. 4140 resistance/capacity bridge; all as new.—Box 8619. [7664]

# ELECTRADIX Stocktaking BARGAINS!!

We offer below some special stocktaking bargains at greatly reduced prices.

**HEADPHONES.** Ex-G.P.O. single L.R. Receiver type, S.G.B., with headband and cord, lightweight with bakelite case and cap, 5/- each, or 50/- per dozen.

**BATTERY superseder.** H.T. D.C./D.C. For radio receivers, 6-volt input, 110v. 15 m.a. output 12 volts input, 230v. 30 m.a. output, ball bearings reduced to 55/-.

**D.C. FANS.** 110-volt Oscillator type, on table stand with 12in. blade, 35/-, carriage and packing at cost.

**TELEPHONES.** G.P.O. wall type Telephone constructor's parts with wiring diagram, comprising cabinet with magnetic bell, magneto hand generator, beaknet mike, transformer and condenser, switch hook and contacts, single receiver, old price 30/- each, or 50/- pair. Special offer for this month, 35/- per pair.

**BUZZERS.** The Tiny Townsend high note W/M Buzzer, the smallest Buzzer made; all in good condition, 5/- each.

**MICROPHONES.** Hand mikes in moulded bakelite case, latest model G.P.O. inset, 4/6. Tannoy hand mike, as illustrated, multi-cell carbon type, metal case with neat switch in handle for sports meetings and announcers, reduced to 12/6; special transformer, 7/6. G.P.O. microphone insets, 2/6.



**SEND-RECEIVE Hand-com.** All-metal field type, the famous No. 16 Govt. pattern as used in field telephones, mike and ear-piece with damaged finger switch, reduced to 5/- each, no cord supplied. 4-way ex-G.P.O. Cord, 5ft. long, 2/6.

**THREE 5FT. Fluorescent Tubes** only, each with trough. Can be seen at our Battersea Showroom, they are a callers bargain only.

**TRANSFORMERS.** Double wound, 2.2 k.W. transformers, 400 volts input, tapped every 25v. to 220v.; 50 cy., £8/10/-. Auto-transformers 230/110 volts, 1 k.W. £7/10/-. 300 watts, 65/-, 150 watts 35/-, 85 watts 25/-.

**INDUCTOR ALTERNATORS.** 400 watts, beautifully made to Government specification, totally enclosed single or 3-phase 50 cycle 230 volts 4-pole, ball bearings speed 2,800 r.p.m. need 6/8 volt separate excitation; as new, £8/10/-.

**MOTORS.** D.C. Fan Motors, 110 and 220 volts, large bulkhead type, 35/-. Small universal A.C./D.C. 1/20 h.p. motors for sewing machine conversion, 230 volts, 8,000 r.p.m., with flange, flat enclosed type, £4. 1/50th h.p., 3,000 r.p.m. universal motors, 230 volts, £3/10/-. 1/27th h.p. Universal motors, 230 volts, 4,000 r.p.m., with 4-hole base, £3/15/-. 110-volt D.C. shunt wound motor K.B.3., protected type, 1/100 h.p., 2,000 r.p.m., with 20/1 reduction gear, mounted on C.I. base, 30/-.

**SPARK COILS,** large 4in. coil on pol. wood base, in good condition, heavy contacts, £10/10/-; 8in. coil on base, £18/10/-; both for 12-volt D.C. battery operation. Mercury Interrupter, 110 volts D.C., 50/-, 1/2in. spark coils, ex-G.P.O., 6/12-volt coil, 25/-.

**MAGNETS.** D.C. Electric magnets, weight 10 oz., lift on 2 volts, 1 1/2 lb., 4 volts 3 lb., 6 volts 4 lb., new surplus, 7/6 each. Permanent powerful flat bar magnets, 2 1/2in. x 1in. x 1/2in. drilled 2 holes each end, for any pole pieces, 2/- pair. Send for special Magnet Leaflet "W."

**SWITCHES.** Dewar key panel type 8-pole C.O. flush fitting, 5/-. Yaxley 3-pole 3-way, 3/6; 8-pole 1-way, 3/6. D.P.C.O. toggle switch 250 v. 1 amp. flush panel, 3/3, 8-way Lucas switch box, 3/6; 6-way, 3/-.



**ELECTRADIX RADIO**  
214, QUEENSTOWN ROAD, LONDON, S.W.  
Telephone: MACaulay 2159

**1 Salford valve voltmeter diode probe 3-range,** 1, 3 and 15 volts, and scale battery operated; best offer.—W. F. Parsonage, Radio and Electrical Engineer, Inducta Works, Park Rd., Bloxwich, Walsall, Staffs. [7458]

**INDUCTANCE** and capacity bridge, 1,000 cycles' buzzer operation, range 5 micro henrys to 100 henrys, and 5pf to 100mf. "Q" and power factor, accuracy 5% or better, complete, less phones, £12/10.—Electronic Services, Arwenack St., Falmouth. [7514]

**NEW** boxed radar indicator, comprising 6in. short afterglow green tube, complete with time base, etc.; 7 valves, ideal for oscillograph and television service, cost approx. £35; our price £6/10/-; p. and p. 10/- extra.—Pal Radio, 142, Crouch Hill, London, N.8. Mou. 4463

**COSSOR** 339 D.B. scope: Avo model 40 C meters; Wee Megger; Universal Avo's; Supreme pocket universal test meters; Supreme combined valve and universal meters; Avo and Mullard R/C bridges; surplus meters 0.5-1ma; sundry meter movements and universal testers; list.—172, Park Rd., Blackpool. [7365]

**NUPLANS** add to their test gear plans range No. 7, the main signal generator and the circuit analyser, both complete with 1ma meter; see recent W.W. adverts. for the oscilloscope, signal tracer, etc.; each set of plans 2/6, from E. Bradley, "Whinnie Knowe," Escalls, Sennen, Cornwall. S.a.e. for lists.

**OSCILLATORS** and wavemeters, heavy aluminium case, circuit diagram, correction chart, accurate to within 1/2 kc/s., a real laboratory instrument, covering 1.3 to 7.5 mc/cycles, but easily adapted to cover other frequencies, cost approx £25, our price 30/-, as new; spare valve 5/- extra.—Norvall, 154, Colney Hatch Lane, N.10, Tudor 4399. [7495]

**SPECIAL** offer, small quantity only, flush mounting 2 1/2in millimeters, F.S.D. equals 1ma, first grade, tropicalised, calibrated white enamelled dial, 0-15 D.C. volts, 0-300, 0-750, complete with high accuracy, wound external resistances for the above ranges, 50/- each plus 2/- carriage and packing, whilst available.—W. Harford, 128, Greengate, Salford, 3. [7468]

**A** 100-ohm-frequency oscillators, resistance capacity type, range 25-16,000 c.p.s., output 1 volt, excellent stability and waveform, specially designed for radio-gramophone development and service, particularly suitable as bridge source, details and demonstration on request; price £30.—Donald Dun, Ltd., 12, Hollywood Rd., S.W.10. Flaxman 5705. [7499]

**WAVEMETERS,** ex-Gov't., class II No. 1. Mark II ranges 1,900-4,000 kc/s., 4,000-8,000 kc/s., check frequencies at intervals of 1 mc up to 25 mc/s., oscillator crystal check, battery operated, supplied with spare vibrator, spare valve, and instruction book, brand new; £6/15, carriage paid; send for fully descriptive leaflet; also a few only less spare at 85/- (carriage 3/-).—U.E.I. Corp'n., 32, St. Gabriels Rd., London, N.W.2. [5910]

**A GIFT**—Cathode ray tube oscilloscope, ex W.D., in good condition and working order, containing 2 1/2in tube, also 3-valve amplifier, 5 variable controls, complete in steel cabinet, limited stock; order early; only £3, plus 5/- carriage; also aerial coupling units, in cast aluminium case, containing shortwave variometer and a 0-200 thermo couple milliammeter, only 27/6, plus postage; s.a.e. lists and other bargains.—Amateur Radio Service G6HP Canning St., Burnley. [7473]

**OSCILLOSCOPE,** laboratory model, 6in tube new, single beam, X & Y shifts, brilliancy, focus, gain, synchronising, velocity, amplitude, trigger controls, selector switch for 10 condensers, selector switch for SS, DC, AC, AI, plates operation, additional terminals for external time base, generator for calibration, AMP & SYN, blackout, complete with separate power pack, cable and plugs, ready for use, £65; AVO 7, £19/10.—Cobban & Haboney, 255, Fulham Rd., Chelsea, S.W.3. Tel. Flaxman 1387. [7437]

**NEW LOUDSPEAKERS**  
HIGH quality, precision-built speakers. Ticonal magnets, detachable diaphragm, die-cast chassis, twin cone.—Broad east & Acoustic Equipment Co., Ltd., Broad east House, Tombland, Norwich 26970. [6435]

**"REXONAX"** introduce an outstanding duplex reproducer consisting of low frequency and high frequency horn loaded units of specialised design incorporating separate output transformer and frequency dividing network; exceptionally smooth response from 40 to 12,000 c.p.s., efficiency approximately 35%; low intermodulation and harmonic distortion with high power handling capacity; even distribution of all frequencies over wide area from mouth equivalent of over 16 sq feet; adjustable "high-low" balance; compact dimensions; built to highest ideals, not down to a price, for those engaged in obtaining the most realistic reproduction of sound.—Details and demonstrations. REXONAX, Lowther House, St. Marks Rd., Bromley, Ravensbourne 5225

## THE SUPERHETERODYNE RECEIVER

By Alfred T. Witts, A.M.I.E.E.

An outstanding book by an experienced practical man, giving expert practical information on construction and maintenance. Now in its sixth edition, it should be studied by everyone interested in up-to-date receiver design and construction. 6/- net.

## RADIO SIMPLIFIED

By John Claricoats

Specially prepared for those requiring a sound basic knowledge of the subject in the shortest possible time. Explanations are simple and lucid, and there are many diagrams to illustrate the text. Second edition. 4/8 net.

## RADIO RECEIVER SERVICING & MAINTENANCE

By E. J. G. Lewis

A practical manual specially written to give the radio dealer and the service engineer up-to-date and reliable assistance in the technical details of their work. A handy fault finding summary is a feature of the book. Third edition. 8/6 net.

## PITMAN BOOKS

Parker Street, Kingsway, London, W.C.2

## COULPHONE RADIO

"The Return of Post Mail Order Service."  
58 DERBY STREET, ORMSKIRK, LANCs.  
Phone: Ormskirk 496.

Telegrams: Coulphone, Ormskirk.

NEW GOODS ONLY.  
C.W.O. or C.O.D. Post Free over 5/-.

### MAINS TRANSFORMERS

PRIMARIES for 200/300 volts. Universal 4, 5 and 6.3 v. L.T.'s, 300-0-300 v. 60 mA., 23/6; 350-0-350 v. 100 mA., 23/6; 450-0-450 v. 200 mA., 4 v. 8 a. C.T., 4 v. 4 a. C.T., 4 v. 4 a., 45/-; 450-0-450 v. 200 mA., 6.3 v. 4 a. C.T., 6.3 v. 4 a. C.T., 5 v. 3 a., 45/-; 450-0-450 v. 200 mA., 6.3 v. 6 a. C.T., 4 v. 2 a. C.T., 4 v. 2 a. C.T., 5 v. 3 a., 47/6; 1,250-1,000-750-0-750-1,000-1,250 v. 300 mA. (no L.T.s), 92/6; 4 or 6.3 v. 6 a. C.T. (Filament), 16/6. Auto. (Filament), 4 v. to 6.3 v. 4 a. (or vice versa), 13/6.

### SMOOTHING CHOKES

15 H. 40 mA. 380 ohm., 5/-  
20 H. 60 mA. 425 ohm., 6/-  
15 H. 90 mA. 240 ohm., 7/-  
20 H. 100 mA. 425 ohm., 12/6  
20 H. 200 mA. 150 ohm., 21/6  
30 H. 200 mA. 350 ohm., 25/-

### OUTPUT TRANSFORMERS

Midget Power Tan. 5/6. 84. Univ. with C.T. 6/6. Large Univ. with C.T. 1/6. Heavy Duty Univ. for 3, 8 and 15/2. 2/6. Extra Heavy Duty, 37/6. SPECIAL (to author's specification), for quality amplifier, described in April and May issues of "The Wireless World", 57/6.

### COILS, COIL PACKS, etc.

WEYMOUTH TRF. COILS. M. and L., with cct., pair 9/6.  
SUPERBET 3 W.B., with cct., 465 kc/s., pair 11/6.  
WEYMOUTH COIL PACKS. Completely aligned, 36/6.  
B3 TUNING (FEEDER) UNIT. With R.F. stage. Completely aligned, station named scale, 28 15s.  
I.F. TRANSFORMERS. Midget, 18/9 pr. Standard, 15/- pr.  
J.B. MIDGET 2-GANG CONDENSERS. .0005, L/Tr., 11/6; W/Tr., 12/6.  
"P" COILS. Full range, 2/8 each.  
MUTHEAD PRECISION REDUCTION DRIVES. 54:1, 12/6.

### SUNDRIES

LINE CORD. .3 amp. 60Ω per ft., 2 w., 2/3 yd.; 3 w., 2/6 yd.  
MAINS DROPPERS. 3 a. 800Ω, 4/6; 2 a. 1,000Ω, 4/3. CARBON RESISTORS (50Ω to 5 MΩ), 1 w., 6d.; 1 w., 9d.  
EDDYSTONE SHORT WAVE GEAR.  
ROMAC SUPER CAR RADIO. VIDEO PORTABLES. Send 2/6 stamp for new 24-page Catalogue.

4 IN perm. mag. loudspeakers metal fret over cone, 16/- each; two-way Lander pattern A/M mark wall switches, new, 3/- each; panel boards containing average 40 pieces condensers and resistances for tropical use, 7/6 each, post extra.—Kaye, 11, St. Anns Rd., Harrow. [7446

£5/18/6.—New Baker Super Quality 12 in. 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 2/4d 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 18 in 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 4226).

**LOUDSPEAKERS, SECOND-HAND**  
FERRANTI M2 with 2ft 6in baffle, £3.—Haskell, 8, Ash Grove, Guildford. [7509]

BAKER'S P.M. cinema speaker, 18 in. in cabinets, new, two, £7/10 each.—Baker, 113, Milton Rd., Cambridge. [7491]

VITAVOX Bi-Tone loudspeaker, £25; Western ball-type microphone, £6; both in first-class condition.—Box 8519. [7518]

SOUND Sales phase inverter, complete, £10; B.A.F.C. twin cone H/FI, 12 in., £7; new—Furness "Braeknowe", Pilochry, Perth.

BAKER 12 in. with rectifier unit, new cone and coil by maker, Ferranti I.P. output, 2 matched PX25s; £5/10.5/20, Fairmount Rd., Brixton Hill. [7660]

### VALVES

PHOTO electric cells, 1st grade, G.F.C. C.M.G. 8 4-pin top cap, 35/- each; all individually tested in sound head circuit.—Robinson, 847, Kingsway, Manchester, 20. [7319]

LARGEST and most comprehensive range in the country. British and U.S.A. types, at Board of Trade prices; send for lists (valves available), free, s.a.e.; valves sent c.o.d.; retailers not supplied.

RANSOM, Bond St., Brighton. [7223]

FOR sale. 9 in television CRT, Mazda CRM91, new, in sealed makers' cartons, £8/15; 2nd hand focus scanning and deflection coil assemblies, £2/10; rubber masks, 15/-.—A. Gordon Galloway & Co., 120a, Myddleton Rd., Bowes Park, London, N.22. Bowes Park 3472.

TRANSFORMING valves, new and guaranteed. Hytron 807, 12/6; Eimac 35T, £2; Hytron T240, 35/-; large stock of British and American receiving and transmitting valves and components.—Odeon Radio, 56, College Rd., Harrow, Middx. [7379]

VALVES, new, boxed at maker's list price + P.T. 1A7, 6A7, 24, 42, 1A6, 43, 18, 75, 77, 80, 84, FC4, PC13C and many others; please write for details of other types available for scarce replacements.—Revall, "Eureka", Beergate, Av., Hayling Is., Havant. [7525]

PUBLIC address and charging plant, surplus to our requirements, guaranteed in first-class condition. Interested parties invited to submit offers.—MEICO, 30A 30watt, new; Rothermill, 60watt, new; Trix TP.633 (cabinet type with P.U.), new; Trix RGA.633; Tannoy transportable power microphone, new; F.I. 12-volt car amplifier. LOUD SPEAKERS: F.I. 70 in horn L.S.5 unit, F.I. 40 in horn L.S.7 unit, F.I. 40 in flat horn L.S.7 unit. NEWTONS

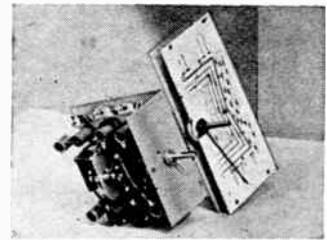
constant potential battery charging plant 7.5 to 15 volts, 100amps, 200volt 50-cycle single phase, 1,400 r.p.m. size S.C.P.62. GRYPHO rotary converter, 200v D.C., input 200v.

VALVES, surplus to our requirements, new, boxed. List price; Mazda AC/HLDD, AC/P, AC/HLDDD, DC2SG, DCPen, DC3HL, DD41, DD101, DD207, HI.1320, HI.41D, L21D, Pen141, SP42, SPI320, SP2220, TH41, TP22, TP26, TP26/20, UG8, U07, U30/250, U030/250, V914, VP41, Mullard: EBC3, EBC33, EL3, EL33, PM2A, PM202, SP4, Marconi: DA30, DL63, MH41, X61M, D63, KT33C, U52, DH, KT35, W42, 304, DH42, KT4T, X41.

Cosmor: 41MP, 202DDT, 220IPT, MSPen, 41STH, 210JDT, IDT, MVSPen, PT10, Tungram: 6K7G, AP4A, HR210, MH1118, SP220, 6X5G, D14, HP1118, P215, VP48, 35, DD13, LD210, SP48, 6B8G, Brimar: 1A5G, 6H6G, 6L7G, 912, 25A6G, 85, 1C5, 6J7G, 6U7G, 11D3, 25Z4G, 43, 6A8G, 6K7G, 7D5, 12F5GT, 42, 46, 6AG6, 6K8G, 812, 1512, 75, 4D1, 6P6G, 6L6G, 9A1, 20A1, 78, 5Y4, 5Z4GTG.

LARG'S, Whitehall Street, Dundee [7420]

## HENRY'S



"REGAL" TUNING HEART.  
4 Wave-band coil pack, Meal, Long, and Two Short Waves. Complete with 2-Gang Condenser, Dial, Epicyclic Tuning; Switching includes "Gram" position.  
For 465 kc/s., including 5 valve superhet circuit, 79/6.  
Drilled Chassis to suit, 7/6.  
Whistle Filter, 3/-.

A further selection from our Current List.

MIDGET A.F. UNIT.  
Comprising 31T4 valves, Midget Weairite "Hyperloy" Mike Trans, Midget Vol. Control, Condensers and Resistors, Mounted on Paxolin Panel. New and Guaranteed, 25/-.

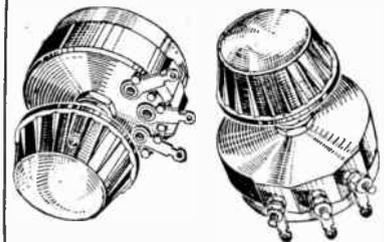
ELECTROLYTICS.  
8 mfd., 500 v.w., 4/-; 16 mfd., 500 v.w. 5/-; 8 x 8 mfd., 500 v.w., 6/-; 40 mfd., 150 v.w., 4/-; 25 mfd. x 25 mfd., 200 v.w., 6/6; Micropack 25 mfd., 25 v.w., 2/6; 12 mfd., 50 v.w., 1/6; 50 mfd., 12 v.w., 1/6; Midget Picopacks, 20 mfd., 12 v.w., 10 mfd., 25 v.w., 2/6. Tubular Condensers, all values in stock. 2 pf. 1 mfd., at 5/6 doz. Comprehensive stock of resistors, valve-holders, transformers, chokes, coils, I.F.T.s, tuning Condensers, speakers, switches, chassis, vol. controls, etc., etc.

A stamp will bring our List.  
Cash with Order, or C.O.D. (over £1).  
Wholesale and Retail.

5 HARROW RD., W.2

PAD. 1008/9

## RELIANCE POTENTIOMETERS



Type T.W.

Type T.T.

Continuous Wire-Wound

Rating: 5 watts (linear)  
3 watts (graded)

Ranges: 10-100,000 Ω linear Max.  
100-50,000 Ω graded  
100-10,000 Ω Non-inductive

### Characteristics:

Linear, tapered, graded, log., semi-log., inverse log., non-inductive, etc.

Write for full details to

## RELIANCE

Manufacturing Co. (Southwark) Ltd.

Sutherland Road, Higham Hill,  
Walthamstow. E.17

Telephone: Larkwood 3245

**VALVES.**—Is your work held up for valves? If so, we may be able to help you; we have large stocks of all types available at list prices; send for monthly lists.—Scott's Valve Service (Dept. D), 14, Gardner St., Brighton.

**RADIOGRAPHIC, Ltd.,** 66, Osborne St., Glasgow, C.1, mail order specialists.—Transmitting valves, from stock, RK20A £2/14/6, T200 £9/9, RK25 £2, 805 £5/10, TZ40 £2/15, etc., etc.; further types available soon, send for list; 813 ceramic bases, 6/6 each; 58 set vibrator packs, £2/10; 4mfd 800v condensers, paper, 4/6; 4mfd 2,000v test, 9/- each; R1155 receivers, £15/15 each, complete with Jones power plug and mod. details; single speaker amplifiers, ac/dc, complete with transverse current microphone, £22/10; twin speaker amplifiers, ac/dc, ribbon mic., £30; all new and unused; 0/350ma R.F. thermometers, 17/6 each; new list now available; visual indicators comprising 2 500 micro amp Weston meters and 2 large neons, real bargain, 9/3 each.—Radiographic, Ltd., 66, Osborne St., Glasgow.

**DYNAMOS, MOTORS, ETC.**

**ROTARY** converter 240 D.C. to 230 A.C. 180 V.A., as new; offers over £14.—Box 8147. [7409]

**ROTARY** converter, Crypto, 220v D.C.-230v R.A.C., 150 watt, cabinet, filter, perfect; £18.—"Siggers," London Rd., Bracknell, Berks.

£3/10 L.T. dynamos, 24v, 15amps, ball bearings, brand new 10/- rheostats, lead-acid type, 25amps, 0.4ohms, goods surplus.—B. E. Rewinds Co., 38, Brighton Rd., Birmingham.

**WESTINGHOUSE** rectifier, unused, input 230v, output 36v, 56amp charging board complete with meters, ideal for light welding; £50 delivered.—Vampyle, 67a, Main Ridge, Boston, Lincs. [7435]

**STABILISED** generators, input 24v D.C. 9 amps, 230v 50 cps single phase output, 80-150 watts, £25 each; a superbly made instrument.—Send for further details to B.S.R. Ltd., Claremont Works, Old Hill, Staffs. [7451]

**BATTERY** chargers for home and export, 4 models, 2-6-12v, 1, 2, or 4amp dc, any mains voltage; generous trade terms. Write for catalogue. Tel. Hoddesdon 2659.—The Banner Electric Co. Ltd., Hoddesdon, Herts.

**ALL** types of rotary converters, electric motors, battery chargers, petrol-electric generator sets, etc., rotary transformers, input 12v d.c., output 600v at 250ma; price £7/10 each, nett, post paid.—Ward, Loverscroft Works, Haverhill, Suffolk. Haverhill 201. [7503]

**GRAMOPHONES AND SOUND EQUIPMENT** J. H. BRIERLEY, Ltd., announce a complete range of new equipment.—

**RIBBON** pick-up, £5/10 plus £17/6 tax; special Mumetal screened transformer for ribbon pick-up, £2; armature pick-up, 5gns plus £1/6/9 tax; special Mumetal screened transformer for armature pick-up, £1; combined coupling transformer and domestic tone compensation unit for armature pick-up, £17/6; the latest JB/12/Q amplifier for use with the above pick-ups with many special features, £48; pre-amplifier, standard type, £9; filters, JB/1/PF 1 and 2 with cut-off frequencies of 7,500 c/s and 13,000 c/s respectively, matched for a terminating impedance of 24,000 ohms, £3/10 each.

FULL details of any or all the above items will be supplied on receipt of 3d in stamps. WE have the following items, surplus to our requirements: Small quantities of 32 and 45 a.w.g. enamelled wire; laminations, 300 70T (Mumetal) insulated, 800 Rola No. 3, 17 gross Rola No. 4, 25 gross M.E.A. Silcor 2 No. 29A; please state needs.—J. H. Brierley, Ltd., 46, Titebarn St., Liverpool, 2. [7226]

**ROLA** G.12 with field supply, Wilkins & Wright coil p.u.; £10.—Box 8551. [7527]

**CONNOISSEUR** pick-up and trans. unused; £3/5.—"Siggers," London Rd., Bracknell, Berks. [7393]

**RECORDING** motor ac/dc, 78/33½; £20 near offer; m/board and case extra £5.—Box 8549. [7523]

**L**EXINGTON Junior pick-up, transformer, as new; £3/15.—6, Elmhurst Ave., Northampton. [7357]

**FLOOR** model record player, ample record space, "Collaro" unit, cabinet polished; £15.—Strange, 16, Carnarvon Rd., Leyton, E.10. [7276]

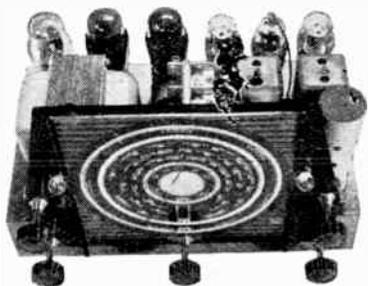
**FOR** sale, Trix T633 30 watts amplifier, used once, £26; 2 A12 loudspeakers, £10/10 each.—J. A. Lowe, Hartley Winney, Hants. [7380]

**TRANSFORMERS,** tone control and filter chokes for all "W.W." circuits.—R. Clark, 30, Langland Crescent, Stanmore, Middx. Wor. 531. [7532]

**RECORDING** equipment, blank discs and accessories available from stock in small quantities.—University Recording Co., 113, Milton Rd., Cambridge. [7492]

# ARMSTRONG

## Model EXP83



### ALL-WAVE 8-VALVE SUPERHET CHASSIS

incorporating wave band expansion. Large glass scale treble boost control. Gram. switching High quality push-pull output gives 10 watts audio. For 100-250 v. A.C. mains.

Price 14 gns. plus tax

## Model UNI-83

### ALL-WAVE 8-VALVE SUPERHET CHASSIS

incorporating wave - band expansion, e.g. the 16-50 m. band covers just over 20 inches on the large glass scale, treble boost control, gram. switching, all controls work on both radio and gram., high quality push-pull output giving 6 watts audio. For 200-250 v. D.C. or A.C. mains.

Provisional Price 14 gns. plus tax

## \* Model EXP53

### ALL-WAVE 7-STAGE RADIOGRAM CHASSIS

This new radiogram chassis incorporates wave-band expansion on all bands. Volume and tone controls work on both Radio and Gram. 4 watts R.C. coupled output. Supplied complete with full size loudspeaker. This chassis has a lively performance, good quality reproduction, and represents excellent value. For 200-250 v. A.C. mains.

Price with speaker £13 plus tax

\* Owing to the National Emergency and the consequent loss of production we may be compelled to suspend this Model temporarily. We shall, however, do everything possible to avoid this.

## Model AMP14

### HIGH GRADE AMPLIFIER CHASSIS

Two inputs, bass compensating circuit, treble boost control, 14 watts push-pull output preceded by 4 triodes.

Price 13 gns.

Demonstration Sets are now available for interested callers to hear and illustrated technical specifications are now ready.

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

**RECORDING** machines, recording amplifiers, B.S.R. amplifiers and turntables, discs, stylus, trailer needles, all recording accessories.—Bristol & West Recording Service, 79, Old Market St., Bristol. [7206]

**COILS** for W.W. tone control and filter circuits (Brierley and Hartley spec.); high fidelity, mic. line and output transformers; s.a.e. full list.—R. Clark, 30, Langland Crescent, Stanmore, Middx. Wor. 5321. [6971]

**INFINITE** Baffle corner deflectors, scientifically designed acoustic chambers as reviewed "Wireless World," June; send for catalogue.—Broadcast & Acoustic Equipment Co., Ltd., Broadcast House, Tombland, Norwich 26970. [6434]

**RADIOGRAM**, walnut cabinet, H.M.V., 8 changer, light weight P.V. (sound sales, 12 watt amp, and tuner, bass and treble cut phase inverter speaker, walnut), record cabinet, mahog., 300 record space, excellent product., perfect cond.; £110.—"Siggers," London Rd., Bracknell, Berks. [7390]

**PORTABLE** recording equipment: M.S.S. recording machine, 20 watt amplifier, new, from stock; Blank discs, cutting needles, trailer needles, microphones, lightweight pick-ups, matching transformers, speakers, etc.; trade enquiries invited.—Sound Discs (Supplies) Ltd., 83a, Bold St., Liverpool. [6964]

**1947** quality record reproducers, amplifier and radio chassis, gram motors, pick-ups, speakers, micrograms, players, etc.; lowest prices in the trade; s.a.e. for detailed list; special 10gns month, Universal amplifiers, 12 watt, 10gns; 15 watt, £14/10.—Radio Unlimited, 16, Carnarvon Rd., Leyton, E.10.

**TECHNIFON, Ltd.**, manufacturers of direct disc recording equipment and accessories. Precision built traverse gear complete with first class quality cutting head, £15/15; delivery 3 wks.; s-sided 12in blank discs still available, 3/- each; for all lightweight pick-ups using push in stylii, our h.f. type sapphire stylus now available, 9/2 inc. P.T.; postage and packing extra.—Technifon, Ltd., 99, Belgrave Rd., London, S.W.1. Vic. 8814.

**CHARLES AMPLIFIERS** welcome lovers of recorded music to their new premises where their high fidelity amplifiers can be heard together with Lexington Connoisseur and Rothermel pick-ups and B. and A.E.C. Vitavox and Wharfedale speakers, B. and A.E.C. acoustic chambers, infinite corner baffle deflectors, etc.; we like you to bring your own familiar records for comparison; this is a service devoted entirely to the high fidelity reproduction of music; one minute from the Albert Hall and Kensington High St. Station, buses 73, 49 stop at the door.—Charles Amplifiers, 1e, Palace Gate, Kensington London, W.8. [6642]

**TELEVOX** playing desks.—We wish to apologise to the large number of our customers who have been obliged to wait several weeks for these units; we are doing all we can to overcome the acute shortages of essential parts that are seriously affecting our production. THE Televox Sound Service has pleasure in announcing the production of their model P.D.11 playing desk, fitted with a belt-driven turntable and powered by a constant speed induction motor, with speed adjustment; this model will be mounted on the same chassis as our previous models, namely, with black ripple finish, size 14½in x 12½in x 3½in deep, mounted on 4 rubber feet, with or without pick-up.—For further particulars write to Televox Sound Service, Kings Studios, 37, Albert Rd., Southsea, Hants. Tel. Portsmouth 4982.

THE Televox Sound Service has pleasure in also announcing the early production of a floor model record player, incorporating the above belt-driven turntable unit, mounted in a sliding cabinet, and supported on a modern tubular steel frame with easy access record rack; the top of this player is covered with a substantial black vitrolite (plastic glass) surface, specially designed to support table model radios.—Further particulars from the above address. [7666]

**SPECIAL** offer to experimenters and amateur enthusiasts of moving coil earphones and microphones, combined; these instruments are of the very latest type, issued to the Services, and are all new and boxed, as from the makers; special attractive price to clear, £1 for the complete set, which is less than half their usual value; also small size Westinghouse metal rectifiers, half-wave type, size ½in x ½in., pass approx. 50-60ma, price 2/- each, or £1 doz.; full-wave type, size ¾in x ½in., pass approx. 100ma, 3/- ea., or 30/- doz.; all new and in their original wrapping; counterpoise aerial systems, containing in all 40ft of copper insulated aerial wire, only 2/- each concentric aerial feeder, as used by R.A.F., 1/- yard; please note, we pay all postage and carriage expenses; c.w.o. please.—Pearson, 58, Bain St., Glasgow, S.E., and 263, Gallowgate, C.4. [7673]

# OUR ADVERTISING

IN THIS SMALL SPACE, SELLS AS MANY  
**AMPLIFIERS & TRANSFORMERS**  
AS WE CAN COMFORTABLY PRODUCE  
UNDER PRESENT CIRCUMSTANCES.—

We would like to show photographs and print full technical descriptions on our range of eight amplifiers. Prices range from 8gns. to 45gns., with outputs from ten to fifty watts.

# IT IS NOT POSSIBLE

as space in the "Wireless World" is very restricted but we are fortunate indeed to be in every issue of this journal. Our Audio Catalogue has twenty pages, the Transformer Catalogue eight pages of over fifty popular specifications.

We ask that you send 3d. in stamps to cover postage and despatch, and we will be delighted to forward you this wealth of detail. Trade Discounts to Dealers. Quotations for Export, names of local stockists in your area, every assistance most gladly given. Send Now Please.

**General Lamination Products Ltd.**  
294, Broadway, BEXLEYHEATH KENT.  
Phone; Bexley,heath 3021.



# ANNOUNCEMENT

Important new features introduced

In response to many requests, the Peerless Chassis will now incorporate several important new features, including:

- ★ Self-contained pre-amplifier for Moving Coil Pick-up
- ★ R/F & A/F stages now separately housed —either may be purchased independently
- ★ Lower power output alternatively available for those not requiring full 25 watt capacity

Write for full details of an impressive specification, which includes:

- ★ 15 valves
- ★ 6 wave ranges
- ★ Frequency coverage 150 K/Cs to 60 M/Cs
- ★ Independent bass and treble control
- ★ 25 watts output

Phone Western 1221 or write:  
**PEERLESS RADIO LIMITED**  
374, Kensington High Street, London, W.8

## MORSE EQUIPMENT

MORSE practice equipment for classroom or individual tuition; keys, audio oscillators for both batt. or main operation.—Webb's Radio, 14, Soho St., W.1. Ger. 2089. [2291]

**NEW MAINS EQUIPMENT**  
M AINS transformers, 750-0.750, 200ma, 4v and 6.3v L.T., 230v input, 65/-; 350-0.350, 100ma 5v C.T. and 6.3v L.T., 230v input, 27/6; aluminium sheet, polished half hard, 22 gauge 1/4, 18 gauge 2. 16 gauge 3/ sq ft; duralumin tube, 1/2in, 10ft, 4/-; all postage extra; transmitter and amplifier racks built to your requirements; enquiries, and stamp for component list. Panthorpe, 68, Hepworth's Arcade, Hull. [7274]

**TRANSMITTING EQUIPMENT**  
100 watt C.W. 40watt phone transmitter, complete with all equipment, also 2 communication receivers, all in perfect working order, s.a.e. for details.—Offers to Thomson, 14, North St., Fovey, Cornwall. [7543]

250W ham transmitter, rack built, 61.6-307.813 Mod. 6S 7-6J5-pp 6A3 pp1Z40. power packs 1.500v, 1.000v and 450v and bias; original cost of parts £260; complete and working on all amateur bands, £180.—G4HV, 16, Keswick Gdns., Ruslip. [7378]

**COMPONENTS—SECOND-HAND SURPLUS VALUE!** Matt has it.  
SPECIAL offer headphones, w/lead and jack plug, 5/6 per pair (boxed 2 pairs).  
SPEAKERS, P.M. 4in 17/6, 5in 15/6, 8in 22/6, all less transformers; transformers (out put) to match, 5/6 ea.  
CONDENSERS, 0.1, 0.01, 9/- doz; 8 mfd (canned) 3/6; 8-8 (canned), 6/6; all 500v working 16 mfd electrolytics (chassis mount ing), 7/6.

LINE cord 0.3 amp (60 ohms per ft), 2 wv 1/6 per yd, 3-way 2/8 per yd.  
VOLUME controls (Centralab), various values, 1/s 3/6, w/s 4/9; Rothermel crystal pick-up; luxe, £2/16 3 (inc. P. Tax); metal £2/12/6 (inc. P. Tax); Cosmoconcord-Magnetic P/aps, 33/-, inc. P. Tax; television cable (aerial lead-in), 1/- per yd; a large assortment of B.V.A and V.S. valves always in stock; let us have your enquiries  
MATT RADIO SERVICE (Kingston 4881), 152, Richmond Rd., Kingston-on-Thames, Surrey. [7168]

**A** NEW disposal item service.  
THERE are many ideas for using the various disposal items now offered; we have tried most of them so let us pass the benefit on to you; the service is free to customers and ensures you getting the best of your bargain in every way. Look at these offers and then write for details.

MK. 58 "Walkie-Talkie" sets, complete with valves, at £8/10; vibrators and batteries also available.

CLASS "D" No. 1 wavemeters, complete with spare ECH 35 and vibrators at £5 5; components alone worth double.

AERIAL coupling units, type "A," including 200ma H.F. ammeter, at 35/- each; the R.1124 receiver unit is the ideal base for a television amplifier or f.m. unit; complete with all six valves at £4 10.

VALVES, 1R5, 1T4, 185, 1299a, and many other scarce types; spares, components of every make and type; send stamp for lists and remember that the service goes with the sale; terms cash with order or c.o.d. over £2.

Orders to Dept. W.W., Ariel Trust, Ltd., 185, Vauxhall Bridge Rd., London, S.W.1. [7417]

**MIDLAND RADIO COIL PRODUCTS.**  
I.F. transformers for 465 kc/s, permeability tuned, 3 1/2in high by 1 1/2in square, per pair 14/6; Superhet coils, 2/3; T.R.F. pairs, 6/6; mains trans. 350v 80ma, 6 or 4v, 26/6; steel instrument cases, 18in x 8in x 7in, fully louvered, open one end, 12/6; tuning hearts, coil packs, etc.; 3d stamp for lists and data.—Midland Radio Coil Products, 13a, Silver St., Wellingborough, Northants. [7463]

**UNIVERSAL ELECTRONIC PRODUCTS** (G8UQ), 36, Marybone High St., London, W.1. Tel. Wel 4058.

TUNING units.—Our new type A tuning unit now available from stock. Consists of 3 waves long, medium and short (16.50m). Complete with I.F. transformers and valve holders, all wired and aligned ready for connecting to i.d. triode and amplifier. Complete with attractive glass dial and drive but less valves. (Requires 6K8-6K7.) £5/5, plus postage 2/6. R1155.—If you are not satisfied with the performance of your set write for details of our conversion. We now have a special department dealing with these receivers and can offer prompt service. [7539]

CHASSIS panels in aluminium from 3/9 each, prompt delivery, any size, plain or punched for valveholders, etc.—Mead, 13, Bence Lane Darton, Barnsley [7432]

## LASKY'S RADIO

THIS MONTH'S SPECIALS.

- A.F. UNITS, ex-Govt., consisting of: 3 Midget valves-1T4 and 3 ceramic button-valve holders; A.F. Midget transformer; 8 resistances; 9 condensers; 1 Midget 50,000 ohm potentiometer. The unit new and unused, 25/-, post extra 6d.
- MIDGET 2-GANG VARIABLE CONDENSERS, size 1 1/2 x 1 1/2 x 1, ceramic insulation, Capacity, .0001 mfd. Price 8/6 each.
- MIDGET 2-GANG TUNING CONDENSERS, with trimmers .0005 mfd., size 2 1/2 x 1 1/2 x 1 1/2. Price 8/6 each.
- ELECTROLYTIC BLOCK CONDENSERS, 32 mfd. 500 v.w., 7/6 each.
- MIDGET ELECTROLYTIC CONDENSERS, 4 mfd. 425 v.w., 3/- each.
- CHASSIS MOUNTING ELECTROLYTIC CONDENSERS (single hole fitting), 4 mfd. 500 v.w. Price 4/6 each.
- TUBULAR CONDENSERS, 20 mfd. 150 v.w. Price 4/- each.
- BUTTON VALVEHOLDERS to fit 1T4, and 1R5, etc. Ceramic 1/- each; 9/- doz.
- AMPHENOL, 80, each; 7/6 doz.
- £250 CERAMIC VALVEHOLDERS, 1/- each; 9/- doz.
- MIDGET 1.4 VALVES, 1T4 and 1R5. Price 11/- each.
- 6L5 metal, 12/6 each; 5Z3, 12/6 each; 6K7, metal, 10/- each; 6V6 gt, 10/- each; 6SJ7, 10/- each. Brand new ex-Govt.
- ROLA 5in. ENERGISED MOVING-COIL LOUD-SPEAKERS, 1,000 ohm field with pentode O trans. Price 29/6 each.
- ELECTROLYTIC CONDENSERS. Small cardboard tubular, 8 mfd. 600 v.w. 3/6 each; 36/- doz.
- MIDGET AX E. TYPE SWITCHES—  
4-pole, 3-way ..... each 2/6  
2-pole, 2-way ..... each 2/6  
2-pole, 3-way ..... each 2/6

Very large stock of Radio Valves, All types, British and American. A.C.; Battery; All-Dry; Universal; Metal; Glass; Midget, etc., at B.O.T. prices. We have a large selection of ex-Govt. chassis Rx and TX, etc., at knock out prices. It will pay you to pay us a visit. Send 1d. stamp for our current list. Enquiries invited. TERMS: Cash with Order, C.O.D. or Pro-forma (No C.O.D. under £1). ALL goods covered by our unconditional guarantee. Satisfaction or money refunded.

**LASKY'S RADIO**  
370, Harrow Road, Paddington, W.9  
(Opp. Paddington Hospital.)  
Telephone: Cunningham 1979.

# 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

1/6s. in unsealed envelope, 1d. stamp

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

NAME.....

ADDRESS.....

W.W. 60.

**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 Recording, 2/-; Test Gear Construction Manual, 1/6; Radio Pocket Book formulas, tables, colour code, etc., 1/-; Ten Hows for Radio Constructors, 1/-; Bulgin Radio Service Manual, 2/6; Radio Constructors Manual, 3/-; Radio Resistor Chart colour codes at a flick, 1/-; Radio Reference Hand book cloth bound, comprehensive and up-to-date; covering all Branches of Radio, 12/6. American Service Manuals, Sparton-Emerson, Crosley-Belmont (Parts 1 and 2), Stewart Warner-Pada, 12/6 per volume. Postage extra on all publications.

**YAKLEY** type rotary switches, 11-way, 5-resistances, assorted values, 2 watt to 1/4 watt, 20/- per 100; permanent crystal detectors, 2 6 each; aluminium panels, 16 gauge, 18in x 7in 3/8; Cutler-Hammer rheostats, 30 ohms and 10 ohms, 4/6; ex-Government Morse keys, brand new, 1/6 each (15/- per dozen); ex-Government buzzers, brand new, 1/6 each (15/- per dozen); Westectors, type WX6 and W12 1/- each (10/- per dozen); Luftdra adjustable hole cutters for use on metal, wood, plastics, etc., 5/- each.

**LATEST** ex-Government purchase: Rotary transformer, brand new, ex-Government stock, 12v input, 480v output, D.C., 17/6 each, plus 2 6 carriage and packing; 28v input, 120v output, 25/- plus 2/6.

**SOUTHERN RADIO SUPPLY Co.** 46 Lisle St., London, W.C. Gerrard 6653 [6981]

**ALL** new, 4lb boxes of spare parts; 3/-, post free.—Hagerty, 1, King-way Parade, Hoyton, Lancs. [7441]

**HARTLEY-TURNER** duode, standard permanent magnet; each £5/10. 93, Falcondale Rd., Bristol. [7350]

**L.T.** and L.T. rectifiers, charger kits, fluoro-cent chokes, no surplus goods offered, all charger kits guaranteed one year.

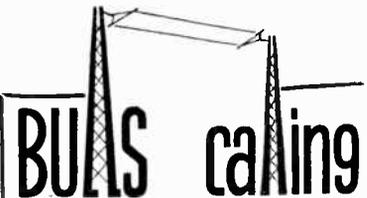
**SELENIUM** metal rectifiers, new small space type, 250v 60 ma for ac/dc receivers, take the place of valve rectifier, with circuit 9/6 post 5d, ditto 120v 20 ma for eliminators 7/3, ditto 120v 60 ma for U.S.A. midgets 9/6 post 5d, product of famous manufacturer.

**ELIMINATOR** kit, 120v 20 ma rectifier with transformer, 2 8mfd condensers and trickle charger rectifier for 120v 20 ma eliminator, 39/6, post 10d; selenium L.T. rectifiers, well-known make, new goods, with instruction sheet, 12v 1.5 amp 10 6 post 5d, 12v 2 amp 15/- post 7d, 12v 3 amp 18/6 post 10d, 12v 4 amp 25/-, 12v 5 amp 32/6, also 12v 6 amp heavy duty type with giant cooling fins, 38/6 post 1/-; other types in stock including rectifiers for converting garage-type valve chargers to metal rectification; charger kits, 50 watt mains transformer with 12v 3 amp rectifier and ballast bulb for 2v to 12v charger, no rheostat or ammeter needed, 48/6 post 1/-, ditto with 2 amp rectifier 39/6 post 11d, also for 2v, 6v only 36/-; mains transformer 75 watt with 12v 4 amp rectifier and ballast bulb for 2v to 12v charger, weight 9lb, 62/-, postage 1/1; heavy duty transformer, 150 watt with 5 amp rectifier, for 6v, 12v charger, high grade 0-6 amp ammeter included, £4/14/6, post 1/2.

**CHARGER** kits for small radio store, guarantee one year, for one to 20 cells at one amp, comprises 150 watt transformer, selenium rectifier and ballast bulb and holder, £4/15/-; ditto to 1 to 20 cells at 2 amps, £6/15/- transformer and rectifier specially designed; ammeters, flush mounting, reliable and accurate 0-6 amp, 15/-, post 6d; transformer and rectifier for 2v trickle charger, 13/6, post 7d; fluorescent chokes, 80 watt, boxed and bitumen filled, 23/0 1/2; and tapped 200-250v 21/-, postage 1/2. **CHAMPION**, 43, Uplands Way, London, N.21, Tel. Lab. 4457. [7371]

**EX-GOVERNMENT** stock.—7,500 transmit- ters, oscillators, power units, receivers, rotary converters, de luxe slow motion dials, 12-24v meters, amp and voltmeters, at fraction of original cost; callers only.—Alec Davis, 8, Percy St., W.1. [7225]

**NEW** S.T.C metal rectifiers and other goods still available at last month's prices, all rectifier users should realize that for a given rise in disc impedance the current output is dependent on the type of load, being higher with resistive or inductive load than for a battery; all our rectifiers are rated for continuous use for battery charging and if used with other loads mentioned above, 20-25% higher current may be drawn; rectifiers over 4a output are heavy-duty types with 75in sq cooling fins; all rectifiers are current products and supplied by Messrs. S.T.C.—Pearce, 66, Gt. Percy St., London, W.C.1. [7670]



**BULL & SONS (W.W.)**, 246, High Street, Harlesden, N.W.10

or call at the above address. Bus, 186, Trolleys, 682, 664, Tube or L.M.S.: Willesden Junction. Phone: ELGAR 4446-7-8 (extension 6).

**Wire: BULLRAD HARLES LONDON** Cable: BULLRAD LONDON for RADIO VALVES: British and American, from 5/10. All at official List Prices, not increased since 1946.

**BRIMAR**—1D6, 4B2/20A, 6BG, 6G8, 6K8, 6K7, 6S7, 6S87, 6T7, 6V8, 7B5, 7B7, 7F7, 7C8, 7D5, 7Y4, 8D2, 8D2, 10D1, 11D3, 11D5, 12BR7, 25Z4, 1D5, 15D2. **COSSOR**—4TPB, 4TSP, 138PA, 41MP, 41MPT, 41MRC, 42mp/Pe, 42-OT-DD, 42PTB, 203THA, 210DG, 210LF, 220UT, 220P, 220FA, 207B, DD4, M7PEB, M8PEB, M9PEB, B, M10PEB, M11PEB, M12PEB, M13PEB, M14PEB, M15PEB, M16PEB, M17PEB, M18PEB, M19PEB, M20PEB, M21PEB, M22PEB, M23PEB, M24PEB, M25PEB, M26PEB, M27PEB, M28PEB, M29PEB, M30PEB, M31PEB, M32PEB, M33PEB, M34PEB, M35PEB, M36PEB, M37PEB, M38PEB, M39PEB, M40PEB, M41PEB, M42PEB, M43PEB, M44PEB, M45PEB, M46PEB, M47PEB, M48PEB, M49PEB, M50PEB, M51PEB, M52PEB, M53PEB, M54PEB, M55PEB, M56PEB, M57PEB, M58PEB, M59PEB, M60PEB, M61PEB, M62PEB, M63PEB, M64PEB, M65PEB, M66PEB, M67PEB, M68PEB, M69PEB, M70PEB, M71PEB, M72PEB, M73PEB, M74PEB, M75PEB, M76PEB, M77PEB, M78PEB, M79PEB, M80PEB, M81PEB, M82PEB, M83PEB, M84PEB, M85PEB, M86PEB, M87PEB, M88PEB, M89PEB, M90PEB, M91PEB, M92PEB, M93PEB, M94PEB, M95PEB, M96PEB, M97PEB, M98PEB, M99PEB, M100PEB, M101PEB, M102PEB, M103PEB, M104PEB, M105PEB, M106PEB, M107PEB, M108PEB, M109PEB, M110PEB, M111PEB, M112PEB, M113PEB, M114PEB, M115PEB, M116PEB, M117PEB, M118PEB, M119PEB, M120PEB, M121PEB, M122PEB, M123PEB, M124PEB, M125PEB, M126PEB, M127PEB, M128PEB, M129PEB, M130PEB, M131PEB, M132PEB, M133PEB, M134PEB, M135PEB, M136PEB, M137PEB, M138PEB, M139PEB, M140PEB, M141PEB, M142PEB, M143PEB, M144PEB, M145PEB, M146PEB, M147PEB, M148PEB, M149PEB, M150PEB, M151PEB, M152PEB, M153PEB, M154PEB, M155PEB, M156PEB, M157PEB, M158PEB, M159PEB, M160PEB, M161PEB, M162PEB, M163PEB, M164PEB, M165PEB, M166PEB, M167PEB, M168PEB, M169PEB, M170PEB, M171PEB, M172PEB, M173PEB, M174PEB, M175PEB, M176PEB, M177PEB, M178PEB, M179PEB, M180PEB, M181PEB, M182PEB, M183PEB, M184PEB, M185PEB, M186PEB, M187PEB, M188PEB, M189PEB, M190PEB, M191PEB, M192PEB, M193PEB, M194PEB, M195PEB, M196PEB, M197PEB, M198PEB, M199PEB, M200PEB, M201PEB, M202PEB, M203PEB, M204PEB, M205PEB, M206PEB, M207PEB, M208PEB, M209PEB, M210PEB, M211PEB, M212PEB, M213PEB, M214PEB, M215PEB, M216PEB, M217PEB, M218PEB, M219PEB, M220PEB, M221PEB, M222PEB, M223PEB, M224PEB, M225PEB, M226PEB, M227PEB, M228PEB, M229PEB, M230PEB, M231PEB, M232PEB, M233PEB, M234PEB, M235PEB, M236PEB, M237PEB, M238PEB, M239PEB, M240PEB, M241PEB, M242PEB, M243PEB, M244PEB, M245PEB, M246PEB, M247PEB, M248PEB, M249PEB, M250PEB, M251PEB, M252PEB, M253PEB, M254PEB, M255PEB, M256PEB, M257PEB, M258PEB, M259PEB, M260PEB, M261PEB, M262PEB, M263PEB, M264PEB, M265PEB, M266PEB, M267PEB, M268PEB, M269PEB, M270PEB, M271PEB, M272PEB, M273PEB, M274PEB, M275PEB, M276PEB, M277PEB, M278PEB, M279PEB, M280PEB, M281PEB, M282PEB, M283PEB, M284PEB, M285PEB, M286PEB, M287PEB, M288PEB, M289PEB, M290PEB, M291PEB, M292PEB, M293PEB, M294PEB, M295PEB, M296PEB, M297PEB, M298PEB, M299PEB, M300PEB, M301PEB, M302PEB, M303PEB, M304PEB, M305PEB, M306PEB, M307PEB, M308PEB, M309PEB, M310PEB, M311PEB, M312PEB, M313PEB, M314PEB, M315PEB, M316PEB, M317PEB, M318PEB, M319PEB, M320PEB, M321PEB, M322PEB, M323PEB, M324PEB, M325PEB, M326PEB, M327PEB, M328PEB, M329PEB, M330PEB, M331PEB, M332PEB, M333PEB, M334PEB, M335PEB, M336PEB, M337PEB, M338PEB, M339PEB, M340PEB, M341PEB, M342PEB, M343PEB, M344PEB, M345PEB, M346PEB, M347PEB, M348PEB, M349PEB, M350PEB, M351PEB, M352PEB, M353PEB, M354PEB, M355PEB, M356PEB, M357PEB, M358PEB, M359PEB, M360PEB, M361PEB, M362PEB, M363PEB, M364PEB, M365PEB, M366PEB, M367PEB, M368PEB, M369PEB, M370PEB, M371PEB, M372PEB, M373PEB, M374PEB, M375PEB, M376PEB, M377PEB, M378PEB, M379PEB, M380PEB, M381PEB, M382PEB, M383PEB, M384PEB, M385PEB, M386PEB, M387PEB, M388PEB, M389PEB, M390PEB, M391PEB, M392PEB, M393PEB, M394PEB, M395PEB, M396PEB, M397PEB, M398PEB, M399PEB, M400PEB, M401PEB, M402PEB, M403PEB, M404PEB, M405PEB, M406PEB, M407PEB, M408PEB, M409PEB, M410PEB, M411PEB, M412PEB, M413PEB, M414PEB, M415PEB, M416PEB, M417PEB, M418PEB, M419PEB, M420PEB, M421PEB, M422PEB, M423PEB, M424PEB, M425PEB, M426PEB, M427PEB, M428PEB, M429PEB, M430PEB, M431PEB, M432PEB, M433PEB, M434PEB, M435PEB, M436PEB, M437PEB, M438PEB, M439PEB, M440PEB, M441PEB, M442PEB, M443PEB, M444PEB, M445PEB, M446PEB, M447PEB, M448PEB, M449PEB, M450PEB, M451PEB, M452PEB, M453PEB, M454PEB, M455PEB, M456PEB, M457PEB, M458PEB, M459PEB, M460PEB, M461PEB, M462PEB, M463PEB, M464PEB, M465PEB, M466PEB, M467PEB, M468PEB, M469PEB, M470PEB, M471PEB, M472PEB, M473PEB, M474PEB, M475PEB, M476PEB, M477PEB, M478PEB, M479PEB, M480PEB, M481PEB, M482PEB, M483PEB, M484PEB, M485PEB, M486PEB, M487PEB, M488PEB, M489PEB, M490PEB, M491PEB, M492PEB, M493PEB, M494PEB, M495PEB, M496PEB, M497PEB, M498PEB, M499PEB, M500PEB, M501PEB, M502PEB, M503PEB, M504PEB, M505PEB, M506PEB, M507PEB, M508PEB, M509PEB, M510PEB, M511PEB, M512PEB, M513PEB, M514PEB, M515PEB, M516PEB, M517PEB, M518PEB, M519PEB, M520PEB, M521PEB, M522PEB, M523PEB, M524PEB, M525PEB, M526PEB, M527PEB, M528PEB, M529PEB, M530PEB, M531PEB, M532PEB, M533PEB, M534PEB, M535PEB, M536PEB, M537PEB, M538PEB, M539PEB, M540PEB, M541PEB, M542PEB, M543PEB, M544PEB, M545PEB, M546PEB, M547PEB, M548PEB, M549PEB, M550PEB, M551PEB, M552PEB, M553PEB, M554PEB, M555PEB, M556PEB, M557PEB, M558PEB, M559PEB, M560PEB, M561PEB, M562PEB, M563PEB, M564PEB, M565PEB, M566PEB, M567PEB, M568PEB, M569PEB, M570PEB, M571PEB, M572PEB, M573PEB, M574PEB, M575PEB, M576PEB, M577PEB, M578PEB, M579PEB, M580PEB, M581PEB, M582PEB, M583PEB, M584PEB, M585PEB, M586PEB, M587PEB, M588PEB, M589PEB, M590PEB, M591PEB, M592PEB, M593PEB, M594PEB, M595PEB, M596PEB, M597PEB, M598PEB, M599PEB, M600PEB, M601PEB, M602PEB, M603PEB, M604PEB, M605PEB, M606PEB, M607PEB, M608PEB, M609PEB, M610PEB, M611PEB, M612PEB, M613PEB, M614PEB, M615PEB, M616PEB, M617PEB, M618PEB, M619PEB, M620PEB, M621PEB, M622PEB, M623PEB, M624PEB, M625PEB, M626PEB, M627PEB, M628PEB, M629PEB, M630PEB, M631PEB, M632PEB, M633PEB, M634PEB, M635PEB, M636PEB, M637PEB, M638PEB, M639PEB, M640PEB, M641PEB, M642PEB, M643PEB, M644PEB, M645PEB, M646PEB, M647PEB, M648PEB, M649PEB, M650PEB, M651PEB, M652PEB, M653PEB, M654PEB, M655PEB, M656PEB, M657PEB, M658PEB, M659PEB, M660PEB, M661PEB, M662PEB, M663PEB, M664PEB, M665PEB, M666PEB, M667PEB, M668PEB, M669PEB, M670PEB, M671PEB, M672PEB, M673PEB, M674PEB, M675PEB, M676PEB, M677PEB, M678PEB, M679PEB, M680PEB, M681PEB, M682PEB, M683PEB, M684PEB, M685PEB, M686PEB, M687PEB, M688PEB, M689PEB, M690PEB, M691PEB, M692PEB, M693PEB, M694PEB, M695PEB, M696PEB, M697PEB, M698PEB, M699PEB, M700PEB, M701PEB, M702PEB, M703PEB, M704PEB, M705PEB, M706PEB, M707PEB, M708PEB, M709PEB, M710PEB, M711PEB, M712PEB, M713PEB, M714PEB, M715PEB, M716PEB, M717PEB, M718PEB, M719PEB, M720PEB, M721PEB, M722PEB, M723PEB, M724PEB, M725PEB, M726PEB, M727PEB, M728PEB, M729PEB, M730PEB, M731PEB, M732PEB, M733PEB, M734PEB, M735PEB, M736PEB, M737PEB, M738PEB, M739PEB, M740PEB, M741PEB, M742PEB, M743PEB, M744PEB, M745PEB, M746PEB, M747PEB, M748PEB, M749PEB, M750PEB, M751PEB, M752PEB, M753PEB, M754PEB, M755PEB, M756PEB, M757PEB, M758PEB, M759PEB, M760PEB, M761PEB, M762PEB, M763PEB, M764PEB, M765PEB, M766PEB, M767PEB, M768PEB, M769PEB, M770PEB, M771PEB, M772PEB, M773PEB, M774PEB, M775PEB, M776PEB, M777PEB, M778PEB, M779PEB, M780PEB, M781PEB, M782PEB, M783PEB, M784PEB, M785PEB, M786PEB, M787PEB, M788PEB, M789PEB, M790PEB, M791PEB, M792PEB, M793PEB, M794PEB, M795PEB, M796PEB, M797PEB, M798PEB, M799PEB, M800PEB, M801PEB, M802PEB, M803PEB, M804PEB, M805PEB, M806PEB, M807PEB, M808PEB, M809PEB, M810PEB, M811PEB, M812PEB, M813PEB, M814PEB, M815PEB, M816PEB, M817PEB, M818PEB, M819PEB, M820PEB, M821PEB, M822PEB, M823PEB, M824PEB, M825PEB, M826PEB, M827PEB, M828PEB, M829PEB, M830PEB, M831PEB, M832PEB, M833PEB, M834PEB, M835PEB, M836PEB, M837PEB, M838PEB, M839PEB, M840PEB, M841PEB, M842PEB, M843PEB, M844PEB, M845PEB, M846PEB, M847PEB, M848PEB, M849PEB, M850PEB, M851PEB, M852PEB, M853PEB, M854PEB, M855PEB, M856PEB, M857PEB, M858PEB, M859PEB, M860PEB, M861PEB, M862PEB, M863PEB, M864PEB, M865PEB, M866PEB, M867PEB, M868PEB, M869PEB, M870PEB, M871PEB, M872PEB, M873PEB, M874PEB, M875PEB, M876PEB, M877PEB, M878PEB, M879PEB, M880PEB, M881PEB, M882PEB, M883PEB, M884PEB, M885PEB, M886PEB, M887PEB, M888PEB, M889PEB, M890PEB, M891PEB, M892PEB, M893PEB, M894PEB, M895PEB, M896PEB, M897PEB, M898PEB, M899PEB, M900PEB, M901PEB, M902PEB, M903PEB, M904PEB, M905PEB, M906PEB, M907PEB, M908PEB, M909PEB, M910PEB, M911PEB, M912PEB, M913PEB, M914PEB, M915PEB, M916PEB, M917PEB, M918PEB, M919PEB, M920PEB, M921PEB, M922PEB, M923PEB, M924PEB, M925PEB, M926PEB, M927PEB, M928PEB, M929PEB, M930PEB, M931PEB, M932PEB, M933PEB, M934PEB, M935PEB, M936PEB, M937PEB, M938PEB, M939PEB, M940PEB, M941PEB, M942PEB, M943PEB, M944PEB, M945PEB, M946PEB, M947PEB, M948PEB, M949PEB, M950PEB, M951PEB, M952PEB, M953PEB, M954PEB, M955PEB, M956PEB, M957PEB, M958PEB, M959PEB, M960PEB, M961PEB, M962PEB, M963PEB, M964PEB, M965PEB, M966PEB, M967PEB, M968PEB, M969PEB, M970PEB, M971PEB, M972PEB, M973PEB, M974PEB, M975PEB, M976PEB, M977PEB, M978PEB, M979PEB, M980PEB, M981PEB, M982PEB, M983PEB, M984PEB, M985PEB, M986PEB, M987PEB, M988PEB, M989PEB, M990PEB, M991PEB, M992PEB, M993PEB, M994PEB, M995PEB, M996PEB, M997PEB, M998PEB, M999PEB, M1000PEB, M1001PEB, M1002PEB, M1003PEB, M1004PEB, M1005PEB, M1006PEB, M1007PEB, M1008PEB, M1009PEB, M1010PEB, M1011PEB, M1012PEB, M1013PEB, M1014PEB, M1015PEB, M1016PEB, M1017PEB, M1018PEB, M1019PEB, M1020PEB, M1021PEB, M1022PEB, M1023PEB, M1024PEB, M1025PEB, M1026PEB, M1027PEB, M1028PEB, M1029PEB, M1030PEB, M1031PEB, M1032PEB, M1033PEB, M1034PEB, M1035PEB, M1036PEB, M1037PEB, M1038PEB, M1039PEB, M1040PEB, M1041PEB, M1042PEB, M1043PEB, M1044PEB, M1045PEB, M1046PEB, M1047PEB, M1048PEB, M1049PEB, M1050PEB, M1051PEB, M1052PEB, M1053PEB, M1054PEB, M1055PEB, M1056PEB, M1057PEB, M1058PEB, M1059PEB, M1060PEB, M1061PEB, M1062PEB, M1063PEB, M1064PEB, M1065PEB, M1066PEB, M1067PEB, M1068PEB, M1069PEB, M1070PEB, M1071PEB, M1072PEB, M1073PEB, M1074PEB, M1075PEB, M1076PEB, M1077PEB, M1078PEB, M1079PEB, M1080PEB, M1081PEB, M1082PEB, M1083PEB, M1084PEB, M1085PEB, M1086PEB, M1087PEB, M1088PEB, M1089PEB, M1090PEB, M1091PEB, M1092PEB, M1093PEB, M1094PEB, M1095PEB, M1096PEB, M1097PEB, M1098PEB, M1099PEB, M1100PEB, M1101PEB, M1102PEB, M1103PEB, M1104PEB, M1105PEB, M1106PEB, M1107PEB, M1108PEB, M1109PEB, M1110PEB, M1111PEB, M1112PEB, M1113PEB, M1114PEB, M1115PEB, M1116PEB, M1117PEB, M1118PEB, M1119PEB, M1120PEB, M1121PEB, M1122PEB, M1123PEB, M1124PEB, M1125PEB, M1126PEB, M1127PEB, M1128PEB, M1129PEB, M1130PEB, M1131PEB, M1132PEB, M1133PEB, M1134PEB, M1135PEB, M1136PEB, M1137PEB, M1138PEB, M1139PEB, M1140PEB, M1141PEB, M1142PEB, M1143PEB, M1144PEB, M1145PEB, M1146PEB, M1147PEB, M1148PEB, M1149PEB, M1150PEB, M1151PEB, M1152PEB, M1153PEB, M1154PEB, M1155PEB, M1156PEB, M1157PEB, M1158PEB, M1159PEB, M1160PEB, M1161PEB, M1162PEB, M1163PEB, M1164PEB, M1165PEB, M1166PEB, M1167PEB, M1168PEB, M1169PEB, M1170PEB, M1171PEB, M1172PEB, M1173PEB, M1174PEB, M1175PEB, M1176PEB, M1177PEB, M1178PEB, M1179PEB, M1180PEB, M1181PEB, M1182PEB, M1183PEB, M1184PEB, M1185PEB, M1186PEB, M1187PEB, M1188PEB, M1189PEB, M1190PEB, M1191PEB, M1192PEB, M1193PEB, M1194PEB, M1195PEB, M1196PEB, M1197PEB, M1198PEB, M1199PEB, M1200PEB, M1201PEB, M1202PEB, M1203PEB, M1204PEB, M1205PEB, M1206PEB, M1207PEB, M1208PEB, M1209PEB, M1210PEB, M1211PEB, M1212PEB, M1213PEB, M1214PEB, M1215PEB, M1216PEB, M1217PEB, M1218PEB, M1219PEB, M1220PEB, M1221PEB, M1222PEB, M1223PEB, M1224PEB, M1225PEB, M1226PEB, M1227PEB, M1228PEB, M1229PEB, M1230PEB, M1231PEB, M1232PEB, M1233PEB, M1234PEB, M1235PEB, M1236PEB, M1237PEB, M1238PEB, M1239PEB, M1240PEB, M1241PEB, M1242PEB, M1243PEB, M1244PEB, M1245PEB, M1246PEB, M1247PEB, M1248PEB, M1249PEB, M1250PEB, M1251PEB, M1252PEB, M1253PEB, M1254PEB, M1255PEB, M1256PEB, M1257PEB, M1258PEB, M1259PEB, M1260PEB, M1261PEB, M1262PEB, M1263PEB, M1264PEB, M1265PEB, M1266PEB, M1267PEB, M1268PEB, M1269PEB, M1270PEB, M1271PEB, M1272PEB, M1273PEB, M1274PEB, M1275PEB, M1276PEB, M1277PEB, M1278PEB, M1279PEB, M1280PEB, M1281PEB, M1282PEB, M1283PEB, M1284PEB, M1285PEB, M1286PEB, M1287PEB, M1288PEB, M1289PEB, M1290PEB, M1291PEB, M1292PEB, M1293PEB, M1294PEB, M1295PEB, M1296PEB, M1297PEB, M1298PEB, M1299PEB, M1300PEB, M1301PEB, M1302PEB, M1303PEB, M1304PEB, M1305PEB, M1306PEB, M1307PEB, M1308PEB, M1309PEB, M1310PEB, M1311PEB, M1312PEB, M1313PEB, M1314PEB, M1315PEB, M1316PEB, M1317PEB, M1318PEB, M1319PEB, M1320PEB, M1321PEB, M1322PEB, M1323PEB, M1324PEB, M1325PEB, M1326PEB, M1327PEB, M1328PEB, M1329PEB, M1330PEB, M1331PEB, M1332PEB, M1333PEB, M1334PEB, M1335PEB, M1336PEB, M1337PEB, M1338PEB, M1339PEB, M1340PEB, M1341PEB, M1342PEB, M1343PEB, M1

# RADIO CORNER

(Proprietor, T. B. WILLIAMS)

138 GRAY'S INN RD., LONDON, W.C.1  
Terminus 7937

**MAIL ORDER.** Delivery by return. **THE BANNER CHARGER.** Type 1/1, 1 amp, ideal for Motorists, a really first-class job. Input 240 v A.C. Output 2, 6 or 12 v D.C., at £3. Designed for the motorist who likes to keep his batteries in tip-top condition.

**RADIO VALVE MANUAL,** giving American and British Valve Equivalents and Data. Price 3/6  
**Radio Constructors Manual.** Price 3/-  
**Radio Tuner Unit Manual.** Price 2/6  
**Engineers and Electricians Handbook.** Price 1/-  
**Cathode Ray Oscilloscope Manual.** Price 2/-  
**Radio Reference Book.** Price 12/6.

**American Radio Valves.** Types as under at controlled prices. 45Z5GT, 5Y3G, 1A5GT, 1C5GT, 1T5GT, 80G, 35Z5, at 11/- each. 6J5GT, 12J5GT, 1H5GT, 125F5GT, at 9/2 each. 6Q7GT, 12Q7GT, 125Q7GT, at 11/7 each. 125K7GT, 6K7GT, 6K6GT, 6V6GT, 42G, 43G, at 12/10 each. 6A8GT, 6K8GT, at 14/- each. Postage paid. Other types as they become available for distribution

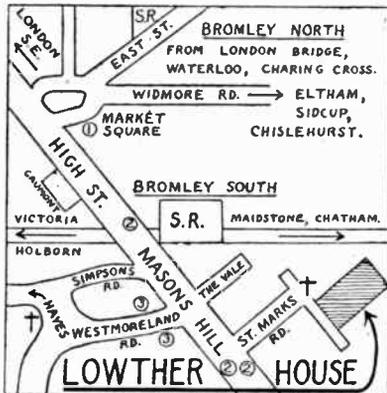
## AMERICAN RADIO SERVICE MANUALS

- Volume I. Spartan Emerson.
- II. Crosley Belmont. Part I.
- III. Crosley Belmont. Part II
- V. Emerson. Part II.
- VI. Stewart Warren FADA.

At 12/6 per Volume, or complete set of six manuals £3 12s. 6d. These Manuals cover the complete range of American Radio Receivers as given and are invaluable and contain all the technical data necessary.

Terms. Cash with Order only. We regret that we are unable to send goods C.O.D.

## How to reach the MECCA OF ELECTRO-ACOUSTIC REPRODUCTION



- Key to buses
- (1) 227
  - (2) 47, 94, 402, 410, 704, 705
  - (3) 119, 128, 138, 148A

Demonstrations daily at

**THE LOWTHER MANUFACTURING CO.**  
Lowther House, St. Mark's Road,  
BROMLEY, KENT.

Rev. 5225

**IRON** dust cored coils of exceptional efficiency and stability. **AERIAL** and oscillator short, medium or long wave, size 1inx 3/16in, 7/8 pair; size 3/4inx 1/4in, 6/9 pair; l.r.f. dual wave, medium and long wave, aerial and h.f. 9/6 pair; coil packs, a complete three-range (16-50m, 200-550m, 800-2,000m), superhet coil assembly, i.f. 465 kc/s, 39/6 each; all coils fitted with adjustable cores and supplied with circuit diagram.

**I.F. transformers** 465 kc/s, this transformer has enclosed dust cores, and is permeability tuned by means of screws which protrude through side of screening can, size 1in dia. x 1 3/4in high, 9/6 each; h.f. chokes, short wave, 3/8 each; miniature rotary switch, 4-pole, 3-way, 3/9 each; terms, cash with order or c.o.d. on orders over £1; postage free; trade enquiries invited.

**MONOCHORD RADIO,** 235, Streatham Rd., London, S.W.16. [7478]

**SUPERIOR Components**—Mains trans., 230v 50cy, 500-0-500, 170ma, 4v 4a C.T., 30/-; 500-0-500, 100ma, 4v 3a, 5v 3a, 6.3v 1a O.T., 35/-; 350-0-350, 200ma, 5v 3a, 30/-; 200-250v 50cy, 6.3v 5a, 6.3v 7a, 6.3v 8a, 27/6; L.F. chokes, 20hy 200ma 140ohms, 25/-, 5hy 200ma 110ohms, 10/-; condens., post. paper, 8m, 1,000v, wkg. at 140° F. £1, 4mf 2,000v 4/6; 2mf 8m wkg. at 140° F. 1/9; electrolytic, 8mf 450v Wob. cans, 3/6; 16mf 700v wkg., 7/6; W.W. pots, 3w 100, 1,000, 5,000, 10,000 25,000ohms, 4/-; valves: 8P61 7/6, EB34 4/-, 8130 8/6, Philips MC150, £3, DC1150 £3; door safety switches, for Tx. amps, etc., 4/6 complete; steel boxes, 2 1/2inx 8inx 10in deep, 16G with separate lid cover, 2 1/2in deep, black enamel, vent holes, suitable amplifiers, etc., £1/1. Also wide range of smaller gear. Please send your enquiries for scarce lines. Terms cash, with cash refund guarantee, post free on delivery.

**TELEVISION DEVELOPMENT Co., 4, The Parade Kilburn High Rd., N.W.6** (adjoining Kilburn Empire) est. 20 yrs. Tel. Mai. 3991.  
**ELECTRAD** offer: Paper condensers, 4mfd 1,500v test, 4/6; 2mfd 1,500v working, 5/-; metal con. 1mfd 250v wkg., .5 350v wkg., .1 350v wkg. 4d each; silver mica 5 to 5,000 pf, 5 1/2d each; ceramic conds., most values, 6d each; resistors, 1 watt 6d, 1/2 watt 3d, 1/4 watt 1 1/2d each, most values available; 40 ohm w.w. 5 watt, with adjustable clip, 1/-; 110 ohm w.w. wire ends, 9d; red panel lights, 1/4; valve holders, Amphenol octal 9d, ceramic octal 1/3, Loctal EF.50 1/3, UX 4-pin pax 3d, 60v s.b.c. neons 1/-; pie wound h.f. chokes TX 4/-, RX 2/-; valves, all types, at list prices, a few 2108, 6/- each; Westectors, metal rectifiers, main transformers up to 1,500v bakelite sheet and strip; 0-40 moving coil voltmeters, at 7/6 each; 0-1ma meters, at 30/- each; steel and alum. panels and chassis, tagged, group boards, metal cabinets, many more items in stock; send us your enquiries, terms, cash with order (please include postage); c.o.d. over £1, postage paid; special prices for large quantities.—Electrad, Old Rudge Works, Crow Lane, Coventry. [7347]

**SUPREME RADIO,** 746b, Romford Rd., Manor Park, London, E.12. Est. 15 years, still the lead with component parts: 2-gang condensers 9/6, 3-gang 13/-; line cord, 60-70Ω fet., 20/ doz. yds.; droppers, .2 or .3, with fixing feet, 3/9; volume controls, best makers, long spindle with switch 4/-; less switch, 3/-; 10,000Ω wire-wound, less switch, 5/-; bias condensers, 50-12 1/9, 25-25 1/9, 50-50 3/3; tubular condensers, 0.01, 1,000 V.W., 4/6 doz.; 0.05,500 V.W., 4/6 doz.; 0.1 350 V.W., 4/6 doz.; 0.2 250 V.W., 4/6 doz.; 0.25 mfd, can. condensers, with clip wire ends, 500 V.W., 9/- doz.; 8 mfd, can. condensers, 500 V.W., 36/- doz.; resistances, well-known maker, 1/2w, 1,000Ω, 10,000Ω, 20,000Ω, 22,000Ω, 27,000Ω, 51,000Ω, 100,000Ω, 220,000Ω, 279,000Ω, 560,000, 1 meg, 1 1/4 meg, 2 meg, all at 3/- doz.; 1w, 27,000Ω, 75,000Ω, 4/- doz; assorted wire-wound 1 and 2w, handy sizes, 2/6 doz.; string drum drives, 3/-; sleeving, 3/- doz. yds. U.S.A. octal and standard valve holders, 4/6 doz.; screen caps, lead attached, standard size, 9/- doz.; Ivorine dials, 3 1/2inx 4in all-wave, 1/6, 6x6 2/6; glass dials, all-wave, 8inx 5in 3/6; midget chokes, 60 ma 6/-, 100 ma 10/-; midget speaker trans, 4/6; coils M and L, 8/6; med only, 5/-; speaker trans, pen, 5/9; 30w PP, 6,600Ω-15Ω, 20/-; solder, 1lb 4/-; P.B. wire, stranded 4/6 100ft; 1/4in black tape, 1/4lb, 2/-; Weymouth coil packs, IFS, 465 kc, etc.; P.P. output transformers, 30w 25, 45 and 55-1, £1 each; ex-Government earphones with headbands, 4/- pair; carbon microphones, 2/- each; moving coil earphone inserts, 30Ω, 2/6; switch wafers, 2 pole 3 way, porcelain, 4/6 doz.

"CLEARANCE" lines; cannot be repeated when all sold.  
TERMS, c.w.o.; no c.o.d.; send 6d extra for postage and packing all orders under £5; 2 1/2d stamp all enquiries and price list. [7291]

# R.R.

## DEVELOPMENT LABORATORIES LTD CONSULTING ENGINEERS

TRANSFORMERS, CHOKES & COILS to your own Specification. Delivery 14 Days.

PRECISION BUILT ALL-WAVE SIGNAL GENERATOR (Type 5) 100 Kc/s-30 Mc/s coverage.

HIGH QUALITY AMPLIFIERS 14-30 watt fully compensated Bass and Treble tone control.

DECKS & CASES to your requirements.

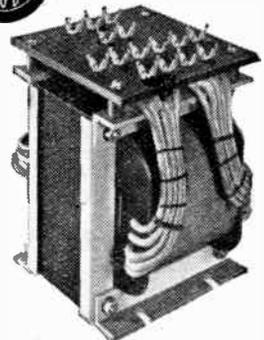
Enquiries Invited.

Telephone: Bfd. 4902.

BARNARD RD • BRADFORD



## TRANSFORMERS



(Patent Applied for)

The AA2 Series of Bryce Transformers have been designed to cover a very wide range of application consistent with high percentage efficiency performance under difficult conditions. All windings are layer wound and interleaved, and coils are finally pre-heated and thoroughly dried out before being vacuum waxed or varnish impregnated.

Send for leaflet giving full specification.

**W. ANDREW BRYCE & CO. LTD.**  
Shenley Road, Boreham Wood, Herts  
Telephone: ELStree 1875 & 1117.

**A** PERFECT joy to build!—The 5-valve ac or ac/dc 3-wave Superhet Assembly (all main components ready mounted on chassis) forms the foundation of a powerful receiver at a price you'll like; send postage now for full details.—N. R. S. 66 Parkhill Rd., N.W. 3

**S**ANGAMO synchronous motors, self-running exceptionally good torque, rotor speed 200 rpm. 200-250 v.a.c., 50c, consumption 21/2 watts, size 2 1/2" x 2 1/2", geared 1 rev. 60 min., can be reset to zero by friction drive from front or back, shaft 3/16" x 1/10 to run clockwise ideal movements for making electric clocks, time switches, etc., nickel plated finish; price 22/6 each; 12 to 1 dial trains to fit above spindle, per set 2/6; as above, with Chamberlain & Hookham synchronous motors (enclosed type 25/-; moving-coil headphones, P.M. energised by Alni magnets, 45 ohms, 1/2 in. coil ideal for mikes, miniature loudspeakers, etc.) 1 1/2 in. overall in bakelite cases with 3 in. front flange, 6/6 each.

15-AMP. mercury switches, enclosed bakelite tubular cases, 2 1/2" x 3/4", fitted swivel saddle, connector block, etc.; 5/6 each; cash with order, post paid on all above goods; to callers only, a comprehensive stock of scientific instruments, meters, gears, relays, etc. TO CALLERS.—Large quantities of surplus Naval, Army and Air Force radar, transmitting and receiving apparatus, rotary converters, rectifiers, power units, cathode ray units, relays, meters, motors, etc.; a visit to our premises will not be in vain.

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

**A**LUMINIUM panels, 18in x 12in 4/6, 18in x 8in 3/-, 18 gauge; foil, 18in x 8in, 1/3; alm. chassis, undrilled, 14in x 8in x 2in deep (4-sided), 7/-; speaker gauze, 6in square, 5. 12in 2/9, 18in 4/3; metal grille, light bronze or cream, 9in square, 3/11; Perspex, 18in x 13 1/2 in x 3/4 in 2 1/2; half size, 10/6; Westinghouse instrument rectifiers, 1 or 5ma, 10/6 ea; Weymouth all-wave sheet coil pack 36/6, or coils only 11/6 pair; stand-off insulators, 2in, 1/6 pair; 1/2 meg v controls, less switch, 2/9; exceptional quality International oct. v. holders, 9d ea; 6v car radio screened vibrator packs, giving smoothed dc output of 200v at 30ma, or 150v at 50ma, 42/-; suppressors, plug or distributor, 1/9 ea; HiVac midjet valves, 1.5v, XII, XI, XD, 11/-, XSG, XY, 16/-; magnet type pickups 31/7, crystal 53/6; Solon elec. soldering irons, 21/9; moving coil speaker units, 2 1/2 in, 3/5in, 5in, 6in, 8in, 10in, 12in, prices from 25/6; Wharfedale Golden speaker, 10in, £3 16; filament transformers, input 200/230/250v, output 6.3v, tapped 4v at 3amp, 19/3; varnished cotton styroflex, 2mm 4-wire lengths, 1/-; all above-mentioned goods sent carriage paid; official Edlystone stockists, official Wearite ceramic switch stockists, Varley mains transformers, chokes, etc.; Avo Minor dc meter, 4gms; ditto ac/dc, £8/10; model 7, £19 10 model 40, £17/10; Bridge, £11, plus usual postage; special offer to callers only of a limited supply of excellent conditional 4-valve sheet all-dry portable complete, from 6gms each.—Barnwick, Dept. P., Gt. Brickkiln St., and Snow Hill, Wolverhampton, Tel. 24607.

**R**OTARY transformers, brand new, ex-Govt. stock, with 6v input, output 200v at 50ma continuous, or 150v at 80ma up to three hours, with 12v input, output 480v at 40ma continuous or 400v at 80ma up to three hours, size length 7 1/2 in, height 3 1/2 in, weight 6 1/2 lb, ideal for car radios, mobile amplifiers, etc., original price £7/7, each 25/-; m.l. wave, with reaction, circuit, 7/6; m.l. wave, iron cored, adjustable cores, circuit, 10/6; s.m.l. aer. and osc. coils, circuit, 10/6; Weymouth midjet i.f.s. iron core, 465 kc/s, per pr. 18/9; standard i.f.s. 465 kc/s, per pr. 15/-; standard ditto, 2 mc/s, each 3/6; Weymouth all-wave coil pack, 36/6; 2-gang condensers, 0.0005mfd, 12/6; ditto 0.0001mfd, 7/6; ditto 0.0017mfd, split stator, 6/-; Tiny Tim ditto, fitted trimmers and perspex dust cover, 2 1/2 in x 1 1/2 in x 1 1/2 in, 17/6; speakers, minus trans., p.m., 5in, 2 1/2 in; ditto p.m., 6in, 27/6; coloured ivorine dials, s.m.l. wave, 4 x 3 1/2 in, 2/-; 5 x 5 1/2 in, 2/6; 6 x 5 in m.l. wave, 1/6; slow motion drum drive, 3/-; epicycle drives, 5/3; Rothelmer Senior piezo crystal pick-ups, 56/3; Avo capacity bridge, £11; 6L6 output, p.p. trans, heavy duty, 6.600 ohms, 15 ohms, 21/-; Ferranti ditto, p.p. output, 2/1, 15/-; Varley heavy duty, p.p. input, 2.5-1, 20/-; Varley, class B. (t) P trans, tapped output, 1.5-1 and 2-1, 15/-; screened rubber covered twin 8mfd, 500v, 7/6; midjet cabinets, cream and green, 13in x 7in x 6in, 40/-; comprehensive lists monthly; 2/- stamp with enquiries; postage extra all orders.

O. GREENLICK, Ltd., 34, Bancroft Rd., Cambridge Heath Rd., London, E.1. Tel. Stepney Green 1334 [7375]



**"Q-MAX" SHORT-WAVE ALL-DRY 4**  
receiver covering wavebands from 11 to 250 metres and using Plug-in coils. A four-valve circuit is used comprising an I NS RF amplifier, I CS detector, I H5 LF amplifier and I CS output stage for loudspeaker or headphones. Power supply is 90 volts high tension and 1.5 volts low tension. Slow motion dial operates precisely adjusted two-gang condensers, the whole is housed in a black crackle finished metal cabinet with side handles and rubber feet. Lid on top makes coil changing quite easy. £12. 12. 0. Purchase Tax £2. 17. 5. Speaker, Battery and Coils, extra.

**SLOW MOTION DIALS**  
"Q-MAX" Full Vision Slow Motion Dials for individual calibration. Complete with dial, engraved 5 blank scales and I calibrated 0-180" glass and escutcheon. SMDA. 9-I Slow Motion Drive with large fluted knob (dial 6 1/2" x 3 1/2") 15/6. (Dial only 3/-).



**"Q-MAX" CHASSIS CUTTERS.**  
Holes cut easily and cleanly without distortion of the metal. 1 1/2" (Octal) ... .. 10/6 1 1/2" and 1 1/4" ... .. 12/6 Postage 9d. extra. (Patent Applied for).

**"Q-MAX" TANK COIL UNITS**  
for maximum efficiency on all "HAM" bands. Mk I—fitted with 34 pf + 34 pf Split-stator condenser suitable for powers up to 50 watts and 500 volts high tension. £2. 15. 0 (Excl. coils and neutralising condensers) Mk II—for powers up to 150 watts and 2,000 volts high tension, consisting of 60 pf + 60 pf Split-stator condenser built in 350 mA RF Choke and 5 KV By-pass Condenser, Tank Coil and swinging link mounting. Can be fitted with one or two neutralising condensers for single end or push-pull operation. £4. 14. 6 If you have had our catalogue, send Stamped Addressed Envelope for latest additions. If not, send 6d. stamp for both.

**ABSORPTION WAVE-METER AND PHONE MONITOR**  
for checking frequency harmonics and parasitics in Oscillators, Doublers, etc. All amateur bands covered. With Inductance Price 35/- (Extra inductances, 3/9 each)

Obtainable from your local "Q-Max" Dealer or direct from:

**BERRY'S**  
(SHORT WAVE LTD.)  
25, HIGH HOLBORN, LONDON, W.C.1  
(Opposite Chancery Lane) Tel: HOL 6231

Illustrated Catalogue "W.W." Price 6d. Post Free.

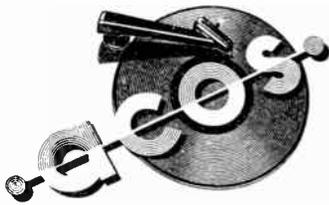
**G**A. RYALL, 65, Nightingale Lane, London, S.W.12. Mail order only, no c.o.d. under £1 please; postages extra on all orders; please write plainly; all new goods, unused. U.S.A. make, 0.1mf 500v tubular screened condensers, 5/6 dozen; resistances, assorted, 1/4w, 1/2w, 1w, best makes, sizes from 100ohms to 2megohms, including 15 1/2 watt sizes, level selection given, 40 for 5/-; also 2watt, 150,000, 220,000, 470,000, 820,000, 43,000, a 3/- per dozen; 33,000ohm 3watt, 3/- dozen; 1,800 wire wound, 1/- dozen; panels with screened 0.1mf and 12 resistances, 2/3 each. Yaxley type switches, single bank 9-way 2/3, and 2b 3p 3w 2/3; 3-bank 2p 4w, with middle screen, special type, 3/9, post 8d; Octal plugs with metal caps and chassis-type paxolin sockets 3/2 6; with solder tags, 3 3/-; U.S.A. 4-5-6 pin chassis-type paxolin valve holders, British made, 3/- dozen to clear. Variable condensers, 1/4in spindle, capacity .0004 on all four sections, note, a 100mm trimmer will bring these condensers to standard capacity, price 8 9 each; three-gang condensers with ceramic insulation, .0004, complete in screening box with air-spaced 100mm trimmers, 10/- each; twin-gang condensers, air-spaced, of the panel mounting type, ceramic end plates, sweated vanes, which are offset for minimum capacity, an ideal short-wave tuning condenser, 4-hole fixing, capacity .0003, silvered vanes, 7/6 each. Single-type trimmer, variable with 4in spindle, Govt. quality, paxolin end plates, capacity .00006; single-hole fixing, wide vane spacing, 2/6 each. Metal boxes finished in flat black, ideal for instrument boxes, etc., complete with paxolin 1/4in panel, size 8 1/2 x 7 1/2 x 3 1/2 deep approx., four fixing lugs, four corner sockets for panel-fixing, 6/9 each complete. R.F. amplifiers, type 25, ex-R.A.F., new in cartons, contain 5w 5p 3b ceramic switch with good knob, 15RF type trimmers in three divisions, three SP41 metalized valves in amphenol valve holders, ceramic coils easily removable for rewinding, fixed tuning of 30/40mc, complete in metal case with res. and cond.; 50/- each. New high resistance phones with sponge earpads, magnetic type, with microphone of good quality, 10/9 set; complete with 4w plug type 1011/10991. Power microphones of multi-insert type, new, 20/-; ditto, secondhand, with high resistances phones, not guaranteed, 8/9. High speed relays with platinum contacts, 1,000ohms, on/off, 5/-; ditto on/off, 300ohms, about 20ma ceramic insulation, 3/6. Volume controls, 10,000ohm, medium spindle, 1/6; short spindle, 1/2 meg and 1 meg, 1/6; 300ohm, preset wire wound, 1/6. Control boxes, small type, with fixing bracket containing toggle switch, wires as SP DT HF choke section wound 25 ohms and 0.0005 mica condenser, 800ohm resistance, size 3 x 2 x 1 1/2 in approx.; 1/9 each. Control box, metal with Yaxley type 2b 4w 2p switch, with 2 1/4 in well-finished pointer knob, on/off toggle, and DP DT toggle, case size 6 x 6 x 3 approx.; 5/-.

**G**E.E.P.C.T.R.I.C. 15, Little Newport St., London, W.C.2. Tel. Ger. 6794.—Offer radial components of all descriptions, from our large and comprehensive stocks, including condensers, resistors, transformers, valves, test gear and everything for the service man; also a very large and varied stock of ex-Govt. radar and communication surplus at very keen and competitive prices.

**T**HIS month's specials.—3 1/2 in C.R. tube, E.C.R.35, complete with holder, Mu metal screen, lime base parts and valves, all enclosed in original case, ex-Govt. In guaranteed condition; £4/10; packing crate and carriage 5/- extra; trade enquiries invited. (7536)

**P**OST RADIO SUPPLIES offer copper instrument wire: Enamelled 17 s.w.g.42 s.w.g., tinned and fuse 17 s.w.g.42 s.w.g., cotton covered 18 s.w.g.45 s.w.g., silk covered 16 s.w.g.46 s.w.g. Above include most odd goods. Screws, nuts, washers, soldering tins, eyelets, rivets, etc.; ebonite and laminated bakelite panels; covered wires, flexes, etc.; crystals, permanent detectors, etc.; earphones, etc., etc. List available. Trade supplied.—Post Radio Supplies, 33, Bourne Gardens, E.4. **H**ARRY JAMES PRODUCTIONS, 270, Leith Walk, Edinburgh, 6.—Mail order only. C.o.d. or cash with order. Loudspeakers, 5in, 19/9; coils, T.R.F. with circuit M. and L., 8/6; condensers 2 gang 0.0005, 12/-; T.R.F. chassis, 4/-; resistances, 1/4 watt 3d, 1/2 watt 4d, 1 watt 6d, all standard values; volume controls, 1/4 and 1/2 meg, 4/9; dropper resistances, 0.2 and 0.3amp, with feet, 4/6; multi-ratio speaker transformers, 6/6; valve holders, 5. 7 pin and Octal, 6d; Amphenol type, 9d; electrolytics, 8mfds B.I. 3/-, 8 x 5/6, 16mfds 4/9, 0.1, 0.01, 0.05 8d; valves, c.o.d., most English and American types in stock. Give us your enquiries for anything in radio. Small delivery of 12A7 expected May. [7372]

# CRYSTAL PICK-UP



WITH *Unbreakable* CRYSTAL

The ACOS G.P.10 combines purity of reproduction with extreme reliability. A unique flexible assembly renders the crystal virtually unbreakable, while a needle-pressure adjustment is incorporated in the base. Resonance-free response from 50-8,000 cps. Output 1.5v. at 1,000 cps. Needle pressure 1½ ozs. (adjustable). Vibration-free arm movement. Screened lead. Price in Great Britain 44/- (in-pend. abroad). Licensed by British Crystal Co. Ltd.



Flexible coupling A protects crystal B against breakage. (Brit. Pat. 579,524. Pats. pend. abroad). Licensed by British Crystal Co. Ltd.

Obtainable only from Radio Dealers  
**COSMOCORD LTD**  
ENFIELD: MIDDLESEX

*"We Were Greatly Impressed"*

This phrase was used by a leading Electrical instrument concern in connection with

## TRANSFORMERS and CHOKES

supplied by us, and is praise to which we have become accustomed. Our modern factory is fully equipped with vacuum and pressure impregnators, and all the latest test equipment.

- POWER RATINGS 8 V.A. to 8 K.V.A.
- AUDIO RATINGS 3 watts to 200 watts.
- OUTPUT TRANSFORMERS TO Mr. D. T. N. Williamson's Specification. £3. 10. 0.

PROMPT DELIVERIES

**AUSTIN MILLS LTD.**  
LOWER CARRS,  
STOCKPORT

Established 20 years Phone : STO 3791

**I**F transformer replacement bobbins (uses original can and trimmers), 6/- each; r.f. chokes, superhet type, 2/-; sectionalised all wave, 3/-; type X coils, 1½in x ¾in dia., all ranges, 3/-; 3-band coil assemblies, 6/9 each.—Electronic Services, Arwenack St., Falmouth [7216]

**C**OVET. surplus components.—20,000 and 50,000 pots, 1/6; 1½w resistances, 1/3 doz.; Int. and Mazda oetal holders, 2/- doz.; valves, 514 5/-, 615 3/6; many other types; service kit, including 8mf elec., 2 doz.; resistors, 1 doz. coils, resin solder, 10/-; screened flex, B.A. nuts, bolts, etc., 10/-; Hoyle, 320, Dewsbury Rd., Wakefield, [7327]

**C**HARLES BRITAIN RADIO, Ltd.—It will pay you to read this. Selenium metal rectifiers, miniature type H18 Sen-Ter-Cel, replaces any half-wave rectifier, 5/- ea. larger type H25 7/6 ea; smoothing chokes, heavy duty, 360 ohm, 7/6 ea; modulation chokes, first class, impregnated, 8/6 ea; transceivers, brand new walkie-talkie with valves, phones and mike, etc., only £4 5. carriage paid; transceivers, ex-Army No. 22 sets in good condition, 2-Becs, £11/10, carriage paid; U.H.F. receivers, R1147B, contain the following new valves and are mainly new, 2 EF36, 1 EBC33, 2 EF50, 1 EC52, 1 EF54, in strong packing case, 39/6 carriage paid; indicator units, in metal case, 6in E.S. tube, time base and amplifiers with 7 valves, make your own scope, £6 ea (callers only this item); these represent only a small part of our constantly growing stocks and we have all our previously advertised and standard radio lines in stock; 2/- stamp for list.

**C**HARLES BRITAIN (RADIO), Ltd., Radio House, 2, Wilson St., E.C.2. Tel. Bis 2966.

**R**ADIO CLEARANCE, Ltd., 27, Tottenham Ct. Rd., W.1. Mus. 9188. Sets: Special offer U.H.F. receivers, ex-R.A.F., type 1481, range 66-86 mc/s, 10 6.3v valves, sequence R.F. (VR65), mixer (VR65), osc. (VR66), 3 i.f.s (VR53), b.l.o. (VR53), det. and a.v.c. (VR54 double diode), a.f. (VR57), output (VR67), beautiful 0-180 degree 6in x m. dial, tuning meter, r.f. and i.f. gain controls, a.v.c./main/b.l.o. switch, i.f.s 12 mc/s, jack sockets for main and line outputs, size 19in x 10½in x 10½in (fits standard 19in rack), ideal for conversion to 5 metres, etc., requires power pack 250 and 6.3v, all brand new, supplied complete with all valves, in original wooden cases with hinged lids (1ft 10in x 1ft 4in x 1ft 1in); price £12/12, with circuit diagram. Mains transformers, primary 230v 50c, secondary 300-0-300v, 200ma, 5v 3a, 6.3v 2.5a, 6.3v 3a, 25/-; primary 230v 50c, secondary 300-0-300v, 200ma, 5v 3a, 6.3v 4.5a, 22/6; primary 230v 50c, secondary 2,000v 2ma, 2v 2a, 4v 2a, 21/-; primary 80v, 1,000c, suitable for re-winding, 3/6. I.F. chokes, 2.5h 200ma, 7/6; 5h 200ma, 10/-; 20h 200ma, 12/6; 20i 400ma, 18/6. H.F. chokes, short and medium wave, 1/6; U.H.F., 1½ coils, super het, M.W. ac, M.W. osc., L.W. ac, L.W. osc., former size 1½in x 1½in, 2/6 each; iron-cored 465kc trap, 2/9; set of 4 coils and trap, 11/6. I.F. transformers, 465kc/s, iron core, 14/- pair; 480kc/s, iron core, 9/- pair. Speakers, p.m., all well-known makes, 2/-in, 21/-; 5in, 22/6; 8in, 22/6; 8in with transformer, 25/-; 10in with trans., 39/6. Volume controls, with switch, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1 meg, 5/- each; less switch, carbon 20k, 30k, 50k, 100k, 500k, 1 meg, 2/6 each; double 1 meg, 3/6 each; mini. carbon, less switch, 1k, 20k, 100k, 200k, 500k, 1/6 each; less switch, wire wound, 200Ω, 500Ω, 1k, 2k, 5k, 10k, 20k, 50k, 2/6 each; mini., wire wound, 30Ω, 2/- each; 500Ω w.w., 15w, 4/6; double 500Ω, w.w., 4/-; 5,000Ω and 50,000Ω, ganged, 4/- each. Valveholders, 4-pin Brit. 1d Amphnol, 4p U.X., 5p U.X., 5p Brit., Madza oet., 6d each; Int. oct., pax, 6d each; Amphnol, 8d each; ceramic, 1/6 each; porcelain 7p Brit., 8d each; R.F.50, pax, 6d; micales, 1/-; ceramic, 1/6 each. Electrolytic condensers, 8mf 450v can, 3/3 each; 50mfd 12v can, 1/9 each; 100mfd 12v, 1/- each. Mansbridge condensers, 0.25mfd 400v working, 5d each; 0.25mfd 600v working, 7d each; 0.25mfd 2,000v working, 1/9 each; 0.25mfd 2,500v working, 2/- each; 0.5mfd 1,000v working, 9d each; 0.5mfd 1,200v working, 1/- each; 1mfd 350v working, 8d each; 1mfd 1,000v working, 1/3 each; 1mfd 2,500v working, 2/- each; 4mfd 600v working, 4/6 each; 4mfd 1,500v working, 5/- each. Mica condensers, 0.0001-3.5, 4d each; 0.01-2.45, 5d each; 0.1, 6d each. Silver mica condensers, 6pf-6,000pf, 6d each. Ceramic condensers, 2, 10, 20, 25, 50, 100pf, 6d each. Visual indicators, ex-R.A.F., in bakelite case, inc. 2 complete Weston moving coil meter movements, 300 microamps, f.s.d., 6/11 each. All orders under 10/- to include postage; c.o.d. orders over 10/-.

**MISCELLANEOUS**

**E**LECTRIC shilling slottmeters: from 47/6; s.a.e. parties.—1, Barnfield Rd., Paignton.



Come to the point!

It's hot—all the time! That's because the heating element is housed inside the bit in the Solon Electric Soldering Iron. Soldering is easier; you get a neater, cleaner job in less time. All internal connections are housed at end of handle away from heat. A robust core grip prevents sharp bending of the flexible lead. Complete with 6ft. of Henley 3-core flexible. Solon irons are made for the following standard voltages:—200 220 230 250.



Illustration shows a 125-watt standard model.

W.T. HENLEY'S TELEGRAPH WORKS CO. LTD.  
Engineering Dept., 51-53, Hatton Garden, London, E.C.1.

★  
**'Radiospares'**  
**Quality Parts**  
The Service Engineer's First Choice  
★

## ALUMINIUM CHASSIS



An engineering job, not just a folded sheet of metal. Fitted with steel straps, for extra rigidity, and tapped 2 B.A. for cabinet fixing. Open ends give greater accessibility for assembly and wiring. Light, strong, easy to work. Being free from rust or paint, as with cheap sheet-iron chassis, you get perfect bonding and earthing.

**PLEASE NOTE REVISED PRICES**

Undrilled, 5 1/2in. x 9 1/2in. x 2 1/2in. deep	5/6
Undrilled, 7in. x 7 1/2in. x 2 1/2in. deep	5/9
Undrilled, 1 1/2in. x 7 1/2in. x 2 1/2in. deep	6/8
Undrilled, 1 1/2in. x 9 1/2in. x 2 1/2in. deep	7/6
Undrilled, 1 1/2in. x 10 1/2in. x 2 1/2in. deep	8/9
Undrilled, 1 1/2in. x 10 1/2in. x 2 1/2in. deep in heavy (10) gauge	9/6
Punched, 10in. x 9 1/2in. x 2 1/2in. deep for Midgee Radio, with aperture for 6 1/2in. Speaker and seven 1 1/2in. holes	8/6

Packing and Postage 1/- each Chassis extra. C.W.O. Orders despatched on day of receipt, no waiting.

**WIRELESS SUPPLIES UNLIMITED**  
284-286, Old Christchurch Rd., Bournemouth, Hants.

**L**AMINATION strip, 6in x 7/8in x 0.005in, 1 1/2 tons.—John Downton & Co., 89, High St., Epping. Tel. 2163. [7521]

**T**IME Recorders.—Write for particulars.—Gledhill Brook Time Recorders, Ltd., 83 Empire Works, Huddersfield. [7249]

**4**BA and 6BA brass lock nuts; 1/10 gross, minimum 20-gross lots.—John Downton & Co., 89, High St., Epping. Tel. 2163. [7425]

**110** SUCCESSIVE *Wireless Worlds* ending issue Sept., 1940, completely card indexed.—Offers to 25, Dollis Park, N.3. [7399]

**S**PARKS' data sheets offer the widest range of tested and guaranteed designs, in full-size data sheet form, obtainable in this country.

**T**INY Two, just released, a 2-valve all-dry self-contained portable, med. waves.

**D**ESIGNED for individual listening to local stations on speaker, size 5 1/4 x 5 1/2 x 5 1/4 in. 18-volt HT; 2/6.

**T**HREE-VALVE all-dry portable, m/1 waves, 9 x 6 x 4 in., a most popular set; 2/6. Send a stamp for full list (W).

**S**PARKS' Data Sheets (W), 9, Phoebeth Rd., Brockley, S.E.4. Tel. Lee Green 0220. [6509]

**C**OMPLITE wireless station, ideal Field Day outfit, price and details on request.—J. Bull (Ruiship), Ltd., 42-46, Windmill Hill, Ruiship, Middlesex. [7203]

**M**ODERN table radiogram cabinet, metal drilled, £10; suit Weymouth or any TRF chassis up to 12x8, dial 4x3.—Burman, 64, Reighton Rd., Clapton, E.5. [7472]

**S**TANDARD telephone and Davenset accumulator chargers, heavy duty, in perfect running order; £15 each.—Norvall, 154, Colney Hatch Lane, N.10. Tudor 4389. [7496]

**S. G. PARNELL**, formerly of Leicester College of Technology, would be glad to hear from any former member of R.A.F. or Army groups.—Write **BM/VOLTS**, W.C.1. [7489]

**W.W.**, May, '43-Dec., '46, 50/-; Ghirardi's "Modern Radio Servicing," 27/-; "Radio Physics Course," 17/-.—Paul, Trevilla, St. Mary's Rd., South Norwood, S.E.25. [7555]

**C**OIL winders, self-contained, brand feed machines, for hand or power drive, with automatic wire tensioning; early delivery.—Symax, Ltd., 39, St. George's Rd., Reading. [7440]

**M**INIATURE relay, 4,000ohm, D.P.D.C., 3/6; oz; make your own from our complete and fully illustrated instructions; 4/6 post free; we can also supply materials.—J. M. Noble, 210, Tottenham Rd., Dunstable, Beds. [7519]

**L**ATHE.—Why wait months for delivery? Build your own from easily obtainable parts and material; well tested sets of diagrams and full instructions; price 5/-, posted promptly.—W. W. Barham, Bridge Av., St. Sampsons, Guernsey. [7440]

**T**O clear! 100ft reels stranded bronze aerial wire, with clips; usual price 4/6, our price 2/3, post 8d.—Marble Arch Motor Supplies, Ltd., Head Office and Showrooms, 286, 302, Camberwell Rd., S.E.5 (Rod, 2181), and at all branches. [7485]

**B**OUND copies of *Wireless World*, January to December, (2 volumes) 1927; January to June, 1929; January to June, 1931; January to June, 1932; January to December, 1933 (2 volumes); July to December, 1934; £2/10 per volume.—Box 8346. [7467]

**A**MERICAN magazines are now available by annual subscription; post free for one year, P.M. and Television, 30/-; Radio Craft, 16/6; Q.S.T., 21/6; C.Q. (Radio Amateurs Mag.), 18/6; Radio Maintenance, 18/-.—For list of other magazines obtainable, send s.a.e. to Dept. W.W., Willen, Ltd., 120, St. George's Rd., London, E.10. [7452]

**S**OLDERING difficulties solved.—Have you been put off making a set because of soldering difficulties either through lack of electricity or low voltage? Here is the answer—use the "Dorset" Hot Spot soldering outfit in conjunction with any car battery (hired if necessary from garage); as used during recent cuts for construction of our coil packs, etc.; makes cleaner and neater joints and avoids damage to components; complete with instructions for use, 5/6.—Weldona Radio Accessories, Ltd., 49, North St., Portslade, Brighton. [7141]

**WANTED, EXCHANGE, ETC.**

**W**ANTED, coil-winding machines, for winding fine wire.—Box 8515. [7504]

**W**ANTED, "W.W." Jan. and Feb., 1947.—L'Ancrese: Hayne Rd., Beckenham. [7475]

**W**ANTED, "W.W." July, 1946.—Darling, 76, Link Lane, Wallington, Surrey. [7475]

**W**ANTED, service sheets, all makes, from 1936.—Condition and price to Box 8437.

**W**ANTED, TR9 or similar (amateur w.l.) ready for op.—BM/EKVV, London.

**R**K. senior spkr., any field, straight corrugated cone, pref. internal spider.—Box 8344.

**W**ANTED, B.T.H. carbon microphone.—Price and condition to Box 8153. [7436]

**W**ANTED, Rogers Majestic 10-120 or eleven 11-x. H.M.V. auto-radiogram.—Box 8144.

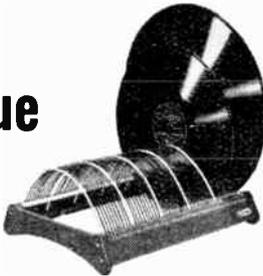
1890

# Have You Seen



Holding up to 50 records, 10" and 12", yet requiring no more space than a medium-sized table lamp, the new lightweight portable IM RAK is the latest and neatest solution to your storage problem.

# This Unique



Every record easy to get at. Every division individually numbered. Records held firmly in position by resilient, plastic-covered, sprung-steel divisions and cushioned at points of contact.

# Record Library?



Finished in a wide choice of gay colours. And you can add on new racks just like a unit bookcase. Now available at most record shops, price 29/6d. plus 6/5d. tax. Optional dustproof plastic cover 7/9d. plus 1/8 1/2 d. tax.

The new



MADE BY THE MAKERS OF THE FAMOUS IM NEEDLES

For details of your nearest supplier write to ALFRED IMHOF LTD., Dept. W.2., 112, New Oxford Street, London, W.C.1. Museum 5944.

**W**ANTED, plastic cabinet for Emerson l.w. midget, any colour, for cash.—Box 8554. [7540]

**T**RANSFORMERS, type 10K/7916, used in R.A.F. intercom., wanted in any quantity.—40, Bonsall Rd., Birmingham, 23 [7414]

**W**ANTED, Garrard or Collard auto record change unit, mechanically sound.—West, 32, Broomfield Grove, Rotherham, Yorks.

**W**ANTED, surplus transformers, new or damaged.—Send sample and price required to Sea Rescue Equipment, Ltd., Chiltern Works, Watford. [7266]

**W**ANTED, Ekco A.C. 97 glass station dial, also speaker fret for Ekco A.C. 74, both urgently wanted to clear up jobs.—J. Moxham, 41, College Rd., Epsom, Surrey. [7583]

**G**W. SMITH & Co. (RADIOS), Ltd., require the following: new or ercond-hand radio receivers and radiograms; all classes of radio test equipment; highest cash prices paid. G. W. SMITH & Co. (RADIOS), Ltd., 2, Cecil Rd., Southgate, London, N.14. Tel. Entonprise 5463. [5116]

**W**ANTED, T.P. Solo or similar, 3 1/2 x 2 1/2 or 1/2-pl. reflex, suitable for interior port traits and outdoor; full details.—Gill, 100 Broadwood St., Woodville, Burton-on-Trent.

**W**ANTED, "Prater" service sheets for S. Ever Ready all dry radio, M.W. and S.W. only; also Blue Spot radio model A69.—Ross, 133, Chelmsford Ave., Grimsby, Lincoln.

**W**ANTED, valves for Ultra Lynx dc model; any or all of the following, dc 28GPM (Met), dc 28G Magla, dc PEN, Phillips' Mam watt.—Write K. Martin, Archeven, High St., Henfield, Sussex. [7462]

**W**E need for radio production 2 gauge (c.c.) detectors, mains transformers, electrolytics, loud speakers, valves and all kinds of other components; please let us have your offers without delay.—Write Box 6856. [7102]

**R**EQUIRED immediately, several cwt 47 s.w.g. enamelled copper wire (preferably double enamelled), or alternatively 46 s.w.g., 45 s.w.g.; could exchange heavier gauges if necessary.—Wright & Weaire, Ltd., Simonside Works South Shields. Tel. South Shields 2301. [7498]

**W**E 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 of phone to University Radio, Ltd., 22, Lisle St., Leicester Sq., W.C.2. Ger. 4447.

**REPAIRS AND SERVICE**

**M**AINS transformers rewound, new transformers to any specification.

**M**OTOR rewinds and complete overhauls; first class workmanship, fully guaranteed.

**F. M. ELECTRIC Co., Ltd.,** Potters Bldgs, Warsaw Gate, Nottingham, Est. 1917 Tel. 3855

**M**AINS transformer rewind and construction to any specification; prompt delivery.—Brown, 3, Bede Burn Rd., Jarrow, 34c0

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

**L**OUdspEAKERS repaired; transformers, clock coils, chokes, rewind; prompt attention; prices quoted.—E. Mason, 5, Balham Grove, Balham, London, S.W. [7667]

**E**LECTRICAL measuring instruments skillfully repaired and recalibrated.—Electrical Instrument Repair Service, 329, Kilburn Lane, London, W.9. Tel. Lad. 4168. [6935]

**R**EWINDS and windings to specifications; radio consultant engineers; components supplied; catalogue on application.—Diskin & Holden, 370, Station Rd., Westcliff-on-Sea.

**"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]

**R**EPAIRS to moving coil speakers, cones, coils fitted, field rewind or altered; speaker transformers, clock coils rewind, guaranteed satisfaction, prompt service; no mains trans accepted.

**L.S. REPAIR SERVICE, 49, Trinity Rd.,** Upper Tooting, London, S.W.17. [4819]

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

**L**OUdspEAKER repairs, any make, reasonable prices, prompt delivery, to the trade and quality fans; 25 years' combined experience with Rola, Magnavox, Goodmans, Celestion.—Sound Service Radio, 80, Richmond Rd., Kingston-on-Thames, Kin. 8008. [4977]

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

**THESE ARE IN STOCK**

Radio Troubleshooter's Handbook, by A. A. Ghirardi, 35s., postage 10d.  
 Modern Radio Servicing, by A. A. Ghirardi, 35s., postage 10d.  
 Radio Physics Course, by A. A. Ghirardi, 35s., postage 10d.  
 Television Receiving Equipment, by W. T. Cocking, 12s. 6d., postage 5d.  
 Radio Engineer's Pocket Book, by F. J. Camm, 3s. 6d., postage 3d.  
 Radio Laboratory Handbook, by M. G. Scroggie, 12s. 6d., postage 6d.  
 Radio Receiver Circuits Handbook, by E. M. Squire, 6s., postage 4d.  
 Radio Engineer's Handbook, by F. E. Terman, 35s., postage 9d.  
 Time Bases, by O. S. Puckle, 16s., postage 5d.  
 Radio - Frequency Measurements by Bridge and Resonance Methods, by L. Hartshorn, 21s., postage 6d.  
 Radio Tube Vade Mecum, by P. H. Brans, 12s. 6d., postage 6d.  
 The Wireless World Valve Data, 2s., postage 2d.

WE HAVE THE FINEST STOCK OF BRITISH AND AMERICAN RADIO BOOKS. WRITE OR CALL FOR COMPLETE LIST.

**THE MODERN BOOK CO.**

(Dept. W.23), 19-21, Praed St., London, W.1

**THIS** → *Does these*



**ACCURATELY AND QUICKLY** chassis, brackets, brackets, Condenser and transformer clips  
 REPAIRING Steel or Aluminium.  
 Five sizes—12" to 36"  
 Full particulars from  
**A. A. TOOLS, (W.),**  
 197a, WATFORD ROAD,  
 WATFORD, Herts.

**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.E.E.F., 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

**Anodised Aluminium Dials, 3 waveband 180° sweep, engraved with station names, in green, red and white, with switch indicator markings. 8½" x 5¼" post paid. ... 6s. 3d.**

**AC/DC Superhet kits, 3 wave, 5 valve, with full wiring diagrams and instructions, chassis valves and 8 inch speaker post paid £13 10s. 0d.**

**3 wave Superhet Coil Pack with wiring diagram, switch, padders and trimmers post paid ... 37s. 6d.**

*Special Components Catalogue, 1/- post paid.*

**B. T. S.**

63, London Road, Brighton, I. Sussex.

**R**EWINDS and conversions to mains and output transformers, fields, etc., from 4/6; pp equipment a speciality.—N.L. Rewinds, 4, Brecknock Rd., N.7. Tel. Arnold 3390. [6283]  
**L**OUDSPEAKER and transformer repairs "almost by return of post"; we offer the quickest service in the trade, at competitive prices.—A.W.F. Radio Products, Ltd., Borough Mills, Bradford, Yorks. [17167]  
**C**OIL specialists.—Tuning and oscillator coils, i.L. and l.L. transformers, chokes, etc., rewound and wound to specification.—Electronic Services (R.T.R.A. Service Section), Arwenack St., Falmouth. [7117]

**24-HOUR** service, 6 months' guarantee, any transformer rewind, mains outputs and i.f.a., etc., all types of new transf., etc., supplied to specification; business heading or service card for trade prices.—Majestic Winding Co., 180, Windham Rd., Bournemouth.

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

**L**OUDSPEAKER repairs.—L. Cottenham for your loudspeaker repairs at keen competitive prices; all types repaired; field coils fitted or rewound to any resistance; quick service and guaranteed satisfaction; send to L. Cottenham, loudspeaker repair factory, Whetley Lane, Bradford, Yorks. Your enquiries will receive immediate attention. [7377]

**A**LL makes and kinds of electrical and radio measuring instruments repaired by skilled technicians, A.I.D. approved; all work quoted by return without charge. Also for sale, large variety of voltmeters, ammeters, milli-ammeters. 2in and 2½in dial, reconditioned ex-Air Ministry stock.—W. O. Prescott, Ltd., Dept. D., 29 31, Cowcross St., E.C.1. Tel. Cic. 6783. [6205]

**WORK WANTED.**

**R**ADIOGRAMS and television cabinets for home and export; first-class work only.—Mr. Glennie, 7, President St., Goswell Rd., E.C.1. [7438]

**W**E magnetize or de-magnetize permanent magnets for the trade and individuals; any quantity; immediate delivery.—I.A.G., 39, Toys Lane, Cradley, Staffs. [7410]

**E**X-GOVERNMENT stores classified and civil uses suggested; modifications planned and completed on small quantities.—5, Dora Rd., Wimbledon, London, S.W.19. [7506]

**W**E make wireless cabinets, also for radio-grams, for home and export, immediate deliveries.—Radiac, Ltd., 26, Brondesbury Rd., London, N.W.6. Maida Vale 8792. [7243]

**K**EEP a permanent record of your circuits! Complete blueprints drawn from your sketch, component valves, etc., inserted, 5/-, extra copies 1/3.—Send to BCM/Manuscripts, London, W.C.1. [6856]

**C**IRCUIT diagrams (individual designs) to order, suggestions and theory; consultation work accepted; drawings and tracings prepared (electrical or mechanical), repairs.—Write R. G. Young, 3a, Bridges Rd., Wimbledon.

**E**NGRAVING.—Precision instrument firm in West London can undertake specialized machine engraving of knobs, dials, tannels or sundry components; excellent delivery on small quantities.—Write Box 1641, c/o Charles Barker & Sons, Ltd., 31, Budge Row, E.C.4.

**T**ELEVISION aerial installations and aerial maintenance, full range of antennas supplied and/or installed by experts; removals and re-erctions arranged; our pre-war Trade Service Dept. is now open.—Brochures from Wolsey Television Ltd., 87, Brixton Hill, S.W.2, Tulse Hill 1240. [7320]

**T**HE name to note for all kinds of radio, and electrical metal work to specification, modern rustproof, all shapes and sizes undertaken, and for tropical use; components and sub-assemblies executed to meet recognised wiring and material standards; consultation, advice without obligation.—Write Dept. 23, Sea Rescue Equipment, Ltd., Chiltern Works, Clarendon Rd., Watford, Herts. [5977]

**BUSINESSES FOR SALE OR WANTED**  
**R**ADIO and electrical, excellent main road position, Streamham, modern lock-up shop, rent £125 p.a.; price £300, s.a.v.—Inwood, 230, Stockwell Rd., Brixton 1736. [7400]

**R**ADIO electrical shop and service dept., centre Essex village, population 2,000, no competition, outgoings £70 p.a., profit £5/10 weekly; £350, s.a.v.—King c/o 65, South Primrose Hill, Chelmsford, Essex. [7515]

**W**ELL-KNOWN London suburban electrical factor forced to give up through ill-health, offers very valuable road connections and manufacturing contacts at knock-out price of £2,500 including 15cwt van; rare opportunity for purchaser willing to handle radio accessories.—Apply Box 6158. [7447]

**WAVEBAND COVERAGE**

**12.5-2000** metres

OBTAINED WITH OUR **D**COILS

For further details ask your dealer. Please note that all components are available through trade channels only.

**ENQUIRIES INVITED FROM MANUFACTURERS**

**WEYMOUTH RADIO MFG. CO.**

Phone **CRESCENT WORKS, 701/2**  
 Grams 'Weyrad' **WEYMOUTH**

**RADIO BATTERY TESTER**

Use "Quixo" method of battery testing.

Reliable results. Guaranteed.

Send for interesting leaflet R115 on battery testing.



**RUNBAKEN • MANCHESTER 1**

**HARTLEY-TURNER HIGHEST FIDELITY SERVICE**

The wide smooth response of the 215 speaker which manufactures neither artificial Bass nor metal top, demands an equally good response from the rest of the equipment. The average "high fidelity" T.R.F. receiver may not have as wide a response as its owner believes, nor does it follow that an amplifier made from a good design is necessarily free from distortion. To cope with this situation we shall introduce a sensitive T.R.F. receiving unit with the 3rd Programme very much in mind, and a 30-watt amplifier available either complete, in kit form, or as a "book of words." Full details of these and other products will be sent to everyone on our mailing list. See that your name is included. Meanwhile the most important single item is the

**SPEAKER : MODEL 215—£9**

**H. A. HARTLEY CO. LTD.**

152 HAMMERSMITH RD., LONDON, W.6  
 TELEPHONE : RIVERSIDE 7367

**L-R-S DELIVERY from STOCK**

**Avomitor DC Test Meters ... 4 Gns**  
**Avomitor AC/DC Test Meters ... 25 10 0**  
 (Both supplied on Easy Terms if desired)

**Stuart Centrifugal Electric Pumps**  
 for all pumping purposes, garden fountains, etc.  
 No. 10. 100 galls. p.h. ... 25 10 6  
 No. 11. 300 " " ... 26 16 0  
 No. 12. 600 " " ... 28 8 0  
 Inc. foot valve and strainer, carr. paid. STUART adjustable fountain jet, 5/3.

**Morphy Richards Cydon Door Chimes ... 49/6**  
 Post Free.

**Ex-Govt. R.A.F. Pocket Watches.** 15 jewel high-grade Swiss movement. First-class time-keepers ... 7 Gns.  
 Regd. Post 10d. extra.

**The LONDON RADIO SUPPLY CO.**  
 (The L.R. Supply Co. Ltd.) Est. 1925  
**BALCOMBE SUSSEX**

# STERNS of FLEET STREET

Extensive Range of proprietary makes of Radio Components and Instruments are at your disposal.

Send 2d. stamp for our May 1947 Stock List.

**Midget Radio Kit of Parts**, entirely complete, Valves, M/Coil 5pk., Wiring Inst., 4-valve Medium and Long Wave, 200-250 volt AC/DC, Valves 6J7, 6K7, 25Y5, 25A6. Size 1 1/2 in. x 6 in. x 8 in. Price, incl. Tax. £7/6.

An attractive **Light Veneered Cabinet** can be supplied at 30/- extra.

**Ex-Govt. M/Coil Meters**, 0-1 m/a, 2in., 21/-; 2 1/2in., 37/6; 0-500 micro/amp, 2in., 21/-.

**Avo Meters**. Universal AC/DC Minor, £8/10.-. D.C. Minor, £4/4.-. No. 7, £19/10.-. Valve Tester, £16/10.-.

**Wearite "P" Coils**. Ranges, 12-2,000 metres, in stock, A, HF, osc., 3/-.

**Wearite I.F. Transf.**, 465 k/c. Standard, 20/- pr. Midget, 21/- pr. Iron Core.

**Atkins Coil Packs**, 3 wavebands, 15-50, 200-600, 900-2,000 metres. Iron Coiled Coils, size, 1 1/2 in. x 2 1/2 in. x 3 1/2 in., 38/6.

**Speakers**. P.M., 2-3 ohm, 2 1/2 in. Celestion, 27/6. 3 1/2 in. Goodmans, 30/-.

**Output Transf.** in stock for above, Multi ratio, Midget and Standard.

**Varley P/Pull O/pot Transf.**, 15 watt. ratios 20-1 to 68-1, DP46/48, 23/6.

**Heavy Duty P/Pull Input Transf.**, 26/-.

**Ex-Govt. Precision Slow Motion Drives**, 50-1, 12/6.

**L.F. Chokes**, 20 Hny., 300 ohm, 60 m/a., 6/6.

**Centralab Volume Controls**, 5K, 10K, 25K, 50K, 100K, 1/2 meg., 1 and 2 meg., with switch, 6/-; less switch, 4/3.

**W/Wound V/Controls**, 6 ohm to 25K, in stock, 5/-.

**Droppers**, adjustable, .2 amp, 1,000 ohm, 3/9.

**Denco Maxi-Q Coils**, Octal Base Plug-in and chassis Mtg. types, ranges, 9-30, 20-68, 167-727, 500-1760 metres. A, H.F., and Osc, 4/- and 4/3.

**Carbon Hand Mikes**, with D/pole Send/Receiver Switch, 5/-.

**Mike Matching Transf.**, Ratio 100-1, 5/-.

**Epicyclic 2 speed Ball Drive**, 1/2 in. shaft, with Coupler, 3/6.

**Garrard type Crystal P/Up Heads**, 46/11.

**Selenium Metal Rect.**, Bridge type, 12v., 1.5 amp, 12/6.

**Mains Transf.**, 200-250v. giving 12 and 16v. 3.5 amp, 24/6.

**Filament Transf.**, Input 200-230 v. giving 4v. at 7.5 amp, C.T., 12/6.

**Varley Mains Transf.** 350-0-350 v., 80 m/a., 6.3 v. 2.5 amp., 5 v. 2 amp., 30/-.

**Also in stock**. Condensers, Electrolytics, Resistances 1/2 to 20 watt. Coils, matched pairs, M. and L. wave, medium wave, etc. H.F. Chokes, etc

**Terms Cash with Order or C.O.D**

**Enquiries Welcomed!**

**STERN RADIO LTD.**  
115 FLEET STREET, E.C.4.

Tel.: CENTRAL 5814.

### TECHNICAL TRAINING

A.M.I.E.E., City and Guilds, etc., on "No Pass—No Fee" terms; over 95% success; for full details of modern courses in all branches of electrical technology send for our 112-page handbook, free and post free.—B.I.E.T. (Dept. 388A), 17, Stratford Place, London, W.1. [6270]

### BUSINESS OPPORTUNITY

**WANTED**, coil-winding capacity, including wave-winding and assembly capacity for radio receiver coils, I.F. transformers, output transformers and mains transformers; all material supplied; drawings and full specifications available; delivery required to commence within three months at 500 sets per week; write, giving full details of capacity which will be treated in confidence.—Box 8342.

### FINANCIAL PARTNERSHIP

**WORKING** partner wanted in growing trade and retail television and retail service business in Essex; applicant must be conversant with all radio and T.V. repairs and to invest £500-£1,000; good opening for keen man.—Replies in confidence to Box 8155. [7442]

### AGENCIES

**EXPERIENCED** British radio sales engineer designer, well-known transmitter, now resident in Far East, wishes contact manufacturers, distributors, who want competent technical and commercial representation; own staff and equipment; prepared to accept contracts for installation of transmitting, receiving or telephone equipment and the like in any territory.—Box 8618. [7661]

### SITUATIONS VACANT

**BOROUGH** of Fulham. Electricity department.

**TRAINEE** radio mechanic. Applicants should have had training in the use of simple workshop tools and have elementary knowledge of general principles of electricity and magnetism. The successful applicant will be required to continue his studies at a technical institute and, if necessary, will be allowed one day from work per week without pay for this purpose. The position is progressive and on the successful completion of his training and on the successful completion of his training and studies the applicant should be eligible for the position of radio mechanic. The rates of pay are £1/12.1 per 44 hour week at 14 years of age, rising annually to £4/8.2 per 47 hour week at 20 years of age.

**TERMS** of employment will be in accordance with N.F.E.A. agreements.

**FORMS** of application for above position may be obtained upon application to the Borough Electrical Engineer, 587, Fulham Rd., S.W.6.

**MINISTRY** of Civil Aviation.—Appointment of radio operators.

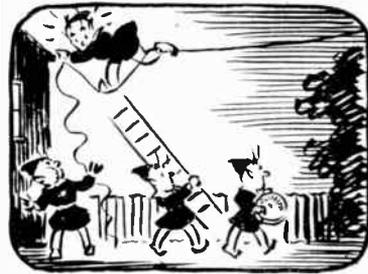
**APPLICATIONS** are invited for appointments as radio operators at Civil Aviation Radio Stations. Applicants must be at least 21 and under 40 years of age on 1st May, 1947. Candidates for appointment to Grade II must possess the Postmaster General's Second-Class Certificate of proficiency in radio telegraphy or the Air Operator's Licence with practical experience as a wireless operator in H.M. Forces, the Merchant Navy, civil aviation, etc. Ex-Service candidates not possessing these qualifications will be considered if they possess the Service "trade" qualification combined with suitable practical experience.

Opportunity exists for suitably qualified officers to be promoted to Grade I, and candidates already qualified may be appointed direct to that grade. Qualifications required for Grade I are similar to those laid down for Grade II except that candidates must possess the Postmaster General's First-Class Certificate of proficiency in radio telegraphy or the Air Operator's Licence, and have had practical experience in direction finding work.

Rates of pay on entry to Grade II range from 98/- a week at age 21 to 106/- a week at age 25 or over, rising by annual increments to a maximum of 130/-.

Rates for Grade I range from 104/- a week at 21 to 120/- a week at 25 or over, rising by annual increments to a maximum of 165/- a week. These rates include consolidated bonus addition. When final complements are settled establishment will be offered within those complements to suitable operators. Candidates should apply by postcard for a form of application to the Ministry of Civil Aviation, Establishment Division (B), 10 Fleet St., London, E.C.4, quoting reference Est./351.

The latest date for the receipt of completed application forms is 7th June, 1947. Applications from candidates serving in the Forces overseas, if not received by that date, will be considered in connection with vacancies which will arise during the next few months, provided that they are received by 16th August, 1947; such applications may be by letter, giving date of birth and full details of qualifications and experience. [747]



### THE "FLUXITE QUINS" AT WORK

"I'll soon fix the aerial light 'aid Oi' with a spot of FLUXITE

"Ah, the ladder!" cried EE

"I'll borrow it, see

Or we'll never get finished tonight!"

See that **FLUXITE** is a'ways by you—in the house—garage—workshop — wherever speedy soldering is needed. Used for over 30 years in Government works and by leading engineers and manufacturers. Of all Ironmongers—in tins, 10d, 1/6 & 3/-.

**TO CYCLISTS!** Your wheels will NOT keep round and true unless the spokes are tied with fine wire at the crossings AND **SOLDERED**. This makes a much stronger wheel. It's simple—with **FLUXITE**—but **IMPORTANT**.

### The FLUXITE GUN puts FLUXITE

where you want it by a simple pressure Price 1/6, or filled, 2/6.



**ALL MECHANICS WILL HAVE**

# FLUXITE

**IT SIMPLIFIES ALL SOLDERING**

Write for Book on the ART OF "SOFT" SOLDERING and for Leaflets on CASE-HARDENING STEEL and TEMPERING TOOLS with FLUXITE. Price 1d. each.

### FLUXITE LTD.

(Dept. W.W.), Bermondsey Street, S.E.1

# A.C.S. RADIO

**SPECIALISTS IN SHORT WAVE and high-class broadcast equipment offer a wide range of components for the constructor and enthusiastic amateur.**

We are Agents for Eddystone, Raymart, Hamrad and Labgear components including Variable Condensers for receiving and transmitting, Air Trimmer condensers; plug-in coils and coil formers; valve holders; R.F. and A.F. Chokes; Mains transformers; mica, paper and electrolytic condensers; volume controls; quartz crystals for the amateur bands; frequency standards and crystal gate receivers; aerial wire and equipment; meters and test sets by M.I.P. (Pullin) Ltd.; B.V.A. and American valves including transmitting types by Standard Telephones, and specialised U.H.F. types; Cathode Ray Viewing units by Labgear; Amplifiers and radio tuner units by Lowther Mig. Co.; Voigt Speakers and Corner Horns; Amplifiers by Leak, including the famous Point-One Series.

We have continually changing stock of Communications Receivers such as National, RME, Hallicrafters, Hammarlund and can often offer high grade American All-wave receivers, such as Scott, McMurdo Silver, etc. Home Talkie conversion kits, including Sound Heads, Amplifiers, etc. Latest LISTS sent on request.

**44 WIDMORE RD BROMLEY, KENT**  
Phone: Ravensbourne 0156



## BATTERY CHARGERS and TRICKLE CHARGERS

Trouble-free Chargers fitted with selenium all-metal rectification. Good allowance on your old Charger. Thirty years experience behind every Runbaken product. Booklet R.15 describing 12 Models on request.

**RUNBAKEN-MANCHESTER-1**



**WE APOLOGISE** to those who have been waiting months for replies. Our post-war plans have been frustrated so far. Sorry

**VOIGT PATENTS LTD.**

## AMATEUR CRYSTALS IN MINIATURE

02%, calibration accuracy. 2 in 1 mill of 1% temperature coefficient.

7 megacycles..... 27 6 each.  
14 megacycles..... 35 - each.  
Hermetically sealed in glass button bases, available standard BTG base.

(Small stocks at present, but deivers mounting)

### AMERICAN VALVES (NEW)

Button Base, Acorn, Metal and U.T. types. Available from Stock.

9001, 9002, 9003. 15 - ea. 6AK5, 6AK5, 6C4, 6J6, 15 - ea. 955, 25V, 957, 35 - ea. 0Z4, 15.3. 6BK7, 6BJ7, 6BG7, 12 10 ea. 6AC7, 1852, 21 4. 6AG7, 21/4. 6C5, 6J5, 9 2 ea. 6H6, 6H9. 6F6, 6L7, 6K6, 12 10 ea. 6BA7 14 - ea. 6E5, 15 - ea. 6L6, 6N7, 6AL7, 6AC7, 18 3 ea. 12SK7, 12BJ7, 12BG7, 12AG, 12 10 ea. 12K8, 14 - ea.

International Octal Bases (Ceramic). 2 6. R.C.A. Button Bases, for 9001, 6AK5, etc. (Ceramic). 1 6. Button Bases with shield cans. 3 - American Acorn Bases (Ceramic). 2 - American Loktal Bases (Bakelite). 1 - LF50 Bases Ceramic or siliconeised polystyrene. 3 -

## TELE-RADIO (1943) LTD.

177, Edgware Road, London, W.2

Telephone: PADDINGTON 6116

PLEASE NOTE: Above is our only address we are in no way associated with any other company of similar name

### CROWN Agents for the Colonies

APPLICATIONS from qualified candidates invited for the following posts:— JUNIOR Radio Engineers required by the Government of the Bahamas for a tour of three years in the first instance; salary £500, rising to £600 a year. On salary of £500 a cost-of-living allowance of £150 a year is payable. Free passages. Candidates, not over 40 years of age, must have had good basic training in radio engineering for vacancies (A), (B) or (C), or in electrical engineering for vacancy (D), and possess one or other of the following qualifications:—

(A) For radio receiver maintenance. A good knowledge of radio receiver design, construction and maintenance, fault finding procedure, and high frequency and vhf receivers. (M N 17500.)

(B) For radio transmitter maintenance. A good knowledge of radio transmitter circuit design and operation and experience in the maintenance of telegraph and radio telephone transmitters up to 5kw on broadcast, high frequency and vhf. Mechanical ability in the use of tools essential. (M N 17501.)

(C) For general radio maintenance. Good experience with antennae and antennae construction and ability to maintain and operate teletype machines. A good knowledge of the use of workshop facilities, test equipment, small machine tools, and the method of construction of small equipment essential. (M N 17502.)

(D) For radio telephone terminal equipment maintenance. Good practical experience with speech amplifiers, filters and filter circuits, voice-operated switching and control systems, and some knowledge of landline telephony and telephony repeaters. Ability to use drawing instruments or simple drawing work. (M N 17503.)

Apply at once in writing, stating age, whether married or single and full particulars of qualifications and experience and mentioning this paper to the Crown Agents for the Colonies, 4, Millbank London, S.W.1, quoting for (A) M N 17500, (B) M N 17501, (C) M N 17502, (D) M N 17503, on both letter and envelope.

**BOROUGH of Fulham. Electricity department.**

RADIO mechanic. Applicants must have had experience in the servicing of all types of radio receivers, alignment of superhets, use of all types of instruments and a sound knowledge of radio theory. Television circuitry knowledge an advantage. Rate of pay 2 9 per hour or £6 9 3 per 47 hour week.

TERMS of employment will be in accordance with N.F.E.A. agreements.

FORMS of application for above position may be obtained upon application to the Borough Electrical Engineer, 587, Fulham Rd., S.W.6.

**BOROUGH of Fulham. Electricity department.**

RADIO diagnostician. Applicants must have had experience in fault tracing in all types of radio receivers, alignment of superhets, use of all types of instruments and a thorough knowledge of radio theory. Television circuitry knowledge an advantage. Rate of pay 2/11 per hour or £6 17 1 per 47 hour week.

TERMS of employment will be in accordance with N.F.E.A. agreements.

FORMS of application for above position may be obtained upon application to the Borough Electrical Engineer, 587, Fulham Rd., S.W.6.

**REQUIRED** test engineer with knowledge of high power, high frequency valve generators.—Box 6222.

**CONTACT** sought with specialist able to advise occasionally on R.F. transmission line problems.—Box 7442.

**TESTERS** reqd. for Alba Radio City factory, 5 day week, staff canteen.—Apply A. J. Balcombe, Ltd., 52, The Parade St., E.C.2.

**REQUIRED** by instrument company en-paged on industrial telecommunications and medical measuring equipment:—

(A) ONE Development Engineer; good physics degree or equivalent and some years' experience in comparable work; age at least 25 years; salary according to experience.

(B) ONE Mechanical Designer; radio experience and degree or equivalent essential; salary £450-£590 p.a.

(C) ONE Technical Assistant; radio experience essential; salary £6 per week upwards according to experience.—Box 6857.

**COUNTER** salesman required for small components, W. London, some technical knowledge useful.—Details and salary required to Box 8632.

**RADIO** service engineer, with previous experience in leading makes of radio and television, required for S.W. H.M.V. dealer. Box 8135.

**SHORTHAND-TYPIST** required in London for familiar wireless technical terms, quick and accurately; interesting; non-commercial work. Box 8647.

### VALVES AVAILABLE

At B.O.T. prices, British and American, these are only a selection of our 10,000 valves held in stock. Please send for our comprehensive Valves Available List, free, enclosing S.A.E. for reply. Postage 6d. extra. C.W.D. or C.O.D.

Mullard.—DF33, DL33, DL35, KF32, KF35, FR322, EL33, VP23, SP2, PE22M, TH22A, PM211, 1M2A, PM202, QP22B, RM4, EM35, EC145, EF3, EF30, EF36, EF37, EF50, EF54, EC31, EB34, 1L33, BC33, BC31, ECC32, EL32, EL3, EL3, EL35, EL30, PM24M, TH4B, VP1, SP1, SP4B, 2D4A, 354V, 164V, Pen4A, Pen4B, Pen4DD, P133P, P133, SP13, SP13C, DL33, HL33C, CHL33, DW435, CV4, CV31, AZ1, AZ4.

Brimar.—2012, 15D2, 1H3, 1H5, 10D1, 2A1, 8A1, 8D2, 7D5, 4D1, 7A2, 11A4, 11H4, 7A7, 7B6, 7B6, 7B7, 7B8, 7C5, 7C6, 7C7, 7Y4, 15, 18, 19, 23A, 26, 27, 31, 32, 34, 32, 43, 46, 71, 75, 76, 77, 78, 79, 80, 85, 84, 89, 2103, 2A6, 2B7, 1X5, 5Y4, 5Z4, 5A3, 6A06, 6A8, 6B8, 6C7, 6F4, 6H6, 6J6, 6J7, 6K7, 6K8, 6L6, 6N7, 6Q7, 6N87, 6U7, 5A5, 6X5, 6I7, 6C9, 6D6, 6C8, 6B7, 6C8, 6K6, 6U8, 6A8, 6F9, 12D1, 25Z6, 25Z6, 35L6, 35Z4, 50L6, 6A87, 12A6, 12D1, 12Q7, 12K8, 12N17, 12K7, 12J7, 12F5, 11Z6.

Mazda.—V914, DH1, DH207, D10020, H12, H125, AC HL, AC 2H1, HL10, AC 1P, HL1322, HL133, 80216, AC 802W, SP141, SP210, VP210, AC VP1, VP41, SP41, SP42, VP133, 1P22, 1P23, 1P25, TP26, AC TH1, TH41, 1P2620, 1H221, TH23, AC HLDD, HL PD1520, Pen25, QP230, QP25, AC Pen, AC2 PenDD, AC5 PenDD, Pen44, Pen45, Pen45DD, Pen46, Pen48, Pen49, Pen4920, Pen49DD, AC19, AC17, AC18, AC19, U21, U22, 3 11, Gram.—174, U52, U50, U31, U34, U10, H10, K174, D174, KT66, KT63, KT61, DL33, DH33, D66, L66, H63, KT63, KTW63, KTW60, No. X63, No.1, DA30, PX25.

### H. RANSOM

34, Bond Street, Brighton Phone: Brighton on 5603

### MIDLAND INSTRUMENT CO.

Ex-G.V. AMPLIFIERS, 40 to 400 P.P. output, four transformers, key switch, on-off switch, auto. resistance, etc. Contained in black steel cases, 7in. x 5in. x 4in. Operates on 2-4-8 and 120vac/100vac batteries. Ideal for pickup amplifier or loudspeaking intercom, already converted for immediate use. 25/- post 1/- Electro-magnetic induction phones for above amplifiers, 3/6 extra. Send for our May 1946, 2d. with S.A.E. Note new models.

MOORPOOL CIRCLE, BIRMINGHAM 5, 17

Tel.: B412444-1838

**Beethoven ROTARY CONVERTORS**  
220 D.C. to 220 A.C.  
Details from—  
**BEETHOVEN ELECTRIC EQUIPMENT LTD.**  
Beethoven Works, Chase Road London N.W.10

## SOUTH-WEST "HAMS"!

Obtain your Gear from

**GRAHAM NEWBERRY G3BO**  
AXMINSTER, DEVON

Agents for Labgear, Woden etc

## COVENTRY RADIO

COMPONENT SPECIALISTS SINCE 1925.

### SPECIAL OFFER!

High Grade Microammeters, centre zero 20-0-20  $\mu$ A,  $3\frac{1}{2}$ " straight line scale edgewise meter. A valuable asset for laboratory or workshop use £3-6-0 post paid.

**COVENTRY RADIO,**  
DUNSTABLE ROAD, LUTON, BEDS.

# Specialists in

HIGH POWER - HIGH QUALITY

## PUBLIC ADDRESS SYSTEMS

### ★ AMPLIFIERS

from 150 W to 1kW

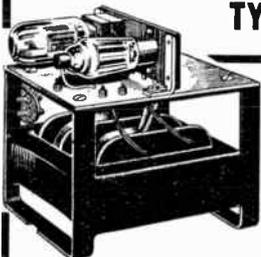
**W. Bryan Savage Ltd**

WESTMORELAND ROAD, LONDON, N.W.9

Telephone: Colindale 7131

EX-ADMIRALTY

## MAINS-TRANSFORMERS TYPE 62



Carriage  
Paid

**75/-**

230 Volts Primary. Secondaries 700-0-700 volts; 0-1200 volts. Rectifier valve holders fitted on top panel for RZ1/150 and U17 Valves. A real super job, unused and in the Manufacturers' sealed crate. Offered at a fraction of original cost.

## 10 VALVE, 1½ METRE SUPERHETS

Ideal for conversion into Television receivers. Circuit comprises, 1 pre-amp. oscillator; mixer; 5 I.F.'s, detector and Video amp. I.F. Frequency 12 Megs. Band width 4 Megs. Co-axial input and output sockets. An external source of L.T. and H.T. is required. Manufactured to stringent government specification by such famous makers as R.G.D. Murphy, Pye, etc. Complete with 10 Mazda Mains type valves, 6.3 volt filaments. Unused and in Manufacturers' sealed cartons.

Carriage Paid **7Gns.**

**WIRELESS INSTRUMENTS  
(LEEDS) LTD.**  
54-56 THE HEADROW, LEEDS, 1

**R**ADIO service mechanic required by engineering firm; location S.E. London area.—Write, stating qualifications, experience and salary required, to Box 8141. [7395]

**R**ADIO engineer assistant required in Berkshire area; good fault-finder essential knowledge of television an asset; write, stating experience and salary.—Box 8157. [7444]

**E**XPERIENCED radio and television engineer required, preferably under 35.—Full partiers, and salary to R. W. Clitherow, Radio Supply Stores, 27, High St., Saffron Walden.

**D**RAUGHTSMAN, junior, under 20, either sex, radio and electrical technical drawing for reproduction; perspective drawing an asset; good prospects; C. London; age, experience, salary.—Box 7433. [7218]

**R**EQUIRED by large oil company for service in Middle East areas, Assistant engineers possessing degree in radio engineering and some experience in low-powered wireless transmission/reception; age limit 30.

**S**ALARY (progressive) would be from level not less than £550 per annum, together with the additional benefit of free quarters/messing and allowances between the range of £195-£400 yearly, dependent on family circumstances; the service is pensionable—non-contributory; married applicants must be prepared to live singly for the first three years overseas.—Write, quoting P.T. to Box 1650, c/o (Charles Barker & Sons, Ltd., 31, Budge London, E.C.4. [7448]

**S**ENIOR draughtsmen required, with experience in design of radio equipment and components; A.E.S.D. rates and over according to ability.—Apply Personnel Manager, E. K. Cole, Ltd., Malmesbury, Wilts. [7407]

**T**ECHNICIAN wanted for London, carrier and picture telegraphy, good knowledge electronics, radio amateur or telecommunication, City and Guilds preferred.—Address, 0350 Wm. Porteous & Co., Glasgow. [7668]

**W**ELL established firm of quality radio manufacturers require sensible works manager, able to maintain production and keep records thereof in the customary manner; static age, exp. and salary required.—Box 8150.

**D**EVELOPMENT radio engineer-designer required; must be experienced in design, connected with electronic sound equipment.—Apply, with fullest details of career, to Personnel Manager, Miles Aircraft, Ltd., Reading

**I**NSTRUMENT makers required for prototype and development work; good wages and conditions; lodging accommodation can be arranged if required.—Apply to Personnel Dept., E.M.I. Factories, Ltd., Blyth Rd., Hayes, Middx. [7430]

**L**ARGE organisation in West Middlesex requires field service engineers with good television and radio knowledge, smart appearance, car an advantage but not essential.—Apply, stating details of past experience, age and salary required, to Box 8616. [7556]

**E**XPERIENCED radio component and test gear design engineer wanted, must have sound theoretical knowledge, plus ability to get jobs in production; progressive position for man with ability and enthusiasm; salary according to qualifications.—Box 8146. [7406]

**E**NGINEERS for development work are required by Marconi's Wireless Telegraph Co. for staff appointments at Chelmsford; candidates must possess a recognised engineering qualification and have good practical exp. Salary range £300-£700.—Box 8138.

**T**HE Home Office invites applications from men between 21 and 40 years of age with experience of Very High Frequency Wireless for temporary posts of Wireless Technician in the Headquarters and Regional Wireless organization; salary, £280-£370.

**C**ANDIDATES should apply for application forms & fuller details to Establishment Officer, Room 299, Home Office, Whitehall, S.W.1.

**M**ANUFACTURERS of L.F. and H.F. acoustic relay equipments and rectifying units invite applications for position as chief electrical engineer, in full charge of test and quality control; applicants must have sound knowledge and proven qualifications.—Reply, with full particulars, Box 8149. [7427]

**R**EQUIRED, senior foreman for radio assembly shop; must be first-class engineer, experienced in designing jigs and fixtures required on new assembly lines and capable of solving all problems connected thereto; location S.E. London area; good salary and prospects for right man.—Write, stating experience, salary required, etc., to Box 8140. [7394]

**C**HIEF electrical radio engineer with creative ideas and initiative wanted to control radio research laboratory, drawing office and development shops, covering the design and development of radio receivers and allied apparatus; first-class opening for the right man London area.—Write in confidence, giving technical qualifications, practical experience and terms required, to Box 8156 [7443]



## OUR UNIT SYSTEM of CONSTRUCTION

### FULL SIZE BLUE PRINTS (2 Practical and 1 Theoretical)

are now available for the following units:

- No. 1. R.F., F.C., I.F., second detector, three wave bands.
- No. 2. L.F. Amplifier, L.F. Stage 6C5, output 6v6 and rectifier 6 watts.
- No. 3. As No. 1 but 6 wave bands and EF50 R.F.
- No. 5. L.F. Amplifier, L.F. Stage, Phase inverter, 2-6v6 or 2-6L6's in push-pull and rectifier 12 watts.
- No. 6. L.F. Amplifier, L.F. Stage, double triode phase inverter and second L.F. Stage, 2P4's in push-pull and rectifier. 8 watts.

#### BLUE PRINTS

2 Practical and 1 Theoretical = 1 Set)  
5/- per set.

### BLUE PRINTS still available

**TELEVISION BLUE PRINTS.** Electrostatic and Magnetic (as advertised in April and May issues) 10/- per set.

**9-VALVE A.C. SUPERHET.** R.F. stage 6 wave-bands, radiogram circuit, 5/- per set.

**5-VALVE A.C. SUPERHET.** Radiogram, 3 wave-bands. 3/6 per set

### SPECIAL

**SHORT-WAVE COIL KIT.** 4 wave-bands 5-200 metres, R.F. stage. 1 RF using EF50 or our standard superhet circuit. 3-bank ceramic switch wafers.

**IRON CORED COILS.** 5-10, 10-30, 30-70, 70-200, 200-540 and 800-2,000 metres. A., H.F. and Osc., 7/6 per set of 3.

**307, HIGH HOLBORN.**  
LONDON W.C.1. Phone: HOLborn 4631

## CALLING AMATEURS with BUGGLEUCH

### PRECISION BUILT EQUIPMENT

- STEEL CHASSIS SMOOTH BLACK  
17" x 10 1/2" x 2 1/2" 9/9 17" x 10" x 2" 8/9
- PANELS-CRACKLE  
18" x 24" 4/- 18" x 7 1/2" 6/9
- 18" x 8 1/2" 7/9 18" x 10 1/2" 8/9
- ANGLE BRACKETS .. 12 1/2" long  
pair 7/6
- (All in Bright Aluminium, same cost.)
- COMPLETE RACK ASSEMBLY  
(Rigid 4-Pillar) 63" £3/6s
- CHASSIS, etc., TO ORDER at 4d  
sq. inch. (Include sides when costing).
- PUNCHING CHARGES UP TO 1 1/2" 2d
- VALVE HOLES 1 1/2" or 1 1/4" 6d
- METER HOLES, etc. 1/6
- SQUARE HOLES—2/-

**BUGGLEUCH RADIO MANUFACTURERS  
1 & 2 MELVILLE TERRACE, EOINBURGH, 9**

'Grams: "Therm", Edinburgh.  
Factory: Wheatfield St., Edinburgh.

**HILL & CHURCHILL LTD.**

BOOKSELLERS

**SWANAGE, DORSET.**

Available from Stock:—

Terman	"Radio Engineers Handbook"	35/-
Terman	"Radio Engineering"	30/-
Zworykin	"Electron Optics and the Electron Microscope"	60/-
Braierd	"U.H.F. Techniques"	28/-
Shener	"Transmission Networks and Wave Filters"	38/-
Emery	"U.H.F. Radio Engineering"	18/-
Puckle	"Time Bases"	16/-
Cocking	"Television Receiving Equipment"	12/6

Postage Extra

We have a large selection of English and American Books on RADIO and TELECOMMUNICATION

CATALOGUE ON APPLICATION

**LONDEX for RELAYS**

Midget Relay ML/C

for A.C. and D.C.

2 VA Coil consumption from 2 to 600 volts and tested to 2000 volts, Aerial change-over Relays, mercury Relays, measuring Relays and time delay Relays.

Ask for leaflet RE/WW

**LONDEX LTD**MANUFACTURERS OF RELAYS  
207 ANERLEY ROAD LONDON S.E.20SYDNEY  
6258-9

100 kcs.  
QUARTZ  
CRYSTAL  
UNIT  
Type  
Q5/100



for Secondary Frequency Standards

★ Accuracy better than 0.01%. ★ New angles of cut give a temperature coefficient of 2 parts in a million per degree Centigrade temperature change. ★ Vitreous silver electrodes fired direct on to the faces of the crystal itself, giving permanence of calibration. ★ Simple single valve circuit gives strong harmonics at 100 kcs. intervals up to 20 Mcs. ★ Octal based mount of compact dimensions

PRICE 45/- Post Free

Full details of the Q5/100, including circuit, are contained in our leaflet Q1. Send stamp to-day for your copy.

**THE QUARTZ CRYSTAL Co., Ltd.**63-71 Kingston Road,  
NEW MALDEN, SURREY  
Telephone: MALDEN 3034

**SERVICE** department manager wanted. Established radio manufacturers, London, thoroughly experienced service engineer required, knowledge all makes radio, television, organising ability, flair for correspondence, good prospects, working facilities; applications treated in strictest confidence.—Write, stating particulars and salary, Box 8159, [7418]

**PHYSICIST** or engineer required, preferably with a good honours degree, with experience in research and development in telecommunications, for work on radio communication equipment.—Apply by letter only, stating age, experience and qualifications to the Director, Research Laboratories of the General Electric Co., Ltd., N. Wembley, Middx.

**LABORATORY** mechanic required by research laboratory in West London area, preferably with service experience equal to Tele-Mechanic (H.A.A.), Class 1 or 2; please apply in writing to British Insulated Callender's Cables, Ltd., 38, Wood Lane, Shepherd's Bush, London, W.12, giving details of age, qualifications exp. and salary required.

**RADIO** engineering company in South London requires engineer to take charge of test department specializing in radio navigational equipment; applicants must be able to prove they have first class technical qualifications combined with considerable experience in similar work; position offers good opportunities to the right man.—Write full details to Box 7429.

**DRAUGHTSMEN** or designer-draughtsmen required for engineering dept. of radio manufacturers in Enfield district, with experience of light engineering and mechanics; extensive development and design programme with prospects of original work; five-day week, first class working conditions and amenities.—Apply Personnel Officer, Ferguson Radio Corporation, Ltd., Gt. Cambridge Rd., Enfield.

**TECHNICAL** assistant required by well known company situated West London district for investigation of improved processes in cathode ray tube manufacture; degree in chemistry or an equivalent qualification desirable; industrial experience on similar work an asset.—Applications, which should include full details of training, exp. age and salary expected, should be addressed to Box 8436.

**PHYSICISTS** and electrical engineers required for work on Radar and radio navigational equipment; experience in radio research or development is essential, an honours degree desirable; several vacancies exist within the salary range, £400-£900, dependent on qualifications and experience.—Application forms are obtainable from the Personnel Manager, Ferranti, Ltd., Ferry Rd., Edinburgh, 5.

**FIRM** specializing in temporary installations and operation of P.A. equipment requires intelligent young man with initiative, good organizing ability and a conscientious worker; must have thorough knowledge of L/F, and be able to drive; opportunity is offered for learning direct recording; wages £5/5 per week.—Apply by letter giving full particulars of past experience to R. G. Jones, Morden Park Sound Studios, London Rd., Morden.

**EXPERIENCED** wireless mechanics capable of carrying out complete overhauls and repairs to various types of Army and trade pattern wireless transmitters and receivers; wages 104/6 per week, plus up to 20/- per week ability pay according to technical qualifications and skill.—Applications should contain full personal particulars of applicant and experience and should be forwarded in writing to Civilian Establishment Officer, Kinnear Workshops, R.E.M.P., Holywood, Co. Down.

**AIR-SERVICE TRAINING, Ltd.**, invite applications to fill the following vacancy: Radio Engineering Instructor; qualifications required: applicants should have good theoretical and practical knowledge of principal radar and radio aids to navigation; a degree in physics or mathematics is desirable though not essential, but candidates must have real teaching ability and a sound knowledge of higher mathematics and be prepared to teach radio fundamentals if required.—Apply, giving full details to The Commandant, Air Service Training, Ltd., Hamble, Southampton. [7501]

**A. C. COSSOR, Ltd.**, radio and television manufacturers, require radio research engineers with physics, engineering or mathematics degrees, or equivalent technical experience in radio, television, acoustic or electronic instrument design; the vacancies are for experienced engineers only; salaries £600-£900 p.a., according to qualifications; also requires University graduates without commercial experience, who will receive an engineering training at commencing salaries of £400 p.a.; 5-day week, canteen on premises.—Apply by letter to Staff Manager, A. C. Cossor, Ltd., Research Laboratories, Highbury Grove, N.5

THE

**TELERADIO.**new  
Model A60."SPACE RANGER"  
Superhet kit set.

an improved version of the popular 50A, with better sensitivity and ease of construction. 3 full-size blueprints 5/- post free.

Kit of parts £7.10.0 plus P.T. 32/6. Valves, £3.2.6. Cabinets, 48/- & £60/-.

Send stamp for leaflets to NEW mail order ADDRESS

**THE TELERADIO COMPANY**  
14, VALANCE AVENUE, E.4.**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.

Safeguard your future; send for your copy at once—FREE.

B.I.E.T., 387, SHAKESPEARE HOUSE,  
17, STRATFORD PLACE, LONDON, W.1.**TRANSFORMERS & COILS TO SPECIFICATION.**MANUFACTURED OR REWOUND  
**JOHN FACTOR LTD.,**

(Formerly Stanley Cattell Ltd.),

9-11 East Street, TORQUAY, Devon

Phone: Torquay 2162.

**REWINDS**

Armatures, Fields, Transformers, Pick-ups, Vacuum Cleaners, Gram. Motors, Speakers Refitted New Cones &amp; Speech Coils.

All Guaranteed and promptly executed. New Vacuum Cleaners, most popular makes. Send stamped addressed envelope for list of Radio Spares, and C.O.D. Service.

**A.D.S. Co.** 281-3-5, Lichfield Road,  
F. STON, BIRMINGHAM, 6**MIDGET IRON CORED COILS**

GIVING MAXIMUM GAIN &amp; SELECTIVITY

**AERIAL AND OSCILLATOR**, short, medium, or long wave, size 1 1/2 in. x 1/2 in. 7/6 pair.**AERIAL AND OSCILLATOR**, medium or long wave, size 1 1/2 in. x 1/2 in. 6/9 pair.**DUAL WAVE COILS**, medium and long wave acria and h.f. 9/6 pair.**I.F. TRANSFORMERS**, Standard Frequency 465 k.c.s. Size 1 1/2 in. diam. x 1 1/2 in. high. 9/6 each.**MINIATURE ROTARY SWITCH**, 4 pole, 3 way 3/9 each.

All coils fitted with adjustable iron cores. TERMS: Cash with order or C.O.D. on orders over £1. Postage free.

**MONOCHORD RADIO**  
235, Streatham Road, London, S.W.16

**CHIEF** radio buyer required by manufacturing firm, London area; previous similar post desirable but not essential if held responsible, buying position in radio or light electrical distributive trade, must be keen, possess initiative and have knowledge of markets.—Write in confidence, stating qualifications, experience, age and terms required, to Box 8343.

**SITUATIONS WANTED**

**RADIO** technician, Dutchman, age 30, seeks employment in U.K. 12 several years' practical exp. in research & development.—Box 8345.

**RADIO** engineer, 28, Assoc. Brit. I.R.E., requires responsible position in design or in charge, South England preferred.—Box 8613.

**EX-SERVICE** man studying for membership of Brit. I.R.E., for experience seeks engagement in radio or allied trade, moderate salary.—Box 8151. [7429]

**QUALIFIED** senior service engineer, 5 years pre-war radio and television experience, ex-A.I.D. and R.E.M.E., W.O.1 (wireless mech.) requires situation.—Box 8614. [7550]

**YOUNG** married man, sound knowledge of radio theory and practice, ten years R.A.F. W/Opr, keen amateur, own car, seeks situation with good prospects.—Box 8137. [7387]

**TECH. officer**, R. Signals, age 26 years, ex-foreman of signals, seeks interesting and progressive position requiring initiative and first-class technical and administrative qualities, available June, South of England, preferred.—Box 8142. [7396]

**RADIO** and television service manager, 33, seeks change, London area, at present in charge service dept. of large retail organisation in London, fully experienced all makes, as well as costing, buying and selling, also interested in position as branch manager or buyer.—Box 8139. [7389]

**ADVERTISER**, 34, 12 years retail radio/electrical (6 years R.A.F. radar), service, sales, inc. television, electrical installation, estimates, repairs, all domestic appliances, etc., thoroughly competent, own car, desires change good position, present £8 per week, S.W. Eng. or overseas.—Box 8617. [7557]

**TUITION**

**THE** British National Radio School

**OFFERS** you a career. **WRITE** to-day for free booklet describing our wide range of training courses in radio, Radar, telecommunications, principles, mathematics, physics, and mechanics; correspondence and day classes for the new series of C. & G. examinations; we specialise in turning "operators" into "engineers," and for this purpose our "Four Year Plan" (leading to A.M.I.E.E. and A.M.Brit. I.R.E., with 9 C. and G. Certificates as interim rewards) is unsurpassed; "our guarantee has no strings attached."—Studies Director, B.Sc., A.M.I.E.E., M. Brit. I.R.E., 6th Addiscombe Rd., Croydon, Surrey. [6811]

**ENGINEERING** careers and qualifications. **BOTH** Government and industry have announced and emphasised that young men with technical knowledge and qualifications must receive every chance to rise to the highest positions within their capacity, in post-war engineering and allied industry; write to-day for "The Engineer's Guide to Success"—200 courses free—which shows you how you can become A.M.I.E.E., A.M.I.A.E., A.M.I.Mech.E., A.F.R.Ae.S., etc., and covers all branches in radio, automobile, mechanical, electrical, production, aeronautical, etc.

**THE** Technological Institute of Great Britain, 82, Temple Bar House, London, E.C.4. [4918]

**RADIO** training.—P.M.G. exams. and I.R.E. R. 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]

**ENGINEERING** opportunities.—Have you had your copy of this free guide to A.M.I.Mech.E., A.M.I.E.E., and all branches of engineering, building and plastics? Become technically trained on "no pass—no fee" terms for higher pay and security.—For free copy write B.I.E.T. (Dept. 387B), 17, Stratford Place, London, W.1 [6939]

**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—ate moderate.—The Syllabus of Instructional Text may be obtained post free, from the Secretary, 20, Fairfield Rd., Crouch End, N.8. [6722]

# GALPINS

ELECTRICAL STORES

408 HIGH STREET, LEWISHAM, LONDON, S.E.13

Telephone: Lee Green 0309. Near Lewisham Hospital.

TERMS: CASH WITH ORDER. NO C.O.D.

**EX-R.A.F. CRYSTAL MONITORS TYPE 2.** 3-valve Battery working, complete and ready for use less valves and xstals, operational frequency depends on xstal frequency, condition as new. Price 10/6 each plus 1/6 carriage. Complete in carrying case size 8 1/2 in. x 8 in. x 6 in.

**EX-R.A.F. MICROPHONE TESTERS.** These consist of a Ferranti 2 1/2 in. m/coil 0 to 1 m/a. meter with Westinghouse Rectifier incorporated, calibrated at present 0 to 10 volts, microphone transformer, jacks, etc., all contained in polished teak case, size 6 1/2 in. x 5 1/2 in. x 5 in. Condition as new. Price 37/6 each.

**EX-G.P.O. (AMERICAN) VIBRATOR PACKS.** Type M222, 4 volts D.C. input, output 100/120 volts A.C. 20/30 m/amps. New and unused, 27/6 each, carriage 2/6.

**METERS.** All first grade moving coil instruments, new, boxed, ex-Govt., 0 to 40 volts, with series resistance removed. 5 m/a 15/- each, 0 to 10 amps. 15/-, 0 to 1 m/amp. 21/- All 2 in. scale and by well-known makers.

**VOLTAGE CHANGER TRANSFORMERS.** Ex-Govt., auto wound. Tapped 0, 10, 20, 25, 90, 130, 150, 190, 210, 230 volts, 1,000 watts, all tapping at 1,000 watts. New and unused £5/10/- each, carriage 5/-.

**EX-NAVAL CATHODE RAY RECTIFIER UNITS.** New and unused, sold for components which consist of:—2 x .5 mf. 2,500 v., 1 x .1 5,000 v., 6 x 2 mf. 800 v., 2 x 8 mf. 800 v., approx. 15 volume controls, various values, approx 100 small condensers and resistances, smoothing choke and 9 v. holders, including 3 EF50 and 1 tube base. All components wired and with the addition of mains transformer would make a good oscilloscope. Price 55/-, carriage paid.

**AUTO WOUND MAINS TRANSFORMER (Mains Booster).** 1,500 watts tapped 0, 6, 10, 19, 175, 200, 220, 225, 240 and 250 volts. New, ex-Govt., £5/10/- each, carriage 5/-.

**EX-R.A.F. AERIAL COUPLING UNITS,** absorption type. Range from 1.2 to 5.3 m/cycles. 10/- each, post 1/-.

**RECTIFIER UNITS, EX-GOV'T.** Input 200/250 volts A.C., output 110 volts 7 amps. D.C. The ideal garage charger, condition new. Price £17/10/-, c/forward (selenium rectifiers).

**ELECTRIC LIGHT CHECK METERS,** for 200/250 volt 50 cyc. 1 phase, ideal for subletting, etc., guaranteed electrically 2 1/2 amp. load 12/6, 5 amp. 12/6, 15 amp. 20/-, 20 amp. 25/-, 30 amp. 30/-, 40 amp. 35/-, 50 amp. 45/-, 100 amp. 50/- each, plus 1/6 carriage extra.

**EX-R.A.F. I.F.F. UNIT (Model) 3002** complete with 10 valves, types 3X70E, 1EF50, 4VR65, 2XYT61A, and rotary converter 12 volts input 450 volts 40 m/amps. output. These units are as new. Price complete £3/10/- c/paid. Ditto Model 3009, 24 volt input, £3, c/paid.

**EX-R.A.F. R.F. UNITS TYPE 110A.** New and unused, consisting of 5 valves including grounded grid 750 m/cy. tube, small 12 volt motor and numerous other components, would make very useful crackers. 55/- each, 5/- carriage.

**LARGE MAINS TRANSFORMERS** for welding, etc. Input 200/250 in steps of 5 volts, output 30 volts at 5 kilowatts, price £12/10/-. Another, double wound, 2 to 1 ratio at 4 kW. 240 to 120 or vice versa, price £12/10/-. Both these are ex-Govt. and new.

**L.T. RECTIFIERS (new),** 6 volts 1 1/2 amp. 7/6 each, 12 v. 1 1/2 amp. 10/6 each, 9d. post. Instrument Rectifiers, S.H., 10 or 20 m/a. types, 4/6 each.

**EX-NAVAL ROTARY CONVERTERS,** 24 volts D.C. input, 50 volts or 100 volts 500 cycles 1 phase at 300 watts output, good condition, £5 each, C/F. Ditto, 80 volt D.C. to 80 volt A.C. at 2,000 cycles 1 phase 8 amps output, £4/10/- each, C/F.

**SMALL MAINS MOTORS,** ex-naval fan type, approx. 1/6 h.p., series wound with laminated fields 200/240 volts, 27/6 each, carriage 1/6. A few only 100 v. also. Please state voltage when ordering.

**EX-R.A.F. RADAR IMPULSE TRANSFORMERS (new, boxed).** We have no actual data on these, but believe them to have an output of 15,000 volts at 3 kW, for a micro second. A bargain for the experimenter at 10/6 each P.F.

**EX-GOV'T. ROTARY TRANSFORMERS.** D.C. to D.C. 12 volts input, 230 volts at 4 m/a. output, 21/- each. Another, 24 volts input, 450 volts at 40 m/amps output, 30/- Another, 24 v. input, 450 v. at 60 m/a. output, 32/6.

**EX-G.P.O. VERTICAL TYPE GALVANO-METERS,** centre zero reading 30/0/30, 7/6 each post 1/-. Mallory 12 volt vibrators, new and unused, 7/6 each. Electrolytic condensers, 80 mf. 350 volt wkg., 5/6 each, post 9d.

**WESTON MOVING COIL METERS,** edge type with knife edge pointers, 2 1/2 in. scale, all 2 m/a. F.S.D. 0 to 300 m/a., 30/-; 0 to 2 amps., 27/6; 0 to 60 volts, 27/6; 0 to 150 volts, 27/6; ditto, 0 to 1 volt 1 m/a. 1,000 ohm per volt, 35/-; another 301 model 0 to 3 m/a., 35/-; 0 to 50 m/a., 30/-; 0 to 200 m/a., 32/6; another 501 model 0 to 50 m/a., 27/6; 0 to 10 m/a., 27/6.

**VOLTAGE CHANGER TRANSFORMERS,** auto wound, fully guaranteed, immediate delivery, all tapped 0, 110, 200, 220, 240 volts, 250 watts, 45/-; 350 watts, 55/-; 500 watts, 70/-; 1,000 watts, £5/15/-; 2,000 watts, £8/15/-.

**SHUNT WOUND D.C. 110 volt motors,** 1500 r.p.m., approx. 3/4 h.p., condition as new, 17/6 each, post 2/-.

**EX-G.P.O. Permanent Magnet Moving Coil Speakers (makers Tannoy),** suitable for extension or small P.A. work, fitted in wooden case, 9 x 9 x 7 in., as new, 27/6 each.

**MAINS TRANSFORMERS** by well-known makers. Input 200/250 volts, output 700/0/700 v., 80 m/a. 4 v. 3 a. 12 v. 1 a., 30/- Ditto, 300/0/300 v., 200 m/a. 6.3 v. 20 amps 5 v. 3 a., 45/- Ditto, 450/0/450 v., 150 m/a. 5 v. 2 a. 6.3 v. 4 a., 37/6 Ditto, 500/0/500 v., 150 m/a. 4 v. 4 a. 6.3 v. 4 a. 5 v. 2 a., 55/- Ditto, 350/0/350 v., 120 m/a. 4 v. 4 a. 5 v. 2 a. 6.3 v. 4 a., 35/-

**TRANSFORMER CORES.** These are new and complete with bobbin. 25 watt 4/-, 100 watt 8/6, 500 watt 17/6. We also have a few only larger cores, which please write for quotation.

**VARIAC BALANCER TRANSFORMERS.** Input 200/260 volts, output 220 volts at 1.65 kilowatts. Condition as new, 85/- each.

**LARGE CONDENSERS.** 1 mf. at 4,000 v. wkg., 10/- each. 4 mf. 300 v. A.C. wkg., 2/6 each. Electrolytic 2,000 mf. 12 v. wkg., 10/6 each. 500 mf. 50 v. wkg., 7/6 each. G.P.O. Polarised Relays, 250 ohms 10 or 20 m/amps., 10/6 each. Regret no C.O.D.

**CIRCUIT DATA**

**R.1118a.** Battery Communication Receiver. Theoretical & practical wiring diagrams. 2/3 post free.

**R109.** Short Wave Car or Battery Receiver. 11 pages of circuiting and general dope, including fault-finding. 2/3 post free.

**MCR1.** Circuit diagrams, technical and theoretical and notes. 2/9 post free.

**58 (Walkie-Talkie).** Battery Transmitter-receiver. Copy of official working instructions, plus diagrams of set and vibratory power pack. 3/6 post free.

**V.E.S.,**

**RADIO HOUSE, RUISLIP, MIDDIX**

**NON-MAGNETIC TURNTABLES**

with **STROMBOSCOPIC MARKING**  
An essential accessory for serious **PICK-UP DESIGN RESEARCH**

**SOUND SALES LIMITED**

57 St. Martin's Lane, London, W.C.2  
Temple Bar 4284

Works: Farnham, Surrey

## WARD ROTARY CONVERTERS

For Radio, Neon Signs, Television, Fluorescent Lighting, X-ray, Cinema Equipment and innumerable other applications

We also manufacture:—

Petrol Electric Generating Plants, H.T. Generators, D.C. Motors, etc., up to 25 K.V.A.

### CHAS. F. WARD

Lordscroft Works, HAVERHILL, SUFFOLK.  
Telephone: Haverhill 201

## REWINDS

Send your "Burn outs" to be Rewound — no technical data wanted. Post Transformer, etc., labelled with your name and address marked "for Rewind."

OUR WINDINGS ARE  
LAYER WOUND & IMPREGNATED  
SOUTHERN TRADE SERVICES, LTD.  
297/299 HIGH ST., CROYDON  
Tel. 4870

Manufacturers of TELEGRAPH & ROLUG'S

THE FAMOUS  
M.C.R.I. MIDGET COMMUNICATIONS RECEIVER.  
Complete with A.C. D.C. Power Unit. Tested before dispatch. World reception guaranteed. Total consumption under 60 m.a. An ideal personal receiver. Coverage 20-3000 m. Complete 28 8s. 6d.  
EX-R.A.F. LOW IMPEDANCE HEADSETS (ideal extra phones for the M.C.R.I.). Can be used directly from extension speaker terms of broadcast receiver. Per Pair 10/6  
WAVECHANGE SWITCHES, 2-pole 2-way. Standard 1/4 in. spindle, length 1 1/4 in. Ideal for small 2-band receivers. Brand new. Minimum order 1 doz. 18/-  
1,000 VOLTS. 01 CONDENSERS. No finer condenser has ever been produced. Made to stringent Government Tropical Specification. New and perfect. Per doz. 9/-  
HEAVY-DUTY L.F. CHOKES. Two types. 350 ohms 80 m.a. and 80 ohms 150 m.a. Core area 1 1/2 in. Unused ex-Government Tropicalised. Each 10/-  
Many other items. Send stamp for list. All items. Post free.

**MORTON & DISMORE**  
52c Oldchurch Rd., Chingford, E.4

### PATENTS.

THE proprietor of British Patent No. 531963, entitled "Device for producing vibrato in sound amplifying systems and the like," offers same for licence or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Ehlerst, Stern & Carlberg, 28, East Jackson Boulevard, Chicago, 4, Illinois, U.S.A.  
**BOOKS, INSTRUCTIONS, ETC.**  
27 Technical radio books; offers.—Cawsey, Penryn, Trevoze Cres., Chandler's Ford.

## COUNTY BOROUGH OF BRIGHTON

### BRIGHTON TECHNICAL COLLEGE

Principal: G. E. Watts, M.A., Ph.D., F.R.I.C.

Applications are invited for the appointment of a LECTURER IN ELECTRICAL ENGINEERING, who should hold an Honours Degree in Engineering or equivalent professional qualification. Duties will include teaching of Telecommunications up to Final Degree Standard.

Salary will be in accordance with the Burnham Technical Scale with full allowances for approved research, industrial and teaching experience and for war service. The person appointed will be required to take up duty in September, 1947.

Further particulars and terms of application may be obtained from the undersigned. The completed form should be returned with copies of two recent testimonials to The Principal, Technical College, Brighton 7, within two weeks of the appearance of this notice

W. G. STONE,  
Education Officer.

Education Office  
54, Old Steine,  
BRIGHTON, 1.

## Sunderland Education Committee THE TECHNICAL COLLEGE

Principal: D. A. Wingham, M.Sc., Sen. Wh. Sch., D.I.C., M.I. Mech. E., A.C.G.I.

APPLICATIONS are invited for the post of lecturer in the Electrical Engineering department. Candidates should have a degree in Electrical Engineering, with qualifications in Telecommunications. Practical experience in modern developments in this field would be an advantage.

Salary in accordance with the Burnham Technical Scale. The commencing salary will include an allowance for approved industrial or professional experience after the age of 21 years. Forms of application and further particulars may be obtained by sending a stamped addressed envelope to the Registrar, The Technical College, Sunderland, Co. Durham.

Applications should be returned to the undersigned within two weeks of the date of this advertisement.

Canvassing will be a disqualification.  
W. THOMPSON,  
Education Officer, Director of Education.  
15 John Street,  
Sunderland, Co. Durham.

## "Instruments Made To Measure"

FOR ALL ELECTRICAL AND COMMUNICATION ENGINEERS



Quadrant Works, Finchley Lane, Hendon, N.W.4  
Telephone: Hendon 3682/3230

## BROOKES CRYSTALS

EST. 1929 LTD.

MAXIMUM ACTIVITY  
PRECISION BUILT UNITS  
GUARANTEED ACCURACY  
LABORATORY TYPES  
OSCILLATORS — RESONATORS  
AMATEUR RANGES  
REFERENCE UNITS  
MANUFACTURERS CATERED FOR

51/53 GREENWICH CHURCH ST.,  
LONDON, S.E.10 Phone: GRE. 1828

## MORSE CODE TRAINING

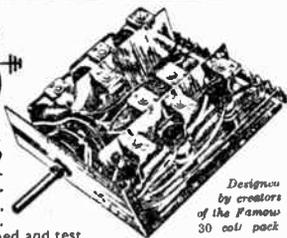


There are Candler Morse Code Courses for BEGINNERS and OPERATORS. Send for this Free "BOOK OF FACTS" t gives full details concerning all Courses.

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

## A.I.S.

THE 40 COIL PACK  
Includes H.F. stage. 9 Iron-cored coils in All-wave Superhet circuit. 15-50, 200-550, 750-2,000 metres. For 465 Kc/s I.F. Aligned and test ed before dispatch. 1d. stamp brings price list.



Designed by creators of the Famous 30 coil pack  
Price 3/6

ALIGNED INSTRUMENTS SERVICES, 1, COLWORTH RD., LEITHEM, MID. EN.



## UNIT OSCILLOSCOPE

A NEW CONCEPTION OF INDUSTRIAL NEEDS

Interchangeable Amplifiers and Time Bases with a wide range of accessories cover every application. No loose wires, no unwanted controls, no complex switches, but standard snap-on units give rigid assembly with tailor-made performance.

**LYDIATE ASH LABORATORIES**  
RESEARCH AND DEVELOPMENT ENGINEER  
Nr. BROMSGROVE  
Telephone: Rubery 168/169

# SEARCHLIGHT on *Quality Control*



Quality Control, in its broadest and widest application, is a never-relaxed feature of every stage in the production of T.C.C. Capacitors

From raw-material acceptance to final Capacitor test, a keen-eyed team of technicians and operatives, backed by the most modern test equipment, is engaged in the application of scientifically-based control methods with one purpose in mind, that of maintaining the highest attainable standards of quality

Periodical examination, by statistical analysis, of the collated data ensures the effective application of the control systems employed

**TCC**  
Capacitors

**THE TELEGRAPH CONDENSER CO. LTD.**

RADIO DIVISION

NORTH ACTON · LONDON · W. 3

Telephone. ACORN 0061

# KING OF THE SET



# MAZDA

**RADIO VALVES AND CATHODE RAY TUBES**

THE EDISON SWAN ELECTRIC CO. LTD.  155 CHARING CROSS RD., LONDON W.C.2  
(R.M. 42)