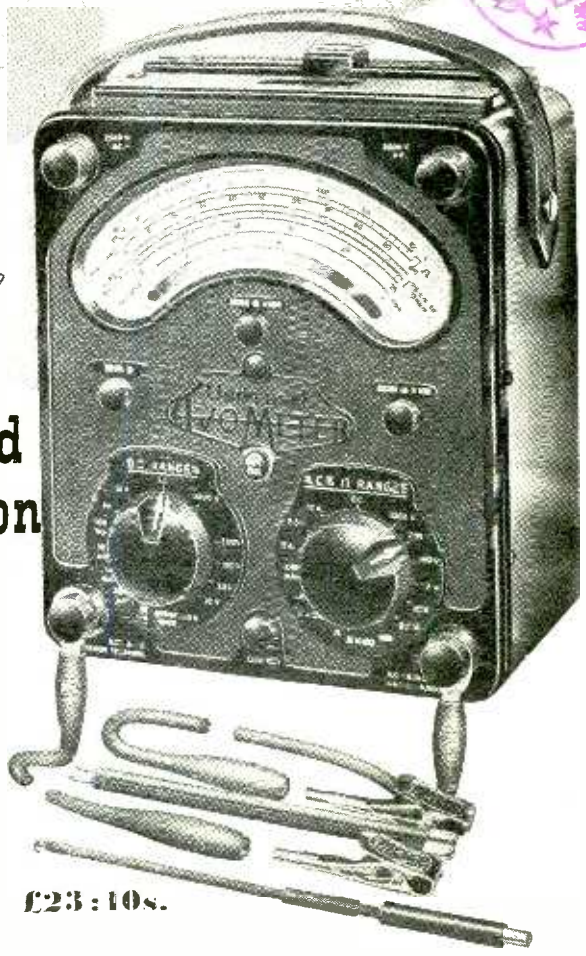
20,000 ohms per volt *plus* AUTOMATIC Overload Protection



£23 : 10s.

Size $8\frac{1}{8}" \times 7\frac{1}{4}" \times 4\frac{1}{2}"$
Weight $6\frac{1}{2}$lbs. (including leads)

Produced in response to a demand for a high sensitivity version of the world-famous Universal AvoMeter, this model incorporates the traditional design features of its predecessors, so highly valued for simplicity of operation and compact portability.

It has a sensitivity of 20,000 ohms per volt on all D.C. voltage ranges and 1,000 ohms per volt on A.C. ranges from 100V. upwards. A decibel scale is provided for audio frequency tests. In addition, a press button has been incorporated which reverses the direction of current through the moving coil, and thus obviates the inconvenience of changing over test leads when the current direction reverses. It also simplifies the testing of potentials, both positive and negative, about a common reference point. A wide range of resistance measurements can be made using internal batteries, separate zero adjustment being provided for each range.

It is of importance to note that this model incorporates the "AVO" automatic cut-out for protection against inadvertent overloads.

For your Valve Characteristic Meter or Valve Tester

Owing to the very large number of valves which have been issued within the last two years, no further amendments will be issued for the original "Avo" Valve Testing Manual. A new, completely revised and fully up-to-date Valve Data Manual is now available from the Company at 15/- post free.

D.C. VOLTAGE	D.C. CURRENT	A.C. VOLTAGE	A.C. CURRENT
2.5V.	50μA.	2.5V.	100mA.
10V.	250μA.	10V.	1A.
25V.	1mA.	25V.	2.5A.
100V.	10mA.	100V.	10A
250V.	100mA.	250V	—
1,000V.	1A.	1,000V.	—
2,500V	10A	2,500V.	—

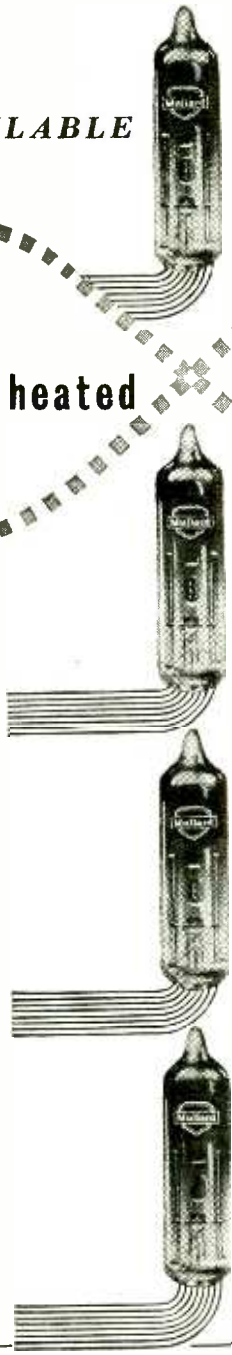
RESISTANCE
First indication 0.5Ω.
Maximum indication 20MΩ.
0—2,000Ω (using internal batteries.)
0—200,000Ω (using internal batteries.)
0—20MΩ (using internal batteries.)
0—20MΩ (using external batteries.)

THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO. LTD.
WINDER HOUSE · DOUGLAS STREET · LONDON S.W.1 *Telephone* VICtoria 3404—9

AVOCET TRADE MARK

AR/1

A



AVAILABLE SOON FOR COMMERCIAL PURPOSES

indirectly-heated *subminiatures*

These new Mullard indirectly-heated subminiature valves, characterised by their extremely robust construction, excellent electrical performance, low heater consumption and small physical dimensions, will shortly be made available for commercial electronic equipments.

Developed originally for Service applications such as guided missiles and fire control systems, they will provide designers with types specially suited to all electronic applications where space is limited and where shock of impact or high g vibration is encountered.

The electrical performance of these subminiatures is equal to, and in certain cases even better than, that expected from valves of a much greater size. The EF72 R.F. amplifier, for example, which is suitable for use in the first stage of telecommunications receivers, combines many of the qualities of larger low-noise receiver input valves, with the ability to work at higher frequencies.

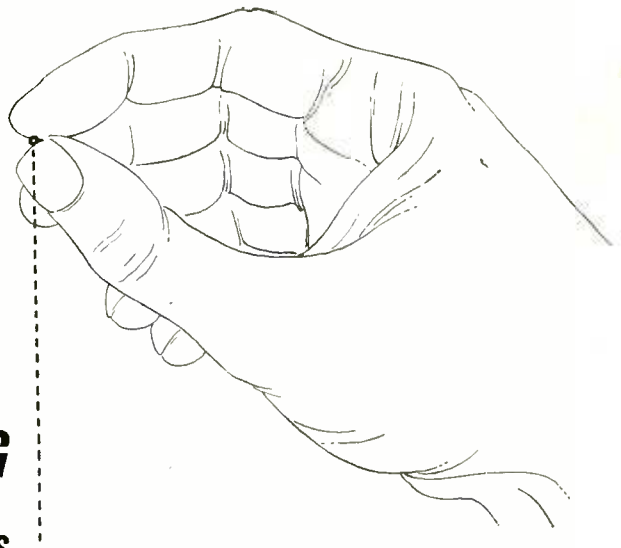
To enable experimental and development work to be carried out with these indirectly-heated subminiatures, a limited number of samples can be made available now. Designers who require further information are advised to send their enquiries to the address below as soon as possible.

Type No.	Description	Filament or Heater (V)	Filament or Heater (mA)	$V_a = V_{g2}$ (V)	$-V_{g1}$ (V)	I_a (mA)	I_{g2} (mA)	g_m (mA/V)
EA76	Single diode (5 mm. bulb)	6.3	150	150 (max.)	—	9.0 (max.)	—	—
EC70	U.H.F. triode oscillator	6.3	150	100	2.0	13	—	5.5
EF70	High slope R.F. pentode with short suppressor grid base	6.3	200	100	2.0	3.0	2.5	2.5
EF71	Variable-mu R.F. pentode	6.3	150	100	1.2	7.2	2.2	4.5
EF72	High slope R.F. pentode	6.3	150	100	1.4	7.0	2.2	5.0
EF73	High slope pentode for industrial applications	6.3	200	100	2.0	7.5	2.5	5.25
EY70	Half-wave rectifier	6.3	450	250 (max.)	—	45 (max.)	—	—
DY70	High voltage rectifier (directly heated)	1.25	140	10KV (P.I.V.)	—	2.0 (max.)	—	—

Mullard

MULLARD LTD., COMMUNICATIONS & INDUSTRIAL VALVE DEPT., CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2

MVP 130



FAULTLESS FLUXING

GIVES

PRECISION SOLDERING

DEMANDS Superspeed

* Enthoven Superspeed has a continuous stellate core of ACTIVATED Rosin which gives an exceptionally high wetting and spreading power, enabling the flux and solder to be drawn rapidly by the force of capillary attraction into restricted spaces, even in the vertical plane. The activating agent volatilizes at soldering temperature.

* The distinctive stellate core ensures a more rapid release of flux and therefore immediate wetting by the solder, at moderate soldering-bit temperatures that lessen the risk of alteration to the electrical and mechanical properties of components.

* The flux in Enthoven Superspeed is always released in exactly the correct proportion. Dry and H.R. joints due to underfluxing or overfluxing cannot occur. One application of Superspeed always does the job effectively.

* The residue from Superspeed flux is non-corrosive and non-hygroscopic. It solidifies immediately to a hard, transparent film of high dielectric strength and insulation resistance.

SAVES TIME, CUTS COSTS

Superspeed

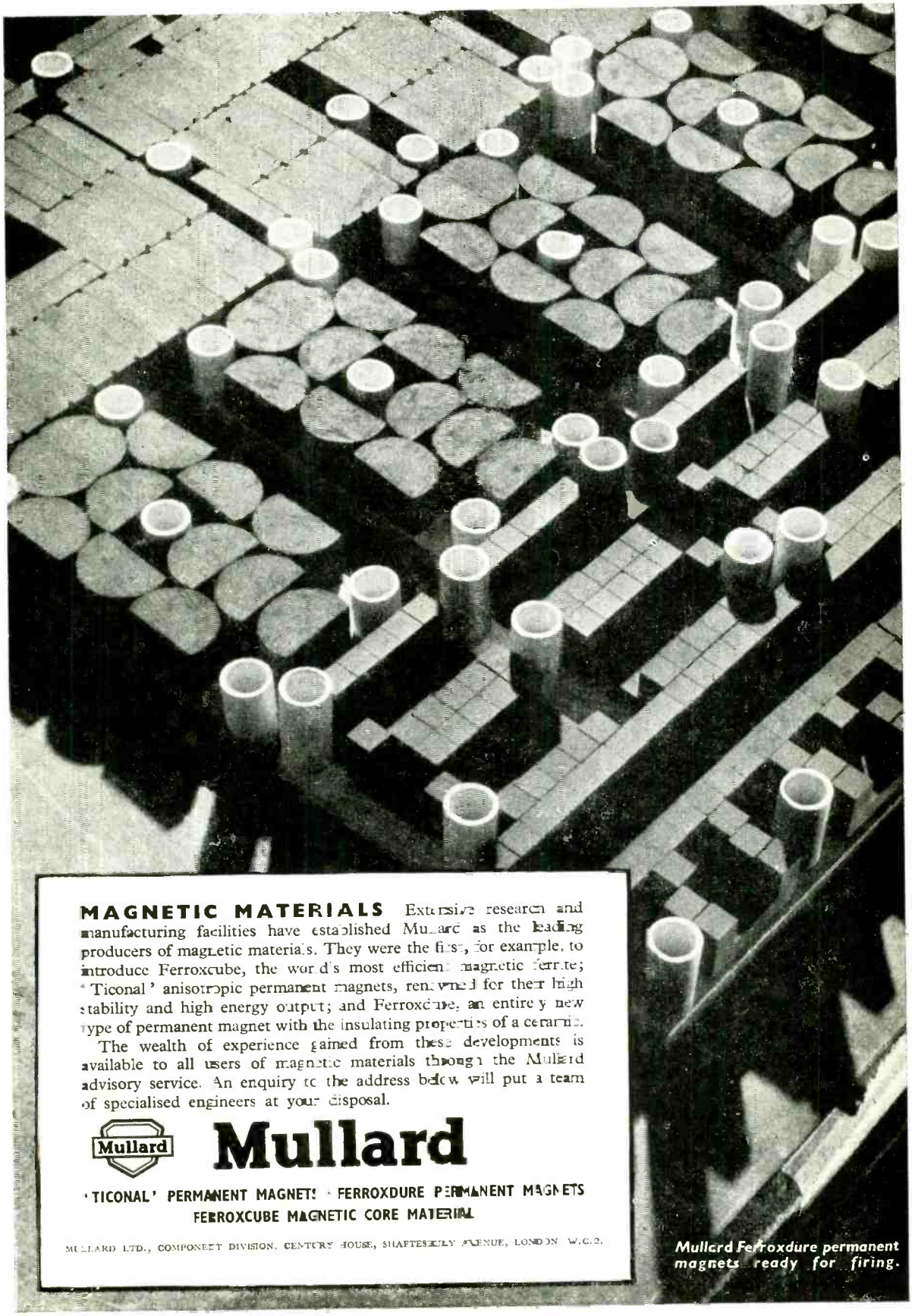
"WHITE FLASH" *activated rosin-cored solder for general electrical, electronic and telecommunication work, and all standard uses. A.I.D. and G.P.O. approved. Complies with M.O.S. Specification DTD 599.*

AN ENTHOVEN PRODUCT

ENTHOVEN SOLDERS LTD.

Enthoven House, 89, Upper Thames Street, London, E.C.4, Tel: Mansion House 4533 will gladly send you their comprehensive Superspeed booklet. Technical advisers are available for free consultation.

3174/2



MAGNETIC MATERIALS Extensive research and manufacturing facilities have established Mullard as the leading producers of magnetic materials. They were the first, for example, to introduce Ferroxcube, the world's most efficient magnetic ferrite; 'Ticonal' anisotropic permanent magnets, renowned for their high stability and high energy output; and Ferroxdure, an entirely new type of permanent magnet with the insulating properties of a ceramic.

The wealth of experience gained from these developments is available to all users of magnetic materials through the Mullard advisory service. An enquiry to the address below will put a team of specialised engineers at your disposal.

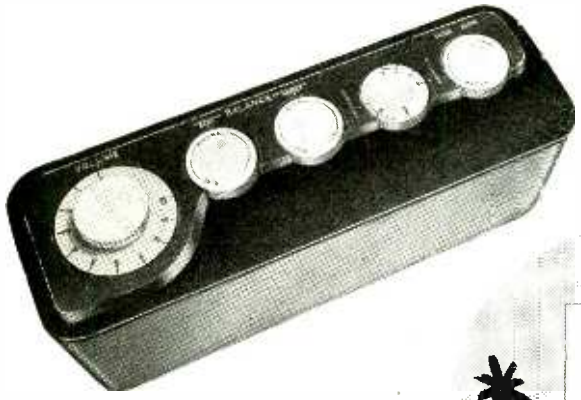
Mullard **Mullard**

'TICONAL' PERMANENT MAGNETS · FERROXDURE PERMANENT MAGNETS
FERROXCUBE MAGNETIC CORE MATERIAL

MULLARD LTD., COMPONENT DIVISION, CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON W.C.2.

Mullard Ferroxdure permanent magnets ready for firing.

A POINT OF DETAIL No. 3 ★



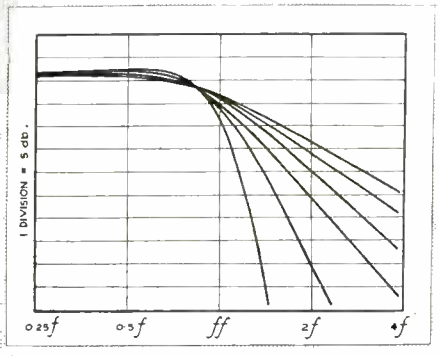
SLOPE . . .
and its rate of change

The present possibility of using wide range loudspeakers for the reproduction of commercial programmes inevitably involves some control over bandwidth if the highest quality is to be obtained at all times.

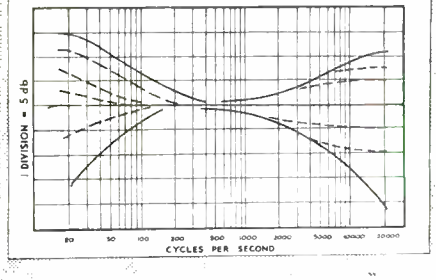
The three main desirable variables are
(a) control of final slope of attenuation,
(b) control of rate of change of slope,
(c) control of frequency of turnover.

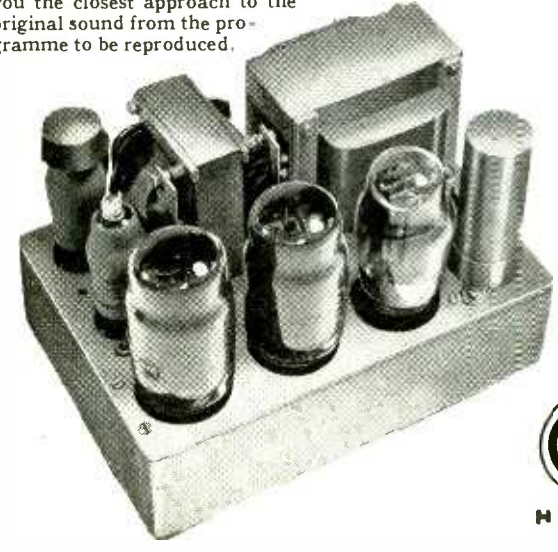
In the Q.U.A.D. amplifier, the final slope and the rate of change of slope are combined in a single continuously variable control with a range as shown.* The whole characteristic may be switched into the harmonic range at two frequencies. In this way the rate of change need be no more than is required by the programme.

The above is just one more reason why the Q.U.A.D. amplifier will give you the closest approach to the original sound from the programme to be reproduced.



Curves of response provided by bass and treble controls.





THE Q.U.A.D. AMPLIFIER

COMPLETE IN TWO UNITS AS ILLUSTRATED

£35

Write for the Q.U.A.D. booklet . . .

ACOUSTICAL MANUFACTURING CO LTD

HUNTINGDON · HUNTS · TEL: 361

IT'S NEW—IT'S TRUVOX

TRUVOX TAPE DECK MARK III

These are the main features :—

1. Three motor drive.
2. " Drop-in " Tape loading.
3. Push-button control, electrically and mechanically interlocked.
4. Separate push-button brake.
5. " Fast-forward " and " fast-rewind " without tape wear.
6. Silent drive eliminating " wow " and " flutter."
7. Half-track working, and two Tape speeds of 7½ inches per second, or 3¾ inches per second.
8. Visual playing-time indicator.
9. With a suitable amplifier, the equipment covers a frequency range from 50-10,000 c.p.s. at 7½ inches per second.

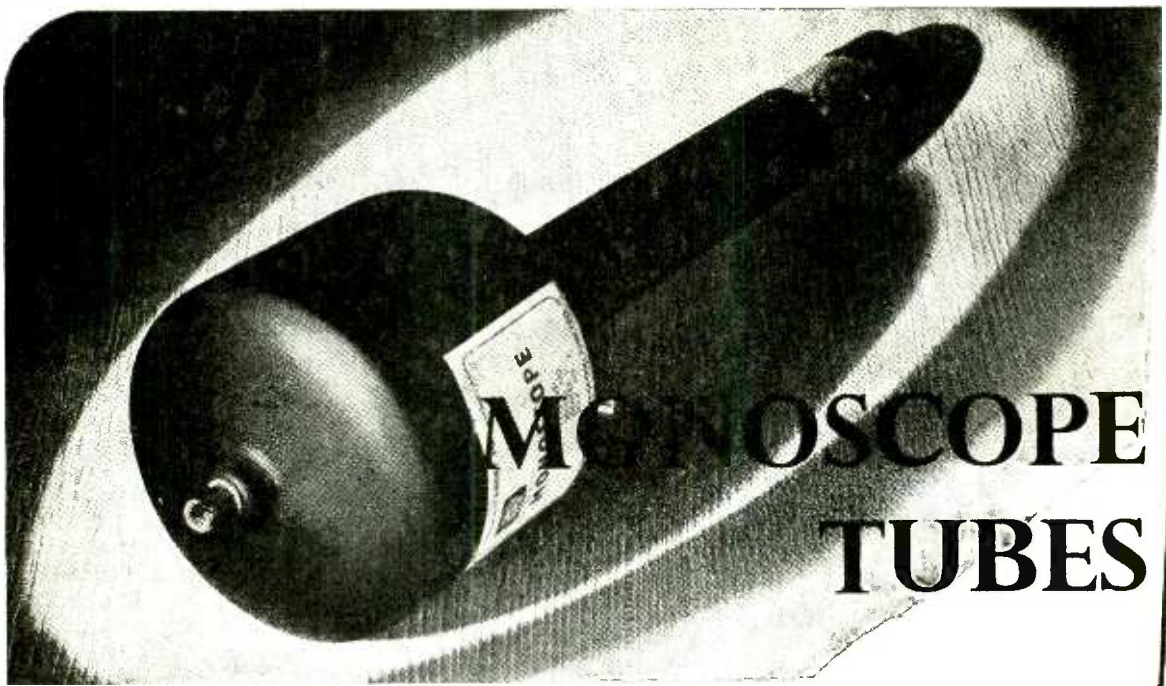
The deck is designed for building into complete recorders which can be handled by inexperienced personnel

22 Gns
MODEL TR2
200/250 volts
A.C. mains only

... and it's available **NOW!**

TRUVOX LIMITED
EXHIBITION GROUNDS WEMBLEY MIDDX
Telephone : Wembley 1212

Sole distributors to the Wholesale Trade for Rola and Celestion Speakers



MONOSCOPE TUBES

THE Monoscope is basically a simple caption scanner apparatus capable of providing a video signal derived from a fixed pattern within the tube.

Almost any pattern comprising pure line, halftones or a combination of both can be supplied on receipt of specific requirements, and two standard types are available.

Type J.101 — Test Chart "A"
Type J.201/XI — Test Chart "C"

TYPICAL OPERATING DATA

Deflection	*electromagnetic*
Focus	*electrostatic*
Vh	6·3 *V*
Vg (cut-off)	−50 *V*
Va1	1200 *V*
Va2 (focus)	800/850 *V*
Va3 (wall)	1200 *V*
V target	1160/1200 *V*
I target	5 *μA*

Resolution better than 500 lines
Video Signal 0.5μA peak to peak (min)

CINEMA-TELEVISION LIMITED

A Company within the J. Arthur Rank Organisation

WORSLEY BRIDGE ROAD · LONDON · SE26

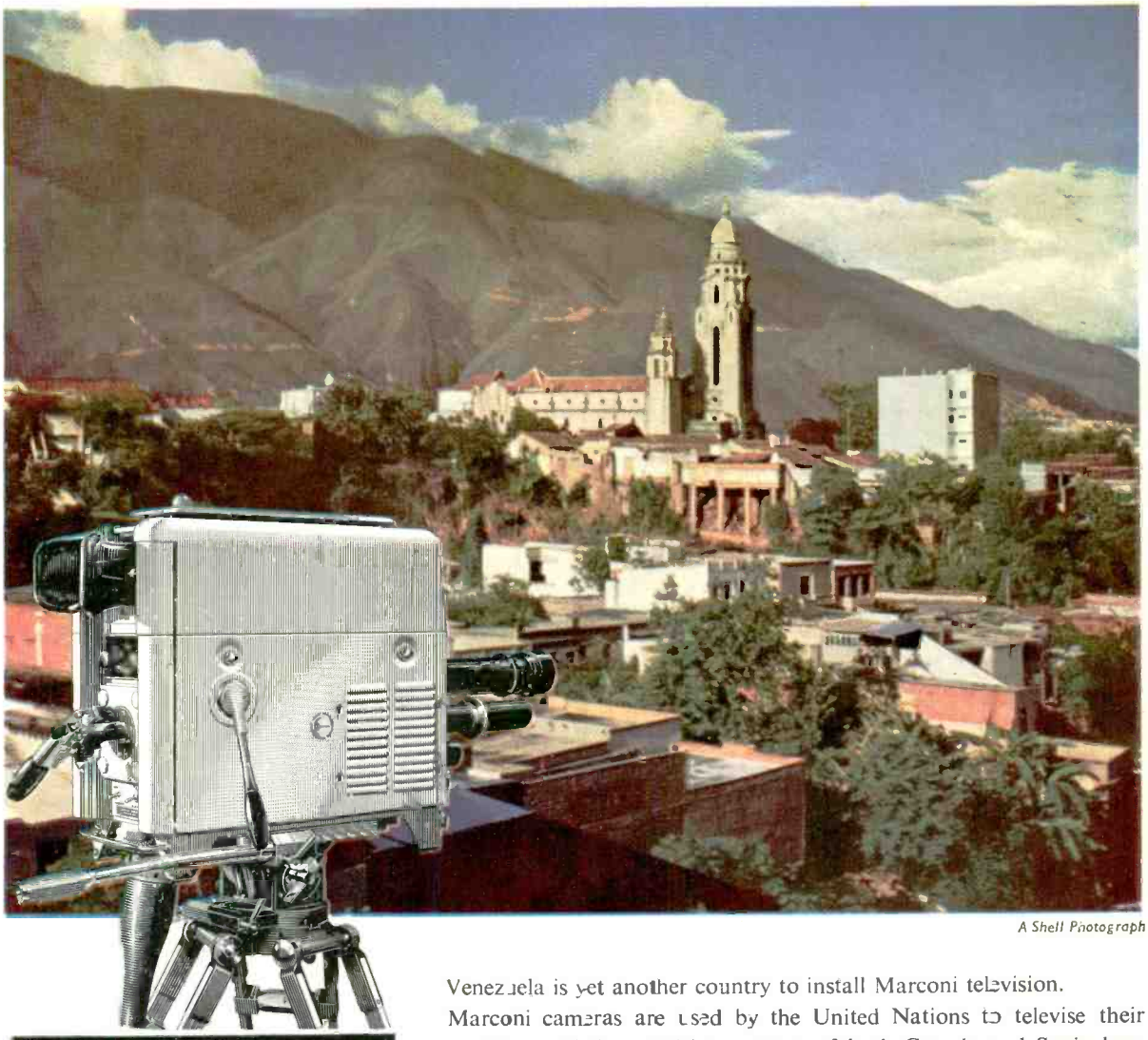
Telephone: HITher Green 4600

SALES AND SERVICING AGENTS

F. C. Robinson & Partners Ltd., 287 Deansgate, Manchester, 3
Hawnt & Co., Ltd., 59 Moor St., Birmingham, 4
Atkins, Robertson & Whiteford Ltd., 100 Torrisdale Street, Glasgow, S.2

CINTEL
REGISTERED TRADE MARK

Marconi Television for Venezuela



A Shell Photograph

Equipment purchased by 'Televisa' for their Caracas Station, includes:

- 5 kw vision transmitter
- 3 kw sound transmitter
- Complete mobile O/B television unit, with two camera channels and micro-wave links.
- Associated aerial system
- Complete studio installation

Venezuela is yet another country to install Marconi television. Marconi cameras are used by the United Nations to televise their Sessions, and the television systems of both Canada and Spain bear the name Marconi.

Marconi transmitters and aerials have been installed in every one of the B.B.C.'s five television stations.

MARCONI

television transmitting equipment

MARCONI'S WIRELESS TELEGRAPH CO., LTD · CHELMSFORD · ESSEX · ENGLAND

A*

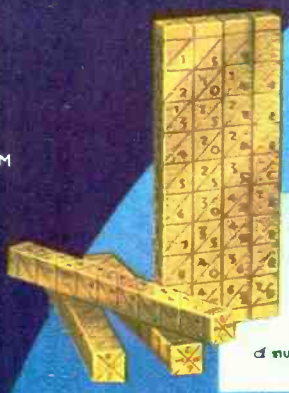
PROGRESS

in Counting ~ through the ages

HISTORICAL ILLUSTRATIONS BY COURTESY OF THE SCIENCE MUSEUM LONDON.

ROMAN ABACUS

Known to have been in use at the time of Julius Caesar. A surviving specimen is preserved in La Bibliothèque Nationale, Paris.



NAPIER'S BONES

Devised in 1617 by John Napier, a Scottish nobleman, as a mechanical means of multiplication by addition.

Cold Cathode Tubes

FOR

Modern

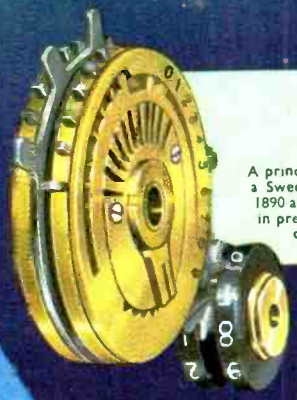
COUNTING · CALCULATING
SELECTING · SWITCHING

LEIBNITZ'S STEPPED RECKONER

Invented in 1694 by the German philosopher and incorporated in the earliest practicable calculating machines

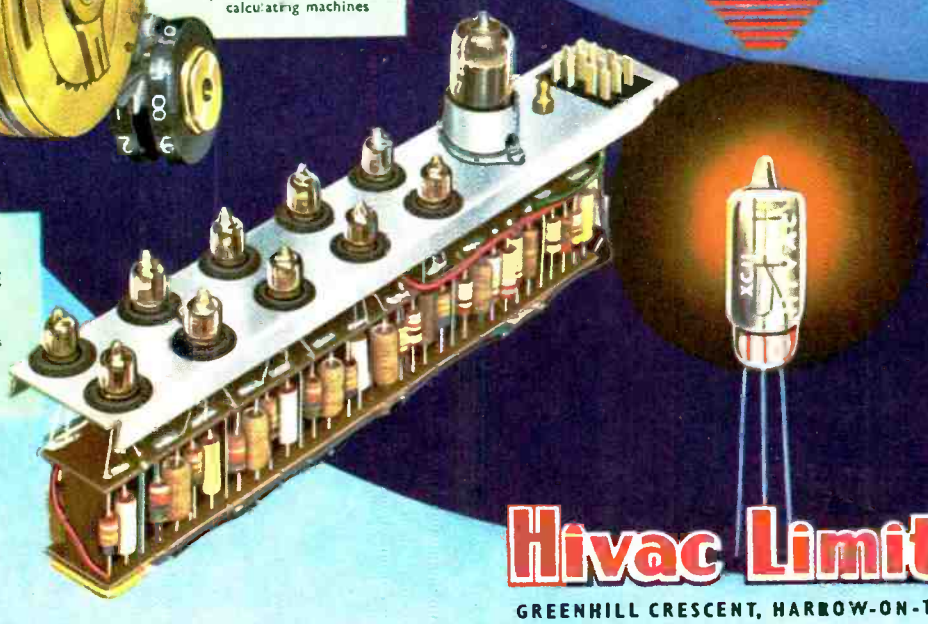
HIVAC

THE SCIENTIFIC VALVE



ODHNER'S WHEEL

A principle first evolved by a Swedish engineer about 1890 and still being applied in present day mechanical calculating machines



HIVAC COLD CATHODE TUBES

The most modern devices for use in electronic systems.

Hivac Limited

GREENHILL CRESCENT, HARROW-ON-THE-HILL
MIDDLESEX, ENGLAND

Phone: HARrow 2655 *Cables: Hivac, Harrow*

HIVAC Cold Cathode Tubes—Miniature and Subminiature Valves—Electrometer Valves—Neon Indicator Lamps—Telephone Switchboard Lamps—are used by the world's leading manufacturers.

VALVES, GERMANIUM CRYSTALS AND CATHODE RAY TUBES FOR TELEVISION

This table consists of the latest additions to our television range, namely B309, N309, LN309, U329 and 6901A, together with the well established television valves, germanium crystal diodes, and cathode ray tubes.

Vision Mixer	Vision Amplifier	Video Detector	Video Amplifier	Sync. Separator	Line Osc.	Line Output	Booster Diode	EHT Rectifier
B309 X79 GEX66 Z77	Z77	GEX35	N309 Z77	Z77	B309 L77 Z77	N339	U329 U319	U37
Frame Osc.	**Frame Amplifier**	**Sound Channel A.F. Amplifier**	**Sound Channel A.F. Output**	**Sound Channel Detector**	**Noise Limiter**	**Spot Limiter**	**Power Rectifier**	**Cathode Ray Tube**
½ LN309 B309	½ LN309 N37	½ LN309	½ LN309	GEX44/1	GEX44/1	GEX44/1	U309	16″ 6901A 12″ 6705A 12″ 6706A 9″ 6504A 9″ 6505A

The B309 is a B9A based double triode, suitable for vision mixer or time-base oscillator application. The valve has separate cathodes and a 12.6 volt, 0.15 amp. heater which is centre tapped for 6.3 volt or series operation at 0.3A.

The recent introduction of large screen television receivers using higher EHT voltages and wide scanning angles has necessitated increased power and efficiency in scanning and video amplifier circuitry. The N309, a B9A based pentode, has been developed for use as a video power amplifier to produce the increased drive required. A booster diode U329, having a heater to cathode insulation of 7.5 kV and a PIV of 7 kV necessary to withstand the high peak voltages encountered in the primary of the line output transformer, results in higher energy recovery; its 0.3 amp. heater permits series operation.

The LN309 is a small output tetrode combined with a medium impedance triode mounted on a B9A base. The systems are completely separate, except for the common heater, and these lend themselves to both sound AF amplifier and output, or frame oscillator and output channels.

The 6901A 16″ cathode ray tube has a 70° scanning angle resulting in an overall length actually less than that of the G.E.C. 12″ tubes. The screen is aluminised, as is common practice with G.E.C. Television tubes, and a sensibly flat screen is provided giving a wide viewing angle.

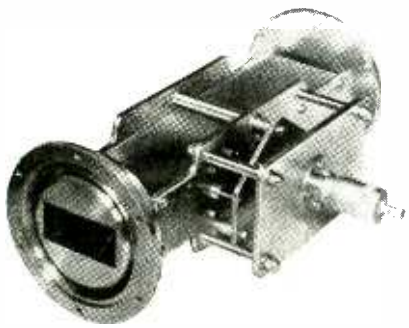
Germanium diodes have numerous advantages such as small size, low capacitance and high forward conductance, and their use is now firmly established in current T.V. practice. The most common applications are vision detector (GEX35), sound detector (GEX44/1) and sound limiter (GEX44/1). For the home constructor and experimenter they are particularly attractive since heater wiring and valve holders are not required, and they can be tried with great ease in various circuit arrangements.

Data on specified valves, C.R.T. and Germanium Crystals is available on request from the Osram Valve and Electronics Dept.

Microwave Test Gear

Metropolitan-Vickers Electrical Company announce a complete range of precision microwave test gear for use in 3 in. x 1½ in. waveguide over a band of wavelengths from 10 cm. to 11 cm.

1



2

3

4

5

6

1 PRECISION ATTENUATOR Type 501

2 MATCHED LOAD Type 506

3 OSCILLATOR Type 508

4 FIXED ATTENUATOR Type 519

5 SHORT CIRCUIT Type 510

6 DIRECTIONAL COUPLER Type 504

Other Metrovick microwave equipment includes variable attenuator type 502, standing wave detector type 512, wave meter type 517, high power load type 515, S & X band spectrometer type 518.

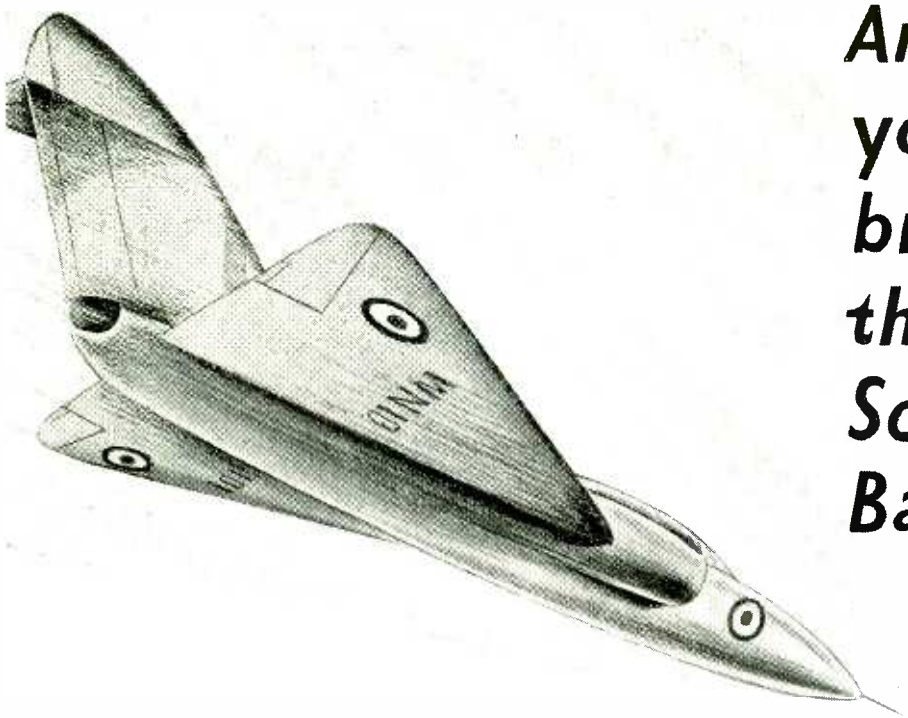
Full technical details will be sent on request.

METROPOLITAN-VICKERS ELECTRICAL CO. LTD., TRAFFORD PARK, MANCHESTER 17

Member of the A.E.I. group of companies

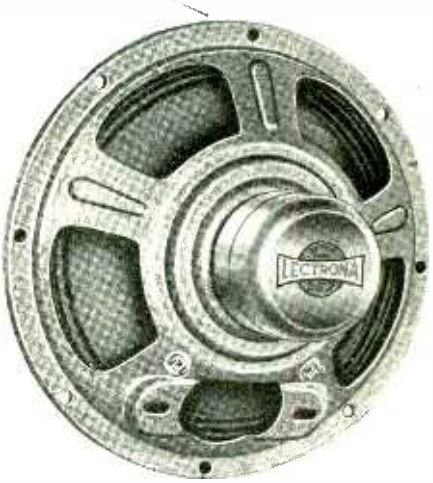
METROVICK *Test gear for the microwave laboratory*

R/E 203



Are you breaking the Sound Barrier?

The amplifying stages of your equipment may be generously designed with plenty of inverse feedback and the electrical characteristics may be 99.9% perfect, but the transition from electrical to acoustic energy may present a serious barrier. **LECTRONA** speakers, incorporating many special design features, will enable you to penetrate this sound barrier with high efficiency and minimum distortion. A wide range of models is available for radio requirements and other special technical applications.



STANDARD TYPE C.6104
Diameter 6½in.
Flux density 10,000 lines per sq. cm.
Peak power handling capacity (speech and music) 4 watts.
Speech coil impedance, 3 ohms at 400 cycles.
Frequency response chosen to suit requirements.

Other models are available in this diameter, with alternative values of flux density and power handling capacity

LECTRONA LOUDSPEAKERS

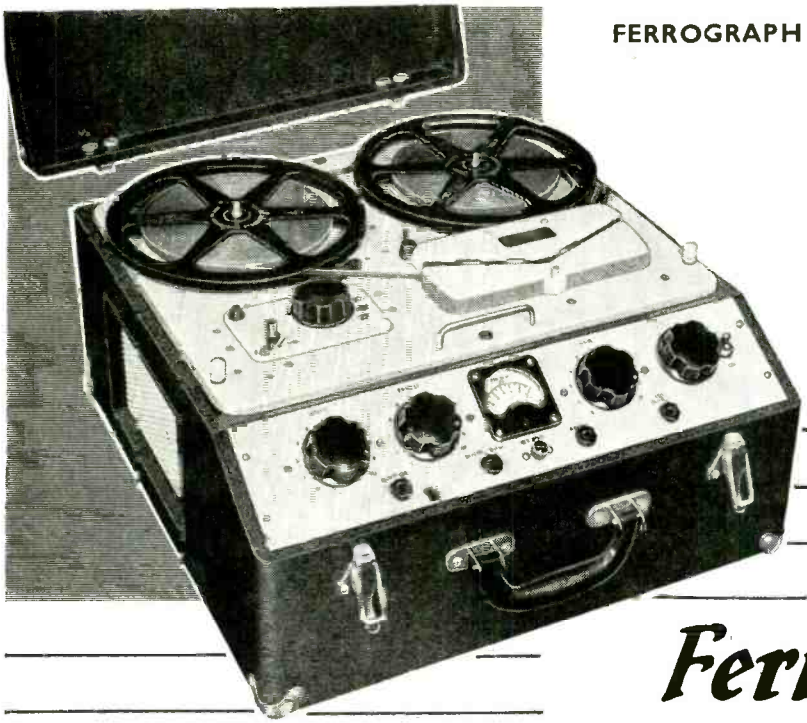
Designed and Manufactured by

ACOUSTIC PRODUCTS LIMITED

STONEFIELD WAY, VICTORIA ROAD, S. RUISLIP, MIDDX. Phone : Ruislip 6093 4

SALES: **EDSTONE LIMITED**

15 BUCKINGHAM PALACE GARDENS, LONDON, S.W.1. Phone : Sloane 0621



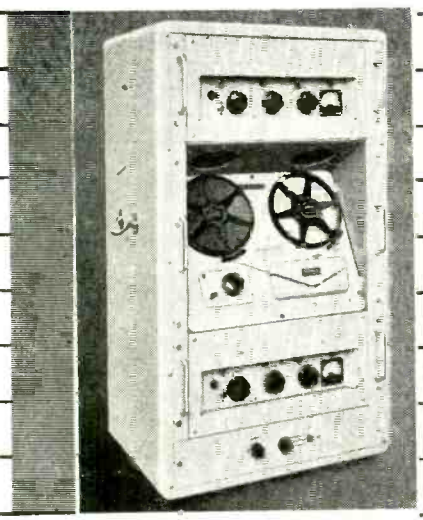
FERROGRAPH MODEL "2A"

Four years ago the first Ferrograph made its appearance, and it has remained virtually unchanged since that date. Now a new model—2A—is offered. Mechanically the same, sound time-proved recorder but incorporating those extra features called for by the many discriminating Ferrograph users.

• Synchronous Capstan Motor • Ability to use 1800 feet reels • Redesigned monitor-meter circuit • Lighter weight • More convenient carrying shape • Greater ease of manipulation • Even lower hum levels and still better performance.

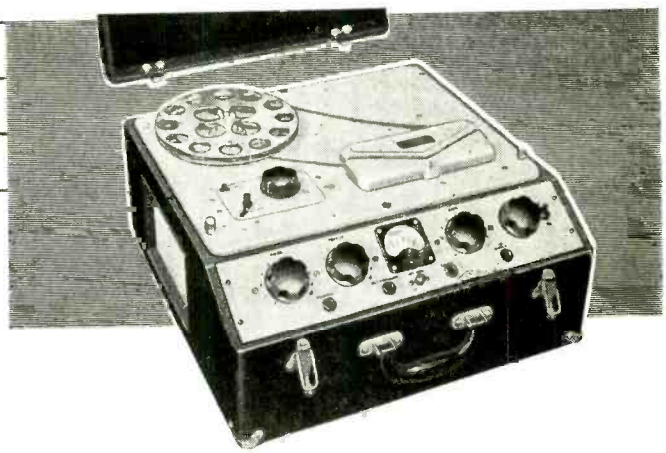
Ferrograph

MAGNETIC TAPE RECORDERS



FERROGRAPH ENDLESS LOOP RECORDER

A memory-loop recorder providing recording and continuous repetition of intelligence at periods variable from a few seconds up to twenty minutes. Can be supplied also for simultaneous dual-track working and with monitoring facilities.



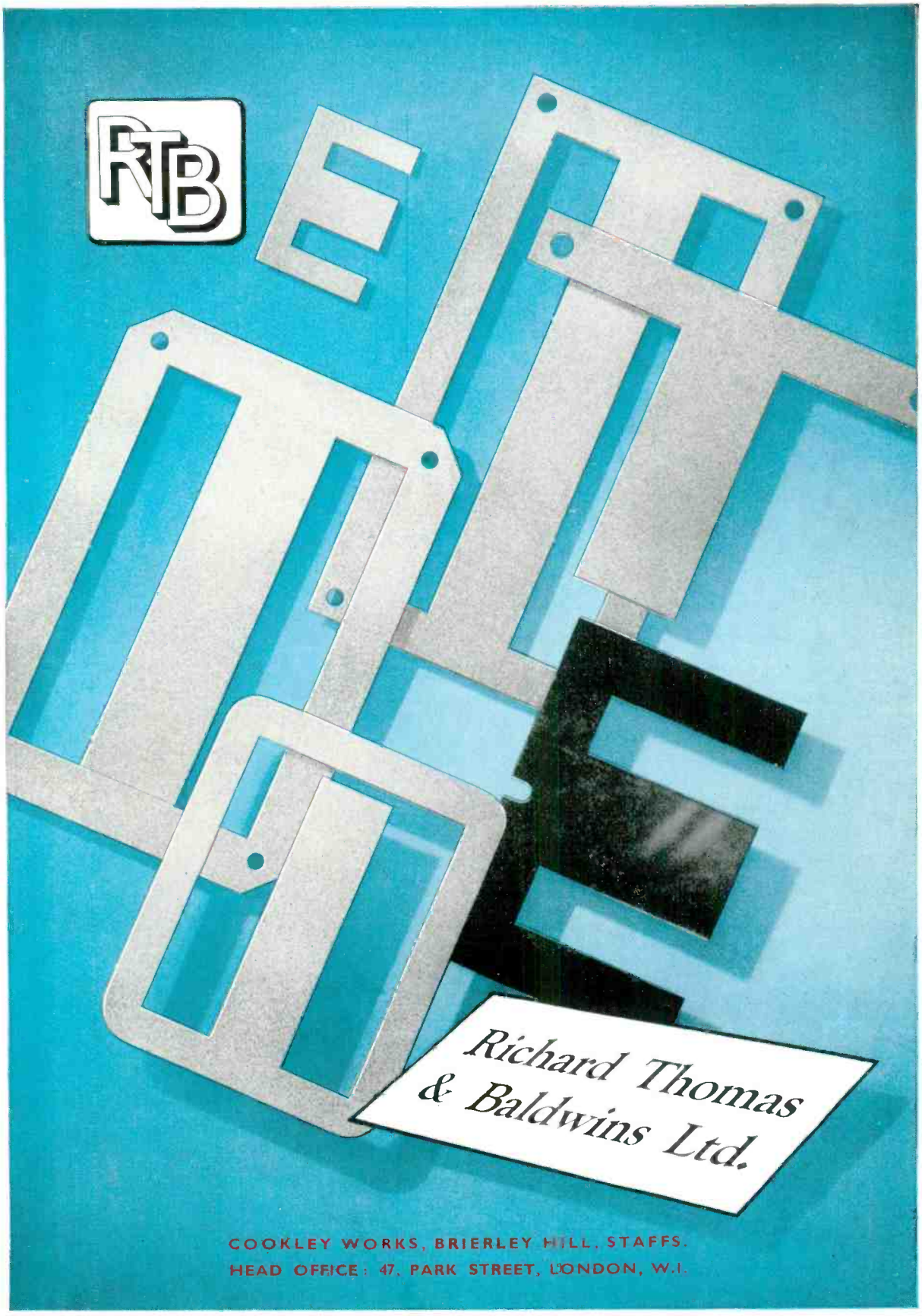
FERROGRAPH DUAL-TRACK TYPE "YDC" EQUIPMENT

A dual-track recorder and reproducer housed in a metal instrument cabinet measuring 24" x 15" x 36" high. Based on the Wearite Type "C" Tape-Deck, it has provision for three operational speeds, viz.—7½", 3¾" and 1⅞" per second—and has as an optional fitment a voice/signal operation unit whereby the available recording time of a reel may be considerably extended.

Designed and manufactured by Wright and Weaire, Ltd. for

British Ferrograph Recorder Co. Ltd.

138 SLOANE STREET, LONDON, S.W.1



REDIFON R50M
Supreme, world-wide, communications receiver for civil, military, naval, aeronautical, meteorological, and other services.

ADEN • ANGOLA • ARABIA • ARGENTINA
AUSTRALIA • BAHREIN • BELGIUM • BERMUDA
BORNEO • BRITISH ISLES • BRITISH WEST AFRICA
BURMA • CAMEROONS • CANADA
CEYLON • CHANNEL ISLANDS
CHINA • COLOMBIA
CYPRUS • CZECHO-SLOVAKIA
DENMARK • DUTCH EAST INDIES
ECUADOR • EGYPT
FALKLAND ISLANDS
FIJI ISLANDS
FINLAND
FRANCE
FRENCH W. AFRICA
GAMBIA
GOLD COAST
GREECE
GUIANA BRITISH
GUINEA PORTUGUESE
HOLLAND
HONG KONG
HUNGARY
ICELAND • INDIA

YUGOSLAVIA
VENEZUELA
U.S.S.R. • UGANDA
TURKEY • TUNISIA
TRINIDAD
TANGANYIKA
SYRIA
SWITZERLAND
SWEDEN • SUDAN
SPAIN • SOUTH AFRICA
SOMALILAND
SIERRA LEONE
SHIPS AT SEA
SARAWAK
RUMANIA • PORTUGAL

★ ★ ★

Redifon

LINKS

Nation to Nation • Town to Town
Village to Village • Ship to Shore
Ground to Aircraft

Radio Telegraph, Telephone and frequency shift Teleprinter; high, medium and low power Transmitters; Communications and Diversity Receivers.

★ ★ ★

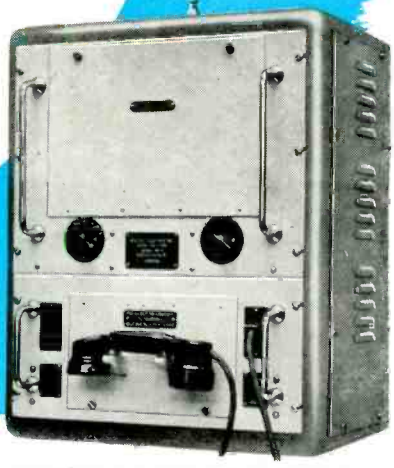
REDIFON LIMITED

Aviation Communications Division

BROOMHILL ROAD
LONDON, S.W.18
ENGLAND

IRAN • IRAQ • IRELAND • ITALY
JAMAICA • JERSEY • JORDAN
KENYA • LEBANON • LYBIA
MALTA • MAURITIUS • NEW ZEALAND • NIGERIA • NORWAY
N. RHODESIA • PAKISTAN
PARAGUAY • POLAND

REDIFON G67
2½ kW Channelised H.F. Transmitter, designed for general purpose long distance communications.



REDIFON G.R.49D Equally suitable for fixed, transportable and mobile installations. The G.R.49D. is a complete transmitting and receiving station providing both Telephony and C.W. Services.

C

miniature in size...

mighty in performance

Little wonder that OSMOR "Q" RANGE COILS are the "big noise". No imitation, regardless of price, can compare with them for super selectivity and sensitivity. And you don't just have to take our word for it—the watertight guarantee makes your satisfaction certain! Consider these points of superiority:—

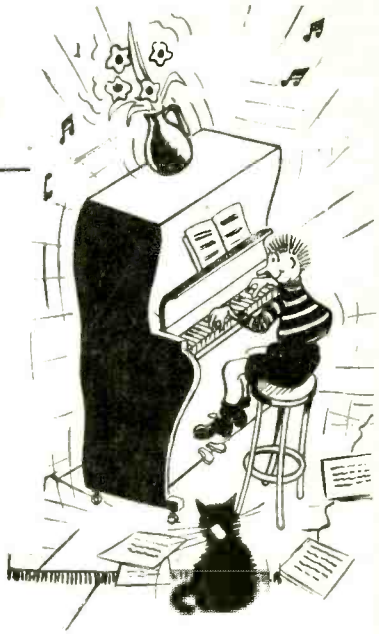
★ **Only 1 in. high.**
★ **Variable iron dust cores.**
★ **Low loss Polystyrene formers.**
★ **Packed in damp-proof containers.**
★ **Fitted tags for easy connection.**

COILPACKS. A full range is available for Superhet and T.R.F. Mains or Battery. Size only 1⅞in. high x 3½in. wide x 2½in. Ideal for the reliable construction of new sets, also for conversion of the 21 RECEIVER, TR 1196, TYPE 18, WARTIME UTILITY and others.

Aligned and tested, with full circuits, etc. Fully descriptive leaflets available.

WARNING!!

Any coils from fire, salvage or similar sources are not subject to our guarantee and service. Buy from reputable sources only.



Outstanding OSMOR *Quality Lines of Interest*

You'll get a shock—

the first time you hear your own voice! Have fun and find endless pleasure in using an **inexpensive TAPE RECORDER** you can build yourself. We can supply all the parts to make a really efficient unit, utilising your gramophone turntable (which can still be used for its normal purpose). Send **2/6** only for easy-to-follow blueprints and instructions, or ask for details.

CRYSTAL MICROPHONES

As used in the Tape Recorder mentioned above and for almost any equipment where quality at a low price is desired.

ACOS 22-2. Table or hand model, as illustrated, including removable base. Uniform response. 40-6,000 c/s. **£6/6/-.**

ROTHERMEL 2AD56. Black anodised finish, as illustrated, for hand or table use. Tapped to fit any standard base. (Table-bases available shortly at approximately **10/-** each.) Uniform response. 30-10,000 c/s. With cable, **£2/19/6.**

FOUR for the Price of TWO!
The NEW OSMOR CHASSIS CUTTER!

of entirely new design. Cuts two sizes of holes with any one reversible punch and die; and can be operated with a spanner or tommy-bar. Blanks easily removed.

Punch and Die sizes:
No. 2—⅞ × 1⅛in.
No. 3—1⅜ × 1¾in.
Enquiries for other sizes are welcomed.

Supplied complete with *both* No. 2 and No. 3 punches and dies for **30/-** (postage and packing 1/3) or **16/-** *one* punch and die only. (Please state which.)

The OSMOR "JIFFY PUNCH" cuts a ⅜" hole with one blow of a light hammer. Complete with punch and die....**5/9** post free.

A spotlight on just one of the range of Osmor "Q" coils.

H.F. CHOKE Type Q.C.1.

Frequency coverage 150 kc/s. to 20 m/c.
Iron-dust core and single-screw fixing
Prototype tested and approved by M. G. Scroggie, B.Sc., M.I.E.E. Ideal as anode load in TRF receivers, for decoupling and general purposes. Price **4/-**.

We keep stocks of many radio components for use in published circuits, including the following:

"WIRELESS WORLD"
"NO COMPROMISE" TRF TUNER, by W. Winder, A.M.I.E.E. (Osmor coils QA11 and QHF11 for M.W. and QA12 and QHF12 for L.W. are suitable, price **4/-** each.)
"MIDGET MAINS RECEIVER," by W. Amos (Osmor coils QA11 for M.W. and QA12 for L.W. are suitable. Price **4/-** each.)
"PRACTICAL WIRELESS"
"3-SPEED AUTOGRAM."
"MODERN 1-VALVER."
"A.C. BAND-PASS 3."
"R1155 CONVERTER."

I.F.s. 465 k/c. Permeability-tuned, with flying leads. Standard size 1⅜in. x 1⅜in. x 3½in. For use with OSMOR coilpacks and others, **14/6** pair. REALIGNED, 1/6 extra.

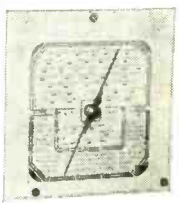
Dear Reader,

We can't mention all our products here, but shall be glad to receive your enquiries. If it's top-quality components and a speedy, courteous service you are looking for—try Osmor. We really shall do our best for you.

Keep those small components—resistors, condensers, etc., neatly stored yet visible, by using an

OSMOR "JAR-RACK"

(If you're a generous husband you'll buy one or two for your wife's larder, too—she will appreciate somewhere to store her preserves.) Holds any 1 lb. jam jars which are easily removed but cannot fall out. Just the thing for the tidy "HAM" or Radio Dealer.
Type 1 for wall-fixing, as illustrated, **6/9** each, holds 8 jars. (Jars are not supplied but are easily obtained.)
Length 24in., enamelled olive green.
Type 2 for screwing under a shelf, **5/9** each, holds 6 jars.
Length 18in., enamelled green. P. & P. 1/-.
(Trade discount allowed to Dealers.)



DIALS

Metal dials, overall size 5⅜in. square, as illustrated. Cream background, 3-colour. Type M1, L.M.S. waves. M2, L. & M. waves. M3, M. & 2 S. waves. Price **3/6** each.

Pointer, **1/6**; Drum, Drive, Spring and Cord, **3/2.**

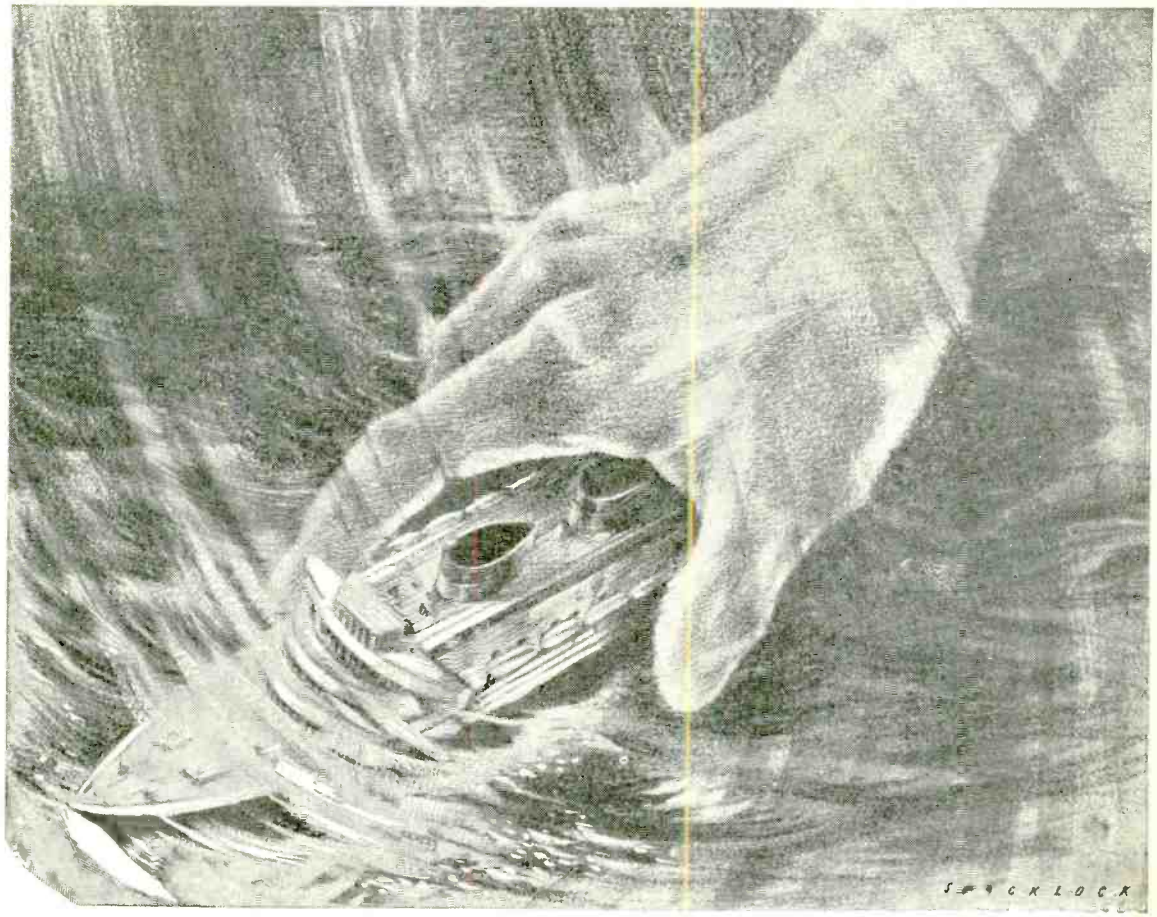
Type A glass dial assembly, measuring 7in. x 7in. (9⅛in. x 9⅛in. overall). Mounts in any position. Choice of two 3-colour scales, **24/6.** P. & P. 1/6.

FREE! *Send 5d, (stamps) for* **FREE CIRCUIT** *and full lists of coils, coilpacks and radio components.*

Osmor Radio Products Ltd.

(Dept. W.37) BRIDGE VIEW WORKS, BOROUGH HILL, CROYDON. SURREY. *Telephone:* **Croydon 5148/9**

C*

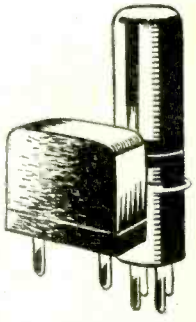


keeping in touch ... with G.E.C. QUARTZ CRYSTAL UNITS

Reliable radio communications must be maintained under all conditions. Only first-class components are good enough for the radio equipment, on which many lives may depend

Quartz Crystal Units are a most vital component, be sure you use the best.

Write for list Q.C. 5012(R)



SALFORD ELECTRICAL INSTRUMENTS LTD

A Subsidiary of THE GENERAL ELECTRIC CO. LTD. OF ENGLAND

PEEL WORKS · SILK STREET · SALFORD 3 · LANCS.

AND NOW!! – the RONETTE

MINIWEIGHT CRYSTAL PICK-UP, *with response up to* 14,000 *c/s.*

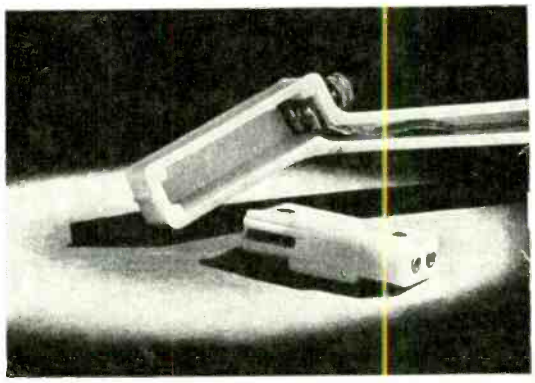
This extremely light-weight high fidelity pick-up is added to the Ronette range for the benefit of the connoisseur, providing the highest possible quality. The Miniweight uses interchangeable cartridges for 78 R.P.M. and Long Playing **with response up to 14,000 c/s.**

RONETTE

Ronette 14,000 c/s. response Miniweight pick-up with one head (Std. or L.P.).

£3.18.0

H.P. Terms £1/6/- deposit and 12 monthly payments of 7/3. Std. or L.P. HEADS ONLY 46/- EACH.



RONETTE

Ronette 14,000 c/s. response Miniweight pick-up with two interchangeable heads for Std. and L.P.

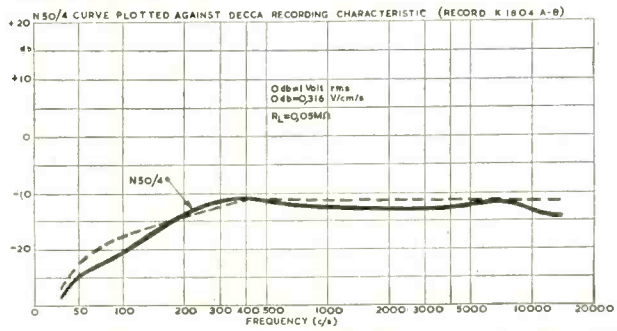
£5.19.6

H.P. Terms, £1/19/6 deposit and 12 monthly payments of 9/6.

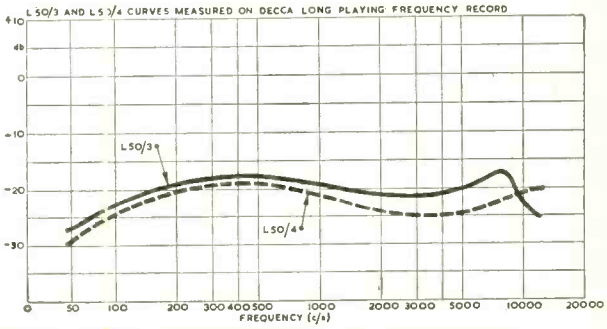
The Miniweight has an extremely light-weight, ivory plastic pick-up arm of scientific design and pleasing appearance. The cartridge holder is offset for minimum tracking error, and cartridge changing is simple. Net weight 2⅛ oz.

Curves for 14,000 c/s. response Ronette pick-ups are below.

STANDARD HEAD N50/4.



L.P HEAD L50/4



WE CAN SUPPLY THE FULL RANGE OF RONETTE X'TAL MICROPHONES AS ADVERTISED IN THIS ISSUE. LEAFLET AVAILABLE ON APPLICATION.

THE GARRARD VARIABLE SPEED TRANSCRIPTION QUALITY MOTOR MODEL 201B/5

This three-speed Motor is a heavy-duty motor, unequalled for performance and quality and specially designed to give long life with continuous running.

Used by the B.B.C. and many other broadcasting stations.

The rotor runs at turntable speed, the heavy rotor and 12" loaded turntable contributing to very even running. Other features:—

- Specially designed, easily replaceable single ball-bearing on main spindle thrust.
- Robust governor, gear and worm.
- Special governor-control cam gives smooth speed control.
- Variable speed control between 33⅓, 45 and 78 r.p.m.

The space required for the 201B/5 is 12¼in. long by 12¼in. wide, with 1 3/16 in. clearance above and 3⅜in. below top of motor board.

PRICE **£24.0.9** *H.P. Terms £8.2.11 deposit and 12 monthly payments of 30/9.*

All 201B/5 Models A.C. 100-250v. 40/60 c/s.

GARRARD AUTOMATIC RECORD CHANGER MODEL R.C.75.

This Record Changer, is a **three-speed** unit which will play batches of 10 records (not mixed), either 10in. or 12in. at 78 r.p.m., 7in., 10in. or 12in. at 33⅓ r.p.m., and 45 r.p.m. large hole records, using Garrard special record spindle.

Minimum cabinet space required: 15½in. long × 13½in. wide with 5¾in. clearance above and 3½in. clearance below top of motor board.

The light-weight pick-up is fitted with an optical indicator, and uses the Garrard turnover magnetic or crystal head as desired.

For A.C. mains 100-250v. 50 c/s

£16.16.0

H.P terms £5.12.0 deposit and 12 monthly payments of 22 -

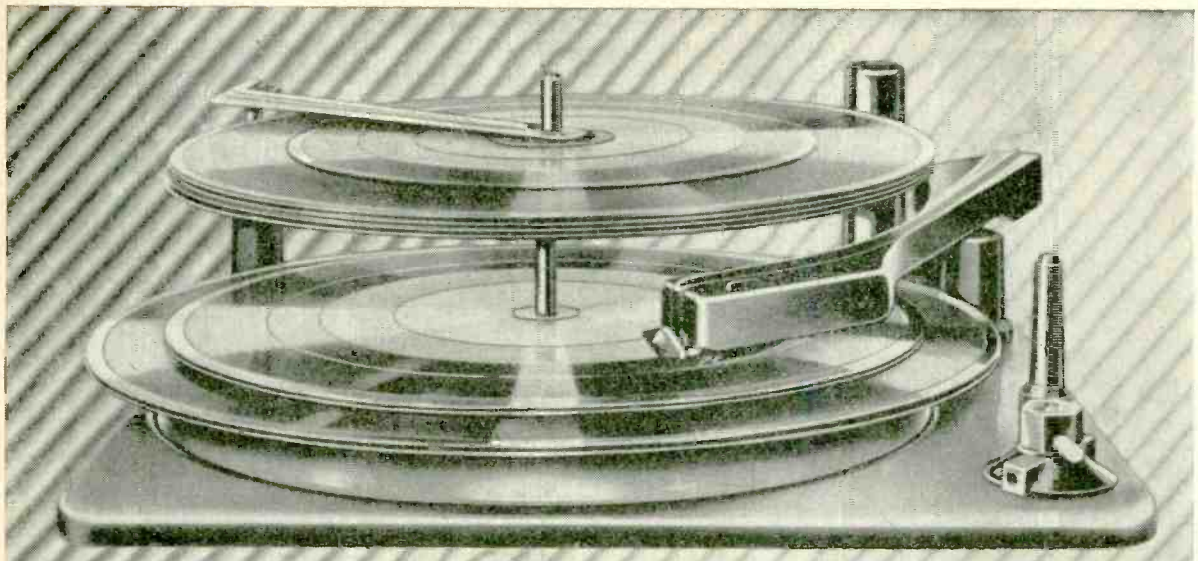
M·O·S

MUSeum 6667

M. & G. MAIL ORDER SUPPLY CO., *The* RADIO CENTRE

Dept. WW, 33, TOTTENHAM COURT ROAD, LONDON, W.1.

D



A record achievement

Discriminating listeners and manufacturers alike have acclaimed the Monarch auto-changer. Its unusual new features, its ease and simplicity of operation and its high standard of reproduction and performance have proved it a masterpiece in design and technical excellence.

Note these outstanding features.

- ★ Automatically selects and plays 7", 10" and 12" records, intermixed, at 33⅓, 45 or 78 r.p.m. Capacity, 10 records.
- ★ New record change mechanism virtually eliminates pause between records.
- ★ New reversible dual stylus crystal pick-up has extended frequency range to 10,000 c.p.s. Self compensated for the L.P. lower frequencies with the Turnover frequency at the correct point.
- ★ Pick-up automatically returned to rest position and motor switched off after last record
- ★ Remarkably compact design makes it an ideal unit for the Radiogram/TV. combination console.
- ★ Simplicity of design guarantees long life and trouble-free operation.
- ★ Beautiful styling and finish that will harmonize with any cabinet design.
- ★ Operates on 100/125-200/250 volts, 50 cycles A.C. Models also available for 60 cycles A.C.

BSR

The REGENT a beautifully styled three speed gramophone. Complete with ingenious automatic stop and light-weight high-fidelity turnover-type crystal pick-up fitted with two permanent sapphire styli.

Birmingham Sound Reproducers Ltd., Old Hill, Staffs. England. Grams: 'Electronic Old Hill, Cradley Heath.'

Wireless World

RADIO, TELEVISION AND ELECTRONICS

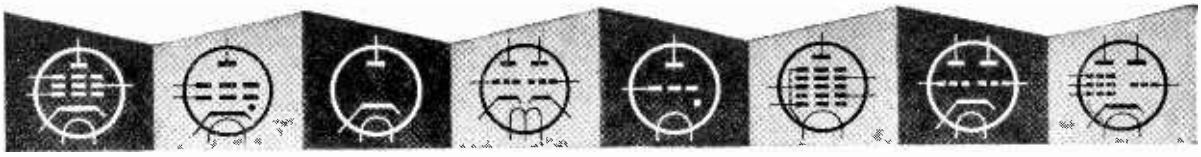
42nd YEAR OF PUBLICATION

Managing Editor : HUGH S. POCOCK, M.I.E.E.
Editor : H. F. SMITH

JANUARY 1953

In This Issue

PUBLISHED MONTHLY (last Tuesday of preceding month) by ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1. *Telephone:* Waterloo 3333 (60 lines). *Telegrams:* "Ethaworld, Sedist, London." *Annual Subscription:* Home and Overseas, £1 7s. 0d. U.S.A. $4.50. Canada $4.00. BRANCH OFFICES: *Birmingham:* King Edward House, New Street, 2. *Coventry:* 8-10, Corporation Street. *Glasgow:* 26B, Renfield Street, C.2. *Manchester:* 260, Deansgate, 3.



VALVES, TUBES & CIRCUITS

1. PREVENTION OF INTERFERENCE BY TELEVISION RECEIVERS

A television receiver is capable of producing interference with broadcast reception over a limited area. This interference is due in the main to induced electric fields and magnetic fields set up in the neighbourhood of the television receiver; re-radiation of parasitic oscillations from the receiver proper is less serious and will not be considered here. The electric field is the more troublesome since it will affect broadcast receivers having ordinary aerials; the magnetic field will influence only that minority of receivers having frame aerials.

The most important sources of interfering electric fields are the line output transformer and associated high potential points; the deflector coils; and high impedance circuits near these components. Since, in general, magnetic fields emanate from the same sources, the measures recommended below will reduce both causes of interference.

(1) The E.H.T. transformer, booster diode and line output valve should be totally screened by a can which makes good contact with the chassis. Two-hole fixing of the can is not entirely satisfactory and it is advisable to make multiple connections between can and chassis. The difference in radiation between a good and a bad connection here may amount to as much as 8 dB for magnetic fields.

(2) Any width or linearity controls of the inductor type should be screened separately if they cannot be accommodated inside the line output screening can.

The design of the line output screening involves problems of ventilation to avoid overheating of the components enclosed by the screen. As a general guide to designers, the maximum safe bulb temperature for the PL81 line output pentode has been determined at 185° C. (design centre rating).

(3) The deflector coils should be screened as far as possible by an aluminium can or by metal foil wound coaxially around the coil and earthed to chassis. Care must be taken to ensure that there is no likelihood of voltage breakdown between the foil and the coils. This form of screening will give good reduction of electric fields and will also reduce magnetic fields but not to the same degree.

To reduce the magnetic field still further, the deflector coil screening can should have endplates with holes only just large enough for the tube neck to pass through. This gives a further reduction of approximately 6 dB.

(4) Care should be taken in the layout of the receiver to keep circuits of high impedance well away from the worst sources of interference.

(5) The graphite coating of the cathode ray tube should be efficiently connected to earth—preferably from two separate points on the coating.

(6) Both conductors of the mains supply should be connected to the earth terminal via 0.05 μF paper capacitors rated for 600 $V_{r.m.s.}$ working.

(7) The use of a perforated foil screen at the back of the set will reduce radiation in that direction.

Mullard

Reprints of this advertisement together with additional data may be obtained free of charge from the address below.

MULLARD LTD., Technical Publications Department, Century House, Shaftesbury Avenue, W.C.2.

MVM 217

Wireless World

JANUARY 1953 VOL. LIX. No. 1

Recording of Broadcasts

MATTERS of copyright are governed in this country by the Act of 1911, which, of course, was framed long before the days of sound and vision broadcasting, and at a time when the art of sound recording was in its infancy. Among the tasks of a Committee appointed in 1951 was to advise the Government whether, in the light of these developments, any changes are desirable in the law of copyright. The Committee's Report,* recently issued, makes many recommendations touching upon technical changes brought about since 1911, but—rather surprisingly at first sight—it does not deal with the question of copyright as it affects the recording of broadcast transmissions in the home. As is well known, equipment for recording on tape is particularly well suited to this purpose and is in fact widely used.

It can, we believe, be argued that home recording of broadcasts for domestic use does not, legally speaking, constitute an infringment of copyright. One could go on to argue that the licensed listener is entitled to 24 hours of entertainment each day, and it is a matter of indifference to anybody whether he listens to "live" transmissions or to home-made records of such transmissions. Further, there is precedent for saying that the combination of radio receiver and recorder constitutes "apparatus for wireless telegraphy" within the terms of the broadcast receiving licence.

Possibly such thoughts as these influenced the Copyright Committee, although evidence had been submitted by the British Sound Recording Association, which had asked for clarification of the legal position of those making recordings "off the air." We understand the Committee considered it was unnecessary to make a pronouncement on this question. The 1911 Act does not, of course, specifically cover such recordings, and so it would be necessary for a court to decide if in fact they constitute infringement of copyright before a successful action could be brought. We understand that no such ruling has yet been made.

There, we suppose, the matter must rest, though, like the B.S.R.A., we should have preferred a clear-cut ruling in the new Copyright Act that will presumably be passed. It must be mildly disturbing to some home recordists to be in doubt as to their legal position, even though they may feel satisfied that nobody is suffering a loss from their action.

* Cmd. 8662; H.M.S.O., 4s 6d.

Compulsory Suppression

THE question of making interference suppression compulsory by law has been debated ever since receivers of high sensitivity were first produced; indeed, imminent legislation was confidently expected about 20 years ago! In this matter there have always been two schools of thought. First came those who insisted that clearly delimited levels of permissible interference and the methods of measuring them should be laid down with precision. Then there were those who wanted quick action, and urged that the observance under legal compulsion of "reasonable" anti-interference precautions would be enough.

The "reasonable precautions" school, with which *Wireless World* admits to having some sympathy, has fought a losing battle, and installation of interference suppression so far has been entirely on a voluntary basis. This has not proved conspicuously successful.

At last, a definite move has been made. The Postmaster-General, acting under the powers conferred on him by the Wireless Telegraphy Act of 1949, has issued regulations making it compulsory to limit the radiation of interference from internal combustion engines. As described elsewhere in this issue, the regulations apply only to new engines and deal in great detail with the characteristics of the apparatus specified for measuring the interference.

To us, these measures seem timid, half-hearted and rather ineffective. If we accept the figure in a recent Brit. I.R.E. paper of 4¼ million unsuppressed vehicles at present in use it will be many years before the present regulations have any observable effect in reducing the amount of television interference. Then there is the question of frequency range: the new regulations apply only to the present 40-70 Mc/s television band. Has the P.M.G. forgotten the alternative television service on higher frequencies, promised to us in the near future?

THE Environment of High-Quality

Conditions Necessary for the Proper Appreciation of Loudspeaker Performance

By F. H. BRITTAIN*

In two previous articles (November and December, 1952) the design and performance of a high-quality loudspeaker were described. The advantages of a reproducer of this type can be appreciated only if the listening environment is itself free from defects which may introduce distortion of the sound. This environment may be regarded as including not only the auditorium, the associated amplifiers and auxiliary electrical circuits, but also the loudness level at which the sound is reproduced relative to the original.

SUBJECTIVE assessment of the performance of a high-quality loudspeaker can be widely influenced by the characteristics of the particular room in which it is operating. This is hardly surprising when it is realized that a hard plastered wall can reflect sound as well as a mirror reflects light. Further complications arise from the fact that sound waves are obstructed and modified by obstacles of the same size as themselves, but they flow around obstacles which are appreciably smaller than themselves.

The wavelength of audible sound varies from less than an inch to greater than 30 feet. Normal domestic objects cover much of this range in size, and will therefore affect some wavelengths and not necessarily others. The most serious considerations are the dimensions, construction, and furnishing of the room itself, since they limit the lowest frequencies which can be reproduced in it. Few living-rooms are 30 feet long, yet even they only permit one single wave of the lowest frequency to be generated in them; but it is possible to generate a half wavelength in any room quite easily; in fact, much too easily.

The reproduction of low frequencies in normal living-rooms becomes a succession of enhanced and inhibited frequencies, the one alternating with the other as the length of the sound wave becomes an exact fit or misfit in that particular room. It is not practicable to do very much about this unfortunate feature of living-rooms, but it is desirable to avoid the worst case where the length, breadth, and height are all equal, or exact multiples of each other. It is quite possible to calculate the "eigentones," as the modes of resonance of a room are called, and it will help if the resonance of the loudspeaker in its cabinet does not coincide with one of them. Moving the loudspeaker to different positions will permit it to couple to a greater or less degree to the sound pattern in the room. Greatest coupling usually occurs near a corner of the room. Wherever possible, it is worth while moving the loudspeaker about to find that position which minimizes the effects of the most serious "eigentones."

So far rooms have been considered with respect to the low frequency end of the spectrum, but they have a marked effect on the quality of reproduction both at the middle and the higher frequencies. In the middle frequencies a complicated "eigentone" pattern still predominates and causes most of the trouble. It is frequently responsible for a high-pitched "boom." The wavelengths involved are of the order of 4 feet, and to have much effect, obstacles of this size are necessary to modify it. Large furniture, or other irregularities in the room will all help to even out the effects of these "eigentones." At the high-frequency end, individual room resonances largely disappear and a general random reflection from all the walls takes their place. Since the wavelength is short, it is easy to modify the high-frequency characteristics of a room by the addition of such things as carpets and curtains.

In addition to the irregularities which the "eigentones" of a room impose on the quality of the sound from a loudspeaker, the fact that the walls of the room are efficient reflectors means that energy is built up in a room to a higher level than it would be if the loudspeaker was used in the open air. Practically all living-rooms have less absorption at the lower frequencies than at the higher frequencies, with the twofold result that the sound from the loudspeaker will be louder when it is heard in a living-room than when it is heard out of doors, and the lower frequencies will be particularly enhanced. Thus it would seem likely that the required frequency response for a domestic loudspeaker normally operated in a living-room should not be the smooth flat curve which will be required out of doors in free space. To check this point, a peculiar form of response measurement was employed. This consisted of adjusting the input to a loudspeaker operating at a given frequency so that its output was judged to be as loud as a standard reference tone. The amount by which the input had to be raised or lowered to accomplish this was expressed in decibels and plotted as a curve (Fig. 1). This curve showed the loudness output of the loudspeaker against frequency, without the use having been made of any microphone or measuring amplifier; instead, the actual ears of the listener had been used. The curve was determined first in a particularly dead measurement room, and, second, in a rather "live" small living-

* Research Laboratories of The General Electric Company.

Reproduction

room. It was very surprising to find that the two curves were almost identical. The explanation is that the brain and mind of the listener were also involved and that his concentration in carrying out the test was so great that at all frequencies he was able to differentiate between the direct sound from the loudspeaker and the random sound reflected back by the walls of the room.

In normal listening, less concentration is given, and less differentiation will consequently be made between direct and reflected sounds, and some increase in loudness in the low frequency end of the spectrum may be expected. Extended listening tests, carried out over the last 20 years, have shown that the subjective effect of a normal living room on the frequency response of a cone loudspeaker is to increase the bass output by about 5 db and to reduce the top output by about 5 db above 5,000 c/s. The high-frequency loss comes about partly because the listener seldom sits directly on the high-frequency beam, and partly by the greater absorption of the high frequencies by the furnishings, etc.

The Amplifier

Power Required.—When using the G.E.C. metal cone loudspeaker, it has been found that for a small living-room an undistorted power output of 12 watts is just sufficient, but if music is to be reproduced sufficiently loudly to simulate the original loudness, which would have been heard by a listener at a concert, the power output should be increased to not less than 20 watts. For large rooms, halls, etc., where music should be reproduced at its normal volume level, something between 60 and 150 watts will be required. The use of these powers will permit complete realism in the reproduction of even quite a large orchestra at its full volume level. It must be borne in mind that the amplifier must remain completely undistorted, even on very high instantaneous peaks, and it is to provide for these high peaks of short duration that these unusually high powers are necessary. The characteristics of the G.E.C. loudspeaker permit it to utilize a higher "peak-to-mean" ratio than other loudspeakers. The peak power rating is 10 watts and the continuous rating 5 watts per unit.

Quality.—It has been found, by very careful listening, that an amplifier having a distortion content of less than 0.1 per cent total harmonic is noticeably better than one which has a total harmonic content of 0.4 per cent. It appears that if full advantage is to be taken of the metal cone loudspeaker, amplifier distortion must be kept to an exceptionally low level. In fact, so small a degree of amplifier distortion is made noticeable that this loudspeaker becomes a valuable tool in the hands of the expert for detecting and eradicating it.

Impedance.—The output impedance of the amplifier should be as low as possible, less than $\frac{1}{8}$ of the loudspeaker impedance, but if it is not very low an improvement can be made by tightly coupling the back of the loudspeaker to a resistive acoustic load. It is most important that this acoustic load should be maintained resistive at all frequencies by the control of cabinet resonances and reflections.

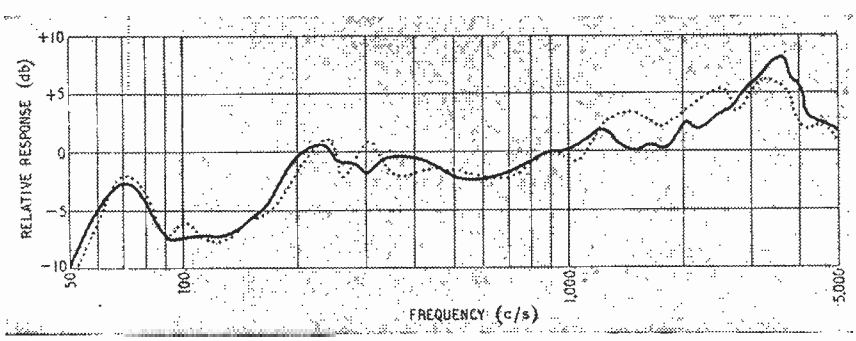
Programme Sources

In theory, any high-quality programme is suitable for reproduction by the metal cone loudspeaker, but in practice the term "high quality" is often purely relative, since the aim of both the broadcasting authority and the recording company must be to give enjoyment to the average listener, who will not always put fidelity of reproduction before every other requirement. There is, for instance, the question of what loudness should be used for announcements at concerts. If the voice is quiet, by comparison with the orchestra, distant listeners, particularly if they have inferior sets, may not be able to hear it. If the voice is loud, it will sound unnatural to nearby listeners, with high-quality sets. Disc recording also has its compromises, and fidelity of reproduction is only one of many desirable features. In general, if the necessary programme and surroundings are available for its operation, a live pick-up by a microphone of the very highest quality will give the best results. This is, however, seldom available to the ordinary listener who is interested in high-quality reproduction.

Radio.—It has been found that the B.B.C. transmissions on the 3-metre band from Wrotham are capable of giving a quality which is indistinguishable from that given by a line direct to the studio, but reception of programmes on the medium-wave band calls for a number of special precautions. First of all, the frequency response of the whole system must be wide, but this is apt to lead to interference from other stations, particularly the 9 kc/s adjacent channel whistle, and some compromise must be found. This can only be made at the listener's own home and, even then, the compromise reached by day will seldom hold by night. It is not possible to compensate for a loss of high frequencies in the radio unit by augmenting them elsewhere in the circuit, because in so doing any distortion having a high-frequency component will be accentuated, and the overall quality spoiled.

The linear operation of a diode is not bettered by

Fig. 1. Subjective "equal loudness" response curves of a loudspeaker taken (solid line) in a lagged "dead" room, and (dotted line) in a "live" small living room.



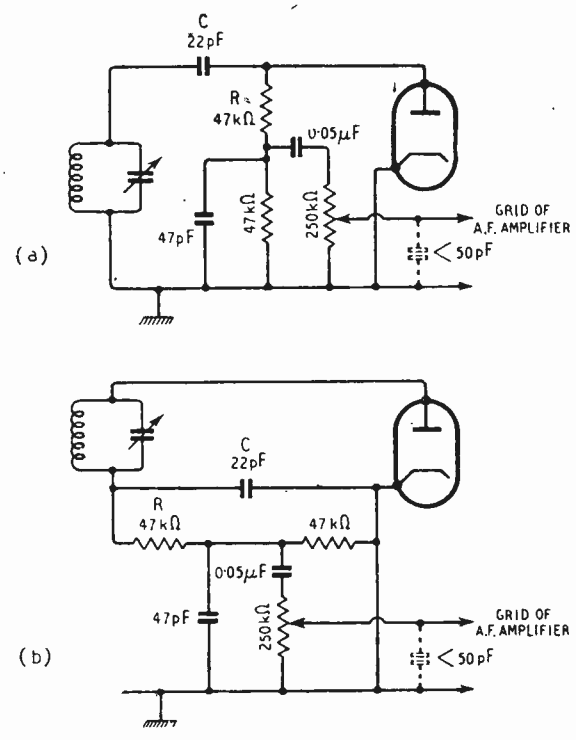


Fig. 2. Typical detector circuits, (a) for t.r.f. receivers (b) superheterodynes, capable of handling 90-per cent modulation at all audio frequencies. To handle 95-per cent modulation the impedance of R and C must be trebled.

any other detector valve, but great care must be taken to avoid operating it at too high a modulation level. It is necessary to make the a.c. load exceed 90 per cent of the d.c. load, not only at low audio frequencies, but also at the higher audio frequencies where both soprano and brass approach the 100 per cent modulation level more often than is realized. This necessitates taking great care of the size and position in the circuit of the r.f. bypass condensers which are always necessary, as well as with the resistance network. Typical circuit values are given in Fig. 2.

When all these matters have been attended to in the detector circuit, it is still very necessary to see that there is no possibility of overmodulation occurring due to the receiver having a greater sensitivity to the sideband than to the carrier. This can easily occur if the receiver is operated off tune, or if the radio- or intermediate-frequency response is "double-humped." In both cases the effect is to reduce the carrier relative to the sidebands.

Records.—Because of the unusually smooth frequency and transient response of the metal cone loudspeaker, it does not over-emphasize distortion or noise on an imperfect programme. It is very suitable for the reproduction of records, since background hiss is devoid of any frequency coloration, and less noticeable than usual since there are no high frequency resonances to be shock-excited by it. The lack of intermodulation in this loudspeaker enables it to show the advances made by the latest recording techniques, but this feature also shows up any high frequency distortion due to worn stampers, tracing distortion of the playback stylus, and bad fitting of the stylus in the record groove.

The best performance from records is obtained with a pickup having its bass and treble resonances outside the working range of the loudspeaker, a response which is corrected to be flat for the make of record being played, and an optional high-frequency cut to remove distortion caused by record wear, etc. This high-frequency cut should be as sharp as practicable without causing appreciable "ringing."

Magnetic Tape.—Records made on magnetic tape are capable of giving an exceptionally high standard of quality, almost indistinguishable from a live input. In order to achieve this standard, however, it is necessary to take the greatest care with every part of the tape machine and its associated amplifiers; there are, in fact, very few commercial machines available which will meet this required standard. The principal cause of the distortion comes from the use of a ferromagnetic substance as a recording medium, and it is essential to keep the signal recorded on the iron as small as possible. This calls for a very low level of noise from the erased tape, together with a low noise level from the reproducing head and amplifier.

During recording it is necessary to restrict the electrical input to the recording head in such a way that the iron oxide powder on the tape is subjected to a uniform magnetization which is constant at all frequencies. The result of this requirement is that it is necessary to amplify the lower frequencies to a greater extent than the higher frequencies in the reproducing amplifier; this calls for a very low level of both hum and motor field pick-up by the reproducing head. It is desirable to apply the lightest possible pressure between the tape and the recording or reproducing heads, otherwise there is a danger of the signal being "pressure modulated." If insufficient pressure is used with a tape having "curl" or a ragged edge, it will not bed down into contact with the head and reproduction will suffer. If the curl or ragged edge occurs in short sections it will alter the volume of sound reproduced from the tape; this alteration in volume will, if it is of short duration, be taken for "wow" or a change of pitch, due to the peculiar action of the ear.

It is surprising to what an extent the correct level of reproduction is ignored. It is at least as important as a correct frequency response, and much more difficult to measure and maintain. If reality is sought, and the metal cone loudspeaker is sufficiently good to deceive some of the best critics in the land the reproduction level must be related to the original sound to within one or two decibels. That is, if the original sound has a certain loudness when heard from a distance of, say, 10 feet, then the reproduced sound must have just the same loudness when heard from the same distance of 10 feet. If, when this has been done, the sound from the loudspeaker is too loud or too soft, it is necessary to reduce or increase the loudness of the original sound. The level must not be altered by means of the volume control which will simply increase or decrease all frequencies at once. Consider what happens when an organist wishes to increase the volume of sound in his church; he may open the swell box to its fullest extent, and after that he has to increase volume by the addition of extra stops and octave couplers. An operation which no ordinary volume control is competent to perform.

Voice Effort.—As a second example, consider a man speaking. Many people will insist that they know just exactly what male speech sounds like, but this can be true only if they have some clue as to how loudly the man is speaking. This "voice effort" has a profound

effect on the frequency response of the human voice, as can be seen from Fig. 3, which compares normal conversation level with soft and declamatory speech. These curves, which will hold only for one particular voice, were obtained by making recordings on magnetic tape of the three levels of speech. The sentence used was: "Friends, Romans, countrymen, lend me your ears; I come to bury Cæsar, not to praise him." This record was passed through an analyser which sorted out the component frequencies in the three cases. In order to present the information, a conversational level was regarded as normal and the other two volume levels drawn as differences from it. The curves show the essential quality of "crooning," and why the Mayor booms if he uses a microphone and a normal voice in place of declamatory speech. A change in voice effort may well alter the frequency distribution of a voice by as much as 20 db. Similar changes occur when instruments are played louder or softer.

Hearing.—It is now necessary to consider the psychological effect of the sound level on the mind of the listener. It does not produce an actual change in the frequency response, as did the voice effort, but the effects are just as real to the mind of the listener. This comes about because of a peculiar action of the ear and brain, which attributes less loudness to weak sounds of low frequency than to weak sounds of high frequency. Conversely, an increase in the sound level of a quiet programme will produce a greater increase in the loudness of the lower frequencies than of the middle and upper ones.

When speech is reproduced, there is a general tendency to increase the volume to a level somewhat louder than that of the original; this increase can be as much as 15 db under domestic listening conditions. Fig. 4 shows the subjective change in "frequency response" due to this cause.

When orchestral music is reproduced in the home its loudness is seldom as great as that of the original, and some subjective reduction in the loudness of the lowest frequencies is likely. This may be offset by the high acoustic output at the lower eigentone frequencies of the room. If the reproducer is used out of doors, the loss of bass will be noticed immediately.

Tone Controls.—There has been much argument as to whether the use of tone controls is correct in connection with a very high-quality system. The answer is that for the greatest possible reality, where all the features are under the control of the listener, no tone control will make any improvement to an already perfect system. When some of the features are not under the control of the listener, as in broadcasting, where it is not possible to ask the announcer to talk louder or softer, tone controls will give very material improvement over what is known to be faulty reproduction. Under these conditions, it is possible to improve realism by correcting the frequency response on the lines given in the previous sections. The actual sequency of events is as follows. It will be assumed that the listener is hearing a man who is speaking in a normal conversational voice into a perfect microphone, but the reproduction in the home is some 15 db louder than his speech. Since the speech is being reproduced 15 db louder than normal, the listener will subconsciously expect that his voice effort would be in keeping with the high volume level, whereas only the reproduction level has changed, not the voice; consequently some improvement in realism can be made by correcting the frequency response for the voice effort which should be there but is not, and the increased loudness which should not be there but is. Fig. 5 shows the frequency correction which should be applied to the perfect reproducer in order to produce the greatest realism.

It will not be as good as if the correct volume level had been used, but it will sound less unnatural than the case where no frequency compensation was used. The reason for the incomplete success of the frequency correction only, lies in the fact that there is a change in the ratio of the consonants, fricatives, and vowels, which cannot be remedied by the tone control.

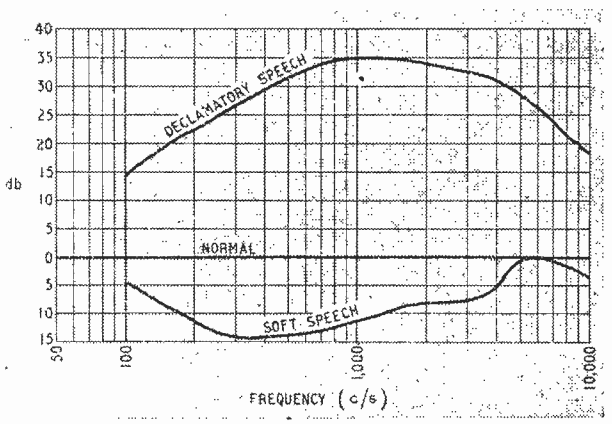


Fig. 3. Relative sound spectra of a male voice speaking at three different loudness levels.

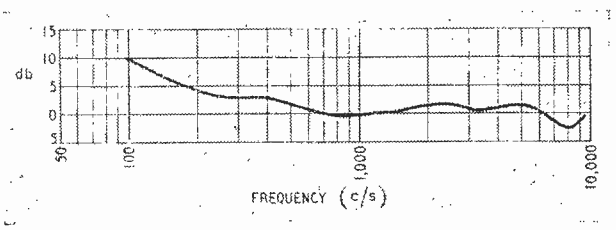


Fig. 4. Subjective change in "frequency response" due to an increase of level from 50 to 70 db above the threshold of hearing.

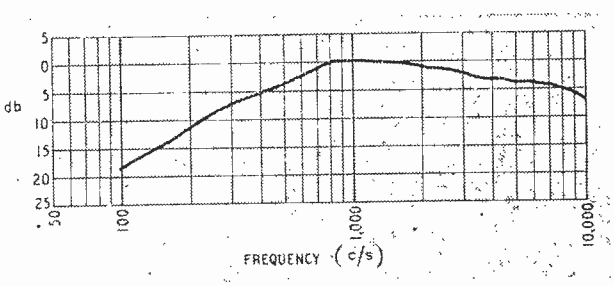


Fig. 5. Overall frequency correction for a 15 db increase in loudness and voice effort.

Sixth R.S.G.B. Radio Show

Display of Commercially Made and Home Constructed Amateur Equipment

AS exhibitions go, the radio amateurs show, which has now been held for six consecutive years by the Radio Society of Great Britain, is a comparatively small one, but what it may lack in size is amply compensated for by the enthusiasm shown by all and sundry.

So far as transmitting apparatus is concerned the "table-top" form of assembly is rapidly gaining in popularity, both for the commercially made sets and for the home constructed models. The once much-favoured and imposing, but cumbersome, rack assemblies are now almost a thing of the past, at least so far as all new products are concerned. In the present style all the equipment, such as radio transmitter, modulator and power supplies is housed in an orthodox type of metal cabinet with a front panel carrying all the controls and having a hinged lid for access to the valves, coils and suchlike. It is intended to be used on a table like an ordinary communications receiver, hence the name.

The extensive use of small, though not always miniature, components and valves has made the table-top idea a reality and its ready acceptance by amateurs has doubtlessly been fostered by the lack of space available in the average home for the "shack" or amateur radio den.

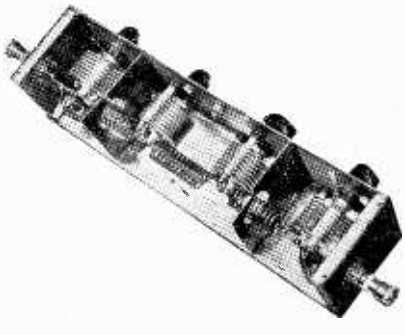
An example of this modern trend is the Panda Type PR120V 150-watt transmitter. It has an accurately calibrated and voltage stabilized VFO with buffer amplifiers and frequency multipliers for switch selection of any amateur band from 3.5 to 28 Mc/s. Provision is made for "break-in" operation on telegraphy and for netting and it is TVI-proof. This expression, now extensively used in amateur circles, means that all harmonics in the television band have been suppressed. The table-top cabinet measures 20 in × 17½ in × 13 in, weighs 150 lb and costs £150.

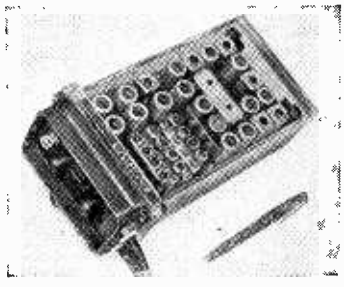
Harmonic Filters

The need to TVI-proof amateur transmitting equipment is now almost as pressing as the suppression of motor car engines and one other item made by Panda Radio consequently looms large in importance. This is a 4-stage TVI-filter It is designed for inserting in 50-ohm coaxial aerial transmission lines and gives a sharp cut off below 30 Mc/s. At 30 Mc/s the attenuation is ½ db but at 40 Mc/s it is 85 db. It costs £3 17s 6d.

Examples of the modern trend in transmitter design and construction were quite plentiful among the amateur exhibits and the workmanship and attractive panel layouts in some cases left nothing to be desired. Such a one was the 150-watt transmitter with switching for all-band operation and complete TVI proofing, shown by John Salvage, amateur station G3HRO. Adopting the table-top technique, it was entirely self-contained.

Left: Taylor Model 66A signal generator covering 100 kc/s to 160 Mc/s. Centre: Panda 4-stage transmitter TVI-filter for 50-ohm coaxial feeders. Right: Army Type 88 pack set, a miniaturized transmitter-receiver for use by infantry. It provides 4 crystal controlled speech channels in the 40-Mc/s band.





Another example was shown by the G.E.C. with the purpose of emphasizing how well Osram valves cater for all amateur requirements. In addition the G.E.C. showed the BRT400 communications receiver, probably one of the finest made in the country, a range of high-grade microphones and some power amplifiers.

No difficulty should be experienced by the home constructor in carrying out modernization of existing equipment, or building new sets in up-to-date style, as a very wide range of crackle-finished and coloured metal cabinets and chassis are obtainable from Philpotts Metalworks.

Some very interesting and specialized type of equipment was shown this year by amateurs, one for example being a helical aerial for use on 70 cm. Consisting of six spirals of stout copper tube, it is 48 in long overall and has a 20-in diameter wire mesh reflector. According to the technical data supplied the forward gain is 14 db over a half-wave dipole and the bandwidth exceeds 100 Mc/s.

The efficiency, characteristics and general behaviour of different scale-model aerials was demonstrated by the Royal Corps of Signals, using a 10-cm radio transmitter and cathode-ray display of the polar diagrams.

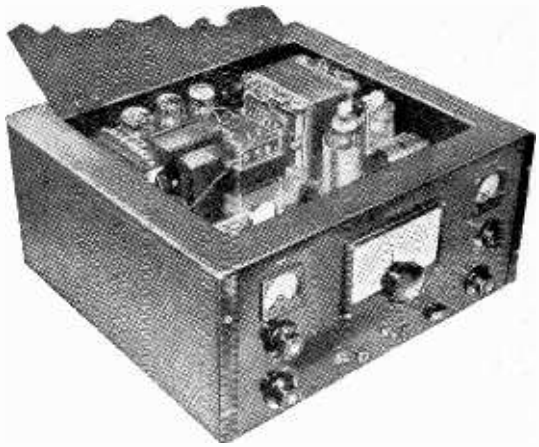
Many interesting items were shown also on the Army's stand, one being the latest Type 88 transmitter-receiver for infantryman's use. Measuring 10 in $\times$ 5 in $\times$ 3¼ in, it weighs 11 lb, including the battery case. It operates on four crystal-controlled channels in the region of 40 Mc/s and has a useful range of about two miles under normal conditions. It is an outstanding example of miniaturization. One of the earliest army wireless sets fitted with "R" valves was included for its historical interest.

The Royal Air Force had some interestingly new equipments in the miniature class also, one was the latest instrument landing equipment for aircraft, another a miniaturized radio altimeter working on a wavelength of a few centimetres. There was a unique historical collection of valves dating back to before 1914.

Amateur Television

Elaborate plans had been made to stage demonstrations of amateur television in the hall over a 70-cm radio channel, but an unfortunate accident on the road robbed the organizers of much essential equipment which could not be replaced in the short time available. Enough, however, was seen to prove that the "show" would have been a most impressive one. The pictures were this year received on a domestic

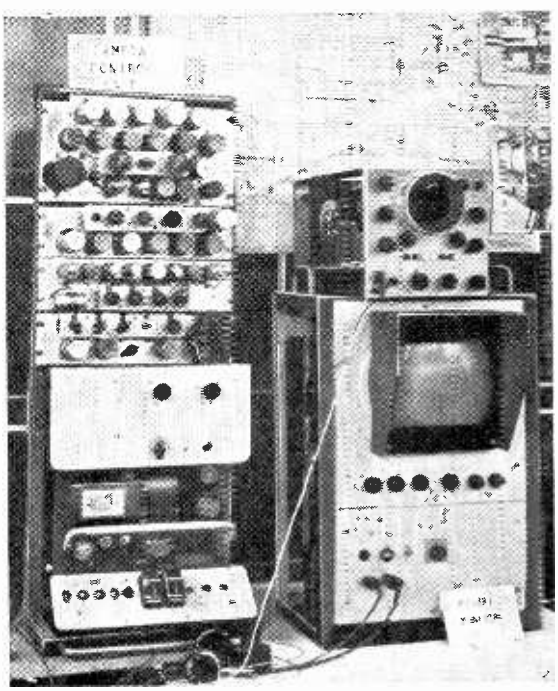
Miniature grid-dip oscillator fitted with plug-in coils shown by K. Young (G3IKY). Fitted with acorn valve it has external power supply and indicating meter.

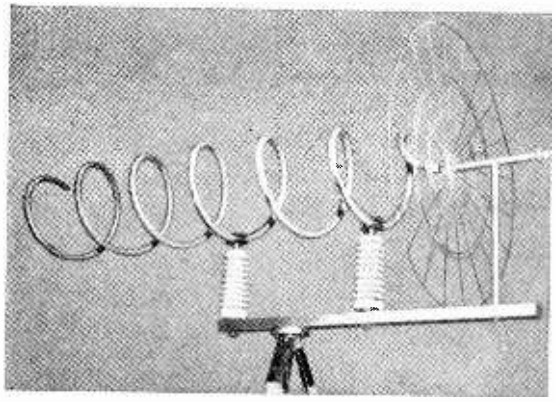


Amateur built "table-top" type transmitter covering all bands and TVI-proofed, shown by John Salvage (G3HKO).

Quartz crystal activity test set shown by Salford Electrical Instruments.

Camera control equipment and picture monitor used for demonstrating amateur television in the exhibition.





Helical aerial for use on 70-cm shown by K. W. Cranfield of the Radio Society of Ha.row.

The new Emicorder magnetic tape recorder made by E.M.I.

television receiver using a small 70-cm converter and employing 25 frames, 200 lines and sequential scanning. The receiver was loaned by English Electric, which firm also had a stand in the exhibition.

These demonstrations were organized by the British Amateur Television Club, and an interesting sidelight on their latest activities was thrown by a display of apparatus used for experiments in amateur colour television transmission and reception. It seems as though the amateurs may have a colour system working long before the B.B.C.!

Many facets of amateur activities, apart from radio transmission and reception, were revealed at the show. Interest in high quality reproduction is reflected in the display of fine loudspeakers made by Goodmans. Demonstrations were given of their latest Type 102 8-in speaker mounted in a corner reflex cabinet. Incidentally, constructional details of the cabinet were available at this stand.

The comprehensive display by Cosmocord of the latest range of Acos gramophone pick-ups gave further proof of the interest in good reproduction and ways to achieve it. One of their newest products is the GP29 turnover pick-up, so called because the cartridge-type head is swivelled and can be turned over to one position for standard records and to the other for long-playing records. Two linked sapphire needles are used. A newer model will have entirely separate sapphires.

There was a new pick-up on the E.M.I. stand which has a single pivot suspension for the arm and an oil dashpot for damping out any violent movement. Interest in this item was shared by a magnetic tape recorder known as the Emicorder. It has a frequency range of 50 to 10,000 c/s, uses plastic tape running at $7\frac{1}{2}$ in/sec, and gives 30 min playing time. Recording, playback and rewind facilities are provided, also a built-in loudspeaker. It costs about £95.

E.M.I. Institutes shared the stand, and here it was possible to obtain details of the preparatory courses available for those wishing to take the radio amateurs' examination for a transmitting licence.

Test Gear

The importance of being able to measure radio frequencies, capacitance, inductance and the resonant frequency of a tuned circuit is fully appreciated by most radio amateurs as the comprehensive display of home-made test and measuring gear amply demonstrated.

Commercially made equipment for this purpose was also quite plentiful. E.M.I. showed a wide-range signal generator, a grid-dip oscillator, bridges and suchlike, all designed especially for the amateur, while both AVO and Taylor had many examples of test equipment applicable to amateur needs. The Taylor Model 66A Signal Generator is just one example; it has a range of 100 kc/s to 160 Mc/s. From 80 to 160 Mc/s second harmonics are used.

Nothing compares with an accurately cut, ground and etched quartz crystal as a standard of radio frequency and some fine examples of different types of G.E.C. crystals in plug-in holders and in valve-type glass envelopes were shown by Salford. An interesting exhibit on this stand was a test set devised and used for measuring the activity of a quartz crystal. It gives a direct measurement of the equivalent parallel resistance of any crystal over the range 1 to 20 Mc/s.

List of Exhibitors

Automatic Coil Winder & Elect. Equip. Co. Ltd., Winder House, Douglas Street, London, S.W.1.
Cosmocord Ltd., Enfield, Middlesex.
Easibind Ltd., 84, Newman Street, London, W.1.
E.M.I. Sales & Service Ltd., Hayes, Middlesex.
English Electric Co. Ltd., Marconi House, Strand, London, W.C.2.
General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2.
Goodmans Industries Ltd., Axiom Works, Wembley, Middlesex.
Panda Radio Co., 58, School Lane, Rochdale, Lancs.
E. J. Philpotts Metalworks Ltd., Chapman Street, Loughborough.
Practical Wireless, Tower House, Southampton Street, London, W.C.2.
Salford Electrical Instruments Ltd., Silk Street, Salford 3.
Short Wave Magazine, 53, Victoria Street, London, S.W.1.
Siemens Electric Lamps & Supplies Ltd., Upper Thames Street, London, E.C.4.
Taylor Electrical Instruments Ltd., Montrose Avenue, Slough, Bucks.
Westinghouse Brake & Signal Co., Ltd., York Way, London, N.1.
Wireless World and *Wireless Engineer*, Dorset House, Stamford Street, London, S.E.1.

Non-commercial

British Amateur Television Club.
G.P.O. Engineering Department.
Radio Society of Great Britain.
Royal Air Force.
Royal Corps of Signals.

Psycho-Optics in Television

Why Larger Screens Seem to Give Better Pictures

By C. BURNS, B.Sc.

MANY people, like myself, must have compared different television screen sizes and felt that the very large sizes seemed "better." They have probably not quite known why, for the strength of this impression would have seemed at variance with the known fact that the actual definition achieved was identical. There is, in fact, a known basis for this impression, but it is very little understood and appreciated for it involves those aspects of vision known as "subjective," where the mind influences and modifies the picture which, from considerations of geometrical optics alone, the eye might be expected to present.

The outstanding fact governing these impressions is that, to a person with normal vision, the apparent size of objects is not governed solely by their distance away. The conscious mind does not receive merely a camera picture, where the apparent diameter of an object is proportional to its true diameter and inversely proportional to its distance, following the laws of perspective. Such a picture is received on the retina of each eye; but the use of binocular vision, by measuring the angle by which the line of sight of the two eyes converge on each object, also supplies information on the distance of each object. This effect, which gives "stereoscopic" or depth-perceiving vision, is well known. But this information is not merely kept separate to be used independently by the brain. It is "fed in," as one might say, along with the independent impressions from the two eyes, and influences them in such a way that the picture "seen" by the conscious mind is a mean between the perspective rendering of the scene and its interpretation in terms of absolute size of each object obtained by stereoscopic vision.

The chain of processes involved in vision is rather as follows (see Fig. 1). Here is an object (a). It subtends an angle θ at my eye, i.e., it forms an image of a certain diameter on my retina. My eyes converge heavily when viewing it. Therefore it is near. Therefore it is really fairly small. Now here is another object (b). It forms an image the same size (subtending the same angle) on my retina. But my eyes converge much less when looking at it. It is much farther away than the first object. Therefore it is much bigger—and, behold, it actually "looks" bigger, for all the steps going before have taken place unconsciously in the automatic processes of vision. Shutting one eye removes this "correction" for absolute size of an object, as can be vividly shown by certain simple tricks. One of the best known is the effect known as the "keystoning" of a lantern screen.

If a lantern is made to project a square slide on to a screen which is sloped away from it instead of

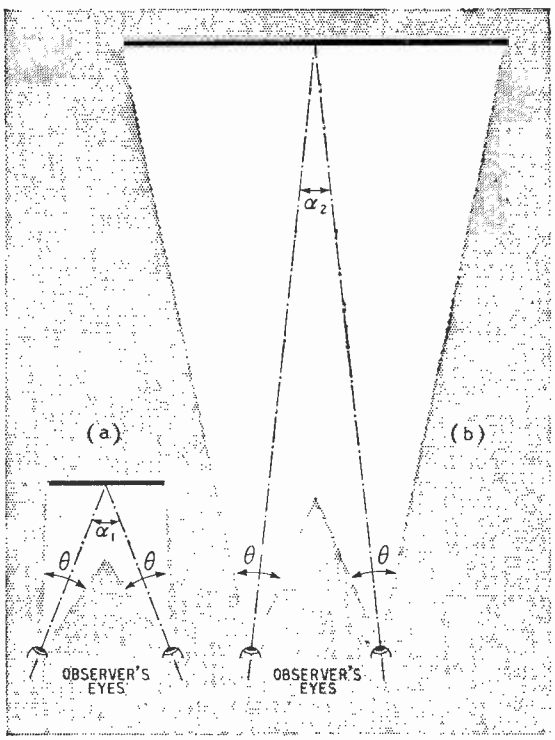


Fig. 1. The large and distant object in (b) subtends the same angle θ at the eye as the small and near object in (a), but the eyes converge less when looking at the (b) object (α_1 is larger than α_2).

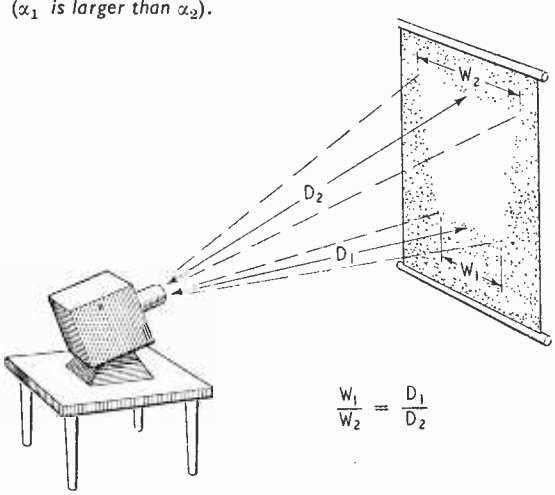


Fig. 2. "Keystoning" effect when a square is projected on to a screen which is not perpendicular to the axis of the lantern's optical system.

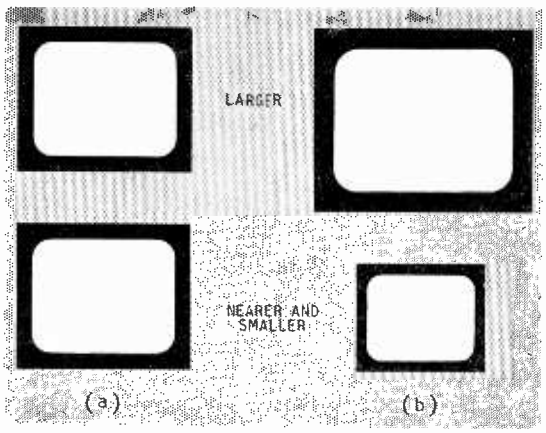


Fig. 3. At (a) is the geometrical image of two screens at distances proportional to their diameters. At (b) is the subjective impression of a human observer from the same viewing position.

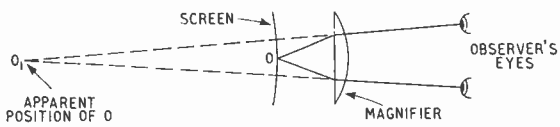


Fig. 4. Action of a magnifier in making a screen appear more distant.

perpendicular to the axis of the optical system (Fig. 2), the image of the square slide on the screen will be a trapezium, being wider at the top where it is farthest away from the projector. If a camera is placed just beside the lantern lens and pointing at the screen, it will form a square image on its plate of the trapezium on the screen, since the extra width at the top is only proportional to its increased distance. But should a human observer place his head in proximity to the lantern lens, the image on the screen will still look wider at the top. When he shuts one eye, however, the right- and left-hand sides of the trapezium seem literally to jump in, so that they are roughly parallel, for the "correction" towards absolute size introduced by binocular vision has disappeared.

On this power of vision to correct for size and distance must be laid the blame for all the unfortunate snapshot photographs of people with enormous feet or knees dwarfing the rest of them.

How does all this affect television screen size? The answer is that the consequences of the above effects make a television picture "look" bigger, *and better defined,* the larger its true size.

The first and more obvious consequence of a small screen size is simply that this appreciation of true size makes the picture seem much less like the original. It is impossible to make it appear as big as the original scene by looking more closely at it, for although this increases the angle it subtends at the eye, the analysis of binocular vision reveals the deception and actually neutralizes it to a large extent in the picture "seen" by the conscious mind. Fig. 3 illustrates this effect, though it is, of course, impossible to simulate completely in a drawing.

But there is one quantity which amongst all this shifting remains constant, and that is the resolving power, or power to perceive detail, of the eye. This is about 2 minutes of arc for a good eye, which is the smallest angular separation at which the eye can still see two points distinct from each other. The human observer, of course, is not conscious of the limitations of the eye and cannot conceive of any performance beyond its capabilities.

Yet present the viewer with a large screen, and a small one, set at the nearest distance at which they can be viewed without the raster becoming visible. Both pictures will seem perfectly sharp, and they will actually subtend the same angle at the eye. But the larger one "looks" larger owing to these subjective effects, i.e., it appears to subtend a greater angle than the nearer screen; and since both pictures seem perfectly sharp the deduction is unconsciously made that the larger picture contains more detail than the smaller, although in fact they are identical.

Although perhaps confusing and rather difficult to apprehend, this seems to me an inescapable consequence of the known and accepted subjective phenomena described above. I have not the least doubt that it is one of the main factors responsible for making a large screen so much more satisfying to view than a small one, though both screens are giving a perfect rendering of the transmitted picture.

It is interesting to note that the use of a magnifying lens, as sold for television screens, is also assisted by the effects of binocular vision. The screen is, in fact, magnified by the lens; but in addition it makes the screen appear farther away and so adds a "subjective" magnification to the simple optical one. The way in which it is made to seem distant to the two eyes is shown in Fig. 4.

This is, as it were, a quasi-stereoscopic effect. It cannot introduce differences in the convergence of the eyes with different distances of object: but by making the convergence for all the objects, and thus their apparent true size, nearer the correct value, it makes the view of the screen that much truer to the view of the original.

CLUB NEWS

Chester.—At the first meeting of the Chester & District Amateur Radio Society in the new year (January 6th) J. W. Swinnerton (G2YS) will speak on tape recording troubles. Meetings are held on Tuesdays at 7.30 at the Tarran Hut, Y.M.C.A. Grounds, Chester. The club also meets on Mondays at 7.30 for morse instruction and technical classes. Sec.: N. Richardson, 1, Victory Villa, Newton Lane, Upton, Chester.

Coventry.—At the meeting of the Coventry Amateur Radio Society (G2ASF) on January 5th at the Y.W.C.A., Queen's Road, Coventry, at 7.30, L. Gardiner (G5GR) will speak on "DX on a Landline." The Society's 21st anniversary dinner will be held on February 27th. Sec.: K. Lines (G3FOH), 142, Shorncliff Road, Coventry.

Hastings.—V.H.F. aerials and tape recorders are the subjects for the first two lectures of the 1953 session of the Hastings & District Amateur Radio Club. The meetings will be held on January 13th and 27th at the Saxon Cafe, Hastings, at 7.30. Sec.: W. E. Thompson, 8, Coventry Road, St. Leonards-on-Sea, Sussex.

Peterborough.—The January meetings of the Peterborough Radio & Scientific Society (G3DQW), which are held at 7.30 at the club's headquarters, St. Paul's Road, include "Radio Fault Finding" by R. H. Houtby (1st), "Radio Direction Finding" by S. Woodward (8th), "Short Wave Receivers—the Superhet" by C. J. Guscott (15th) and "Quality Equipment—the Amplifier" by S. Woodward (22nd). Sec.: S. Woodward, 72, Priory Road, Peterborough.

Sunderland.—"Wired Broadcasting" is the subject on which N. Farmer will speak to the members of the Sunderland Radio & Television Society at the meeting at 8.0 on January 7th at the club room, 16, North Bridge Street. Sec.: C. A. Chester, 38, Westfield Grove, High Barnes, Sunderland.

ELECTRONIC SWITCH

Two Waveform Display with Single-Beam Oscilloscope

By K. R. STURLEY,* Ph.D., B.Sc., M.I.E.E.

AN oscilloscope is a most useful aid in the teaching of radio engineering, but for satisfactory demonstration to classes of 20 or more students a large c.r. tube screen (16-in diameter) is essential. A number of these demonstration equipments can be purchased, but most are capable of displaying only a single waveform at a time. There are occasions when phase relationship needs to be shown and two waveforms have to be displayed; for this purpose a double-beam tube or its equivalent is required. It is well known that this can be achieved by a switching operation, which causes the two waveforms to be applied alternately to the Y plates of a single-beam tube. The author was recently faced with this problem, and his experience in constructing such a switch circuit may be of interest to others who have single-beam tubes.

Before going on to describe the apparatus let us examine first the principles of this switched equivalent of the double-beam tube. Fig. 1 shows a simple block schematic; the two waveforms to be displayed are fed to two separate amplifiers, whose outputs are connected together and taken to the Y amplifier input of the c.r. oscilloscope. Grid bias for the amplifier valves is derived from a switch circuit synchronized with the time base of the oscilloscope. The time-base synchronizing voltage must be obtained from one of the inputs and not from the Y amplifier, otherwise instability, or faulty synchronizing, will result because the switching waveform will be fed into the timebase. The switching frequency may be one-half the time-base frequency—let us call this low-frequency (l.f.) switching—or it may be much faster (high-frequency switching). Assuming ideal conditions, viz., an instantaneous change from one amplifier to the other we should have for l.f. switching the two waveforms displayed on the screen as shown in Fig. 2. Sinusoidal shapes are shown, but they might be of any form. If h.f. switching is employed the two waves will be displayed as dashed curves. The length of the dashes will be determined by the switching frequency, thus, if it is 20 times greater than the time-base frequency, there will be 10 dashes in each waveform, as illustrated in Fig. 3.

In practice the speed of switching is never instantaneous, and if the brightness control is operated the transfer from one amplifier to the other will be seen as a faint blur. With h.f. switching synchronization to the time-base is not essential, but it is preferable because when the switch frequency approaches a multiple of the time-base frequency the drift of the dashes becomes irritating. Another possible display is obtained when the switch frequency is twice that of the time base; the two waveforms are then seen side by side (Fig. 4). The vertical line between the waveforms illustrates the non-instantaneous transfer from one amplifier valve to the other.

Low- and high-frequency switching each have their advantages and disadvantages. L.f. switching tends to give a clearer picture, but fine control of switch frequency is necessary to cover changes in the frequency of the input waveform. A good l.f. response is required for the amplifiers, but this is not difficult to obtain. Coarse control of switch frequency is quite satisfactory with h.f. switching, but the h.f. response of the amplifiers must be good if a satisfactory switch

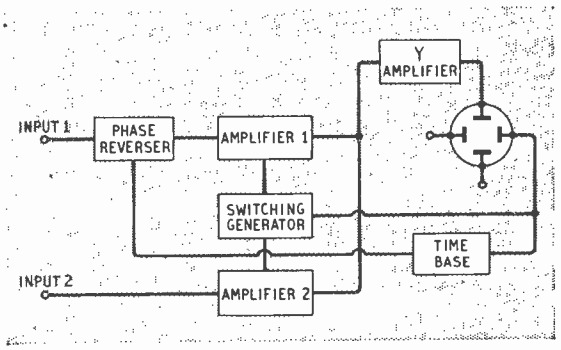
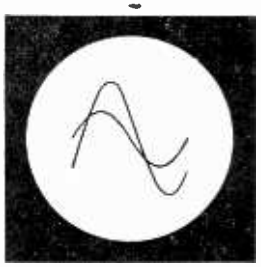
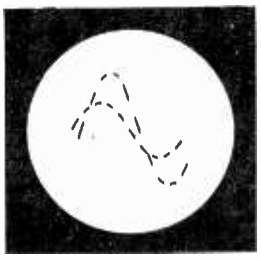


Fig. 1. Block schematic of apparatus for producing a double trace on a single-beam c.r. tube.

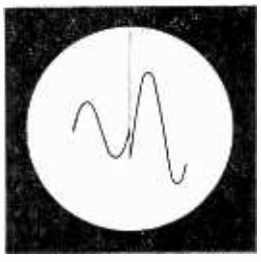
Fig. 2. Example of low-frequency switching.



Below left : Fig. 3. Example of high-frequency switching.



Below right : Fig. 4. Example of switch frequency twice time-base frequency.



* Engineering Training Dept., B.B.C.

shape is to be preserved. For example, switching at 10,000 c/s needs a response in switched and Y amplifiers having little loss at 100,000 c/s if the square wave-shape is to be preserved. A slow transfer between amplifiers causes the dashes to be less visible and increases the blurring (mentioned above) between the two waveforms.

When completed the switching circuit fulfilled the following specification:—

1. Performance to be satisfactory for input waveform frequencies from 20 to 20,000 c/s.
2. The apparatus to be capable of showing two separate waveforms, and of correctly indicating the phase relationship between the two, at the same frequency.
3. The two waveforms to be separable when required. This is the equivalent of the d.c. Y shift in the double-beam tube.
4. The two output waveforms obtained when the same input is applied to both amplifiers to be indistinguishable from a single trace. This means that the gains and phase shifts of the two amplifiers are to be equal over the frequency range given in (1), and are also to be independent of input amplitude.
5. Phase reversal of one waveform to be available.
6. Switching to be possible at a low- or high-frequency rate.

A circuit diagram of the complete switching circuit is given in Fig. 5. There are three main sections: the power supply, the two amplifier circuits, one of which contains a phase-reversing valve, and the switching-voltage generator. The power supply is conventional except that resistance smoothing is employed, R_{24} and R_{25} performing this function. This is made possible by the low total current consumption (15 mA).

In the circuit of amplifier 1 V_1 is a phase-reversing valve providing an output from cathode or anode. R_5 is adjusted to give no change in output amplitude when switching from the direct to phase-reverse condition. The output of V_1 is connected to the g_1 grid of the hexode amplifier V_2. The gain of V_1 is less than unity because of the negative feedback from the cathode and V_2 must give greater amplification than V_3 in order to provide equal overall gains from both amplifier circuits. This is achieved by inserting the additional resistance R_8 in the anode of V_2. The second waveform to be examined is connected to the g_1 grid of the hexode V_3. The output from the valves V_2 and V_3 is obtained from the common resistor R_{10} through the compensating resistor R_8. Control of the screen voltage of V_2 by variation of R_{11} changes the d.c. operating condition of V_2 and allows the two waveforms to be superimposed or separated as desired. V_2 should be selected to give a higher anode current than V_3 when R_{11} is zero, otherwise it may not be possible to superimpose the two waveforms.

The resistances R_1 and R_{15} give control of the two input voltages. At frequencies above about 10,000 c/s phase as well as amplitude change occurs when R_1 and R_{15} are controlled, and the sliders should always be set at maximum when phase measurements are being made.

The switching voltages (approximately square-wave shapes of opposite phase) are applied to the g_3 grids of the two hexodes, which are made to conduct alternately. The grid leaks R_7 and R_{14} are returned to the cathodes; they must have a high value (2 MΩ), otherwise the shape of the square-wave switching voltage is distorted, the base line of each displayed wave having an exponential rise instead of being a horizontal line.

The switching-voltage generator is a conventional

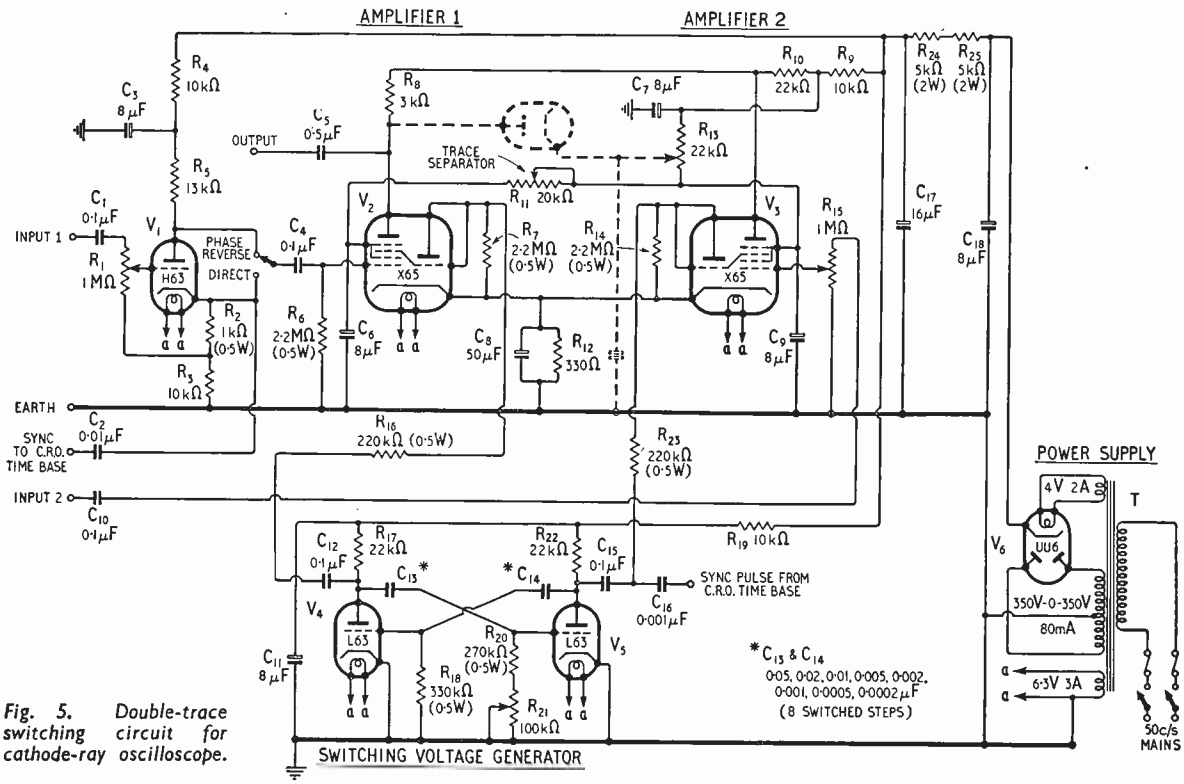


Fig. 5. Double-trace switching circuit for cathode-ray oscilloscope.

multivibrator whose frequency is step-controlled by varying C_{13} and C_{14}. The mark-space ratio of the square wave is adjusted by variation of resistance R_{21}; it also provides a fine frequency control. The square-wave switching voltage is derived from the anodes of V_4 and V_5; the resistances R_{16} and R_{23} in association with the triode sections (connected as diodes) of V_2 and V_3 assist in squaring the waveform of the switching voltage to V_2 and V_3. It is not possible to switch instantaneously from one valve to the other and there is a period during which both valves are shut down as shown in Fig. 6 for high-frequency operation (a) and for low-frequency (b). The duration of the "off" period is determined by the voltage available from the multivibrator and the magnitude of R_7 and R_{14}, both voltage and resistances should be large for a short "off" period. The switching-voltage shape is also improved by making the values of R_{18} and R_{20} as large as possible.

In the particular cathode-ray oscilloscope used by the author the flyback pulse of the time base was connected to the grid of the tube to cut off the beam during flyback. This pulse was used via C_{16} to synchronize the multivibrator. If the time-base sawtooth voltage itself is employed for synchronizing C_{16} may be reduced to about 20 pF.

During preliminary tests on the apparatus several peculiar effects were encountered and are worth recording.

When wiring the circuit the anode of the triode section of V_2 was inadvertently left free and this produced considerable hum on amplifier 1 waveform. It disappeared when the anode was connected to g_3 of the hexode section.

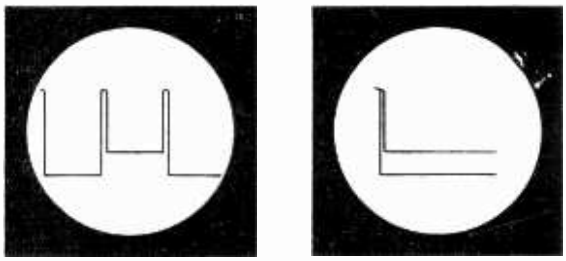
With high-frequency switching and no input voltages to the amplifiers, the "on" periods of each valve were seen to consist of exponential instead of horizontal straight lines. This was traced to injection of the switching voltage into the V_2 and V_3 signal-grid circuits for it disappeared when both were short-circuited. It was cured by keeping leads carrying the switching waveform well clear of the grid (g_1) circuits of V_1, V_2 and V_3.

A slight judder was noticed on the V_2 waveform in the phase-reverse position; this was not observed in the direct position with the signal obtained from the cathode of V_1. The cause proved to be variations of h.t. voltage which were in turn caused by fluctuations of the a.c. mains supply. It could be removed by a stabilizer connected from R_4 to earth. Because of this h.t. fluctuation the synchronizing voltage for the time base was taken always from the cathode of V_1.

There was some change in gain as the screen voltage of V_2 was varied to separate the waveforms. The amplitude of input 1 decreased by about 10% when R_{11} was changed from 0 to 20Ω. Accurate amplitude comparison can only be made with valves V_2 and V_3 operating under similar d.c. conditions.

As stated above, any attempt to derive the synchronizing voltage for the time base from the outputs of V_2 and V_3 or the Y amplifier leads to instability or (if locking is achieved) to an artificial phase shift because triggering occurs from the "off" pulse from V_2 and V_3 and not from the input waveform itself.

If the input waveform is connected to both inputs and the frequency is varied correct synchronization occurs at multiples of the time-base frequency but there are intermediate points where the two waves are synchronized nearly 180° out of phase. This is due to synchronizing taking place alternately on positive and negative peaks of the waveform and occurs when the waveform frequency is $(n+0.5)$ times the time-base frequency. There need be no confusion with correct synchronizing since with this incorrect condition the flyback of one wave starts in the "positive" half of the wave and the other flyback in the "negative" half.



(a) (b)

Fig. 6. Illustrations of h.f. switching (a), and l.f. switching (b), showing "off" period pulse.

There is a possibility that the Y amplifier may be overloaded by the "off" pulse from V_2 and V_3. This is only likely to occur when the input signals are small and the gain of the Y amplifier is large. No trouble was actually experienced by the author but if it is met it can be cured by fitting a biased diode from R_8 to earth so that it conducts and clips the pulse when the output voltage exceeds a value slightly greater than that needed to display the waveform. The diode, which may be a germanium rectifier, is shown dotted in Fig. 5.

Initial Adjustments

The setting-up procedure is best carried out for low-frequency switching. Both input terminals are short-circuited to earth, the multivibrator frequency is set to be greater than that of the time base, and R_{11} is adjusted to separate the traces so giving the stepped display of Fig. 6(a). R_{21} is varied to make the steps approximately equal in length and then C_{13} and C_{14} are increased to slow down the switch frequency until the double trace is obtained with the off pulses at the left-hand side like that of Fig. 6(b). The trace separator R_{11} is now adjusted to superimpose both lines. With the sliders of R_1 and R_{15} at their maxima, a waveform of frequency equal to some multiple of the time base is applied to both inputs. The result should be a single waveform on the end of the tube but any amplitude difference between the two inputs will cause two separate waves to be seen. With the phase-reverse switch at "Direct," R_8 is adjusted to make the two waveforms superimpose exactly. The switch is now thrown to the "Phase Reverse" position and R_5 is adjusted to give the same amplitude as in the "Direct" position.

If synchronizing proves difficult with low-frequency inputs due to the stepped control of C_{13} and C_{14}, R_{21} may be used to secure locking but this will lead to unequal "double-beam" lengths. Alternatively it will be possible to pull the complete equipment into synchronism by increasing the synchronizing voltage to the c.r. tube time base. For example, when examining waveforms derived from the 50-c/s mains supply, a large synchronizing voltage can usually be obtained quite independently of the waveform being displayed.

To change over to high-frequency switching it is

only necessary to switch to lower values of C_{13} and C_{14} and to adjust R_{21} to give synchronizing as near to equal length steps as possible. The two waves can be distinguished if necessary by making the steps unequal, the shorter length step will appear less bright than the longer one.

Test results on the apparatus showed that each amplifier had a gain of 15, and satisfactory operation was achieved with input voltages from 0.02 to 1 volt. The minimum input voltage is determined by that required to synchronize the time base and the maximum by distortion in V_2 and V_3. If the two waveforms are not to overlap when separated to the greatest extent ($R_{11}=20{,}000\Omega$) the maximum signal is limited to 0.5 volt.

The "free-running" switching frequency can be varied in 2-to-1 steps (approximately) by change of C_{13} and C_{14} from 33 c/s to 16,000 c/s for R_{21} maximum. Control of R_{21} gives a smooth variation of about 2.5 to 1.

RADIO TELEMETERING

Techniques Used in Aerodynamics Research

ONE familiar application of radio telemetering is the radio sonde system of meteorological sounding, in which information is transmitted from meteorological instruments in a balloon to a ground receiving station. The same sort of technique is now being used in aerodynamics research for transmitting to the ground information about the behaviour of missiles and other pilotless aircraft, and a recent I.E.E. paper by E. D. Whitehead and J. Walsh outlines the principles of some of the telemetering systems devised for this purpose.

Usually a number of measurements have to be transmitted to the ground simultaneously, so it is necessary to use some kind of multiplexing. This is achieved either by frequency division (using subcarriers) or by time division (using sampling techniques). Sometimes, however, one finds a combination of the two—time division is done on one or more of the sub-carriers of a frequency division system.

The physical effects to be measured are converted into electrical changes by pick-up devices and then modulate in some way the various channels of the multiplex radio system. With frequency division, the sub-carriers are modulated either in amplitude, frequency or phase. With time division there are two basic methods. In one, the pick-up devices are sampled by an electronic or mechanical commutator and modulate in turn a single sub-carrier frequency. In the other, each pick-up device modulates a separate train of pulses, and the pulse trains are interlaced in time and transmitted together—p.p.m. is generally used for this. The carrier frequency of the transmitter is modulated either in amplitude or frequency.

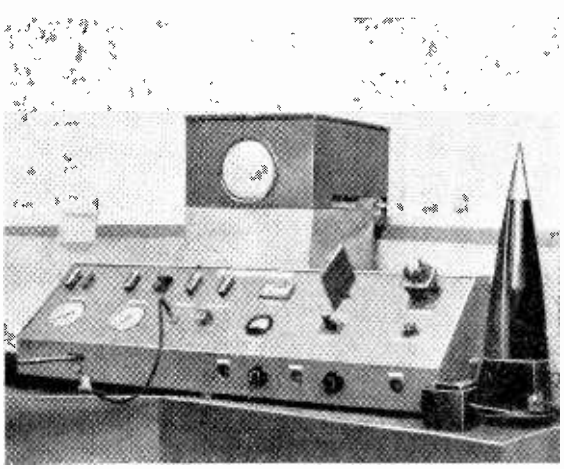
There are various kinds of pick-up devices, but the most common ones work on the principle of using the mechanical displacement to vary either a reactive or a resistive element. A capacitance pick-up made something like a condenser microphone is very convenient for direct measurement of air pressure, while a resistance element can be used in the same direct fashion as a strain gauge or, in the form of a thermistor, for measuring temperature. For rapid mechanical variations, piezo-electric crystals are sometimes used, while a.c. generators will measure speed of rotation by their output frequency.

The equipment carried in the aircraft or missile is usually miniaturized to save space and weight, and the aerial is suppressed so that it will not interfere with the aerodynamic performance.

At the receiving end of the telemetering system the various channels are separated out and the measurements they convey are displayed and recorded. The display is most frequently done on cathode-ray tubes, and permanent records of their traces are made on film.

Not all radio telemetering systems, however, are of the complex multichannel type. Some, indeed, show great ingenuity in their economy of means. For example, in one system for measuring the rate of roll of a missile the airborne apparatus is nothing more than a small transmitter radiating polarized continuous waves. This is received on the ground by a rotating dipole. Thus, when the receiving dipole is at right angles to the plane of polarization no signal is received, so that an indication of the rotation of the missile is obtained twice per revolution of the receiving aerial.

Demonstration model of telemetering equipment at the Signals Research and Development Establishment of the Ministry of Supply. The transmitter is in the nose of the missile on the right. Up to 23 quantities are sampled and displayed on the cathode ray tube as a sequence of steps of different heights.



LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

"*I.F. Inquiry*"

G. H. RUSSELL, in his letter published in your December number, mentioned that the European Broadcasting Union had published the results of its investigation on i.f. for long- and medium-wave receivers. As Secretary of the Technical Committee of the E.B.U., I should just like to explain that our reports are prepared only for the members of the E.B.U. although, in this case, copies were supplied for information to the several national manufacturers' associations that were good enough to provide us with information.

The inquiry concerning the choice of i.f. for television receivers is still in only an embryonic stage, although we have invited certain engineers—including Mr. Russell—in a number of countries for their views on the layout of the questionnaire which will, in due course, be submitted to the national associations. The problem is an extremely complex one and until the replies are received and studied we shall not be able to decide how the information can most profitably be utilized. It might, for instance, prove to be suitable as the basis of a document for submission to Study Group 11 at the C.C.I.R. Plenary Assembly to be held in the United Kingdom during 1953.

I take advantage of this opportunity to refer to Peter Dean's letter in the same number, but here, of course, I am expressing only my own personal viewpoint. A study of the history of v.h.f. broadcasting in the United States and in Germany—and indeed common sense—suggests that a v h.f. broadcasting service cannot develop successfully in the United Kingdom or anywhere else in Europe purely on the strength of the superior quality of reproduction it is capable, in suitable circumstances, of providing. If the public is to purchase v.h.f. receivers or adaptors, they must be induced tc do so because they will thereby be able to receive either the existing programmes satisfactorily in districts where reception is unsatisfactory on long and medium waves or additional programmes that are not radiated on long and medium waves (or, of course, both). Only a quite insignificant number of listeners will pay extra to hear rather better the programmes which they can hear reasonably well already, and any additional licence fee would only further reduce their number. It would seem, then, that any broadcasting authority which wishes to introduce v.h.f. economically—which means, virtually, in such a manner that potential receiver sales will be such that the sets or adaptors can be marketed at reasonable prices—should ensure that the first v.h.f. stations serve effectively those parts of the country where existing reception is least satisfactory and also should ruthlessly radiate on v.h.f. exclusively some of its most popular programmes, supported by, say, stock-exchange reports, detailed weather reports for farmers (to replace the ill-fated AIRMET), stories for children and other specialities aimed at widening the audience and so the market for receivers.

Brussels, Belgium. H. ANGLES D'AURIAC.

"*R.F. Characteristics of Capacitors*"

T. E. CLARKE has raised some interesting points in his letter in your November issue, to which I would like to reply.

The inductors referred to in my article are designed to have their self-resonant frequency in the television band. Because they are wound on a core of suitable ferromagnetic material, their effective bandwidth is wide enough to provide a high impedance over the whole band 40 Mc/s-70 Mc/s. The actual self-resonant frequency is not critical. I have no evidence to suggest that suppression filters utilizing the self-resonant properties of their components are not equally effective at frequencies above self-resonance as at frequencies a corresponding interval below self-resonance (within the resonance band).

The subject of bushing capacitors is too complex to receive full treatment in a general article on capacitors. A few details as to the best way to employ them may, however, assist Mr. Clarke and other readers. Correctly mounted, bushing capacitors can have, in practice, transfer impedances similar to that given in Fig. 4 of my article. Two points must be observed in the mounting:—

(a) The mounting plate of the capacitor must be fitted so as effectively to form an integral part of the earthed case surrounding the source of interference or the space to be kept interference free. For example, bushing capacitors mounted in the terminal box or in the framework of a d.c. generator as output terminals will provide interference-free output leads; mounted in the framework of a screened cage they will filter the mains input leads to the cage.

(b) The mounting flange of the capacitor must make good electrical contact with the earthed mounting plate over the whole surface area of the flange.

Thus, one cannot obtain the unique properties of a bushing capacitor if it is mounted on a side bracket attached to the frame of an appliance: it then merely behaves as a conventional two-terminal capacitor of comparatively low inductance. The considerable reduction of suppression at 10 Mc/s observed by Mr. Clarke may well have been due to an unsuitable or incorrect type of mounting. It may be mentioned that where particularly low transfer impedances are required bushing capacitors are now available for low-voltage applications with transfer impedances less than 0.05 ohm at frequencies above 10 Mc/s, and effective up to at least 400 Mc/s.

Hounslow, Middx. R. DAVIDSON.

Signal Tracing

I MUST contradict the statement by your correspondent E. J. Faulkner (December issue) in which he says, "Signal tracing as a method of fault finding in radio receivers appears to have been completely ignored in this country."

As far back as 1944 Labgear, Ltd., of Cambridge manufactured and placed on the market an excellent and versatile piece of equipment of this kind.

Although basically a signal tracer, it had in addition other useful features, such as the generation of radio frequencies over a wide range and a fixed audio frequency which could be used either to modulate the r.f., or as a separate source of a.f.

Another very useful addition was the inclusion of a small neon lamp, which was used for the testing of mica and paper capacitors and also functioned as a fairly accurate peak voltmeter.

I believe I am correct in saying the Labgear "Electronic Signal Tracer" was the first instrument of its kind to be marketed in this country.

Cambridge. C. H. BROAD.

Transformers in the Tropics

I WAS interested in the article on "Drying Out Transformers," by J. Macintosh, in your December issue, as I have had experience of these components under home and overseas conditions for very many years.

Whilst it is agreed that linseed-oil-based materials can become acidic under tropical conditions, I have never heard that bitumen does so. However, there are many varieties of bitumen compound and it is conceivable that

one type might become acidic, but I feel that this is not general.

From the article it would appear that the first batch of transformers, which gave normal recovery, were not sealed or potted so that external heating easily drove out the moisture. On the other hand, the types which did not recover quickly were stated to be bitumen dipped or potted; now if these transformers had been left exposed to tropical conditions, without working, for several months, there is likely to be a small amount of moisture in the coil. One could interpret the failure of recovery to the effectiveness of the bitumen as a moisture barrier when the heat was applied *outside* the transformers. In order to dry out this type of transformer fairly quickly, it would be necessary to develop iron and copper losses inside the component at reduced primary volts, as well as raising the external temperature. In this way the centre of the coil is perhaps 105°C if materials will allow, the centre is also hotter than the outside, which in turn is above its local ambient.

Has it been proved that recovery fails to take place when this approach is adopted?

Radford, Coventry. D. R. SABEN.

Future of Broadcasting

IN the December *Wireless World* it is suggested that progress on the medium waves is at an end, and it is implied that conditions of interference are becoming intolerable.

It may be true to say that manufacturers find it intolerable that simple straight sets and superhets with no r.f. and one i.f. amplifier do not give sufficient selectivity. Such cheap sets are "out" for practical reasons.

V.h.f. sets are dear; so are better sets (from the selectivity point of view) for the medium waves, but there is a real difference to the ordinary listener, who, as Peter Dean points out quite truthfully, does not look for high fidelity; this difference is the station range. Now I can roam at will (with a good set) over Europe; with v.h.f. I can hear only the B.B.C. This is a dangerous curtailment of our freedom which we are asked to swallow.

Interference of all types can be fought. The P.M.G. has just decided on the suppression of new cars. Other man-produced noise could be abated by enforcement of noise suppression. Interference from other transmitters is a question of set design. One r.f. and two i.fs. give a very good performance, yet I suppose less than one in ten thousand commercial sets have this circuit or its equivalent.

V.h.f. will require relatively expensive receiving aerials, so why not spend this money on a good medium-wave aerial instead of a piece of wire trailing round the room or a capacitor to pick up *all* the mains noise?

Taunton, Somerset. L. STREATFIELD.

HAVING recently returned home to England, I have been very much interested in the correspondence in your last two or three issues. I can also corroborate what John Doe says and am sure that the radio business in this country may find stormy times not far ahead. The question of v.h.f. broadcasting is a good example of this. It is useless to quote America as being an example of the way in which frequency-modulated v.h.f. has failed. We could easily say the same thing about quality audio amplifiers, but I am sure that the designer of the Williamson amplifier would not agree. When considering the merits of a.m. versus f.m. we should look forward to the day when under certain circumstances interference from Continental stations may be experienced. The question of cost is, in my opinion, not the deciding factor. If the Home Service were to be put on v.h.f., I am sure it would be listened to. I would like to ask your correspondent from Manchester, Peter Dean, whether he, or anyone that he knows of, ever uses the short-wave band on his broadcast receiver? Its place could be taken by a v.h.f. band. If it were for a.m. then the extra cost would be about 5 per cent, if for f.m., about 8 per cent: the a.m. oscillator circuit would obviously have to be a good quality one.

I am looking forward to the time when a regular programme will be radiated from the slot aerials at Sutton Coldfield and Holme Moss.

Tibshelf, Derby. G. C. OXLEY.

Maritime Distress Frequency

FOR some years past, the frequency of 1,650 kc/s has been in use in European waters for distress and calling purposes by small craft participating in the short-range maritime radio-telephony service.

As a result of agreement reached at the Extraordinary Administrative Radio Conference, Geneva, 1951, it has been decided that, from 0200 GMT on 1st May, 1953, the functions hitherto performed on this frequency will be transferred to 2,182 kc/s.

The latter will become a world-wide radio-telephony distress frequency and it has also been designated as a general calling frequency, for which purpose it will be used by British ships and coast stations.

This change is of vital importance to all small craft operating radio-telephony in the 2-Mc/s band and is also a matter of some interest in the history of radio-communication. It is thought that this advance information may be of interest to your readers.

G.P.O., London, E.C.1. W. BLOW,
For the Inspector of Wireless Telegraphy.

AMATEUR BANDS

THE recent changes in the amateur bands (the latest being the opening of the 21-Mc/s band for telephony) justifies, we feel, the publication of the following table of frequencies, power and types of transmission permitted by the P.M.G. In addition to those tabulated, the bands 26.95-27.28 and 464-465 Mc/s are reserved for radio control of models.

In the column "types of emission" the prefixes A, F and P indicate the type of modulation—amplitude, frequency and pulse, respectively. The figures denote: 1, c.w.; 2, m.c.w. or i.c.w.; 3, telephony; and 5, television. The suffixes indicate supplementary characteristics of the transmission: *a*, single sideband, reduced carrier; *d*, pulse, amplitude modulated; *e*, pulse, width modulated.

The figure given in the second column for pulse modulation is the mean power; the peak power permitted is 2.5 kW.

Mc/s	Max. d.c. input (watts)	Types of Emission
1.715–2.0	10	A1, A2, A3, A3a
3.5–3.635	150	A1, A2, A3, A3a
3.685–3.8	150	A1, A2, A3, A3a
7.0–7.3	150	A1, A2, A3, A3a
14.0–14.35	150	A1, A2, A3, A3a
21.0–21.45	150	A1, A2, A3, A3a
28.0–30.0	150	A1, A2, A3, A3a, F1 *, F2, F3
144–146	150	A1, A2, A3, A3a
144.5–145.5	150	F1, F2, F3
420–460	150	A1, A2, A3, A3a, F1, F2, F3
425–455	150	A5, F5
1215–1300	150	A1, A2, A3, A3a, F1, F2, F3
1225–1290	150	A5, F5
2300–2450	150	A1, A2, A3, A3a, A5, F1, F2, F3, F5
2350–2400	25	P1, P2d, P2e, P3d, P3e
5650–5850	150	A1, A2, A3, A3a, A5, F1, F2, F3, F5
5700–5800	25	P1, P2d, P2e, P3d, P3e
10000–10500	150	A1, A2, A3, A3a, A5, F1, F2, F3, F5
10050–10450	25	P1, P2d, P2e, P3d, P3e

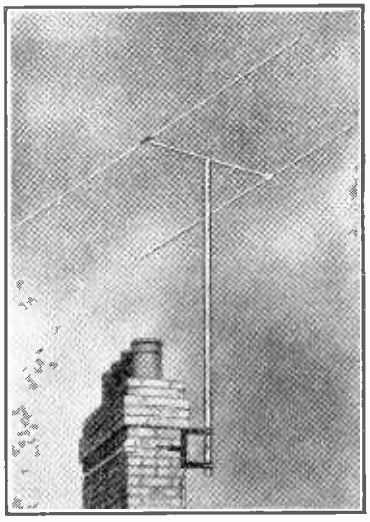
* F1 denotes frequency-shift keying (FSK).

THE "BELLING-LEE" PAGE

Providing technical information, service and advice in relation to our products and the suppression of electrical interference

Pontop Pike and Belfast

It is indeed good news to hear that these two new television transmitters will soon be on the air, even if with temporary 1.KW equipment. The fact that they will require horizontal aerials won't worry us, as we have designed these both for Wrotham and for certain continental T.V. reception. We also sent a sample aerial into the Newcastle area a week or two back. Our designs generally lend themselves to horizontal mounting. It is going to be tricky adjusting ourselves to the idea that distances of twenty miles have to be considered as fringe areas and may well necessitate the use of multi-element arrays.

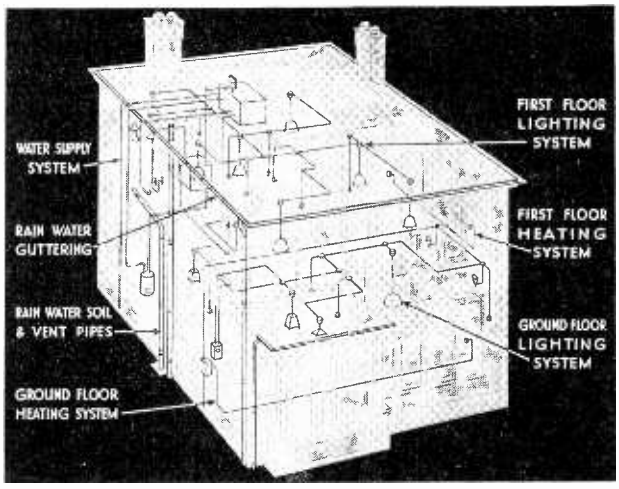


It is no longer good practice to state that such and such an aerial should be satisfactory at thirty miles. We must remember to qualify such a statement. In practice the distances for the 1.KW transmitters are approximately half those of the main transmitters based on the anticipated decay of field strength. These distances are for normal countryside. Variable results must be expected in hill and dale country.

How Horizontal Polarisation Affects our Aerials.

Space does not permit a detailed treatise on this subject, but we would like to let readers know, as soon as possible, just what happens in practice.

All dipoles must be capable of rotation as a dipole is now very directional with its free ends looking at minimum.



The forward gain of an "H" of multi-array is unaltered, but again there are minima at the free ends.

A "Lofrod" cannot be used as an inverted "T" but the centre element should be discarded, the centre strap removed, and the aerial used as a straightforward dipole broadside on.

The "Doorod" is essentially a vertical aerial and is out of place when fitted in a horizontal position. The "Viewflex" comes into its own as it is an ideal horizontal indoor aerial, but remember Pontop Pike is nine miles from the centre of Newcastle and we wouldn't expect to get much change out of an indoor aerial at this distance from the temporary 1.KW transmitter.

The "Veerod" inverted "V" loft aerial will be as good if not better, but remember it will now be directional broadside on to the transmitter.

All horizontal aerials will likely be more prone to interference from above and below e.g., from aircraft reflections and electric sewing machines etc.

You will note that throughout we have quoted the power of the temporary transmitter at Pontop Pike as being 1.KW. The permanent transmitter will radiate 5.KW and this represents an increase of approximately 7 decibels, and remember 1 db can make all the difference between holding sync and not holding sync.

What we have written regarding Pontop Pike applies equally to Belfast.

How much metal in a brick built house?

The above illustration was prepared several years ago. Its purpose was to emphasise the importance of getting a broadcast aerial well away from, or high above, the house, as all the electrical wiring, conduits, waste pipes etc., are so very likely to be re-radiating interference or reducing effectiveness. Re-radiated interference is generally more troublesome at broadcast than at television frequencies.

Nevertheless, the same illustration serves to show just why it is so very difficult to predict the results that may be obtained from an indoor television aerial.

The "Belling-Lee" "Doorod" has many staunch supporters and has proved itself well worthy of them. Tens of thousands have been sold in the past and probably as many will be bought in the future, but they won't give satisfaction everywhere.

We say five to eight miles, we know this is conservative for we know where they work at many times these distances.

The illustration above also shows how the "Belling-Lee" "Lofrod" —our loft mounting television aerial—stands a better chance of collecting more transmitted energy. It is higher, and has less metal above it.

Written Nov. 20th, 1952

BELLING & LEE LTD
CAMBRIDGE ARTERIAL RD., ENFIELD, MIDDX., ENGLAND

Future of Sound Broadcasting

Discussion on the Impact of Television

IS it just a matter of time before television supersedes sound broadcasting? The question was debated in a lively informal meeting of the Institution of Electrical Engineers, opened by Geoffrey Parr. He referred to the accompanying B.B.C. charts showing how the arrival in the home of a television receiver caused nearly all the time formerly devoted to listening to be transferred (during television hours) to viewing, and added that in his case, as a listener of twenty years' standing, the transfer was total.

In the two most important types of programme—outside events and plays—television was obviously superior to sound alone. Meanwhile, with both services running together, television was bound to influence sound broadcasting in various ways; for example, there might be a drift of artists from one medium to the other, leading perhaps to revaluation of their merits.

The situation would be further complicated by sponsored television, though neither Mr. Parr nor anyone else seemed disposed to venture very far in predicting when or how such influence would begin to be felt. It appeared that a sponsor who obtained the rights of televising an event would have a complete monopoly of broadcasting that event, with the startling possibility that the B.B.C. might be unable to broadcast in any form whatever such an occasion as the Derby or even a coronation.

Mr. Parr deprecated the tendency for certain journalists to dramatize the "battle between sight and sound . . . with sound trying to keep as many customers as possible in the face of TV-wooing," and thought that any rivalry that did exist might subside on the appearance of real competition.

Although in the discussion that followed many diverse opinions were voiced, one outstanding conclusion could be discerned: that it was neither desirable nor—in the foreseeable future — likely that sound broadcasting would be superseded. This was argued on a number of grounds: technical, economic, social and artistic. It was difficult, for example, to foresee television taking over the field now occupied by portable sets; and the objections were even greater with car radio. "Music while you work" was said to stimulate production, but that such would be the result of "viewing while you work" seemed unlikely. Many hobbies and household duties carried on while listening could not be continued satisfactorily while gazing in semi-darkness at a screen. Television was enormously more costly than sound both to produce and to receive, and expense did not end when the receiver was paid for.

It was held that in certain types of programme seeing added nothing worth while to hearing. One speaker testified that his enjoyment of Itma ceased from the moment he saw it televised, and others disputed the claim that vision was necessarily helpful to every kind of play. There were occasions when sight disillusioned the imagination. Even outside broadcasts, which it was admitted had most to gain from

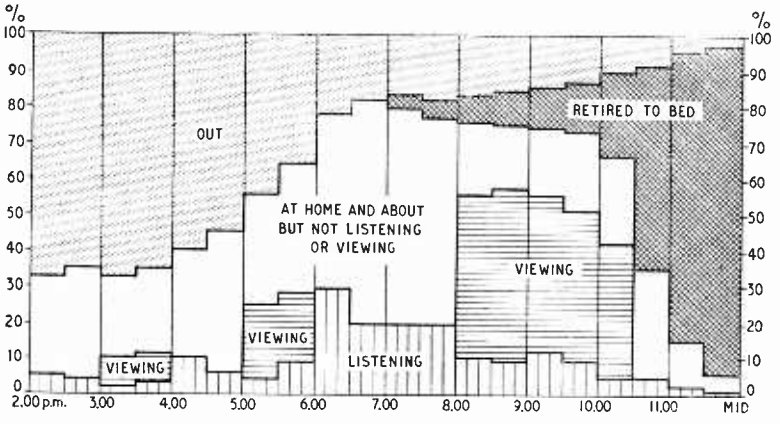
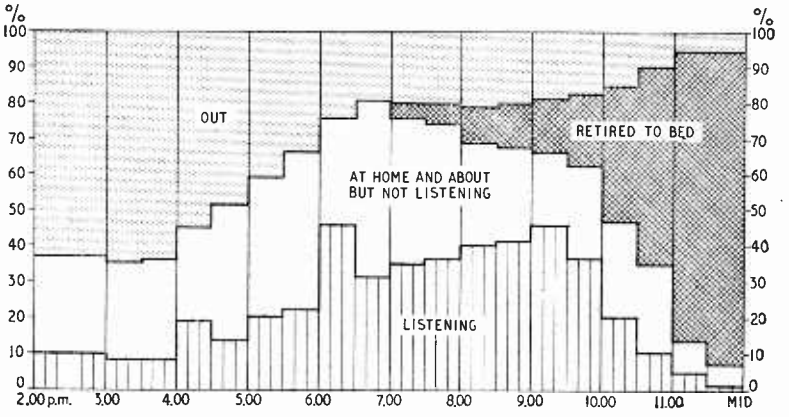


Fig. 1. This chart shows the average proportions of people aged 5 years and upwards occupied during evening hours (weekends excepted) as shown, in homes provided with both television and sound broadcasting reception.

This chart shows the comparable situation where there is no television receiver. It appears that time devoted to viewing is almost entirely at the expense of time formerly devoted to listening, the other categories being hardly affected at all. (Courtesy "The B.B.C. Quarterly".)



vision, might be restricted if there were the necessity to televise every time.

As for the B.B.C. audience research charts, Fig. 1 was explained as an initial "overshoot," which was known to be followed by a steady-state condition in which television and sound programmes were selected on their merits rather than on novelty value. It was agreed that many people inclined one way or the other according to whether they had visual or aural mentalities, but there was some difference of opinion on which indicated the higher intelligence. An eloquent plea was made for each medium of broadcasting to be allowed to develop freely, rather than be planned according to some doctrinaire principle.

Speakers were understandably cautious in arguing from experience in the U.S.A., but an article in the current *B.B.C. Quarterly* was quoted to urge that even greater caution should be exercised by broadcasting planners, for the initial success of many American television stations was not being maintained. Regarding the viewers' side of the economic problem, however, it was said that Americans did not know how they had ever afforded not to have television, it had so reduced their outlay on outside entertainment and car parking.

Interesting evidence was given that both in this country and in Canada the volume of correspondence received by broadcasters about programmes was many times more from viewers than from the vastly greater number of listeners; which seemed to support the belief that the majority of so-called listeners pay little or no attention to what is on, and in this respect at least television is having a notable impact on sound broadcasting.

Nevertheless, concluded Mr. Parr, the discussion as a whole did not appear to provide the B.B.C. with any valid basis for drastically reducing the sound services in favour of television.

COLD-CATHODE TUBES

Their Reliability and Life

NOW that the cold-cathode trigger tube is becoming available in a greater variety of types and characteristics it is beginning to replace the thermionic valve in a good many electronic switching applications. A recent article in *Wireless World** gave some idea of its versatility for this type of work. Now, a discussion meeting at the I.E.E. has thrown some light on the reliability and life of the cold-cathode tube compared with that of the thermionic valve.

The opener, K. Kandiah, was quite frank in saying that if reliability of equipment is a consideration it is preferable to use cold-cathode tubes. Failure of electron tubes, he went on, may be due either to a slow change of characteristics with life or to a mechanical fault. The change of characteristics of cold-cathode tubes is often smaller than that experienced with thermionic valves. Faults due to the glass bulb are comparable in both devices, but there are less strains on the bulb of the cold-cathode tube owing to the absence of the heater. There are many forms of mechanical failure inside the thermionic valve which are not experienced with the cold-cathode tube. Moreover, the failure of other components in an equipment is accelerated by the higher temperatures produced by thermionic valves.

Several speakers had investigated the life of cold-cathode tubes, and figures better than 28,000 hours and 237 million operations were quoted. Two speakers working independently had determined the failure rate as 0.1 per cent per annum. For the special multi-cathode tubes a figure of 50,000 hours' life was mentioned—with the warning that this could fall to 10,000 hours if the tube were quiescent with the glow resting at one electrode.

Mention was made of the improvement in reliability achieved by the molybdenum sputtering technique in manufacture. Speakers noted that the application of excessive voltage produced excessive glow and so reduced the life of the tube. It was known that when the overload condition was reached the life and characteristics deteriorated sharply, but there was a general desire for more precise information from the manufacturers on this point and also on the photo-electric susceptibilities of the tubes.

* "Electronic Switching," by E. A. R. Peddle. October and November, 1952, issues.

Manufacturers' Literature

Dry Electrolytic Capacitors; a leaflet giving the new smaller sizes of the type BR "Drilitic" capacitor and current information on other capacitors made by the Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, London, W.3.

Valve Equivalents of other makes to Emitron types given in a leaflet from Electronic Tubes, Ltd., Kingsmead Works, High Wycombe, Bucks. This also gives a complete list of Emitron valves and c.r. tubes, their characteristics, base connections and prices.

Versatile Component Mounting System; standard set of parts comprising group boards and Meccano-type mountings which can be assembled in many different ways. Descriptive leaflet from Joyce, Loebl & Co., Ltd., Vine Lane, Newcastle.

Valve Manual giving characteristics, base connections, prices and equivalents of all Marconi valves and Emiscope c.r. tubes From The Marconiphone Co., Ltd., Hayes, Middlesex.

Coaxial Connectors; new types fitted with coupling rings, cable-joining types and multi-way screened types listed in leaflets from Transradio, Ltd., 138a, Cromwell Road, London, S.W.7.

Casting Alloys in aluminium, magnesium and zinc; a guide to their selection giving trade names, chemical composition, mechanical test requirements, heat treatment and physical and mechanical properties of 27 different types. From the Birmingham Aluminium Casting (1903), Co., Ltd., Dartmouth Road, Smethwick, Birmingham, 40.

List of Components from the distributors, City and Rural Radio, 101, High Street, Swansea, Glam.

Television Replacements; comprehensive list of exact replacements for well-known receivers. Obtainable from Direct T/V Replacements, 134-136, Lewisham Way, New Cross, London, S.E.14, price 6d including postage.

Narrow-aperture Cabinet Loudspeakers giving even distribution of sound over a wide angle in the horizontal plane. Specification on a leaflet from Standard Telephone & Cables, Ltd., Connaught House, London, W.C.2.

Components and Accessories; an "international" catalogue of parts made by makers in many different countries, from Radio-Parts, G1. Kongevej 89, Copenhagen V, Denmark.

Battery Charging; a booklet "Putting it Back" giving general information on low-rate or "trickle" charging of lead-acid and alkaline accumulators. Obtainable from Easco Electrical, Ltd., Brighton Terrace, London, S.W.9, price 1s including postage.

Valve Wall Chart giving characteristics, base connections, equivalents and prices of Brimar valves, c.r. tubes, germanium diodes, Brimistors and metal rectifiers. From Standard Telephones & Cables, Ltd., Footscray, Sidcup, Kent.

Government Surplus Equipment, components and accessories. A very comprehensive stock list obtainable from A. T. Sallis, 93, North Road, Brighton, Sussex, price 6d.

Functional Circuit Diagrams

Making the Circuit Tell Its Own Story

By C. E. WILLIAMS,* A.M.I.R.E. Aust.

THE writer had some recent teaching experience on relatively complex electronic equipment, and during the course of this work great difficulty was experienced in working from commercially produced circuit diagrams. In fact, in many cases it was found necessary to completely redraw whole circuits before they could be made to give their story to the students.

It must be realized at the outset that circuit drawing is a means of expression: what is good and what is bad is therefore often a matter of opinion and personal prejudice. On the other hand, since it is a means of expression, there is often some subtle way of creating the desired impression in the mind of the reader.

At first thought there would appear to be little scope for subtlety in the resistance-capacitance coupling between the anode of one valve and the grid of the next, but let us examine this a little more closely. Fig 1 (a) shows one way of drawing this circuit. Note that it gives the impression that the signal passes from the anode through the capacitor to the grid of the second valve, and the resistor is merely there to provide a d.c. return path for the valve grid. This is as it should be, and hence the circuit is doing its job and telling its story. But suppose that the signal from the anode of the first valve is a square wave, and the time-constant of the resistance-capacitance combination is so short compared with the duration of the square wave that the signal is differentiated or "pipped." Does the circuit still tell a true story, or is it misleading us?

Fig. 1 (b) shows a slight rearrangement of the circuit, and it is worth noting that here we get no impression of the signal passing from the anode through the capacitor to the grid. Rather, we feel that the signal is applied to the resistor and the capacitor in series, and the resulting voltage developed across the resistor is applied to the grid of the succeeding valve.

We therefore see that these two circuits are not synonymous, and the one used should be decided by the operation performed. That is, if the capacitor serves only as a d.c. blocker, and any changes of the waveform that it may introduce are undesirable, then we should draw it as in (a). On the other hand, if in addition to serving as a d.c. blocker it introduces a desired change in the wave shape or phase, then we should draw it as in (b).

Another very simple circuit is shown in Fig. 2, and here again the way we arrange the components is dependent upon the job that they do. For instance, if the two components constitute a low-pass filter, then they should be arranged to resemble one, as in (a). On the other hand, if they constitute an integrating circuit, or if they are used to introduce a phase shift, then they should be arranged as in (b).

From the foregoing it will be seen that there are plenty of opportunities for subtlety in even the simplest circuit, while with more complex circuits the opportunity (indeed the necessity) for subtlety and thought increases out of all proportion to the number of components.

Of course, the man who is doing the layout cannot indulge in all this thought unless he understands how the circuit works. Hence the emphasis in this man's training must be placed on electronic engineering rather than upon mechanical drawing. This need not cause much hardship, however, since the finished circuits can then be drawn by a tracer, and the requisite skill for the production of the purely mechanical side of circuit drawing is quite readily attained.

It will be apparent that if the layout man is going to think about the placement of each component this will involve time, and one can almost hear those in charge of drawing offices crying in horror at such a proposal. But we must regain our sense of proportion regarding the schematic and where it fits into the scheme of things. The circuit diagram is not an end in itself; rather it is a means to an end, this end being, of course, the telling of a story to the technician. With this in view, one doesn't need to be much of a mathematician to realize that ten minutes of the layout man's time is not wasted if it results in a saving of one minute of the technician's time on each occasion that he has to use the diagram. It would be an exceptional

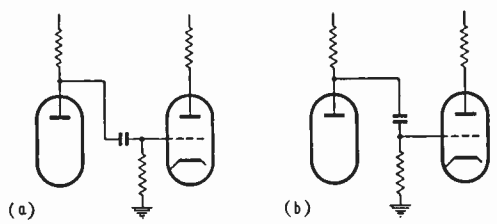
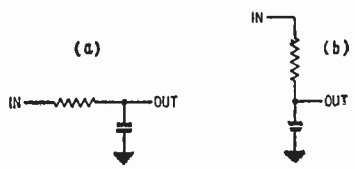


Fig. 1. In (a) is one way of drawing a resistance-capacitance coupling between valves; (b) shows a rearrangement of the circuit.

Fig. 2. In (a) is a low-pass filter circuit. This is rearranged in (b) to indicate an integrating or phase shift action.



* Division of Airways, Australian Department of Civil Aviation. This article is a slightly shortened version of a paper "The Utility Factor in Circuit Diagrams" published in the September, 1952, issue of the *Proc. I.R.E. Aust.*

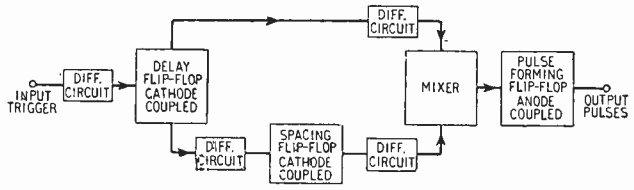


Fig. 3. Block diagram of pulse generator producing double pulses.

equipment indeed if it were discarded before the layout man's time were recovered. With a reasonably large equipment this recovery will probably be made within the maker's factory, and the resulting extra customer goodwill can be added to the firm's intangible assets.

More Standardization Needed

It is rather enlightening to consider a child learning to read. At first the child spells out C-A-T, but after a time he starts to recognize this combination of three letters as being the word CAT, and this word, of course, is applied thereafter as referring to *Felis Domestica*. But just imagine how much harder the child's task would be if the word were sometimes written TAC, at other times CTA, and at other times ACT. This may appear a little ridiculous, and no one would dream of complicating the child's life to this extent, but the circuit diagrams we produce continually ask our technicians to do just this.

In the language of circuit diagrams, individual components are analogous to letters, sub-circuits are analogous to words, while the whole sheet is equivalent to a short story, or a chapter of a longer story, as the case may be. The various standards publications have done their job in educating us up to the point where we now form our component symbols in a reasonably uniform way. That is, in our language we no longer form our letters with a view to expressing our individuality, but rather our aim is to communicate thoughts from one mind to another.

However, our language is getting more complex each day, and it is about time for us to make up our minds how we propose to form our sub-circuits (words) so that our reader can learn to recognize them with the minimum of effort. At the present stage the situation is, to say the least, chaotic, and firm action will be necessary to create order out of this chaos.

The situation would be bad enough if this variation were only between manufacturers, but unfortunately the circuits from the one manufacturer are often non-uniform. Even worse, the author noted that on the one sheet of a recent instruction manual, a sub-circuit which is complete in itself (a cathode-coupled "flip-flop") was drawn in two different ways. The situation was aggravated by the fact that there were five sub-circuits of this type on this one page, three drawn one way and two the other. From this we may conclude that the average technician must be very intelligent if he can take such handicaps in his stride, or that the person responsible did not know that sub-circuits exist. In some fields this lack of standardization does not cause us much trouble, e.g., receiver power supplies. The reason is that by long experience we have become accustomed to every possible way of drawing this simple circuit. However, the newcomer to the field does not have this long experience, and even in this simple case there is considerable advantage to be gained by the adoption of a standardized layout.

It is in some of the less familiar fields that the advantages of standardization are most apparent. This is not only because of lack of familiarity but also because of the techniques involved. For instance, in the field of pulse techniques (with which the author has had most experience) the most complex equipments can be broken down into not more than about half a dozen basic types of sub-circuits. Once the operation of these basic sub-circuits is known and understood, tracing the operation of the complex circuit resolves itself into their recognition, since the only thing which will vary much will be their order and the manner in which they are interconnected.

Let us take as an example a simple pulse generator which is to produce two identical pulses of variable width, with variable spacing, and the first pulse is to be delayed by a variable time with respect to an external initiating trigger pulse. Fig. 3 shows a block diagram to meet this specification.

Even the lowly block diagram cannot escape without some comment, and it is worthy of more thought than it is usually given. In Fig. 3 it will be noted that the signal flows from left to right, and where the signal splits into two paths these paths are shown as being of equal importance; i.e., one is not shown as a bypass or loop for the other. Conversely, where two signals are mixed, the two paths are shown physically as coming together, and then continuing on along a common path.

Fig. 4 shows the circuit diagram as it would probably emerge from a typical drawing office. Note that it conforms to the draughtsman's ideal in that valve envelopes are in line across the page and the other components are lined up in the same way.

Fig. 4. Circuit of the pulse generator in Fig. 3 as drawn by a typical drawing office.

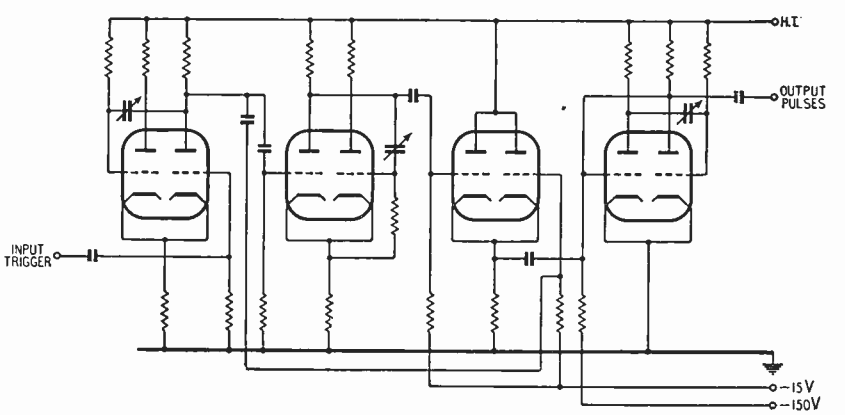


Fig. 5 shows the same circuit redrawn around the block diagram. Note that no effort has been made to put valve envelopes or components in line, but every effort has been made to standardize the sub-circuit layout as much as possible.

Most people, when confronted by the two diagrams and asked to express a preference, immediately vote for Fig. 4. This is to be expected, since, as a piece of drawing, Fig. 4 is by far the neater of the two. However, when these same people are asked to find out how the circuit works, almost invariably they change their preference to Fig. 5. If the reader cares to try this exercise, he will probably agree that the second circuit can be made to give up its information with less effort.

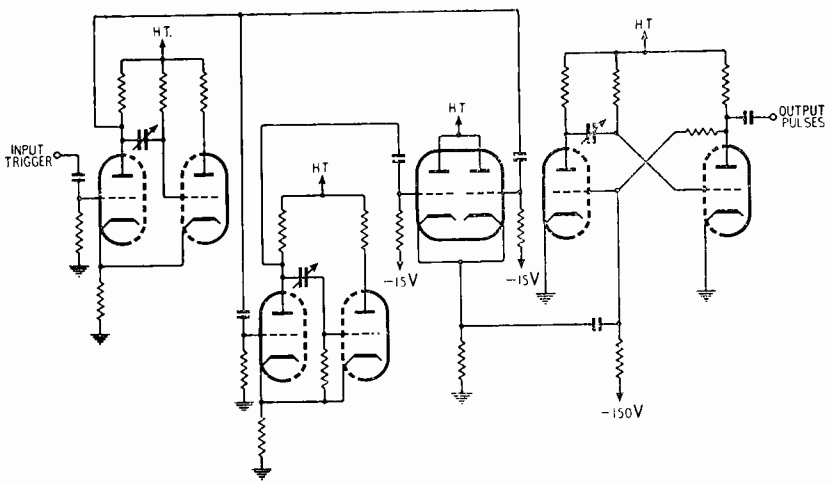


Fig. 5. The circuit of Fig. 4 redrawn to make the operation as clear as possible.

The points to note are as follows. The circuits of the first two valves are practically identical, hence they are drawn to resemble each other as much as possible. An effort has been made to show that the third valve is a mixer by the symmetry of this sub-circuit. The fourth valve is an anode-coupled flip-flop, and the sloping cross-couplings immediately draw our attention to this fact. Note further that all three flip-flops are drawn with the normally cut-off valve on the left, and with this convention we soon realize that we get a negative pulse at the anode of the left-hand valve and a positive pulse at the anode of the right-hand valve. This convention is recommended for general use, for experience has shown that it leads to the most convenient layout in the majority of cases, even though it may be less convenient in any one case.

At times, there will be a strong temptation to deviate from the standard, since this will often lead to a diagram which (from an artistic point of view) is far neater. We should be able to resist this temptation if we always remember that the man who draws the circuit is only one link in a chain.

Superfluous Wires

Most engineers, if asked to comment on the desirability of including valve heater wiring in the body of a circuit diagram, would maintain that this is usually not necessary and it only tends to clutter up the main diagram. On the other hand, the same engineers will usually demand that the high tension and bias lines should be included in full. This does not cause much trouble if there is only one high tension line and one grid bias line. But the situation tends to become rather chaotic if we have two or three values of high tension supply, and perhaps two or three values of bias supply. It is part of the cussedness of inanimate objects that the circuit we are interested in is usually about the centre of the sheet, and therefore, before we can discover the supply voltage for our sub-circuit, we are forced to trace half way across the page. Furthermore, the signal lines have a habit of becoming inextricably mixed up with the supply lines. We have all experienced the frustration which ensues when we set out to trace a signal line through a maze of parallel lines and cross-overs and ultimately find ourselves at the edge of the page, only to discover that the line being traced is labelled 250 volts. We can prevent this situation from arising by terminating our supply lines at the last component and labelling them accordingly. When one becomes accustomed to this convention the drawing in of supply lines soon appears as superfluous as does the drawing in of heater lines at the present time.

Figs. 4 and 5 also serve as examples of the two contrasting methods. It will be generally agreed that the method adopted in Fig. 5 helps to get the story across to the reader with the least possible effort on his part, since every line of any length is actually carrying signals.

Diagrams of telephone switchboards have used a similar convention for years. All leads going to the battery are drawn as terminating on a single cell of a battery and it is understood that, even though this symbol may recur ten or twenty times in a circuit, all these points are in reality connected to the common battery.

The author wishes to acknowledge his indebtedness to R. K. Crow, of the Melbourne Technical College, who first convinced him that a circuit is more than a lot of lines on a piece of paper. G. L. Moore of Austronic Engineering Laboratories has helped to develop that interest by many an hour of argument. Thanks are also due to V. W. Gibbs of the Department of Civil Aviation for helpful and kindly criticism in the preparation of this article.

"Reading" Circuit Diagrams

THE fact that signals are generally made to flow from left to right in circuit diagrams probably comes from our natural habit of reading in this way. Hence the convention of the input on the left and the output on the right. As the Austrian painter Faistauer wrote, apropos pictures in general: "The spectator is accustomed to reading a picture from left to right just as he reads writing. Instinctively or consciously the old masters put the entrance gate to their pictures into the left-hand bottom corner. . . . The painter should take these feelings of his spectators into account if he wishes to be more easily understood."

It would be interesting to know how the Chinese and Japanese feel about circuit diagrams!

COIL WINDING DATA

Charts for Coils on Standard Formers with Dust Iron Cores

By LORIN KNIGHT, GRAD.I.E.E.

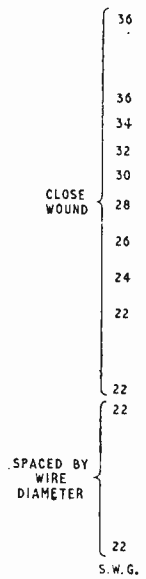
THE moulded bakelite, or polystyrene, coil former fitted with an adjustable dust iron core and fixing feet, and which is typified by the Aladdin Type PP5892, at one time known as the type F804, has become very popular in the last few years because of its small physical size and its cheapness. This former is $\frac{13}{32}$ in in diameter and the winding space is $\frac{7}{8}$ in long. The accompanying charts enable a coil to be wound on this former and to tune to a specific frequency without having first to calculate the required inductance. Curves are given for various values of tuning capacitance. When estimating the latter an allowance should be made for the wiring and valve capacitances. The self capacitance of the coil has been allowed for in the charts.

If coils from Chart No. 2 are wound as fairly neat multi-layer coils instead of wave-wound coils there will normally be enough adjustment in the dust iron core to compensate for any differences.

At very high frequencies the inductance of the rest of the circuit may be comparable with that of the coil. Moreover the total tuning capacitance may consist mainly of stray capacitance, in which case errors in its estimation will be more serious. Consequently the curves can then be taken only as a guide.

There are several alternative makes of small formers in bakelite and other materials that can be used. Some are of $\frac{1}{2}$ in diameter and fitted with brass-stemmed dust iron cores $\frac{3}{8}$ in long. The charts can be used also for these but about 20 per cent *fewer* turns will be required than indicated by the charts.

The charts may also be used for obtaining winding data for the Denco plug-in type former which has pin spacing to fit a "Noval" valveholder. This measures $\frac{3}{8}$ in diameter and gives 1 in of winding length. The dust core is $\frac{1}{2}$ in long and $\frac{1}{4}$ in diameter. In this case about 10 per cent *more* turns will be required.



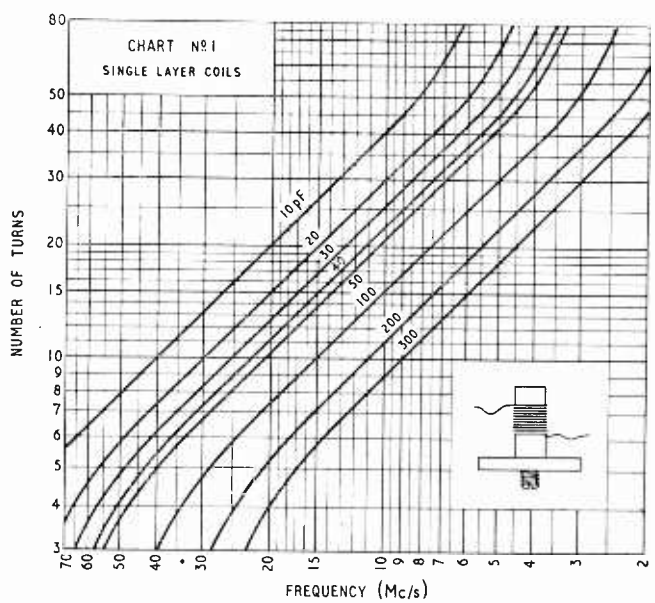


Chart No. 1: This chart gives the number of turns and gauge of wire required to tune to any frequency from 2 and 70 Mc/s using a single-layer wound on an Aladdin Type PP5892 former with dust iron core. Single-silk and enamel covered copper wire should be used.

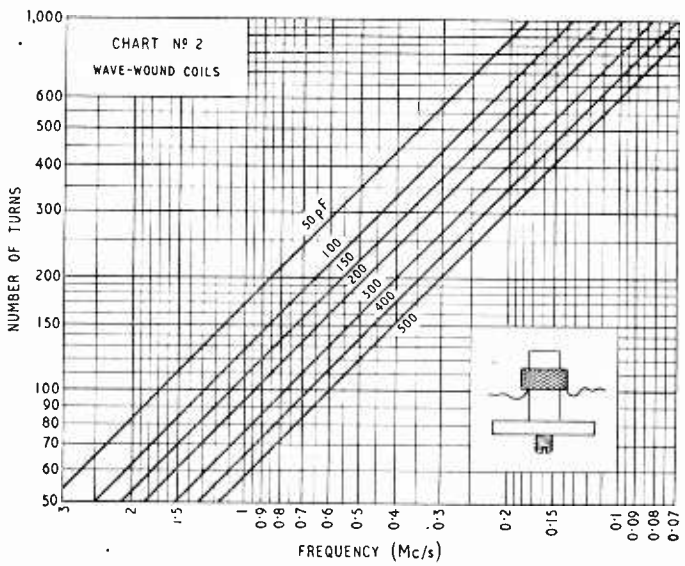


Chart No. 2: This chart gives the number of turns and gauge of wire required to tune to any frequency from 70 kc/s to 3 Mc/s using a wave-wound or muiti-layer winding on an Aladdin Type PP5892 former with dust iron core. No. 36 s.w.g. single-silk and enamel covered copper wire should be used. Up to 150 turns the coil is $\frac{1}{4}$ in long and over 150 turns $\frac{3}{8}$ in long.

WORLD OF WIRELESS

T.A.C. Constitution Upheld • Revolutionary Valve Production • International Electro-Acoustic Meetings • Servicing Certificates and Wages

"A Queer Committee"

THE constitution of the Television Advisory Committee, which was criticized in the leading article of our last issue, was the subject of questions asked in the House of Commons on December 10th.

In an omnibus reply to a number of questions on the direct or indirect financial interest in commercial television of some members of the Committee, the Assistant Postmaster General said: "No member of the Committee was appointed as representing commercial television interests though I understand that one representative of the radio industry has a direct interest in commercial television. Indirect interest might possibly arise in the case of the other representative of the industry and even perhaps in the case of the B.B.C. representative."

Television Show

AS announced last month, the annual exhibition of equipment relating to television engineering and production organized by the Television Society will be held at 155, Charing Cross Road, London, W.C.2, on January 23rd and 24th.

On the first day, when the show is open from 6.0 to 9.30, admission is restricted to members, but tickets for the second day (10.30-6.0) are obtainable from members of the society and G. T. Clack, 43, Mandeville House, Notre Dame Estate, Clapham, S.W.4.

Exhibitors include: Aerialite, Aren, Balcombe, Belling and Lee, Bush, Cinema Television, Decca, E.M.I., Ediswan, Ferguson, Ferranti, Hunt, Leland, Marconi's, Mullard, Murphy, Philips, Pye, Regentone, S.T.C., T.C.C., Telequipment, 20th Century Electronics, Widney Dorlec, B.B.C., B.R.E.M.A. and the Post Office.

Component Reliability

HAVING referred to the valve as "relatively speaking an unreliable device," N. C. Robertson, Director-General of Electronics Production (Ministry of Supply), speaking at the Radio Industry Club luncheon in November, said that a revolutionary conception of valve production forms one of the Ministry's present research projects. If the project succeeds valve reliability will take a great step forward.

Mr. Robertson also stated in the course of an interesting address on the relationship between Government research and industry, that so far there have been disappointingly few practical applications of printed circuits. Recent work, however, on a combination of the printed circuit and dip-soldering gives rise to the hope that there will emerge in the course of the next few years a technique which will both lower the cost and increase reliability.

Extending Television

THE announcement, referred to in "Random Radiations" last month, that temporary television stations are to be erected at Pontop Pike and Belfast in time for the Coronation, has naturally provoked a desire for similar facilities in other areas, especially Plymouth, Isle of Wight and Aberdeen, which are to be served by the remaining three low-power stations planned by the B.B.C.

The Assistant Postmaster General stated on December 8th that the Government cannot, for the time being, sanction any further temporary stations. He added that it was not a question of the B.B.C. being unable, for technical reasons, to erect these stations in time for the Coronation. It is the drain on national resources which is the determining factor, and the suggestions that have been made that commercial enterprise might be allowed to provide stations would not dispose of this objection. For the same reasons the Government cannot allow television relay companies to operate in areas not covered by the B.B.C. stations.

When asked did he not appreciate that private enterprise would put up the repeater stations and that there are plenty of television sets in the shops, the Minister replied: "The limiting factor is not so much the transmitting equipment as the receiving sets," *Wireless World* learns, however, from the British Radio Equipment Manufacturers' Association that the industry is confident it could provide the necessary receivers for areas to be served by all five low-power stations without interference with its export or rearmament effort.

Magnetic Recording

SOME 60 delegates, representing the governments and broadcasting organizations of Austria, Denmark, Finland, France, Germany (Federal Republic), Ireland, Italy, Luxembourg, Monaco, Netherlands, Norway, Portugal, Saar, Sweden, Switzerland, Turkey, United Kingdom, United States and Yugoslavia attended the Magnetic Recording Convention held in Hamburg at the end of November under the auspices of the European Broadcasting Union. Dr. Nestel, technical director of the Nordwestdeutscher Rundfunk, was chairman and the two U.K. delegates were H. Davies, who is in charge of the B.B.C. Recording Section, and A. P. Monson, superintendent engineer (recording) B.B.C.

It was not intended that the Convention should reach any formal decision; it was mainly for an exchange of views and to this end 28 papers were submitted. The matters discussed included the physical principles underlying magnetic recording, studio equipment, tape standardization and magnetic recording in television (including the recording of the picture).

It has been decided to make the International Technical Convention an annual event, each one being devoted to a particular aspect of broadcast engineering.

Electro-Acoustics Congress

AN interesting programme is planned for the International Congress on Electro-Acoustics, to be held in the Netherlands from June 16th to 24th, under the auspices of the International Commission on Acoustics. The principal subjects and contributors will be: Sound Recording (R. Vermeulen, Netherlands), Public Address Systems (E. Meyer, Germany), Acoustic Measurements (L. L. Beranek, U.S.A.), Hearing Aids and Audiometers (P. Chavasse, France), Ultrasonics (G. Bradfield, Gt. Britain), Musical Instruments (E. G. Richardson, Gt. Britain) and Sound Insulation of Lightweight Structures (C. W. Kosten, Netherlands).

The inaugural lecture on June 16th will be given by R. H. Bolt (U.S.A).

Full details are obtainable from the organizing secretary, P. A. de Lange, Mijnbouwplein 11, Delft, Netherlands.

Servicing Certificate Exams.

FOR the first Radio Servicing Certificate examination organized by the Radio Trades Examination Board in 1944 there were 44 entries; for that held in May, 1952, there were 301 candidates, and in addition 131 entered for the Television Servicing Certificate examination (introduced in 1950). Both exams are conducted jointly by the R.T.E.B., which is responsible for the practical test, and the City and Guilds, responsible for the written papers.

The results of the last two

examinations record that 133 of the 301 entrants for the radio exam passed in both the written and practical sections. Sixty-nine passed the written exam, but were referred in the practical test, and 19 candidates previously referred in the practical test completed the exam.

In the television servicing exam 66 of the 131 candidates qualified for the certificate and 43 passed the written paper, but were referred in the practical test.

It is announced that the next exam in radio servicing will be held on April 28th and 30th, and May 16th, for which entries must be received by February 1st. The television servicing exam will be held later, on May 4th and 6th, and June 20th, but the closing date for entries is January 15th.

Syllabuses for the exams and rules regarding eligibility of candidates are obtainable from the R.T.E.B., 9, Bedford Square, London, W.C.1.

Servicemen's Wages

AN increase of 15s per week in their minimum rates of pay has been awarded to radio and television servicemen by the Industrial Disputes Tribunal as a result of a dispute brought before the tribunal by members of the Radio and Television Retailers' Association (the employers) and members of the Guild of Radio Service Engineers (the employees).

The new rates, which are below those claimed by the employees but above those proposed by the employers, are: —

Holders of certificate "A," issued to those on the register of the Joint Standing Committee of the Radio Service Trade who have passed the R.T.E.B. exam, £7 13s 6d p.w.;

Holders of certificate "B," issued to technicians registered by virtue of their having served an approved apprenticeship or having had five years' experience in approved employment, £7 8s 6d p.w.;

Holders of the television certificate, issued to holders of "A" or "B" who have also taken a television course, £7 18s 6d p.w.;

Non-certificated servicemen, £6 5s p.w.

The full terms of the award are given in the pamphlet "Industrial Disputes Tribunal, Award No. 274" published by H.M.S.O. price 4d.

Coronation Plans

THE B.B.C. announces that technical discussions have already taken place between representatives of the Corporation and Radiodiffusion et Télévision Françaises on the question of relaying the B.B.C.'s television transmissions of the Coronation to France. Tests are to be conducted early in the year, R.T.F. being responsible for the relay from Dover. Representatives from other European countries were also present at the discussions and it is probable that some of them will link into the London-Paris chain if the tests are satisfactory.

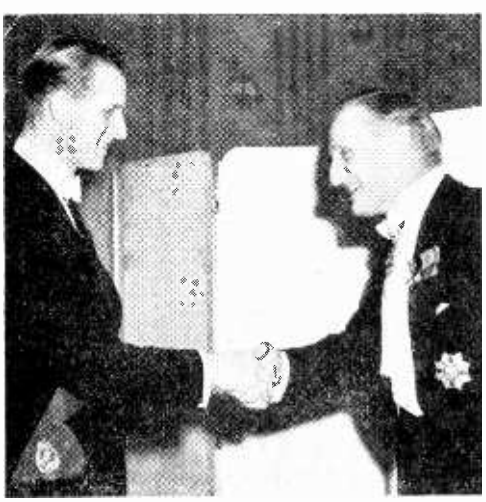
PERSONALITIES

Dr. Balth van der Pol is the latest recipient of the Valdemar Poulsen gold medal awarded by the Danish Academy of Technical Sciences. He has been director of the International Radio Consultative Committee (C.C.I.R.) for the past four years, prior to which he was a member of the board of the Physics Laboratory of the Philips organization in Eindhoven, Holland. The award has been made for his work on the propagation of radio waves both in theory and in practice as director of the C.C.I.R.

Professor H. G. Booker, M.A., Ph.D., A.M.I.E.E., who, during the war, was head of the Mathematics Section of T.R.E. and, since 1948, has been a professor of electrical engineering at Cornell University, New York, is one of three British recipients of the Fellowship of the American Institute of Radio Engineers.

H. Faulkner, C.M.G., B.Sc., M.I.E.E., deputy engineer-in-chief, G.P.O., also becomes a Fellow of the I.R.E. He has been with the Post Office since 1913 and was a member of the team responsible for the design of the Rugby station and was its first officer-in-charge.

Professor J. A. Ratcliffe, O.B.O., M.A., F.R.S., M.I.E.E., who is also awarded the Fellowship of the I.R.E., is reader in physics at Cambridge University and was a member of the Radio Research Board from 1946 to 1949. He was a member of the Television Advisory Committee from 1949 until its recent reconstitution.



H.R.H. the Duke of Edinburgh being greeted on arrival at the Savoy Hotel, for the Radio Industry Council dinner by Lord Burghley (president). In the course of his speech when proposing the toast "The Radio Industry" H.R.H. drew attention to the shortage of qualified radio engineers and physicists to meet the industry's needs.

C. F. Bareford, M.Sc., Ph.D., who, since 1946, has been head of the Mullard Research Laboratory at Salfords, Surrey, has accepted the appointment of chief superintendent of the Long Range Weapons Establishment at Woomera, South Australia. He is succeeding H. C. Pritchard, who, after three years at the establishment, is returning to the Ministry of Supply. Dr. Bareford was for two years with the B.T.H. Company as a vacuum physicist and ten years at the Admiralty Signal Establishment, where he was engaged on radar and telecommunication research, prior to joining Mullard's.

Alexander Landman, M.Sc., M.I.E.E., was recently appointed head of the Electrical Design Department of Murphy Radio in succession to Dr. F. C. Connelly, who is now managing director of Murphy's subsidiary, Acoustic Products, Ltd. In his new position Mr. Landman is responsible for television design and research, radio receiver design, and the engineering division, which among other things undertakes the life-testing of materials. He was with the E.M.I. organization from 1936-1943 and with the Plessey Co. from 1943-1952.

A. Landman, M.Sc., M.I.E.E.

T. David Conway, B.Sc.(Eng.). A.C.G.I., A.M.I.E.E., has been appointed chief engineer of Grundig (Great Britain), Ltd., the recently formed British offshoot of the West German radio company Grundig Radio-Werke. For the past two years he has been an instrument engineer at a large chemical plant of the Ministry of Supply. He was with Ultra Electric as a radar engineer from 1939 to 1944 when he went to the United Insulator Co. From 1947 to 1950 he was with Standard Telephones and Cables as factory valve engineer.

R. J. Gilbert, engineer-in-charge of the B.B.C.'s Ottringham transmitting station since 1945, has retired. He joined the staff of the original British Broadcasting Company at Savoy Hill as an assistant maintenance engineer in 1924 and has served at Plymouth, Washford, Droitwich, Lisnagarvey, Start Point, Stagshaw (where he was engineer-in-charge) and Ottringham.

R. H. Wilson, Assoc.I.E.E., who, until recently, was sales manager of the Ceramic Resistor Department of the Morgan Crucible Co., Battersea, has joined A.B. Metal Products as general manager.

Brigadier E. J. H. Moppett, M.I.E.E., director of Pye Telecommunications, has been appointed radio adviser to the British Mount Everest Expedition which is to attempt an ascent next spring.

OUR AUTHORS

Charles Burns, who contributes the article on psycho-optics in relation to television in this issue, graduated B.Sc. (1st Class Honours Physics) from Aberdeen University in 1940. During the war he was at the Admiralty Signal Establishment and was concerned mainly with air navigational aids. In 1947 he joined the British Iron and Steel Research Association, where he has been engaged in work on instruments for the industry's research problems.

Dr. K. R. Sturley, who contributes the article "Electronic Switch" in this issue, has been head of the Engineering Training Department of the B.B.C. since 1945. He graduated from Birmingham University with B.Sc. (1st Class Honours) and was awarded the Bowen Research Scholarship to pursue investigation on electro-thermal storage problems, which lead to the degree of Ph.D. He joined the staff of Marconi College as lecturer in 1936 and was assistant principal when he left to join the B.B.C. Dr. Sturley spoke on the principles underlying vocational technical training and the methods by which it may be achieved, in his recent inaugural address as chairman of the South Midland Centre of the I.E.E.

K. R. Sturley, Ph.D., B.Sc., M.I.E.E.

C. E. Williams, whose article on circuit diagrams recently published in the *Proc. I.R.E.* (Australia) is reproduced in this issue, has been an airways engineer in the Division of Airways, Australian Department of Civil Aviation, since 1949. After service as a radar mechanic in the R.A.A.F. he studied at the Melbourne Technical College and in 1949 received the College's Associateship Diploma of Radio Engineering.

OBITUARY

It is with regret that the death is announced of **Wilfred F. Kent,** contracts manager of the Marconi International Marine Communication Co., the Radio Communication Co. and the Marconi Sounding Device Co. He was 57. Mr. Kent originally joined Marconi's W/T Co. in 1913, but left for a short while and rejoined the organization in 1933. He had been contracts manager since 1947.

IN BRIEF

Receiving Licences in force in the British Isles at the end of October totalled 12,870,101, including 1,732,882 for television and 168,106 for car receivers. The month's increase in television licences was 77,436.

Television Production.—A record number of television receivers was produced in October—nearly 85,000. The previous highest figure was 72,000 in February. The manufacturers sold over 100,000 sets to the trade during the month compared with 75,000 in September, the previous record.

R.S.G.B. Membership.—For the fourth successive year the annual report of the Radio Society of Great Britain records a decline in membership. In 1948 the membership totalled 14,439, but with decreases of 401, 1,015, 889 and 509 in the four succeeding years, the total at the end of September, 1952, was 11,625. Whilst deploring the losses the Council points out that the membership in 1939 was only 3,500.

Television in the Cinema.—The second of the series of lectures arranged by the British Kinematograph Society to instruct projectionists and cinema technicians in the principles of television and large-screen reproduction will be held in the Lecture Hall, City Museum, Leeds, and will commence on January 13th. The fee for non-members is 25s. Particulars of this and the third in the series (to be held later in Liverpool) are obtainable from the B.K.S., 164, Shaftesbury Ave., London, W.C.2.

Air Radio Show.—As was the case last year, the 1953 S.B.A.C. Show at Farnborough, which includes a considerable amount of aeronautical radio gear, overlaps the National Radio Exhibition to be held at Earls Court, September 1st—12th. The Society of British Aircraft Constructors' show will be held from September 7th to 13th.

Sponsored Television.—It was announced by the Postmaster-General in reply to a question in the House of Commons that 24 enquiries had been received by the Post Office about licences for commercial television stations.

Technical Writing.—A course of seven lectures on the Technique of Technical Writing will be given by G. Parr, M.I.E.E., technical director of Chapman and Hall, at the Borough Polytechnic, on Thursdays at 6.30 commencing on January 15th. Enrolment forms can be obtained from the Borough Polytechnic, Borough Road, London, S.E.1. The fee is 30s.

Speeding Parting Guests.—Pye radiotelephone gear was used to call cars from the City's car parks when guests were leaving the banquet at Lloyd's after the recent foundation-stone laying by Her Majesty the Queen. Car numbers, received by radio vans parked at strategic points, were broadcast by loudspeakers to waiting cars. Guests were enabled to leave at the rate of 700 an hour.

Decca's mobile radar demonstration unit, which has been touring N.W. Germany and Scandinavia, was set up on the island of Fanö, near Esbjerg, to demonstrate the possibility of giving radar assistance to vessels entering the port. For the tests, the Danish United Shipping Company's passenger vessel *Kronprinsesse Ingrid* and the Decca mobile unit were equipped with Pye v.h.f. gear to provide a two-way radiotelephone link.

Juvenile Lectures.—The seventh in the series of Christmas lectures arranged by the I.E.E. for school children will be entitled "Sound Broadcasting" and will be delivered by Dr. K. R. Sturley on January 1st and 2nd. Tickets, which have been circulated to schools in London and the home counties, are obtainable from the I.E.E., Savoy Place, London, W.C.2, where the lectures will be given at 3.0 each day. The series of Christmas-holiday lectures arranged for secondary school pupils by the London County Council includes two of radio interest on December 31st. Geoffrey Parr, honorary secretary of the Television Society, will deal with television at the Norwood Technical College, Knights Hill, S.E.27, and E. G. Doherty will speak on "The Romance of Radar" at the Sir John Cass College, Jewry Street, E.C.3. Both lectures start at 2.30.

BEAMA Catalogue.—The second edition (1952-53) of the BEAMA Catalogue, which is again issued for the British Electrical and Allied Manufacturers' Association by our Publisher, includes in its 1,020 pages a five-language glossary of the technical terms used in the various sections. The catalogue, which provides a comprehensive buyers' guide to products of the British electrical and allied industries (listed under 1,200 headings), is for private distribution.

"Electrical Review", our associate journal, reached its eightieth birthday in November, having first appeared in 1872 as the *Telegraphic Journal and Electrical Review.* We were naturally interested to see that in 1888 it devoted five pages to an abstract of Hertz' paper "On the Speed of Diffusion of Electro-Dynamic Actions."

Practical Electrician's Pocket Book.—The 1953 edition of this useful annual has now been issued. New chapters include those on fibreglass, power-factor correction and time switches, while the section on interference suppression has been revised. Odhams Press, 5s.

FROM ABROAD

Audio Fair, N.Y.—British audio equipment exhibited at the Audio Fair held in New York from October 29th to November 1st included Leak amplifiers, Garrard record changers and pickups, Wharfedale speakers and Hartley speakers, amplifiers and pickups. G. A. Briggs (Wharfedale), H. A. Hartley and H. J. Leak were present at the show.

U.S. Electronics Conference.—Literature from a representative cross-section of American manufacturers who exhibited at the recent National Electronics Conference in Chicago has been secured by the Board of Trade and is available on loan for a maximum of 10 days to firms in this country. It can be seen at Room 7172, Board of Trade, Horse Guards Avenue, London, S.W.1, where a copy of the exhibition catalogue is also available.

French Television.—It would appear from the review in *La Télévision Française* of the second French Television Exhibition, recently held in Paris, that the demand for large screens is much greater in France than in this country. The author states that 36cm (14-in) tubes are obsolescent; the majority of receivers using 17- to 24-inch tubes. With the greater number

of lines (819 compared with our 405) it is, of course, possible to have much larger pictures without over-emphasis of the line structure.

German Radio Show, which was to have been held in Dusseldorf last August and was postponed until February, has now been further postponed until the late summer—August 29th-September 6th.

Aden-U.S.A. Radio-telephone.—The recently opened Cable & Wireless radio-telephone link between Aden and the U.S.A. is transmitted via Nairobi and the United Kingdom.

Cable & Wireless has extended its radio-telephone network in the Far East through its international network station at Hong Kong. The most recent additions are Macao, Formosa and the Philippines, which are now inter-connected through Hong Kong.

EXPORTS

Siam's first two television transmitters, and incidentally the receivers for the initial demonstrations, are to be provided by British manufacturers. A Marconi transmitter and its associated studio equipment was installed at Chulalongkorn University, Bangkok, for the recent Constitution Fair. The second transmitter is to be brought into use by the middle of the year. They will operate on 625 lines. English Electric 16-in metal-tube receivers are being used.

British Television Equipment is also to be used in the Munich and Hamburg studios of the Nordwestdeutscher Rundfunk and the Munich studios of the Bayerische Rundfunk. Cameras and associated equipment have been ordered from Pye.

Underwater Television equipment has been ordered from Marconi's by a Belgrade shipping company for dock and harbour inspection work in Yugoslavia's Adriatic ports.

American Show.—Participation in the radio engineering show, which is being held in New York under the auspices of the Institute of Radio Engineers from March 23rd-26th, is recommended by the Board of Trade to U.K. radio and electronic manufacturers, particularly those with distribution arrangements in the United States. Further information is obtainable from the organizers Clapp & Polliak, 341 Madison Avenue, New York, U.S.A.

NEW ADDRESSES

Elliott Brothers (London), Ltd., have transferred their Birmingham branch office to 181, Corporation Street, Birmingham, 4 (Tel.: Central 8313). The new office is the sales and service centre for the Midlands.

Telcon in Manchester.—The Telegraph Construction and Maintenance Co. has opened a branch office at 43, Fountain Street, Manchester, 2 (Tel.: Central 0758).

Another Factory at Wandsworth has been acquired by Mullard Equipment, Ltd. The older factory in Brathway Road now houses the engineering development departments, and in the new building in Garratt Lane, London, S.W.18, are the main assembly and production lines and the administration and service departments.

An extension now being made to the factory of Arcolectric, Ltd., at West Molesey, Surrey, will increase the total floor space to nearly 18,000 sq. ft.

Valve Division of the Marconiphone Co. has been transferred from Hayes to London. The new address is:—E.M.I. Sales & Service, Ltd., Valve Division, 3, Stanhope Street, London, N.W.1 (Tel. Euston 8051).

Hall Electric, Ltd., exporters of valves, had amongst the 80 guests at a "house-warming" party at their new premises, representatives of the Australian, Belgian, Pakistan and Netherlands governments. Their new address is Haltron House, 49-55, Lisson Grove, London, N.W.1 (Tel.: Ambassador 1041).

MEETINGS

Institution of Electrical Engineers

Radio Section.—"An Improved Scanning Electron Microscope for Opaque Specimens," by D. McMullan, M.A., on January 6th. (Joint meeting with the Measurements Section.)

"Printed and Potted Electronic Circuits," by G. W. A. Dummer, M.B.E., and D. L. Johnston, B.Sc. (Eng.), on January 14th.

Discussion on "The Relative Merits of Harmonic and Intermodulation Measurements for Assessing Distortion in Audio Equipment," opener E. W. Berth-Jones, on January 26th.

The above meetings will be held at 5.30 at Savoy Place, London, W.C.2.

North-Eastern Radio Group.—"High-Gain D.C. Amplifiers," by K. Kandiah and D. E. Brown at 6.15 on January 5th at King's College, Newcastle-on-Tyne.

North Midland Centre.—"Electronic Telephone Exchanges," by T. H. Flowers, M.B.E., B.Sc., at 6.30 on January 6th at the B.E.A., 1, Whitehall Road, Leeds.

North-Western Radio Group.—"The Nervous System as a Communication Network" by J. A. V. Bates, M.A., M.B., B.Chir., at 6.30 on January 7th at the Engineers' Club, Albert Square, Manchester.

South Midland Centre.—"Post-Graduate Activities in Electrical Engineering," by W. J. Gibbs, M.Sc. (Eng.), D. Edmundson, B.Sc., R. G. A. Dimmick, B.Sc. and G. S. C. Lucas, O.B.E., at 6.0 on January 5th.

Discussion on "The Co-ordination of Technical and Practical Training," at 6.0 on January 29th.

Both the South Midland meetings will be held at the James Watt Memorial Institute, Great Charles Street, Birmingham.

South Midland Radio Group.—"Electronic Telephone Exchanges," by T. H. Flowers, M.B.E., B.Sc., at 6.0 on January 26th at the James Watt Memorial Institute, Great Charles Street, Birmingham.

Rugby Sub-Centre.—"Television Programme Origination: the Engineering Technique," by D. C. Birkinshaw, M.B.E., M.A., at 6.30, on January 13th at the Rugby College of Technology and Arts.

Southern Centre.—"Post-Graduate Activities in Electrical Engineering," by W. J. Gibbs, M.Sc. (Eng.), D. Edmundson, B.Sc.; R. G. A. Dimmick, B.Sc. and G. S. C. Lucas, O.B.E., at 6.30 on January 21st at the University, Southampton.

Oxford District.—"The Trend of Technical Education," by J. H. Brookes, M.A., at 7.0 on January 14th, at 37, George Street, Oxford.

British Institution of Radio Engineers

London Section.—"The Modern Single-Layer Selenium Photocell," by G. Veszi, Ph.D., at 6.30 on January 5th at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1.

Scottish Section.—Programme of technical films at 7.0 on January 8th at the Institution of Engineers and Shipbuilders, Glasgow.

West Midlands Section.—"The Search for Bandwidth Economy in Television," by D. A. Bell, M.A., B.Sc., at 7.15 on January 27th at the Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton.

Merseyside Section.—"Design and Application of Quartz Crystals," by R. A. Spears, A.M.Brit.I.R.E., at 7.0 on January 15th at the Electricity Service Centre, Whitechapel, Liverpool.

North-Eastern Section.—"Hearing Aids," by R. A. Bull, B.Sc. (Eng.), at 6.0 on January 14th at the Neville Hall, Westgate Road, Newcastle-on-Tyne.

Television Society

London.—"An Introduction to the Sine-squared Pulse," by C. J. Hunt and E. W. Elliot (G.E.C. Research Laboratories) at 7.0 on January 8th at 164, Shaftesbury Avenue, London, W.C.2.

North-Western Centre.—"Design and Production of Commercial Television Receivers" by J. H. Johnson (Cossor) at 7.30 on January 28th at the College of Technology, Sackville Street, Manchester, 1.

British Kinematograph Society

Television Division.—"The Use of Film in Television Production," by Ian Atkins, at 7.15 on January 28th at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1.

British Sound Recording Association

London.—"Some Physiological Factors in Quality Appreciation" by E. A. Vetter at 7.0 on January 23rd at the Royal Society of Arts, John Adam Street, London, W.C.2.

Portsmouth Centre.—Members' evening at 7.15 on January 15th at the Central Library, Guildhall, Portsmouth.

Manchester Centre.—"Some Aspects of Tape Recording in the Home and Office," by E. R. Friedlander, M.Brit.I.R.E., D. R. Tasker and H. Turner at 7.30 on January 26th at the Engineers' Club, Albert Square, Manchester.

Institute of Physics

North-Eastern Branch.—"Progress in Pure and Applied Ultrasonics," by Dr. E. G. Richardson, F.Inst.P. (University of Durham), at 6.15 on January 14th at King's College, Newcastle-on-Tyne.

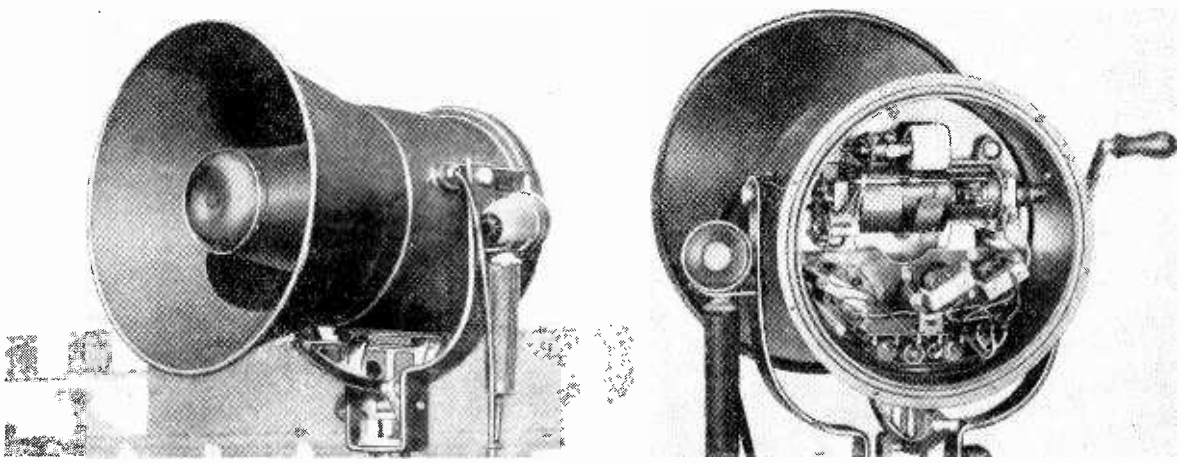
Electronics Group.—"The Electronic Theory of Valency," by Professor C. A. Coulson, F.R.S. (University of Oxford), at 5.30 on January 13th at 47, Belgrave Square, London, S.W.1.

Radio Society of Great Britain

"Single Sideband Transmissions," by R. H. Hammans (G2IG), at 6.30 on January 30th at The Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Friction-driven Loudspeaker

Electro-mechanical Amplification Without Valves



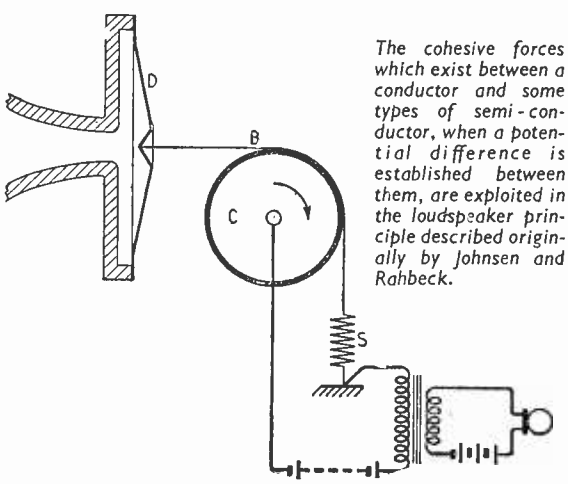
A conventional re-entrant horn is used in the G.N.T. loudspeaker, and components are all housed inside the sealed back.

OVER thirty years ago Johnson and Rahbek designed a loudspeaker which made use of the very considerable attractive forces which exist between a metal surface and some feebly conducting substances—for example, agate—when a potential difference is established between them. The device created considerable interest at the time,[1] and by the standards then current it performed well, but was inclined to be temperamental and dependent not only on the quality of the natural agate but also on humidity.

A much wider range of artificially produced partially conducting substances is available nowadays and Rahbek has recently developed a process of depositing coatings which give a performance sufficiently reliable for use in a loudspeaker designed for public address purposes.

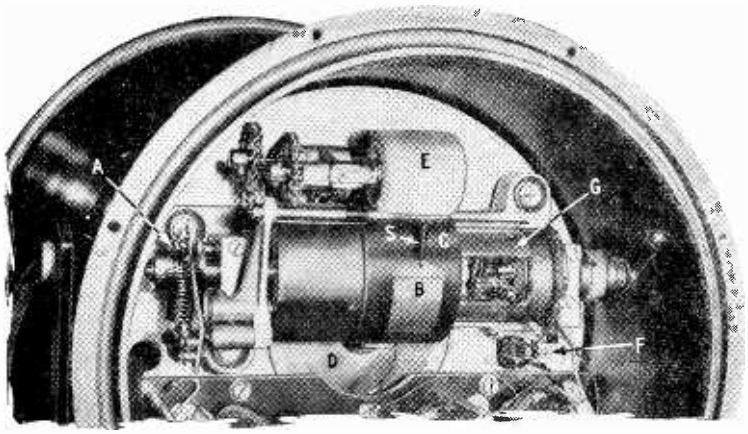
The principle of operation of this instrument is essentially the same as that of the original, and is illustrated in the accompanying diagram. A flexible metal band B is attached at one end to the centre of an aluminium diaphragm D and is held in contact with a rotating cylinder C, coated with the partially conducting medium, by means of the spring S. When a p.d. is applied between the cylinder and the band a considerable pull is applied to the diaphragm—of the order of 0.5kg, in current designs, for an initial voltage of 50. A polarizing voltage is necessary not only to allow positive and negative excursions from a mean position under the influence of a fluctuating force which is essentially unidirectional, but also to work on a part of the characteristic which is reasonably straight, since the force varies approximately as the cube of the applied voltage. Modulation is applied from a carbon microphone through the medium of a step-up transformer.

No valve amplification is necessary and the primary source of energy need not be electrical. In the new G.N.T. loudspeaker, shown in the accompanying photographs, provision is made to turn the cylinder by hand in an emergency—or as a normal method of operation where mains supplies or battery charging facilities are not available. The control current can be generated by a small internal dynamo driven by the handle, or may be supplied from quite small dry batteries. In the latter case loudspeakers will give full acoustic power output for a consumption of less than



The cohesive forces which exist between a conductor and some types of semi-conductor, when a potential difference is established between them, are exploited in the loudspeaker principle described originally by Johnsen and Rahbeck.

[1]See for example *Wireless World* Vol. IX (1921), pp. 225, 256, 289 and 311



Details of the driving mechanism. A is a mechanical servo mechanism for controlling contact area between band B and semi-conducting coating of cylinder C. The surface is cleaned by rotating mops E. F are the mechanically operated vibrator contacts, G is the d.c. driving motor and S the band tension spring.

a transformer and rectifier supplies the current for the motor.

Finally there is a hand-driven model in which a generator similar in design to the driving motors supplies 60 volts for the microphone and polarizing circuits.

To prevent damage to the diaphragm the mean frictional force is controlled by a mechanical servo system associated with the epicyclic gearing between the primary drive and the cylinder. A spring-loaded arm on which the "planet" wheels are pivoted is used as the anchorage for the band tension spring and by altering its angle automatically adjusts the area in contact with the cylinder to give a constant torque, and hence a constant mean pull on the diaphragm.

All the equipment is contained in a sealed chamber behind the re-entrant horn, and the whole unit is mounted on a tripod with a universal head, which may be clamped by a single lever.

The power output is comparable with amplifier-driven loudspeakers of similar size, and speech has an incisive quality which is the essence of high intelligibility.

The makers are the Great Northern Telegraph Company, 4 Sydhavns Plads, Copenhagen SV, Denmark, whose London address is 5 St. Helens Place, E.C.3.

½ watt; only 0.1mA from a 49½-volt polarizing battery and 100mA from a 4½-volt microphone battery. In this model a centrifugal switch is provided to connect the batteries only when the handle is being turned.

Two other types are available in both of which the cylinder is driven through gearing by a permanent-magnet d.c. motor. When operated from an accumulator, the power consumption is 15-20 watts and the polarizing and microphone voltages are derived from a mechanically operated vibrator unit. On a.c. mains

BOOKS RECEIVED

Filter Design Data for Communication Engineers by J. H. Mole, Ph.D., A.M.I.E.E. Deals primarily with Zobel-type filters and supplements basic theory with formulæ and charts designed to reduce the labour of computation. Pp. 252; Figs. 127. E. & F. N. Spon Ltd., 22 Henrietta Street, London, W.C.2. Price 63s.

Les Filtres Electriques by Pierre David. Third revised edition of a general survey of the principles of filter design. Published under the auspices of the Centre National d'Etudes des Telecommunications. Pp. 192; Figs. 142. Gauthier-Villars, 55 Quai des Grandes-Augustus, Paris 6. Price 2,500fr.

Electrical Instruments and Measurements by W. Alexander, M.Sc., M.I.E.E. Theory, construction and use of instruments used primarily for power supply and installation testing. Pp. 352; Figs. 112. Cleaver-Hume Press Ltd., 42A South Audley Street, London, W.1. Price 12s 6d.

Dictionnaire Anglais-Français (des terms relatifs a l'electrotechnique, l'electronique et aux applications connexes), by H. Piraux. "One-way" dictionary giving French equivalents of English and American terms used in radio, acoustics, optics, nuclear physics and many cognate subjects, with an appendix of conversion tables. Pp. 296. Editions Eyrolle, 61, Boulevard St. Germain, Paris V. Price 1,850 fr.

Television Engineers' Servicing Manual. Edited by E. Molloy and W. F. Poole, Assoc. Brit.I.R.E. General notes on servicing and installation, and detailed servicing data on typical British television receivers by twenty-nine makers. Pp. 654+x; Figs. 425. George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2. Price 42s.

Radio Engineers' Servicing Manual. Edited by E. Molloy and W. F. Poole, Assoc. Brit.I.R.E. Introduction to radio receiver servicing with a detailed survey of representative post-war models by thirty-two British manufacturers. Pp. 760; Figs. 585. George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2. Price 42s.

Thermionic Vacuum Tubes, by W. H. Aldous, B.Sc., D.I.C., A.M.I.E.E., and Sir Edward Appleton, F.R.S. Completely revised sixth edition of a monograph on the internal action of valves and their use as circuit elements, written primarily for students of general physics or electrical engineering with an extensive bibliography. Pp. 160+vii; Figs. 98. Methuen & Co., Ltd., 36, Essex Street, London, W.C.2. Price 9s 6d.

The Television Annual for 1953. Edited by Kenneth Bailey. Background information on television programmes and personalities. Pp. 160; Half-tones 116. Odhams Press Ltd., 96 Long Acre, London, W.C.2. Price 9s 6d.

Fundamentals of Radio Communications, by Abraham Sheingold. Wide survey of principles and methods used in sound broadcasting, television, fascimile, multiplex systems, radar and loran. Pp. 442+v; Figs. 332. Macmillan & Co., Ltd., St. Martin's Street, London, W.C.2. Price 40s.

Resonance Curves

Some Things the Textbooks Don't Always Explain

By "CATHODE RAY"

THE popular idea of learning a subject, I suppose, is that one begins at the beginning and goes on to the end; then one knows that subject. Like most popular ideas, it is wide of the mark. There is so much in almost any subject that on that plan one wouldn't be able to see the wood for the trees. It is better to tackle it first in very broad outline. In a first book, the subject should be simplified, with all the small detail left out. That is all right so long as one realizes that it *is* simplified, and does not imagine that one "knows it all." Having absorbed an elementary book, one can go over the subject again in a more advanced book, to fill in the detail.

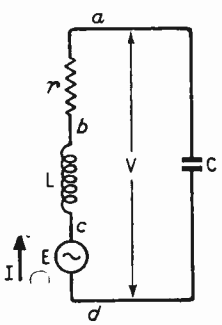


Fig. 1. Simple series tuning circuit. Resonance (meaning maximum current I for a given e.m.f. E and resistance r) occurs when the reactances of L and C are equal.

The subject in mind, of course, is radio. And however simple and elementary the book, one thing it is bound to include is resonance. But the elementary book simplifies the matter, and if its exposition is taken as the whole truth there may be some confusion when one comes up against the bigger textbooks. Series and parallel resonance, for instance; the trouble is that either one may be led to suppose that they are quite different things, or alternatively one may be puzzled to understand why, if they are basically the same, the frequencies of series and parallel resonance seem to be different.

First of all, shall we recapitulate the kind of information about resonance that one can expect in an elementary book? If it is any good at all it will have already explained how capacitance and inductance impede alternating currents, and that the amount of their impedance is called reactance, and that the amount of inductive reactance is $2\pi fL$ and capacitive reactance $1/2\pi fC$. It will also have explained that reactance is reckoned in ohms, like resistance, but that whereas the e.m.f. needed to drive a current through resistance is in phase with that current, the e.m.f. to drive current through an inductive reactance is a quarter of a cycle (or 90°) ahead of the current, and the e.m.f. to drive current through a capacitive reactance is quarter of a cycle behind the current. So if there are both inductive and capacitive reactances in series, carrying the same current, the voltages across them are two quarters of a cycle (or 180°) out of phase. The total voltage is therefore not the sum of the two (as it would be if they were resistances) but the *difference*. So if inductive reactance is reckoned as positive, capacitive reactance is negative, and the total reactance is equal to the difference between the two. If they both happen to be present in equal quantities, the difference is of course nil, and the circuit as a whole behaves as if it had no reactance at all. When an e.m.f. is applied the current is limited only by the resistance, so if the resistance is small the current is large. The large current passing through the two reactances causes large and equal (but opposite) voltages across them, and it is possible for these voltages to be many times greater than the e.m.f. applied—a very useful thing in radio receivers, particularly as voltages of other frequencies are not magnified to this extent, because at other frequencies the reactances are not equal. One has only to look at the formulæ given above to see that rising frequency increases the inductive reactance and decreases the capacitive reactance. And of course vice versa. The condition for greatest current—resonance—is found by making the two reactances equal:

$$2\pi f_r L = \frac{1}{2\pi f_r C}$$

from which, by applying the processes of simple arithmetic, one arrives at the well-known formula

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

The little r at the foot of f is to show that this is not just any frequency but the particular one that causes resonance.

The explanation in any given elementary book may be quite a lot different from this; for one thing, I hope for your sake it would be presented in a form more easily taken in than my very condensed recap. But it would have to amount to the same thing. Just to clinch the matter, here in Fig. 1 is the conventional way of showing a series tuned circuit, in which E stands for the applied alternating e.m.f., and r is the series resistance of the whole circuit at the frequency of E. In most practical tuned circuits r is mainly the resistance of the coil that provides the inductance L; the part that represents the capacitor loss is usually so small that in a simple study it is neglected. I, as usual, stands for the current; and V is the voltage across C. At resonance there is an equal voltage across L, but one can't actually get at it because L is mixed up with r; the voltage across

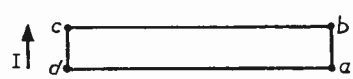


Fig. 2. Vector diagram showing the relative potentials of a, b, c, and d in Fig. 1 at resonance and the relative phases of the voltages between them.

the coil is the one between *a* and *c*. V/E at resonance is the voltage magnification.

Seeing that I is alternating, it may look a little silly to have an arrow alongside pointing in one direction, but this (like the letters *a*—*d*) is to link up with the vector diagram, Fig. 2. This may not be the sort of vector diagram you have been taught, but I think it has sufficient advantages to be worth knowing; the advantages and method of use are explained in the February, 1951, issue, pages 61 to 65. Fig. 2 shows that at the instant when the current is flowing in the direction of the arrow in Fig. 1 the voltage from *d* to *c* (V_{dc}) is in phase with it, and so is the voltage V_{ab}, which is the voltage applied to *r*, reckoned from *a* to *b* via *d* and *c*. The voltage applied to L is V_{bc} (in the direction of the current, via *a* and *d*) and Fig. 2 shows that it leads the current by 90°. The equal V_{bc} *against* the current (i.e., through L itself) is the voltage generated in L by the current. Fig. 2 also shows that $V_{bc} = V_{ad}$, so it represents the condition of resonance.

Conventional Curve

The elementary book may not venture on any kind of vector diagram, but it will certainly contain something like Fig. 3. This, I hardly need say, is what is commonly called a resonance curve, showing that in Fig. 1 the current reaches a peak at the frequency f_r which makes V_{bc} and V_{ad} equal and opposite, because this leaves the whole of E free to drive current through *r*. At zero frequency there can be no current, for then C has an infinite impedance. And at frequencies much greater than f_r the impedance of L is very high and is only slightly offset by the small high-frequency impedance of C. So the general shape at least of Fig. 3 is easy to explain and understand without any recondite vectors or mathematics.

In practice one is more interested in voltages than currents. The voltage across any impedance is of course equal to the impedance multiplied by the current passing through it—assuming no e.m.f. is being generated within it. Now although the same current passes through L and C in Fig. 1, it is only at resonance that their impedances are the same, so at all frequencies other than f_r the voltages across L and C are different, and therefore the shapes of their resonance curves must be different. Fig. 4 shows curves calculated for a particular tuning circuit, in which $L = 199\mu H$, $C = 199pF$, and $r = 200\Omega$. It is only fair to say that these curves are rather artificial; first, because *r* (which incorporates all the r.f. losses as well as the actual resistance of the wire) certainly would not remain the same at all frequencies from 0 to 1,600 kc/s. Assuming, as we do, that it is 200Ω at f_r, however, it wouldn't actually make much difference to the curves even if it did differ as much at other frequencies as it would in practice. Secondly, as I have just said, one can't get at V_{bc}—the voltage across L. V_{ac}—the voltage across the coil, assuming E is generated outside the coil—is so little different from V_{bc} that it couldn't be shown clearly; V_{ab} is "at right angles" to V_{bc} so doesn't add much to it—see Fig. 2, where the distance from *a* to *c* is almost the same as from *b* to *c*. If E is generated within the coil, as it would be if the coil were inductively coupled to the signal source, the terminals of the coil would be *a* and *d*, the same as for the capacitor, so in this case the voltage across the coil would obviously have to be the same as across the capacitor. From now on, references to voltage curves will mean voltage across C, unless stated otherwise.

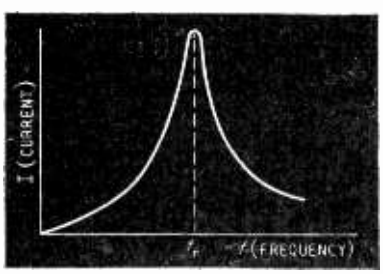
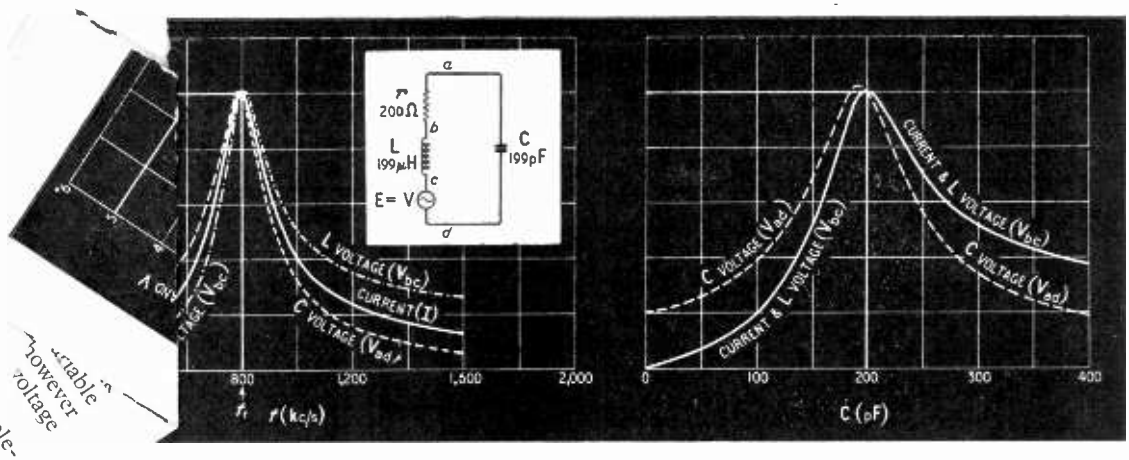


Fig. 3. Typical resonance curve. The fact that this is only one of many resonance curves that can be drawn for a given tuning circuit is not always realized.

The thing about Fig. 4 that is most likely to startle people who are still at the elementary book stage—that is, if it shows up on the reduced scale of the printed copy—is that the peak of the voltage curve is not at f_r! Although the difference in the positions of the peaks is small there is no doubt that there *is* a difference. And in practice resonance is nearly always located by the voltage peak, not the current peak. It may seem rank heresy to say that the frequency of resonance, as normally observed in a pure and simple series tuning circuit, is not $1/2\pi\sqrt{LC}$, but there it is. Moreover, since the voltage peak at this apparent resonant frequency is higher than at the theoretical f_r, the voltage magnification is higher than Q! It is well known that magnification and Q are not quite the same when L is complicated by self-capacitance, but that they differ even in this ideal case may come as something of a shock.

To reassure any readers who feel that their foundations are giving way, I will remind them that the discrepancy needs a fairly large-scale diagram to show it clearly, even though the tuning circuit under consideration has an exceptionally low Q—5 to be exact. In any typical tuning circuit Q would be 50 or more, and the discrepancy—which varies inversely as the square of Q—would be utterly negligible. Still, even though the speck of dust may be invisible to the naked eye, the thought of it existing where immaculate cleanliness was expected may be disturbing to the scrupulous mind. So the first thing to remember is that ideal simplicity and perfection of resonance—$f_r = 1/2\pi\sqrt{LC}$, $X_L = X_C$, phase difference between voltage and current = 0, total circuit impedance = *r*, V/E = Q, and all that—applies only to the simple series circuit (Fig. 1) and *current* maximum. Voltage maximum occurs at a different frequency, though the difference is negligible unless Q is abnormally low, so this particular discrepancy does not affect the practical use of a Q-meter. It is otherwise if the series circuit is complicated by parallel paths, as it always is in practice. Some of these, such as leakage across C, are usually negligible; but self-capacitance, which can fairly well be represented as a small lump of capacitance between *a* and *c* in Fig. 1, is often not. I dealt with this particular problem in the July, 1949, issue, so will not repeat the details now, but only point it out as something extra that has to be taken into account in practical resonance calculations.

We had better take a last wistful glance at Figs. 1—3 before passing on, for nothing else is so sweetly simple. What makes series current resonance so ideal is that the frequency at which it happens is not affected at all by the value of *r*. When the whole circuit resistance is reckoned as a simple series element



Three different resonance curves obtained by varying frequency. All refer to the same series circuit (shown inset), ...ne curves in Figs. 5 and 7. Right: Fig. 5. Current and voltage curves for the series tuned circuit shown in Fig. 4. ...d by keeping the frequency at 800 kc/s and varying the capacitance.

like this it makes no difference how much of it is considered to belong to L and how much to C. If you are thinking that Fig. 3 falls short of perfection because it is unsymmetrical, you must remember that it is really the frequency scale that is unsymmetrical. The proper figure to set against 1,600 (which is twice f_r) is not 0 but 400 (which is half f_r). This can be done by using a logarithmic frequency scale, and then the current curve is perfectly symmetrical.

The case illustrated in Fig. 4—voltage against varying frequency—is far from being the only other kind, but it is a particularly unpleasant one mathematically. I will spare you the gruesome details and only quote one of the results—the frequency of apparent resonance, which we can call f'_r, is given by

$$\omega'^2_r = (2\pi f'_r)^2 = \frac{1}{LC} - \frac{r^2}{2L^2}$$

This is the same as for f_r, except for the addition—or rather subtraction—of $r^2/2L^2$. There is no need to try to remember this, but it may be interesting to compare with the corresponding formula in the next case, which is the type of resonance curve obtained when f is kept constant and C varied.

This is illustrated in Fig. 5, which for ease of comparison refers to the same particular circuit as Fig. 4. The current has a very similar shape, except that it is rather broader; in fact, within about 10% of resonance it is almost exactly twice as broad. But it is not symmetrical, even with a logarithmic scale of C. Being a series current curve, it has its peak dead on $f_r = 1/2\pi\sqrt{LC}$, and there is no question of difference between magnification and Q. Because the frequency is kept constant, the reactance of L is constant, and so is r (even in practice), and therefore the voltage across the coil is exactly proportional to the current. So the I curve will do as a V_{bc} curve. But of course we shall need a separate V_{ad} curve because C and consequently its reactance is varying. This voltage curve shows a more pronounced off-current-resonance peak than in Fig. 4, and it rises noticeably higher. But it is not something to be shunned on that account. It is a most interesting curve. For one thing, on a linear scale of C it is perfectly symmetrical. That being so, if C_1 and C_2 are the capacitances at any pair of points on the two slopes where the voltage is equal, their average, $\frac{1}{2}(C_1 + C_2)$, is the capacitance at apparent resonance C'_r. It can be found more exactly in this way than by trying to decide which is really the top of a rather flat peak. What is more important, the true Q (not the magnification) can be found from these capacitance readings. The simplest calculation is when they are taken at the two points where the voltage is $1/\sqrt{2}$ or 70.7% of the peak voltage, for in that case

$$Q = \frac{C_1}{C_1 - C_2}$$

This is actually one of the commonest and most reliable methods of measuring Q. As a matter of fact the same formula applies to the current curve, but current is usually less convenient to observe, and if there is any parallel resistance it causes complications, which it does not in the voltage case. Another difference—obvious in Fig. 5—is that the capacitance at the peak of the current curve is *not* the average of the two equal-current capacitances.

The fact that the current curve conforms to the equal-reactance or $f_r = 1/2\pi\sqrt{LC}$ or $\omega^2 = 1/LC$ condition for resonance means that the voltage curve does not, for although the frequency is the same for both, the capacitance at apparent resonance is not. The relationship is, in fact,

$$\omega^2 = \frac{1}{LC} - \frac{r^2}{L^2}$$

so the "discrepancy" to subtract from the normal 1/LC is twice as much as in the frequency-variation case. There is an interesting thing about this formula, but the meaning of it will be clearer later on.

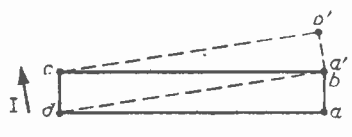


Fig. 6. The dotted lines show how the vector diagram of Fig. 2, which relates to the condition at the current peak in Fig. 5, is affected by altering the capacitance to reach the voltage peak in Fig. 5. The current, which is necessarily in phase with a^1b^1, is no longer in phase with the e.m.f., represented by the vector dc.

The vector diagram for this condition, assuming that the e.m.f. E is the same as before, is shown dotted in Fig. 6. The voltages across L and C are necessarily at right angles to the voltage across *r*, which is necessarily in phase with the current; but C is smaller than at current resonance so the voltage across it must be greater than that across L—hence the distortion of the rectangle, and the phase difference between e.m.f. (V_{ac}) and current. Note that the voltage across C, now represented by *a'd*, is greater than before (*ad*), but Fig. 6 shows clearly that the difference is small if Q (= *cb*/*ba*) is large.

Varying the Inductance

There is obviously one more case in this series-circuit series—variable L. It isn't a very important one for practical purposes, but it is pleasantly simple, because the most readily observable curve—voltage across C—peaks at $\omega^2 = 1/LC$, and there is no difference between Q and magnification. This is because both C and frequency are constant, so the capacitive reactance is constant and the voltage curve is the same as the current curve. It is perfectly symmetrical (Fig. 7) and the Q-finding method described for Fig. 5 holds good, with the additional simplification that the apparent resonance is the true resonance. The V_{bc} curve, shown dotted, is of theoretical interest only, and has an apparent resonance to one side of the true.

And now we have to go through everything again with the parallel resonant circuit. As usually treated, this is a good deal more complicated than the series circuit, for while L and C are reckoned as being in parallel the resistance is still reckoned as being in series (Fig. 8), so the arrangement is really neither one thing nor the other. With the question about how much of it belongs to L and how much to C, one can't dodge is to assume $r_c = 0$, which cer[tainly] of the resistance number of variables to the same does correspond fairly closely w[ith] facts, but there is still a difficulty [in] Does it remain correct to reckon that [this] means $f_r = 1/2\pi\sqrt{LC}$? This is now [not] as the frequency that makes the circuit to a resistance, with current in phase w[ith] Nor is either of them the frequency at w[hich] voltage is obtained, with constant current and frequency. The zero-phase condition does coincide with resonance observed as the peak with varying C or L.

The neatest way to dodge these awkward supplementary questions is the one I wrote about in April, 1952, issue. All the answers that we have already worked out for the series circuit can be used again for the parallel circuit, simply by giving the order "Operation Dual." On this word of command, the following exchange places:

Series		Parallel
E	and	I
R	and	G
L	and	C
X	and	B
Z	and	Y

Instead of the constant e.m.f. E in Fig. 1 working through L, C, and *r* all in series, we have a constant current I in Fig. 9 working through C, L, and G all in parallel. In place of the maximum current, through purely resistive impedance, and therefore with zero phase angle, which was the mark of true resonance, there now is maximum voltage, across purely conductive admittance, and therefore again with zero phase angle. Just as it didn't matter in Fig. 1 how much of the resistance belonged to L and how much to C, because they were in series and just added up to one *r*, so in Fig. 9 the separate conductances of C and L are in parallel and just add up to one G. This G, like *r* in Fig. 1, is relatively small in normal tuning circuits, so the resistance of the circuit, R, = 1/G, is normally very large. Just in case you are thinking this sounds too easy, and are wondering where the complications mentioned in connection with Fig. 8 have vanished to, I would remind you that, for any given circuit, L in Fig. 9 is not quite the same as in Fig. 8. (Nor, unless $r_C = 0$, are the Cs exactly the same.) If you have a sealed box with two terminals connecting to any arrangement whatever of linear resistances and reactances, you have no way of finding out *at any one frequency* the values and arrangement of the actual circuit elements in the box, but you can measure the impedance and phase angle of the thing as a whole, and you can express this as one resistance and one reactance in series or (with different values) in parallel. Given one pair of values, you can convert to the other pair by using these standard formulæ:

$$R_p = \frac{R_s^2 + X_s^2}{R_s} \qquad X_p = \frac{R_s^2 + X_s^2}{X_s}$$

$$R_s = \frac{R_p X_p^2}{R_p^2 + X_p^2} \qquad X_s = \frac{R_p^2 X_p}{R_p^2 + X_p^2}$$

where of course "p" stands for parallel and "s" for series. Using these formulæ, you soon find that a reactance in series with a relatively very small

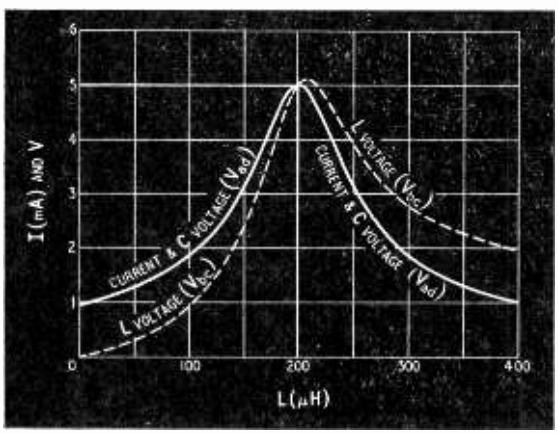


Fig. 7. Current and voltage curves for the series tuned circuit shown in Fig. 4, obtained by keeping the frequency at 800 kc/s and varying the inductance.

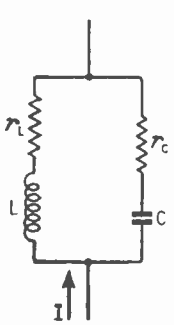


Fig. 8. Tuned circuit with L and C in parallel in the path of a constant current I, the resistances of L and C being represented by r_L and r_C in series with them.

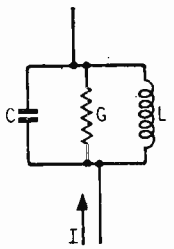


Fig. 9. The calculation of Fig. 8 at any given frequency is greatly eased by representing the whole resistance as a parallel conductance G, L and C in this case being the equivalent parallel values. The circuit is then the " dual " of Fig. 1.

resistance is equivalent to almost the same reactance in parallel with a relatively very large resistance.

Now you remember I said it was interesting that the capacitance giving voltage resonance across itself in a series circuit with constant frequency $\omega/2\pi$ could be calculated by the equation

$$\omega^2 = \frac{1}{LC} - \frac{r^2}{L^2}$$

Well, if you use the series-to-parallel conversion given above to convert L and r in this equation (which are series values) to their parallel equivalents, you find that it reduces to

$$\omega^2 = \frac{1}{L_p C}$$

which is the same thing as our normal $f = 1/2\pi\sqrt{LC}$. In other words, the normal resonant frequency formula, in which resistance plays no visible part, holds good for parallel circuits as well as series circuits, provided that the L and C in it are parallel values I say resistance plays no *visible* part, but of course if the circuit is actually made up as in Fig. 8 the resistance does play a hidden hand by causing a difference between the values of L in Fig. 8 and L in Fig. 9. The usual formula for parallel resonance (which is the same as that for series voltage resonance with capacitance variation) does bring in resistance, but that is because it is based on Fig. 8, not Fig. 9.

Why should it be based on Fig. 8, seeing that all the facts and formulæ relating to the completely parallel arrangement of Fig. 9 are identical in form with those that have been found for the completely series arrangement of Fig. 1? The reason is that unfortunately for calculations the physical nature of a tuned circuit is much more like Fig. 8 than Fig. 9. That, of course, is still only an approximation. A better imitation can be made up by putting in both series and parallel resistance—but the effect on the mathematics is highly discouraging. And even then the paper circuit wouldn't act quite like the real one, particularly if frequency varied, because resistance varies quite a lot with frequency.

So at this late stage I am not going to go through all the combinations of the parallel circuit, but leave it for anyone who is sufficiently interested to work them out from the given series set by duality. After all, the elementary book is quite right in saying that ordinarily the effects of resistance on the frequency of resonance and the shape of the resonance curve are small enough to be neglected. The trouble is that one gets so used to neglecting resistance effects that when the odd occasion turns up in which Q is very small one is likely to forget that the well-known rules are only approximations and be led far astray. Or even if one is aware of the danger there is some difficulty in finding a book that gives information on low-Q resonant circuits reasonably clearly and concisely. So I shall just finish with a summary:-

(1) The relationship between f, L, and C at resonance, and the shape of the resonance curve, depend on which of these is varied in order to obtain the curve, and on which voltage or current is observed, and whether L, C, and resistance are in series or parallel or a combination of both. Resonance is regarded as maximum (or minimum) voltage or current; with parallel resonance, this does not go along with zero phase angle.

(2) The normal relationship at resonance is inductive reactance ($2\pi fL$) equal to capacitive reactance ($1/2\pi fC$), a relationship that can be expressed alternatively as $\omega^2 = 1/LC$ or $f = 1/2\pi\sqrt{LC}$. This applies exactly to series current resonance, Fig. 1 (and therefore also to C-voltage when L is varied); and to parallel voltage resonance *if all the circuit resistance can be reckoned as in parallel*, Fig. 9—but this is not a practical condition except when C—(assumed free from resistance) is the variable.

(3) Series C-voltage resonance with variable C also conforms to the normal relationship *if* L *is the equivalent parallel value.* For any given series value of L, this depends on the series resistance r; so if the series value is used (either for series or parallel C voltage resonance) the normal equation is altered to $\omega^2 = 1/LC - r^2/L^2$.

(4) Series C-voltage resonance occurs at a different frequency still when frequency is the variable, the relationship being $\omega^2 = 1/LC - r^2/2L^2$.

(5) The simple formula $Q = (C_1 + C_2)/(C_1 - C_2)$ is useful in measuring Q, C_1 and C_2 being the values of C at the two points where the voltage at resonance is divided by $\sqrt{2}$. This applies to series or parallel C voltage resonance, which occurs at $C = \frac{1}{2}(C_1 + C_2)$. Q can also be measured by varying f, the formula (which is theoretically not exact but is quite good enough for nearly all purposes) being $Q = f/(f_1 - f_2)$.

(6) Even when boiled down to these main facts it all sounds appallingly complicated, so the final comforting reminder is that with typical values of Q—50 or more—the error due to using the normal formula ($f_r = 1/2\pi\sqrt{LC}$) for everything would seldom be more than 1 in tens of thousands. Where Q is low, you are safe in sticking to current resonance in the simple series circuit, to which the normal formula applies.

Since writing the above I have seen the Army Handbook of Line Communications, Volume I, in which the various resonance conditions are set out most clearly and comprehensively on pages 227-230. Incidentally, in this book resonance is defined exclusively as the condition of zero phase difference between e.m.f. and current.

BRITISH TELEVISION

THE 80 or more papers presented at the Convention on the British Contribution to Television, organized by the Radio Section of the I.E.E. last April, are being published in four special issues of the *Proceedings* of the Institution—Part IIIA, numbers 17-20. The first issue, No. 17, covers the opening session, the papers on the history of television and programme origination and summaries of all the papers presented at the Convention. It costs £1. No. 18 includes the papers and discussions on stations, propagation and point-to-point transmission, No. 19 on receiving equipment and No. 20 on industrial television and general system aspects. These cost 15s each. The complete set (800 pp) costs £3 3s.

NETTING

By H. B. DENT*

Shared Frequency System of Radio Communication

THE expression "net" or "netting" as applied to radio communications is thought to have its origin in Army signal circles, the principle being that all fixed and mobile stations in a particular group send and receive on the same frequency. Group in this connection does not refer, of course, to any recognized formation, but merely to a random collection of stations.

Needless to say, the saving in radio frequencies can be very considerable, especially when a large number of groups are operating over the same terrain, but most important of all, the working frequency of any group can readily be changed if it is causing interference to, or is being interfered with by, other services.

Another advantage of the scheme is that any station in a group can call any other in the same group in the knowledge that the station will not be listening on some other frequency.

Control of Nets

The weakness of the scheme is that, as no more than normal precautions are usually taken to stabilize the frequency of transmitters and receivers, there is a risk that stations may drift away from the working frequency if too long a time elapses between transmissions. In practice this is a remote possibility, as most nets of this kind have a master or controlling station whose duty it is, among other things, to keep a check on conditions and make co-ordinating transmissions periodically during quiet periods.

This type of radio net is a very flexible one, as it can change frequency at will, bring in other stations as required, deflect some to other duties, or disperse the net and allow each station to operate independently.

Certain mobile systems, such as police, fire, taxi and business radio, while operating on fixed frequencies, do not as a rule adopt the single frequency system of operation; moreover, they are tied to a particular frequency by quartz crystal control of transmitters and receivers and by licence restrictions in some cases. These services are all in the v.h.f. bands, whereas the nets we refer to here are to be found in the h.f. bands up to and including 160 metres.

Amateur Nets

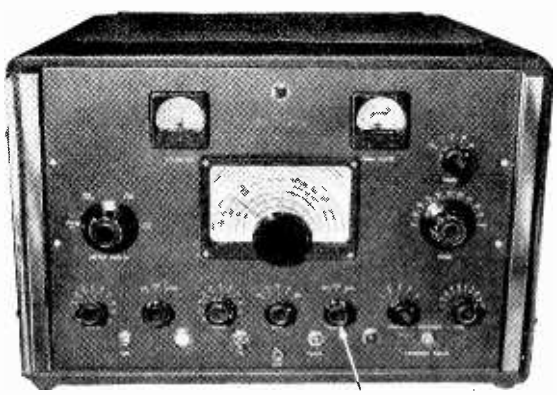
One reason for bringing up the subject here is that the netting system of operation is widely used by amateurs not only in this country but in many parts of the world. Anyone possessing a receiver with a so-called trawler band covering about 100-200 metres will frequently encounter amateur nets on 160 metres, especially on Sunday mornings, while with a good communications set overseas nets can be found in most amateur bands receivable in this country, but in particular in the 80-metre one. Local nets use telephony as a rule but long-distant stations participating often employ telegraphy.

Some idea of the world-wide extent of amateur radio nets can be gauged by the fact that the well-known American amateur journal *Q.S.T.*, publish a radio net directory giving details of nets on all frequencies from 1.8 Mc/s to 145 Mc/s.

In order to participate satisfactorily in a radio net special provision has to, or should, be made, and this generally takes the form of an arrangement of the transmitter switching to enable the master oscillator, or VFO, to be switched on while receiving and its frequency adjusted exactly to that of the received station.

The master oscillator is used as a BFO to heterodyne the distant station's carrier, but in this case its frequency is set for zero beat. This requires that very little signal be injected into the receiver from the VFO as the received signal must not be swamped and any of the message wiped out by excessively strong local oscillations.

Very effective screening of both transmitter and receiver is necessary, and it is also essential to avoid radiation from the aerial of the VFO signal. The screening problem should not be a particularly difficult one, as it is becoming more and more necessary for amateur transmitters to be well screened and filtered to prevent radiation of harmonics likely to interfere with television. Such TVI-proof transmitters will easily modified for netting operations, one switch marked "Net" being the only additional item required in most cases.



A switch position is provided on the control panel of the Panda PR120V amateur transmitter for "netting".

*Amateur radio station G2MC.

Microphony in Superhet Oscillators

By H. STIBBÉ,*
A.M.Brit.I.R.E.

Part 2—How it Can be Cured

FROM the discussion in Part 1 last month it will be clear that the tuning capacitor is a very susceptible component in the oscillator circuit, and that attention must be given to its mechanical design and mounting. The two main requirements are rigidity of the frame, stator and rotor assembly, and a minimum of asymmetry in the rotor and stator spacing.

Practical experience has shown that airborne mechanical excitation of the tuning capacitor almost never occurs. The main paths for the transmission of mechanical vibrations are (a) via the leads to the capacitor, (b) via the chassis, and (c) via the drive to the capacitor.

Rigid leads should never be used for connection to the stator and rotor assemblies. The leads should be as flaccid as possible and just slightly longer than the shortest distance between their points of connection. Leads of the type used for connection to the speech coils of loudspeakers are eminently suitable. Alternatively, leads with only a few strands, covered with a thin wall of p.v.c. Narrow strips of copper foil have also been used successfully by the author.

In order to isolate the tuning capacitor from chassis vibrations a flexible suspension is required. This can be achieved with soft rubber or p.v.c. grommets, or metal springs. Rubber grommets are perhaps the most popular because of their cheapness and simplicity. However, they must be used with care, for if the screws securing the tuning capacitor to the chassis compress the grommets considerably, they then afford little or no flexible support for the capacitor, as in Fig. 5, and may be virtually useless. The chassis vibrations, with this attempted support, may be carried to the capacitor via the now hard grommet and the securing screw. (Only one securing screw and grommet are shown for clarity.)

Fig. 6 (a) shows a screw which is suitable for securing the capacitor without severely compressing the grommet. Dimension "A" should be about 0.001in less than the inside diameter of the grommet, and dimension "B" should be about 0.001in greater than the height of the uncompressed grommet. The hole in the chassis into which the grommet is placed is made about 0.001in greater in diameter than the outside diameter of the grommet at its waist.

Fig. 6 shows this screw, in conjunction with a grommet, securing a capacitor to the chassis (at one point). The clearances between the shoulders of the screw (at either end of its waist) and the inside of the grommet, and between the face of the screw under its head and the lower face of the grommet, have been exaggerated for clarity. The only compression of the grommet is by the weight of the tuning capacitor. The screw does not touch the grommet, so that most of the chassis vibrations are absorbed by the upper portion of the grommet. For the same volume of rubber, a grommet with a waist placed asymmetrically between its faces, and positioned in the chassis hole with the thicker portion of rubber between the chassis and the tuning capacitor, affords better protection than a grommet with the waist placed symmetrically between the faces.

The practical difficulties with this type of mounting in production are the large tolerances on the nominal dimensions of the grommet. If dimension "A" is made 0.001in less than the lower tolerance of the inside diameter of the grommet, and if dimension "B" is made 0.001in greater than the upper tolerance of the height of the grommet, then with grommets having adverse tolerances the tuning capacitor can wobble on the mounting, which is dangerous in transport and gives tuning backlash. The dimensions of the screw have to be a compromise between the grommet tolerances. Then, with a grommet which fouls the outside of the screw, this occurs at only a small portion at each end; the compression between the screw head, the chassis and the

* Bush Radio, formerly Philips Electrical (Mitcham Works).

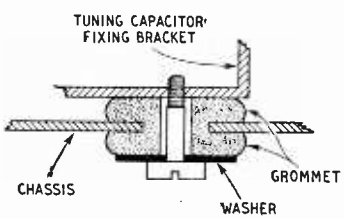
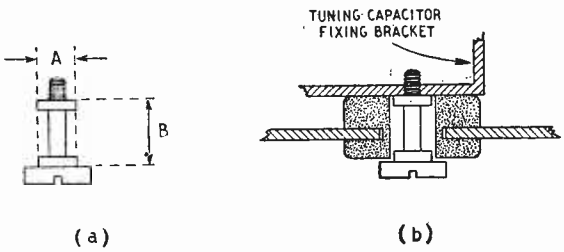


Fig. 5. How grommets can be used as flexible supports to isolate the tuning capacitor from chassis vibrations.

Fig. 6. At (a) is a type of screw which will not compress the grommet; (b) shows how it is used in conjunction with the grommet.



tuning capacitor with the worst-fitting grommet will be far less than that of the mounting of Fig. 5.

A disadvantage of rubber grommets is the hardening which occurs after a period of time in tropical climates.

When the tuning capacitor is mounted on rubber or p.v.c. grommets, it is important to provide a good r.f. earth connection, as the grommets are, of course, insulators. It was for this purpose that the author used copper foil leads: owing to their rectangular cross-section their r.f. resistance at frequencies of the order of 15-20Mc/s was much lower than that of stranded wire leads. Their use increased the oscillator grid current by approximately 30 per cent on that obtained with stranded wire leads.

Spring Wire Mounting

An interesting method of mounting the tuning capacitor, developed by Philips of Eindhoven, is with two specially shaped springs made of piano wire. Each spring, as shown in Fig. 7, acts as a pair of flexible feet, the lower ends of which are secured by screws to the chassis; the upper ends are screwed into the sides of the tuning capacitor mounting plate. In assembly, the springs are screwed to the mounting plate, and when the assembly is placed on the chassis the screws securing the loops at the lower ends of the four feet should all be capable of being aligned simultaneously with the four holes in the chassis. Thus the springs can be screwed to the chassis without distortion, and provide the tuning capacitor with a resilient mounting. The resonant frequency of the mounting is below 30c/s, so that no appreciable

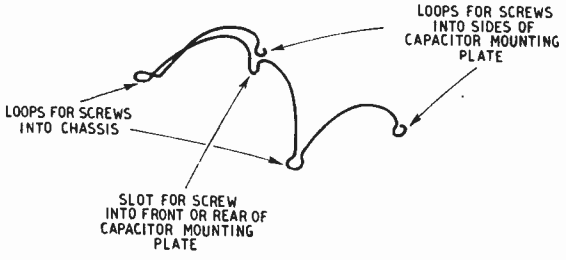


Fig. 7. Flexible spring support made of piano wire. Two are needed for mounting a tuning capacitor.

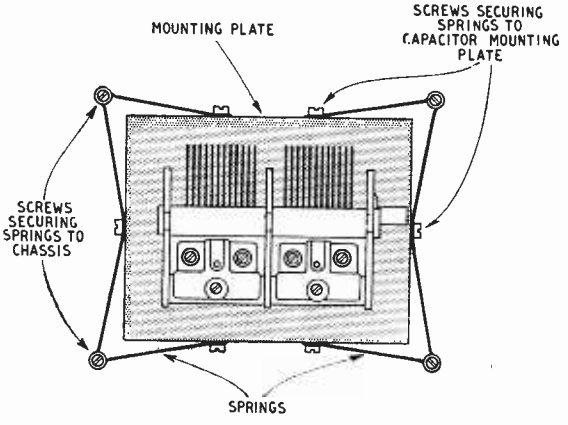


Fig. 8. Top view showing how a tuning capacitor is mounted on two of the springs in Fig. 7.

energy at frequencies which are reproduced efficiently by the speaker can be transmitted by the mounting. A plan view of a typical mounting of this type is shown in Fig. 8.

If a taut wire or cord drive compresses the flexible mounting of the tuning capacitor, whether it be by means of grommets or any other method, much of the intended protection of the mounting may be destroyed. When the drive wire (or cord) enters and leaves the drum on the capacitor spindle on different tangents, as in Fig. 9 (a), the tension in the wire from both sides of the drum will exert a force on the capacitor in the direction of the arrow, and this force will compress the grommets or other mounting. If, however, the wire enters and leaves the drum on any common tangent, as in (b), the resultant of the two tensions can serve only to turn the drum until the tensions become equal in magnitude, and no distortion of the mounting will be caused.

With any form of flexible mounting the torque of the tuning capacitor should be as small as possible, or the capacitor may move on its mounting before the spindle turns, thus causing tuning backlash.

Assuming appropriate precautions have been taken with the tuning capacitor, attention must be paid to other components in or physically near the oscillator circuit. Fixed capacitors should be soldered into the circuit with the shortest of leads. It may be necessary to use flaccid leads of the type mentioned above for wiring to the more susceptible components, e.g., grid and/or anode coupling capacitors. A moderately heavy lead may be "dressed" against a very troublesome component in order to prevent it from vibrating, but this method must be used with care and reserve, or more harm than good may result.

In bandspread receivers two popular methods of achieving the bandspreading are (a) connecting a fixed capacitor in series with each section of the tuning capacitor, and (b) using a tuning capacitor with only a few rotor and stator plates, so that it has a small maximum capacitance and the minimum capacitance remains almost unchanged.

With the first method, the capacitor in series with the oscillator section of the tuning capacitor may be very susceptible to vibration (thus altering its capacitance to earth), particularly if its value is small compared with the capacitance of the tuning capacitor. Whether either of these two methods of bandspreading are used, the wiring and components near the oscillator circuit become more critical (vibration of the latter may alter the capacitance to earth of some nearby component in the oscillator circuit) because the total circuit capacitance may be smaller at a given frequency than without bandspreading, and the change in this capacitance required to produce any given change in frequency will be smaller. Components in the oscillator circuit, other than the tuning capacitor, when taking part in the production of microphony often cause a microphonic howl of the order of 100-200 c/s.

The oscillator valve, almost always combined with the frequency changer in domestic receivers, is, of course, very susceptible to microphony, as vibration of the electrodes, particularly the grid and the cathode, will cause changes in the input (or output) capacitance. This danger is well realized by valve manufacturers and designers, who try to make them as sturdy as possible. Nevertheless, trouble is sometimes experienced, and the usual cure (or palliative) is to mount the valveholder on uncompressed grommets, in a

somewhat similar manner to the tuning capacitor. If the valveholder has a centre earthing contact, this should be earthed with a flaccid lead, again as with the tuning capacitor.

The chassis of the receiver should be mounted in the cabinet on uncompressed grommets in order to minimize transfer of mechanical vibrations from the cabinet to the chassis.

The cabinet should, if the cost allows, be made of wood. If, however, a moulded cabinet is used, it should not be thinner than $\frac{3}{16}$in at the thinnest part, or large-amplitude vibrations may be set up in it. It should be thickened up where possible, and the provision of webs may prove to be an advantage.

The holes in the cabinet for the controls should be a good clearance on the spindles, or the latter may bypass, to some extent, the rubber mounting of the chassis to the cabinet.

The author was engaged for over a year on the preproduction development of a bandspread double superheterodyne (in the Philips laboratories at Mitcham) which proved to have such a remarkable freedom from microphony that it is thought to be worth mentioning here.

This receiver had eight bandspread ranges, each with a frequency coverage of 500 kc/s; these were the normal short-wave broadcast bands of 11, 13, 16, 19, 25, 31, 41 and 49 metres. The essence of achieving freedom from microphony was in having a first local oscillator with a fixed frequency (one frequency for each band). Tuning was accomplished by ganging the first i.f. and the second oscillator circuits and tuning them simultaneously. (The aerial and r.f. circuits were fixed-tuned on each band, and were wideband circuits.) As the first i.f. tuned from 2.75Mc/s to 3.25Mc/s and the second oscillator frequency was 452kc/s below this, it was quite easy to prevent microphony in the second oscillator circuit. Also, as the first oscillator had a fixed frequency and the ganged tuning capacitor was not included in this circuit, a compact layout and short leads on the fixed tuning capacitors were all that were necessary to prevent microphony occurring here.

Production receivers were capable of producing an output, on the bandspread ranges, of 6 watts in a high-efficiency speaker (5 per cent efficiency) without microphony occurring.

This was a very elegant but also very expensive solution to the problem of microphony on the short-wave bands.

Microphony-Free Output

In order to know the degree of freedom from microphony which a receiver possesses, a measurement may be made of the "microphony-free output." At any given frequency, this is the output which a receiver will produce, at a given level of input signal and modulation depth, without microphony occurring. At any slightly higher output than this microphony will be produced.

In order to make the measurement, the signal generator must be placed somewhere acoustically remote from the receiver, so that the output from the loudspeaker cannot affect the frequency of the signal generator in just the same manner as it does its own oscillator when microphony occurs. The measurement is made at a high level of output from the signal generator because the larger the steady voltage at the output of the detector the larger is the variation of this voltage when frequency modulation of the oscillator is produced. An output level of 1-5mV is suitable.

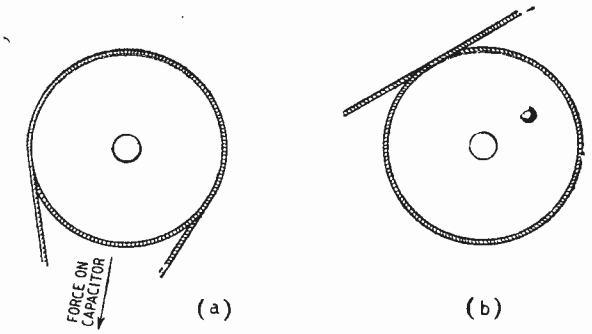


Fig. 9. Drum on the tuning capacitor spindle with drive wire entering and leaving on (a) different tangents and (b) a common tangent.

First, the modulation is switched on in the signal generator in order to identify the signal when the receiver is tuned to it. Then the receiver is tuned to the signal from the generator and the modulation is switched off. The volume control of the receiver is then advanced, and the tuning control is rocked slowly on either side of the correct tuning point. Eventually microphony will start, and at this point the volume control is not advanced any farther.

The tuning control is then adjusted to the most susceptible position on one side of the correct tuning point which gives the worst microphony. On one side of the correct tuning position microphony is generally worse than on the other side, and the worst side has to be determined by experiment. The volume control is then turned back slowly until the microphony just ceases. The tuning control is readjusted on either side of the correct tuning position until microphony just commences again, and the volume control is once more turned back until this just ceases.

This process is continued until on readjustment of the tuning control no microphony will occur. At this last position, the cabinet should be tapped lightly and the volume control adjusted carefully with the receiver tuned to the most susceptible position, until a position of the volume control is found where a light tap on the cabinet will start a soft microphonic howl which will just die away, and where, if the control is advanced the slightest bit farther, a tap on the cabinet will start a microphonic howl which will gradually build up and eventually be sustained.

With the controls in the positions so determined, the modulation is switched on (30 per cent modulation depth), and the tuning control is then readjusted until an output power meter indicates maximum output. This output is called the "microphony-free output" of the receiver. As the measurement is a rather delicate one and requires some degree of personal skill, it is better, even when some experience has been gained, to repeat it two or three times and calculate the mean of the measurements. With care the "spread" of the measurements on any one receiver will not exceed 1-2 db.

If the microphony-free output is found to be of the order of the output of the receiver for 10 per cent distortion, the modulation depth on the signal generator should be reset to 10 per cent, the output re-measured, and this new output multiplied by nine

(since power is proportional to the square of the voltage across a resistance). A well-designed receiver should be capable of producing a microphony-free output upwards of twice the output which the set can provide at 10 per cent distortion. On the face of things, this may make the measurement appear to be an artificial one. However, it only means that if a receiver can produce more than its output for 10 per cent distortion free of microphony when receiving a signal modulated to a depth of 30 per cent, then it can produce undistorted (so-called) output free of microphony when the signal is modulated to a depth lower than 30 per cent, because in this condition the volume control must be advanced farther to produce any given output than when the modulation depth is 30 per cent.

If the measured microphony-free output of a receiver is not large enough, it will be necessary to trace the troublesome component(s). Suppose a howl of the order of 2 or 3 kc/s is produced; suspicion will probably fall on the tuning capacitor. In order to determine whether this is the culprit, its oscillator section should be disconnected and in its place a fixed capacitor with short leads in parallel with a trimmer substituted. If the leads are short these components cannot vibrate, and will be above suspicion. The receiver is then tuned to the signal by means of the trimmer, with the rotor of the tuning capacitor left in its original position, so that the aerial and/or r.f. circuits are not detuned. If microphony at the previously measured output level does not now occur, then the tuning capacitor was definitely playing a part in producing the microphony originally encountered. If, however, the microphony still persists at the same level, then the trouble is probably in the oscillator valve.

Let us assume that the microphony has disappeared. The mounting of the tuning capacitor and its drive must be carefully examined in order to determine a suitable remedy. On no account should the plates of the tuning capacitor be stroked or tapped to find out whether it is microphonic as this practice may seriously upset the ganging. If the capacitor is found to be taking part in producing the microphony it may be re-connected to the oscillator, and the drive wire removed. If microphony again disappears, the mounting has been cleared, and either the drive wire is transferring the mechanical vibrations or it is compressing the mounting. Again suitable remedies will have to be found, working on the principles already described.

Low frequency (100-200 c/s) howl, as mentioned previously, is often due to components other than the tuning capacitor vibrating in the oscillator circuit. These may be checked by adjusting the volume control to the position where microphony does not quite occur and then tapping the various components in turn lightly, until one is found which produces an output from the speaker of the same frequency as the howl at the threshold level.

This may be confirmed by advancing the volume control until microphony just occurs, then holding the suspected component still with an insulated stick and noting whether this stops the microphony or not. This must be done with great care, for if the extra capacitance added into the oscillator circuit by the stick should detune the oscillator, the microphony may cease. The slope of the i.f. response curve at the new i.f. produce by the detuning may be smaller and the microphony may cease purely on this account, thus giving the false impression to the unwary that the faulty component has been located.

In order to achieve a sufficiently high microphony-free output, it may often be necessary to cure several sources. As each one in turn is cleared, another one causes trouble at a slightly higher level.

Consistency of microphony-free output in production can be achieved only by eliminating as many sources as possible, for the level at which each source produces microphony varies widely over a number of receivers of the same type because of the randomness of the individual causes.

At least six, and preferably more, receivers of any one type made under production conditions should be capable of giving 2-3 db more than the output required in production before it is considered that the design is a safe one from the point of view of microphony.

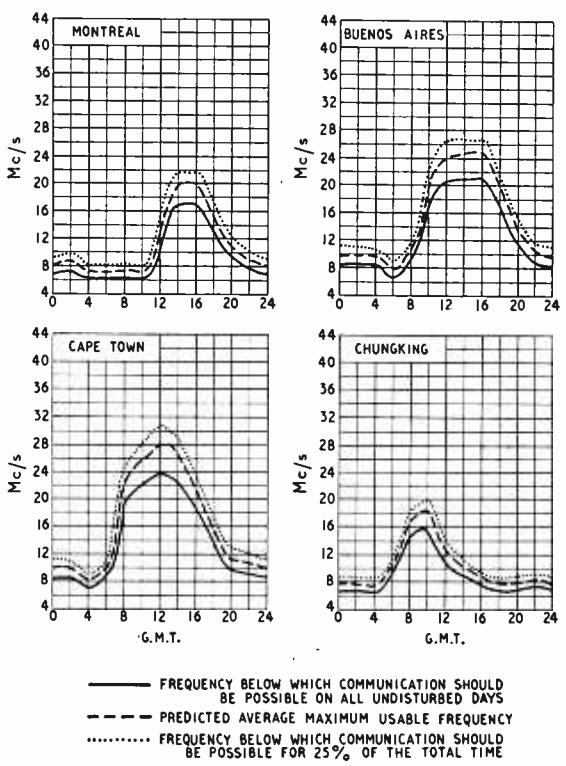
Thanks are due to T. E. Goldup, M.I.E.E., a director of Mullard, for his kind permission to describe certain designs originated in the Philips group of companies.

Short-wave Conditions

Predictions for January

THE full-line curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during January.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.



"Surplus" Relays

Methods of Construction and Operating Principles of Post Office Types

By T. DAWSON *

BECAUSE it is the most easily obtained, attention will be given mainly to the Post Office type 3000 relay which, owing to its general robustness and reliability, has been adopted as a standard on Post Office telephone equipment. This relay (Fig. 1) is assembled from six main component parts, the core, the coil, the yoke, the buffer block, the spring sets and contacts, and the armature.

The core consists of a rod of Swedish soft iron (or sometimes nickel iron), on to which is wound the coil. It is enlarged at one end to reduce the magnetic reluctance of the circuit between the pole face and armature, and turned down and threaded 2 B.A. at the other to provide a means of fixing the completed coil to the yoke.

The coil (Fig. 2) is wound on a fibre bobbin or a sleeve of paper fitted around the core, and may comprise up to four windings. They are terminated on tags affixed to the lower coil cheek and the number fitted depends upon the number of windings. In Post Office practice these tags, of which there are a maximum of five, are designated "a," "b," "c," "d" and "e," reading from left to right, with the relay contacts uppermost.

For single-wound coils, tags "a" and "e" are provided; "a" being the start of the winding. For double-wound coils, tags "a" and "b" are one winding and tags "d" and "e" the other. Tags "a" and "d" are the start of the windings. For triple-wound coils, all five tags are provided: "a" and "c" are the start of two coils and "b" their common finish. Tags "d" and "e" are a separate winding. For quadruple-wound coils, all five tags are provided: "a," "b," "c" and "d" are the start of the coils and "e" their common finish.

The maximum dissipation of the coil is six watts, while the coil resistances vary over the range 0.1Ω to 80,000Ω. For normal work, where marginal operation in series is not required, coil resistances between about 200Ω and 2,000Ω will be suitable and voltages between 12V and 50V will give satisfactory operation. The standard voltage on the main Post Office automatic exchanges is 50V, with variations of between 46V and 52V.

It is, of course, possible to rewind the relay coil

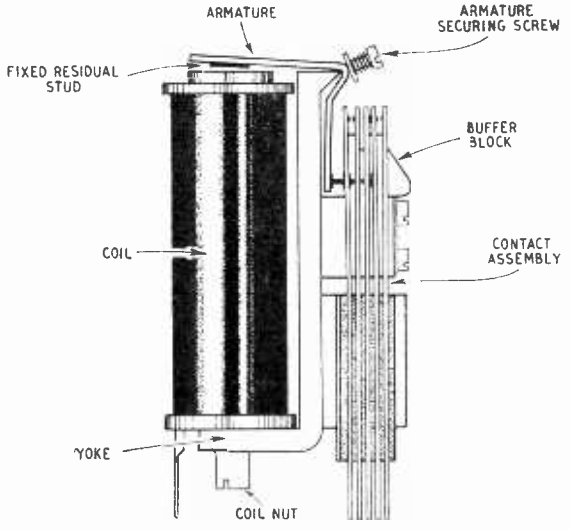


Fig. 1. General view of complete Post Office type 3000 relay.

* Sound Diffusion Ltd.

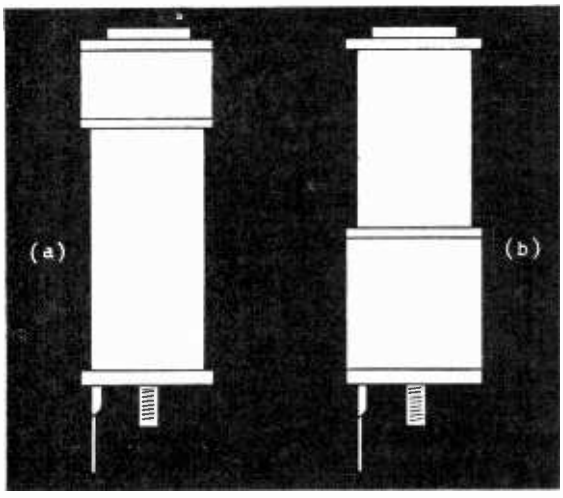
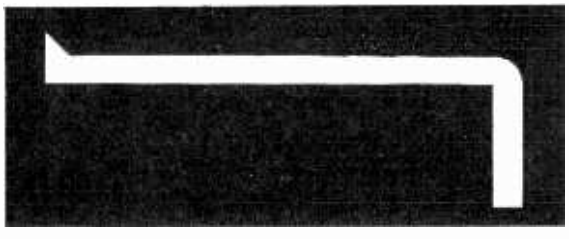


Fig. 2. The coil of the type 3000 relay, with (a) ½-in toe slug, (b) 1-in heel slug.

Fig. 3. Side view of the yoke of the relay (see Fig. 1).



to a different resistance, but for details of this the reader must be referred to the brief treatment given in standard telephony textbooks or to the Post Office graphs and data sheets, if these are available.[1]

The yoke (Fig. 3) consists of an L-shaped piece of soft iron machined to a knife edge on the longer arm around which pivots the armature. In the shorter arm are provided a 2 B.A. clearance hole for fixing the coil and two tapped 4 B.A. holes for fixing the relay. In the longer arm are the fixing holes for the spring sets and buffer block, which are all either tapped or clearance 6 B.A. holes. A 7 B.A. tapped hole is provided in the knife edge for securing the armature by means of a special spring loaded screw.

The buffer block (Fig. 4) is a white synthetic block, provided with steps at intervals, against which rest the projections from the non-moving springs. This block is manufactured in various sizes, with various spacings between steps to accommodate the contact assemblies.

There are four types of contact assemblies found on relays, and they are:—

(1) "Make" spring set, Fig. 5 (a), which consists of two springs, one fixed and one moving.

(2) "Break" spring set, Fig. 5 (b), which also consists of two springs, but the one at the top of the pile is the moving one, as opposed to the one nearest the armature on the "make" set.

(3) "Changeover" spring set, Fig. 5 (c), which consists of two springs resting against the block and a centre moving spring that makes contact with the spring nearest the armature when the relay is inoperative.

(4) "Make-before-break" spring set, Fig. 5 (d), which consists of two fixed and one centre moving spring. The fixed springs are of standard length, but the lower one has a set in it to enable it to make contact with the upper fixed spring when the relay is inoperative. The centre spring, which is considerably shorter, does not normally make contact.

Fig. 4. The buffer block (see Fig. 1).

The contacts themselves are made in three different metals. Silver is the usual material, while tungsten is used for controlling circuits carrying currents of up to five or more amperes. Platinum contacts are always found in circuits that possess considerable inductance, such as uniselector magnet circuits, where there is a danger of arcing and damage to the contacts when the circuit is interrupted. Their high cost makes them unsuitable for general use and they are consequently only rarely found. They are identifiable by a "v" notch cut in the top of each spring.

Both the silver and tungsten contacts (tungsten is now being replaced by an alloy which is easier to fix to the contact springs) are manufactured in various current ratings, but it is usual to employ tungsten contacts for heavy current control as they are generally cheaper than silver ones of comparable rating.

The springs themselves, which are nickel silver, are either 12 or 14 mils thick. A label on the top front coil cheek indicates the thickness, a white label indicating 14-mil springs and a green label 12-mil springs. A red label is sometimes found and it indicates a special purpose assembly. The author has several relays of this type and the component springs of the "make" sets are of different thicknesses. These relays were probably used for impulsing, where the back spring could be made heavier to reduce contact bounce and subsequent sparking.

On Post Office type 3000 relays the maximum number of standard springs that can be accommodated on each side of the buffer block is nine, with a spacing between adjacent springs of between 55 and 60 mils.

When the relay is inoperative the tension on the moving springs should lift the fixed "break" springs a sufficient distance to allow daylight to be just visible between the block and spring. As the relay operates the "break" springs should return to the block and the "make" springs should be lifted just clear. This gap is usually of the order of about 8 mils, but a relay is considered to be correctly adjusted if this narrow strip of light can be seen.

The adjustment procedure is therefore to tension all the fixed springs against the block, and then to tension all the moving springs so that they just lift the "break" springs from the block. Finally the travel of the armature should be checked so that the "make" springs are lifted clear when the relay operates. The block pressure that a 14-mil spring should be adjusted to is between 16 and 20 grams, while for a 12-mil spring it is between 11 and 15 grams.

Operation in Two Steps

Certain applications call for a relay with some contacts that will operate earlier than the remainder. This is achieved by arranging that the contacts nearest the yoke can exert only slight pressure on the armature and that the remainder of the contacts cannot exert pressure until after the first contacts have operated. These contacts are referred to as "x" contacts.

By suitably shortening the lifting pins of the contacts at the top of the pile (the end remote from the yoke) they may be made to operate after the remainder of the assembly. Contacts so arranged are referred to as "y" contacts.

By careful spring tensioning it is possible to arrange for the relay to operate in two steps; half closing on the first step and operating the "x" contacts and fully closing on the second step and operating the remainder of the assembly. An arrangement whereby the relay operates in two steps is not permitted in telephone equipment, for it is a marginal condition of operation which could not be sustained over long periods.

It will be opportune to add a word here regarding the remaking of relay contact assemblies. A relay looks a very simple thing to assemble, but unless one has a large and varied selection of parts from which to choose it is by far the wisest plan to refrain from attempting, for it is a job that calls for experience and skill if the relay is to operate satisfactorily.

The armature (Fig. 6) is L-shaped with a "v" bend designed to enable it to pivot around the knife edge of the yoke without binding. The portions of the armature that make contact with the spring pins, are provided with Caramot bushes which should be squarely aligned with these pins.

For applications where the relay is required to function consistently under widely varying operating currents the cross-sectional area of the armature is reduced, and as a result the magnetic reluctance of

[1] "Telephony," Vol. 2, Herbert and Proctor, p. 132 *et seq.*

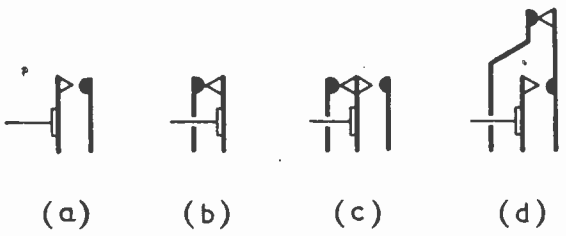


Fig. 5. Diagrammatic sketch of four types of contact assemblies : (a) "make" spring set, (b) "break" set, (c) "changeover" set, (d) "make-before-break" set.

this part becomes very high and saturation of the magnetic circuit is achieved at low values of ampere-turns. These isthmus armatures, as they are termed (Fig. 6 (b)), are used on the impulsing relays of certain types of automatic telephone exchange systems where absence of impulse distortion is essential under varying conditions of subscribers' line circuit.

The gap between the relay coil and armature with the relay operated is termed the residual gap, and is normally fixed by means of a stud of phosphor bronze either 4, 12 or 20 mils thick riveted to the armature. For certain applications where stringent limits are imposed on the speeds of operation and release, this stud is replaced by an adjustable screw and lock nut.

The adjustment of this gap, and of the residual air gap has considerable effect upon the timing of the relay, due regard being given to the adjustment of the armature travel when increasing the air gap. The armature travel is standardized at 31 mils for a normal relay, as measured between the pole face and the underside of the residual stud. For relays fitted with "x" contacts it is increased to 43 mils.

The problem of spark quench does not often become acute when controlling standard relays, but it is possible that the controlling contacts of inductive circuits carrying heavy currents may be badly damaged or even welded together by arcing when the circuit is interrupted.

The voltages induced in telephone circuits by dialling could reach a value of about a thousand volts if steps were not taken to reduce them. The voltage is prevented from rising above 200 volts by the shunt spring assembly of the dial which shunts the impulsing springs with a 2-μF capacitor in series with the 26-Ω winding of the induction coil on the subscriber's instrument.

To prevent arcing occuring and damaging the controlling relay contacts of a selector magnet circuit, a 2-μF capacitor in series with a 100-Ω resistor are fitted across uniselector magnet coils. In addition, the controlling relay contacts are always platinum, which has a high melting point and renders them less liable to damage by arcing than silver contacts. For relays, a resistor equal to, or slightly in excess of, the coil resistance shunted across the coil is usually sufficient to damp any sparking that may occur. It should be remembered that in addition to increasing the current consumption of the circuit, this resistor will also tend to delay the release of the relay.

An extra non-inductive winding is sometimes found in relay coils, and may be either connected internally across the coil to provide spark quench or terminated as a separate winding. It is made non-inductive by the wire being first doubled in half then wound on to the core with the folded end innermost as an ordinary single winding. The single ends are terminated on separate tags or paralleled across the main winding. As there is no true start to such a winding it is virtually non-inductive. The existence of such a winding is indicated by the letters N.I. after the appropriate coil resistance figure.

Although the current through the coil ceases to flow the instant the circuit is interrupted, the magnetic flux will take different times to die away depending on the size of the residual air gap. If this is large, the flux will rapidly die away to a value that will allow the release of the relay. If it is small the flux will take an appreciable time to decay and the release of the relay will be delayed. The releasing times for normal relays range between 10 and 30 milliseconds.

These delay times may be appreciably increased by the use of solid copper slugs positioned at the heel or toe of the coil; three standard sizes of slug are in use, $\frac{1}{2}$in, 1in and 1$\frac{1}{2}$in. The effect of these slugs depends on the fact that a current will be induced in the slug when the circuit is completed or interrupted. In accordance with Lenz's Law the sense of this induced current will be to oppose the main current flow when switching on and to aid it when switching off. The effect of this induced flux on the delay is therefore dependent upon two factors, (a) the direction of the flux (opposing or aiding), and (b) the position of the slug on the coil. If the slug is at the heel end of the coil, Fig. 2 (b), provided there is an ample margin of ampere-turns on the coil the flux through the coil and slug, although in opposition, can have little or no effect on the operating time of the relay. A slug positioned at the toe end of the coil, Fig. 2 (a), will prevent the operation of the relay until after the induced flux has died away.

On interrupting the circuit, the induced currents in the slug will tend to maintain the flux in the same direction as the coil and so retain the armature attracted until after the induced currents have died away. As there is no opposing flux, the effect will be the same whether the slug is at the heel or toe end of the coil, and with a small residual and light spring tensions it is possible to obtain releasing delays of up to 500 milliseconds. This compares with the operating delay of 150 milliseconds which is the maximum obtainable with the slug at the toe end, a large residual air gap and heavy spring tension.

These delays may be produced by other means without resorting to slugged coils: for fast operation and slow release, by arranging that the relay will short circuit its second winding on operation; for slow operation and fast release, by arranging that the relay will remove a short circuit across its second winding on operation.

Other Relays

Turning now to other types of relays, the Post Office type 600 is virtually a smaller and cheaper version of the type 3000 relay described above. The maximum number of coil tags is four, while the number of

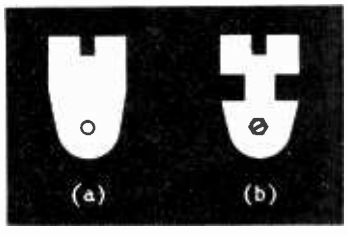


Fig. 6. Two types of armature, (a) standard type, (b) isthmus type with adjustable residual gap.

springs that can be accommodated on each side of the buffer block is limited to six. The residual air gap, which is fixed, is in three sizes, 4, 8 and 12 mils, the 8-mil one being the most common. This relay is not supplied with an adjustable residual. The springs, which are nickel silver, are usually 14 mils thick, but for especially sensitive relays 12-mil springs are used.

The simplest method of making a relay respond to a.c. is to shunt the coil with a half-wave metal rectifier. As the rectifier acts as a short circuit across the relay for alternate half cycles, it is necessary to include a resistor in series with the supply. For the half cycles when the rectifier is not acting as a short circuit it acts as a high-resistance shunt, and will, therefore, because of the current induced in the coil when the rectifier is acting as a short circuit, build up a relatively steady flux through the coil. Because of this induced flux the release of the relay will be delayed.

High-impedance relays are often found in telephone equipment connected across the speech circuits, and the transmission loss is minimized by increasing the impedance of the coil. It can be shown that a sleeve of nickel iron or similar alloy placed around the core will, because of its high permeability and resistivity, make considerable differences to the ohmic and angular values of the relay coil's impedance. The sleeves are 12 mils thick, and published figures for a 200-200 ohm line relay with its windings series assisting show an impedance difference of $5{,}405/55.5^\circ$ with no sleeve, to $15{,}607/76.1^\circ$ with three sleeves.

Polarized and shunt-field relays are used when it is required that a relay shall be sensitive to the direction and magnitude of the current flow. A shunt-field relay comprises two separate coils and cores with a common yoke. When one coil is energized the resultant flux takes the line of least reluctance through the core of the second coil, and so prevents the operation of the relay. If the current flows through both coils so as to produce opposing polarities at adjacent ends of the coils, the relay is again unable to operate. It will only operate when the polarities at adjacent ends of the coils are of the same sense and equal in magnitude. The flux must then take the line of high reluctance across the residual air gap and so operate the relay.

Siemens high-speed relays were developed expressly for the control of motorized selectors, and they are characterized by the exceptionally short operating time of 0.5 milliseconds. The phosphor bronze contact spring carries a single domed platinum contact, which rests between two adjustable screws. Tension is applied to the contact blade by means of an adjustable buffer spring.

The author wishes to acknowledge his indebtedness to his Managing Director, C. P. Stonor, for the valuable and constructive suggestions given in the preparation of this article.

Interference Suppression

P.M.G's Regulations for Ignition Systems

IT will be recalled that the Wireless Telegraphy Act, 1949, made provision for the first time for the Postmaster-General to control interference. The Act empowers him to prohibit the sale of apparatus which fails to comply with such regulations as he may make regarding its non-interfering properties. To assist him in making these regulations he was to set up an advisory committee to consider the various aspects of intereference. Out of a panel of 45 people nominated by the I.E.E. the P.M.G. has actually appointed three advisory committees to deal with different classes of equipment: (a) a seventeen-member* committee to consider ignition interference (July 1950); (b) an eighteen-member committee concerned with refrigeration interference (July 1950); and (c) a twenty-one-member committee to consider the question of interference from small electric motors (March 1952).

The first of these to make its report is that concerned with internal combustion engines. As a result of its recommendations the P.M.G. has laid before Parliament the long-awaited regulation governing the suppression of interference caused by internal combustion engines—the "Wireless Telegraphy (Control of Interference from Ignition Apparatus) Regulations 1952".† It prescribes that new ignition apparatus forming part of an internal combustion engine—other than aircraft engines—which is sold in the United Kingdom on or after July 1st must be fitted with suppressors. Moreover, it is an offence to remove the suppressors thus fitted. The permitted field strength of the radiation at any frequency between 40 and 70 Mc/s in any direction from the apparatus must not exceed 50 μV/m when measured at a distance of 33ft.

The schedule appended to the regulation sets out the method by which the field strength is to be measured, the conditions under which tests are to be made and specifies the measuring equipment to be used in the tests.

It is understood that the advisory committee's recommendations were not completely adopted by the P.M.G. In its report it did not differentiate between existing and newly manufactured i.c. engines, but the P.M.G., in making this regulation, has seen fit to confine it to any new i.c. engine used within the United Kingdom on land or in territorial waters within 100 yards of any moored vessel or within 100 yards of the low water mark.

Commenting on the regulation, Dr. Radley (engineer-in-chief, G.P.O.) stated that it has been drawn up on the assumption that all practicable and reasonable precautions have been taken in receivers.

* Sir Stanley Angwin (chairman); A. H. Ball (Society of Motor Manufacturers & Traders); H. Bishop (B.B.C.); S. R. Burbidge (R.T.R.A.); Sir John Dalton (Federation of British Industries); W. J. Edwards (Association of British Chambers of Commerce); Sir Peirson Frank (Standing Joint Committee, A.A., R.A.C., and R.S.A.C.); P. Gratwick (National Chamber of Trade); Professor Willis Jackson (Imperial College); E. M. Lee (R.I.C.); Dr. Merritt (British Transport Commission); E. L. E. Pawley (B.B.C.); N. E. Rowe (B.O.A.C. and B.E.A.C.); G. F. Sinclair (Institute of Transport); T. M. H. Stubbs (B.E.A.M.A.); Mrs. C. Renton Taylor (National Federation of Women's Institutes); and Dr. S. Whitehead (E.R.A.).

† Statutory Instruments, 1952, No. 2023, H.M.S.O., price 6d.

V.H.F. Radio Noise

Assessment of Total Noise at Selected Receiving Positions

By E. G. HAMER,* B.Sc.(Eng.) (Hons.), A.M.I.E.E.

THE increasing use of v.h.f. radio for fixed services has focused the attention of the systems' planner on the importance of radio noise. This noise originates from a combination of thermal, cosmic, atmospheric and man-made sources and is the main limiting factor in determing the maximum spacing of stations, or the number of links it is possible to operate in tandem. It is usually assumed that the mean thermal noise level in the aerial circuit is 204 db below 1 watt per cycle of bandwidth, and some allowance is made for peaks above this mean level. At very high frequencies, however, other sources of noise may predominate.

Total Noise

With a view to obtaining a guide to the total amount of noise likely to be encountered in actual practice, noise measurements were made at a number of typical sites during the latter part of 1950, at frequencies of 77 and 172 Mc/s. These results were obtained by connecting the rectified audio output from suitable receivers to recording meters, and using diode noise generators to calibrate the equipment. Fig. 1 shows part of a typical record of measurements made near a large factory, showing the effect of the factory closing down for lunch.

To present the large amount of information collected, some form of statistical analysis must be used. The following quantities were therefore noted during the analysis of the graphs obtained :—(a) the number of noise pulses per hour exceeding a certain level, and (b) the number of seconds per hour during which a certain noise level was exceeded.

The noise level was found to be much less in the country and in residential areas than in industrial areas. It was also found that there was no noticeable difference between horizontal and vertical polarization. On the basis of a noise level exceeded for 60 seconds in the worst period of one hour, the following are average results :—

Town Sites	77 Mc/s	—165 dbw per cycle of bandwidth
	172 ,,	—175 dbw ,, ,, ,, ,,
Country Sites	77 Mc/s	—180 dbw ,, ,, ,, ,,
	172 ,,	—180 dbw ,, ,, ,, ,,

A further series of experiments was conducted to determine the variation of total noise level with distance from a main road. Observations over periods of ten minutes were taken at various distances from a main arterial road, and Fig. 2 shows the variation of noise level with distance from the main road at frequencies of 77 and 172 Mc/s.

The general atmospheric noise level in all cases was found to be considerably greater than that due to thermal noise alone, but decreasing with increasing radio frequency. It is possible that if the receiving aerial is located in an industrial area, the decrease in radio noise at the higher frequencies would more than counterbalance other deleterious effects due to the use of a higher frequency, and as a result the performance at 172 Mc/s might be appreciably better than at 77 Mc/s.

* G.E.C. Research Laboratories, Wembley.

Fig. 1. Noise measurement at 77 Mc/s near large factory, showing reduction in noise level during lunch period.

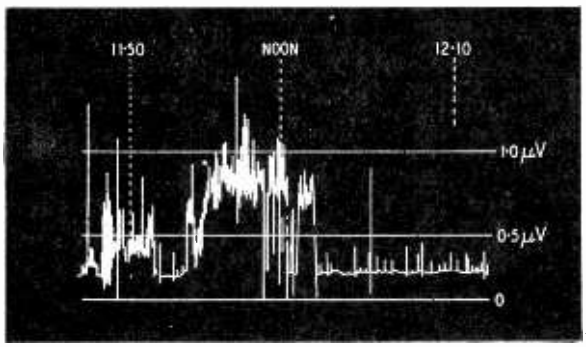
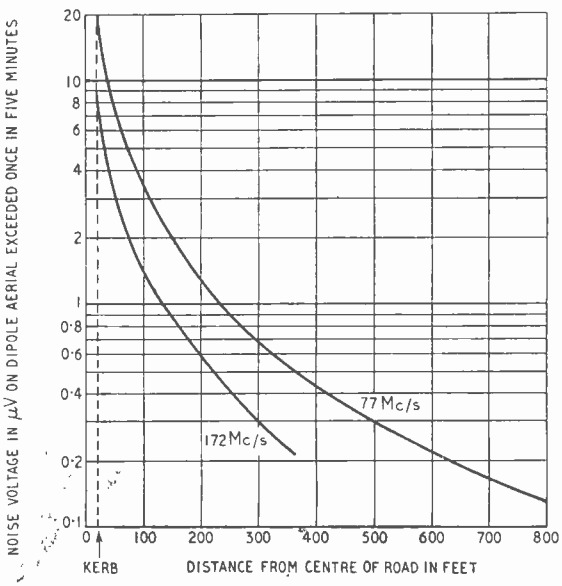


Fig. 2. Variations of noise level with distance from a main road at two frequencies, 77 and 172 Mc/s respectively.

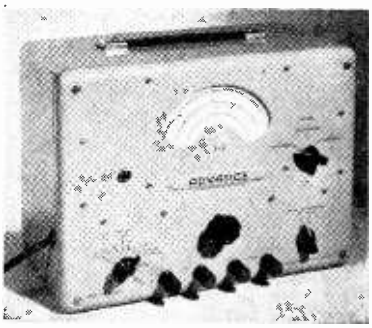


Manufacturers' Products

NEW EQUIPMENT AND ACCESSORIES FOR RADIO AND ELECTRONICS

Audio Signal Generator

AN output of up to 1 watt into 600Ω with less than 2 per cent distortion (above 100 c/s) is claimed for the new Type J1 audio signal generator introduced by Advance Components, Ltd., Back Road, Shernhall Street, Walthamstow, London, E.17. The frequency generator is of the resistance-capacitance bridge type,



"Advance" Type J1 audio signal generator.

and three ranges are used to cover 15 c/s—50 kc/s. The 5½in diameter dial gives a total scale length of 18in, and a slow-motion drive is provided for fine adjustment. Accuracy of setting is ±2 per cent or ±1 c/s, depending on the frequency.

Although designed primarily for telephone engineers there are many applications in radio servicing where it should prove useful.

Television Voltmeter

A VOLTMETER for measuring the very high voltages encountered in the development, production and testing of television equipment has been introduced by W. G. Pye & Co., Ltd., Granta Works, Cambridge. It functions on the electrostatic principle and embodies a suspension-type mirror galvanometer movement, which is critically damped magnetically.

Known as the "Scalamp" this electrostatic voltmeter is extremely compact considering it includes a mains supply for the lamp and a self-contained scale and optical system. As the illustration shows the scale is well-positioned and has a backward tilt for ease of reading.

The meter is available with various full-scale ranges, three suitable for most television requirements being: 1-5 kV, 3-10 kV a.c. and d.c., 5-18 kV d.c. and 5-12 kV a.c. The accuracy is given as one per cent on all d.c. ranges and a.c. ranges up to 12 kV r.m.s. and up to 100 Mc/s in frequency. For portable use the lamp can be run from a 4-volt battery.

High-quality 8in Loudspeakers

THAT high-quality reproduction need not be expensive if one is prepared to concede a little in maximum power handling capacity and extreme bass response is convincingly demonstrated by the latest Axiom 101 and 102 units recently introduced by Goodmans Industries Ltd., Lancelot Road, Wembley, Middlesex. These have fundamental resonances of 65 c/s, and, in conjunction with a vented corner cabinet having dimensions recommended by the makers, give a uniform bass response down to 50 c/s which is more than adequate for most musical scores and does not run into the troubles often experienced from turntable rumble.

We have recently had an opportunity of hearing one of these speakers (Type 102), the response of which seems admirably adapted for use in small heavily damped living rooms. The high-frequency response is exceptionally good and in some surroundings may need a few db of top cut if it is not to mask the middle frequencies. On the other hand it is ideal for applications in which the direct sound arrives at an angle to the axis.

The units are rated for a peak a.c. input of 5 watts and so far as the ear can judge there is no objectionable non-linearity distortion at normal average inputs of one or two watts.

Type 101 has a magnet giving a flux of 51,200 maxwells at a density of 13,500 gauss while Type 102 gives 63,000 maxwells at 16,000 gauss and may be expected to show improved damping when used with an amplifier of low output impedance. Prices (including tax) are £7 2s 9d and £10 14s 1d respectively.

Short-wave Overseas Receiver

THE Model BS54 introduced by Armstrong is a new export receiver especially for listeners abroad requiring a sensitive and easy-to-handle short-wave set at a reasonable price.

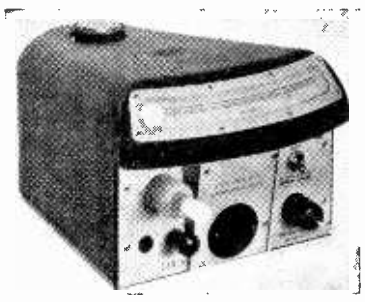
The receiver gives a continuous coverage from 10.9 to 50 metres, this range being divided into four bands. It is said that the bandspread obtained by the limited coverage on each range makes station finding almost as easy on the short waves as it is on the medium waveband of a more orthodox broadcast receiver. This is considerably helped by long scales and a flywheel-type tuning control.

Five valves are used in a more or less straightforward superhet circuit, those employed being 6K8, 6K7, 6Q7, 6V6 and 6X5, all octal-based types easy of replacement almost anywhere in the world. The set is a.c. operated with transformer adjustment for supply mains of 110 V or 200-250 V at 40-100 c/s.

The set is housed in an attractive walnut cabinet together with a high-grade loudspeaker. Negative feedback is incorporated in the output stage.

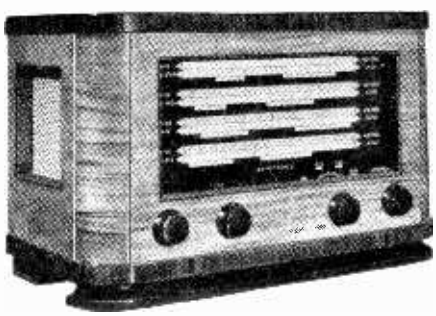
The makers are Armstrong Wireless & Television Co., Ltd., Warlters Road, Holloway, London, N.7.

Pye "Scalamp" voltmeter with self-contained optical system and lamp.

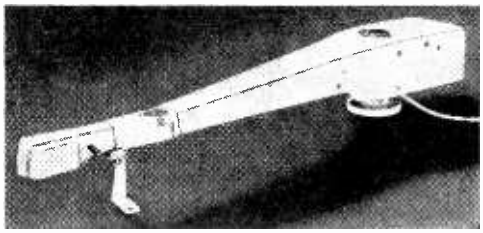


Goodmans Axiom 102 8-in high-quality loudspeaker.

Armstrong export model short-wave broadcast receiver, BS54.



Osmor miniature coils for "No Compromise" tuner.



E.M.I. Type 17 transcription pickup with cantilever-driven moving-iron armature.

Miniature Coils

SAMPLES of miniature coils for the "No Compromise" R.F. tuner described in our October 1952 issue have been submitted by Osmor Radio Products. Type QA11 and QA12 are suggested for the input, or aerial, circuits and QHF11 and QHF12 for the corresponding intervalve circuits. Their identifying colours are blue foot for aerial and green foot for intervalve coils.

QA11 and QHF11 cover medium waves and QA12 and QHF12 long waves. All coils have large primaries and adjustable dust iron cores. They provide an inductance range of 100 to 170 μH in the medium-wave coils and 2,000 to 3,000 μH in the long-wave types. These ranges are adequate for all the requirements of the set.

Coils are packed in sealed transparent boxes, as shown in the illustration, and are thus protected from damage in transit from factory to user. They cost 4s each and six coils are required. The maker's address is, Bridge View Works, Borough Hill, Croydon, Surrey.

Transcription Pickup

THE E.M.I. Model 17 pickup is designed to accommodate all sizes of discs up to 17 inches in diameter and has a tone arm with an adjustable tracking angle. Particular attention has been paid to the design of the tone-arm suspension, which is by means of a single pivot. An oil-filled dashpot gives control of both vertical and horizontal movement and offers resistance to violent movement without impeding the normal low-velocity tracking motions.

The pickup itself is of the moving-iron type with a cantilever-mounted stylus to step down the mechanical impedance at the point. Basic sensitivity is 60 db per cm/sec of transverse recorded velocity, referred to 1 mW. In terms of volts out, a typical figure is 30 mV from the Type 34680CQ high-ratio transformer for high-impedance input circuits, for a lateral r.m.s. recorded velocity + 12 db referred to 1 cm/sec. An alternative transformer (Type 46775E) is available for 600-Ω and 200-Ω lines.

Frequency response is claimed to be level from 30 c/s to 12 kc/s with 0.0025 in stylus and 30 c/s to 10 kc/s with 0.001-in stylus (for microgroove records). Nominal resonances are above 15 kc/s and 12 kc/s respectively. The weight at the stylus point is 6 gm.

The complete pickup costs £13 13s and the head only £2 3s. Interchangeable cantilever styli are available at 13s 6d each. (These prices include purchase tax.) The high-impedance output transformer costs £1 and the 200/600-Ω transformer £1 18s.

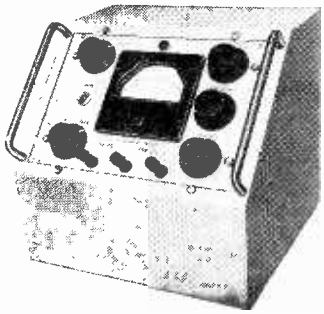
Phase Meter

PROVIDED that the signals to be compared are sine waves and that their amplitudes are of the same order, it is possible, by means of the Southern Instruments Type K159 meter, to obtain pointer readings of their relative phase. The inputs are first equalized and then applied to a differential valve voltmeter so arranged that it shows no reading when the signals are in phase and twice the normal reading when they are in opposite phase. The scale would be cramped between 90 and 180 degrees and is therefore calibrated between 0 and 90 degrees and one input is reversed for measurements between 90 and 180 degrees.

The accuracy claimed is ± 3 deg between 20 c/s and 20 kc/s and ± 8 deg between 5 c/s and 100 kc/s. Input waveforms should contain less than 3 per cent harmonic and should have amplitudes between 1.5 and 10 volts.

The instrument, which works from 200-250-V, 50-c/s supplies is made by Southern Instruments, Ltd., Hawley, Camberley, Surrey.

Southern Instruments Type K 159 phase meter.



RANDOM RADIATIONS

By "DIALLIST"

Another Crackles Mystery

HERE IS ONE of the queerest cases of intermittent noisiness in a wireless receiver that I have ever come across. I was spending an evening with a friend who had recently acquired a house not far from mine. At nine o'clock we agreed that we'd like to hear at any rate the headlines of the news; he got up, went over to the set, switched on and, having waited for it to warm up, tuned in the Home station. As he moved back to his chair there was a sudden outburst of crackles and bangs, which ceased as soon as he sat down and recurred when he walked across to switch off. "That," he said, "is my own pet mystery. The set started these games soon after I got settled in, though the previous owner tells me that nothing of the sort ever happened to him and the wiring is just as it was in his time. Some days the trouble is there, some days it isn't." That sort of thing always intrigues me; any case of intermittent noisiness should be investigated, for it may mean that there is some dangerous defect in the power or lighting circuits. My friend gladly accepted my offer to give him a hand the following Saturday.

Getting Warmer

Soon after breakfast that morning he telephoned that all was well for my visit, for the set was putting up one of its best performances. Arming myself with a multi-range measuring instrument, a dry cell, and sundry tools, I set forth. Now, I don't believe in taking such stern measures as moving furniture, rolling back carpets and levering up floorboards until other investigations have failed to give results. In this case it looked very much as if such measures would be necessary, for we quickly established that movements of one particular board were responsible. Still, it was worth while to take a good look round first. One important point was quickly established; using the 0-300 V range of the instrument, which has a resistance on a.c. of 2,000Ω/V, to test the mains supply we found that there was no flicker on the needle, even if one of us jumped on that floor-board. Both power and lighting circuits were wired for 3-pin plugs and the resistance of all earth sockets to earth was a respectably small fraction of an ohm. The floor-board in question ran to a point opposite the middle of the fireplace, a modern affair using a gas burner for lighting the fire. Was there under that board a lead-covered cable making intermittent contact with the gas-pipe? Aha, we thought; getting warmer now!

Got It!

My hand was reaching to offer my friend the electrician's chisel (after all, they were *his* floorboards) when I paused to take a look at the ornate old brass fender which stood before the fireplace. It had originally had three "paws" at the front of it, but now only the middle one was left. This paw rested on a sheet of metal which was fixed to the boards. At the left-hand end a slot had been cut in the fender to allow the gas feed-pipe to pass to the grate. We connected the dry cell with a voltmeter in series between fender and pipe: no reading until the plank below the paw was trodden on; then violent kicks of the needle. Clearly, as the plank moved it slightly tilted the fender, bringing it into contact with the pipe. So far so good; but the fender's potential must differ from that of the pipe, and how came that to be? The metal sheet must originally have been wider than the present fender. It had been cut short at the left-hand end; but at the other it stuck out several inches. And on this protruding piece stood an electric heater. Since its plug was in the power socket, the frame of the heater was earthed; so, therefore, was the fender *via* the metal plate. The gas pipe wasn't, except when the fender touched it—and there you are! The crackle-less days were those on which the electric fire had been moved off the plate.

A Weak Spot

"MY ACCUMULATOR has broken down," an old friend told me a while ago, "and I really can't afford to buy another just now. I'll just have to wait; but I do hate being without wireless." I learnt that the case had cracked and that the radio dealer had told her that nothing could be done about it. On taking a look at the casualty I found that it was a $3\frac{3}{4} \times 3\frac{3}{4} \times 5\frac{1}{4}$in dry accumulator, housed in a Bakelite case which was well and truly cracked. Now, these dry secondary cells are otherwise remarkably robust: you may recall my telling you a month or two ago how I found one that had lain unused and neglected for years and how, after a long, slow charge and many drinks of water, it proved (and still proves) to be perfectly serviceable. The weak point of many of these cells is that they have thin cases.

Mend and Make-do

Despite a rather general belief that nothing can be done about a

cracked Bakelite case, I have repaired dry secondary cells and components similarly housed quite satisfactorily. Readers may find my method useful. I told my friend that I would endeavour to give her cell a new lease of life, though I could not guarantee that the new life would be a long one—with a very thin case and a semi-solid electrolyte, any deformation of the plates can give rise to local pressures that may be disastrous. Still, with prices what they are, any restoration of a "dud" cell to usefulness is worth while, provided that it can be done easily and cheaply. My poorest result to date is three months' extra life. Here's the method. Lay the cell on its side with the crack uppermost. Scrape off all oozings and dry the crack as far as possible with pieces of rag and blotting paper. Then leave the cell in that position until the crack has thoroughly dried out. When you are satisfied that it *is* dry, take a good big blob of plastic wood and work it well into the crack, just as if it were putty—you can get it off your fingers when the job is done by using acetone. Also spread the plastic in a thin layer extending to a good inch either side of the crack. Next day apply another layer. Then, when that is thoroughly dry, apply a coating of Durofix.

THE WORLD'S JOURNALS

WITH the growing number of technical journals, it is quite impracticable for the technologist to peruse them all (even if he is a linguist) and yet, if he is to keep abreast of electronic developments generally, it is essential for him to know what is published in the world's technical press. This need is met by the monthly publication in our sister journal *Wireless Engineer* of abstracts from, and references to, articles on radio and allied subjects appearing in journals published throughout the world.

In the past twelve months some 3,500 articles have been abstracted in this section which is compiled by the Radio Research Organization of the Department of Scientific and Industrial Research.

The annual index to this section of *Wireless Engineer* is in course of preparation and will include both subject and author indexes and a list of the 160 or more journals regularly scanned for abstracting. The index will, it is hoped, be published in February, price 3s 9d including postage.

UNBIASED

By FREE GRID

More Jungle Jargon

THE stethoscope is a very ancient tool of the medical profession but it was not until George IV lay-a-dying in 1820 that it was given its present panhellenic name which, of course, simply means an instrument for examining the chest. In 1876 a further instrument was developed for making a visual record of heart beats and chest noises by tracing a curve on paper. This new instrument, too,

Visible heart affection.

was aptly and correctly named, being called the stethograph. It was, however, very crude and soon fell into disuse, being revived and greatly improved in our own century when it was renamed the cardiograph as its main function was to register heartbeats.

It is not surprising that modern electronic technique has been harnessed to the problem and the result is the production of an instrument which as *W.W.* tells us (Dec., 1952) "gives both visual and aural observation of the functioning of the heart and lungs" which are, of course, the main organs housed in the chest. This new instrument is, in fact, an electronic stethoscope but is it so-called? Not on your life. It is given the dreadful Latin-Greek hybrid name "auscultoscope." In justice to the inventor I think he is trying to get across to us the idea that the instrument gives both visual and aural indications of what the chest organs are doing. But could not he have used the Greek phrase an "electronic acoustoscope" or if he prefers Latin an electronic "auscultoscrute," which means precisely the same thing.

Information Received

QUEEN ELIZABETH I, although a protestant, seems to have had a very catholic taste in beds; in fact if the local historians are to be believed she spent most nights of her life sleeping in other people's beds. I once made a rough check-up not only in the stately homes of England but also in all our ancient hostelries where they proudly exhibit a bed in which our one and only spinster Queen spent a night and I find they far exceeded the number of her days even though she reached the Psalmist's allotted span.

Since that time I have always mistrusted the so-called "facts" of historians. It is, therefore, refreshing to find one who really does know what he is talking about and has enlightened me on a certain point on which I enquired recently.

You will recall that I asked in the October issue whether wireless was used to convey news of the Coronation of Edward VII in 1902 to ships—more especially ships of the Royal Navy—as, of course, it was in the two subsequent coronations of this century in 1911 and 1937.

I certainly thought it would have been used, as over six years had elapsed since the date of Marconi's first patent. I am, however, assured to the contrary by no less an authority than one who was the P.M.G's Inspector of Wireless Telegraphy—Colonel Chetwode Crawley—until he retired in 1945. He tells me that in 1902, as an officer of the Royal Marines, he was in the Mediterranean Fleet taking a wireless course under Commander—later Admiral—Jackson and he makes it clear that news of the 1902 coronation was *not* transmitted by wireless to ships of the Royal Navy.

Having had the unique opportunity of access to records, which the position of Inspector of Wireless Telegraphy would naturally give, Colonel Chetwode Crawley could, no doubt, clear up many doubtful points, to say nothing of giving the lie to some of the errors and superstitions which have been popularized by amateur historians.

Plagiarism Run Riot

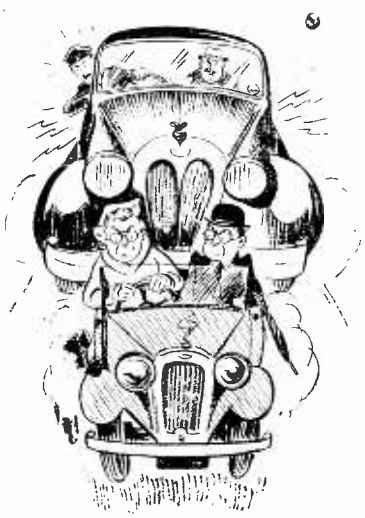
IT is astonishing how old ideas of which details have been published in this journal turn up many years afterwards in a slightly amended—and, not infrequently, debased—form.

The latest of these borrowed and adapted ideas, as reported in the daily press, is "a device projecting high-frequency rays which can be picked up by a vehicle ahead and so warn the driver that he is about to be overtaken." The old-fashioned toot on the horn has apparently been found inadequate on busy roads where there is a lot of heavy traffic. This profound thought has been communicated to the motoring organizations of this country who have, so my newspaper informs me, referred it to their experts.

The same thought struck the French Motor Manufacturers' Associations a long time ago and it has taken twenty years for it to cross the channel. The French had the crude idea of putting a microphone at the back of heavy and noisy lorries and a loudspeaker by the driver's ear so that he could hear the plaintive tooting of the frustrated car behind, and I suggested certain improvements to it in the issue of this journal for January 27th, 1933.

Now that the general idea has at last crossed the channel, I am glad to see that our own people will have none of this noisy tooting, but are going to use what are termed "high-frequency rays." This at first suggested radio to my mind. I cannot help feeling, however, that it is nothing of the kind, but merely a photocell deeply hooded to protect it from daylight and operated by the flashing of headlamps of the car wanting to overtake.

If I am right, then it is nothing more than an adaptation of another 1933 idea which I also reported in *W.W.* (November 3rd, 1933). The photocell arrangement then described was to be used as a safety device to prevent a car running into the vehicle



Noisy tootings.

ahead of it if the latter happened to stop suddenly. My suspicions are confirmed by a statement that this new idea is also to be used as a safety device at cross roads in foggy weather.

G

MAINS TRANSFORMERS

All 200-250 volts c.p.s. primary. Finest quality, fully guaranteed.

MBA/3. 350-0-350 v. 80 mA, 6.3 v. 4 a., 5 v. 2 a. Both filaments tapped at 4 volts. An ideal replacement trans. Price 18/-

MBA/5. 350-0-350 v. 125 mA, 6.3 v. 4 a., 5 v. 3 a. With mains tapping board. Price 27/6

MBA/6. 350-0-350 v. 100 mA, 6.3 v. 3 a., 5 v. 2 a. With mains tapping board. Price 22/6

MBA/7. 250-0-250 v. 80 mA., 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. Price 18/-

MBA/8. 325-0-325 v. 120 m/a., 6.3 v. 2.5 a., 5 v. 2 a. Impregnated. Tapped input, 110-250v. Price 27/6.

AT/3. Auto transformer. 0-10-120, 200-230-240 volts, 100 watt. Price 17/6

METAL RECTIFIERS

6 v. 1 a.	6/9
6 v. 4 a.	17/6
12 v. ½ a.	3/11
12 v. 4 a.	17/6

"HAYNES" radio and television components. A large range available from stock. Send us your requirements.

TEST PRODS. Fused, with fully retractable points. Price 4/11 per pair.

SUPERHET COIL PACKS. 3 Wavebands: 12-35 metres; 35-100 metres; 200-550 metres. Size: 4×4×3in. Price 16/-.

RF.25 UNITS. BRAND NEW AND UNUSED. For use with 1355 Receiver. Supplied with 3 new SP61 valves. 19/11. Carriage 2/6 extra.

TWO-GANG TUNING CONDENSERS .0005MFD.

No. 1. Miniature. With Perspex dust cover and trimmers. Size: 1½ × 2 × 1⅞in. ¼in. spindle **LASKY'S PRICE** 8/6

No. 2. Midget. With trimmers. Size: 2¼ × 1¾ × 1⅞in.. ¼in. spindle. **LASKY'S PRICE** 8/6

No. 3. Midget. Less trimmers. Size: 2×1⅞×1½ ins. ¼ in. spindle. **LASKY'S PRICE** 6/6

No. 4. Standard type. Size: 2½ × 2⅜ × 1⅞in.. ¼in. spindle. **LASKY'S PRICE** 6/6

THREE-GANG TUNING CONDENSER. .0005 mfd. Size 3½ × 2⅜ × 1⅞in., ¼in. spindle. **LASKY'S PRICE** 7/6

P.A. SPEAKERS. Re-entrant horn, 10 watts, beam projector, weatherproof speakers. 7.5 ohm impedance. Horn diameter—14in. **LASKY'S PRICE** 99/6 Spigot mounting 10/- extra Carriage and packing 15/- each.

TANNOY PRESSURE UNITS. 10 watts. 7.5 ohms impedance. **LASKY'S PRICE** 79/6 Carriage 4/6 extra.

A Large range of Garrard and Collaro Auto Changers in stock. For immediate delivery.
Single-speed Garrard. From £8/19/6
3-speed Garrard. From £12/19/6

P.M. LOUDSPEAKERS

All less o'trans. new and unused. First quality.

3in.	12/11
5in.	12/6
6½in.	13/6
8in.	15/-
10in.	25/-
12in.	75/-

CARBON POTMETERS

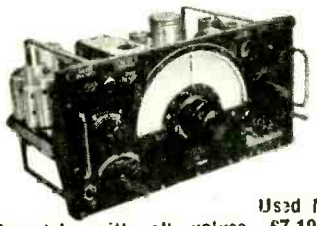
All with long spindle, ¼, ½, 1 and 2 meg. **LASKY'S PRICE** 3/3 less switch each.
With switch 4/3 each. All post extra.

LASKY'S RADIO
World Renowned for Service & Reliability

SPECIAL OFFER

BRAND NEW AND UNUSED R1155 RECEIVERS
AERIAL TESTED BEFORE DESPATCH
THESE SETS ARE THE TOPS

Supplied complete with 10 valves. Circuit: B.F.O., A.V.C., R.F. Amp., two I.F. Stages, magic eye, etc., etc. 5 Frequency ranges: 18.5-7.5 Mc/s.; 7.5-3.0 Mc/s. 1. 500-600 Kc/s.; 500-200 Kc/s.; 200-75 Kc/s.



LASKY'S PRICE
£11 . 19 . 6
Carriage 12/6 extra

Used Models. Aerial Tested.
Complete with all valves, £7.19.6. Carriage extra.

POWER PACK AND OUTPUT STAGE.
Fully assembled. For use with above receiver. Complete with valves, wired and working. For operation on 200-250 volts 50 c.p.s.
LASKY'S PRICE 79/6 carriage 5/- extra.

INTER-COM. SETS

4-station operation. For use on A.C./D.C. mains 200-250 volts. Supplied complete, with 3 new valves, ready for immediate installation.
Fitted in attractive plastic cabinet

MASTER UNIT £7.15.0. Carr. 5/- extra.

Extension Units. As Illustrated. **£1/1/-.** Carriage 2/- each extra.

WEARITE TYPE 550 I.F TRANSFORMERS. Permeability tuned. 445-520 Kc/s. Size: 3½in. high, 1⅞in. square. **Price 12/6** per pair.

CAR RADIOS. BY FAMOUS MANUFACTURER. 12 Volt 6 Valves. Valve line up: 6K7 RF. amp.; 6K8 Frequency changer; 6K7 I.F. Amp.; 6Q7 Detector and A.V.C.; 6V6 Output, 6X5 Rectifier. Non synchronous vibrator. Fitted in two units, with only electrical connections, not Bowden cable.

Fitted 6½in. speaker gives excellent quality output, adequate for the largest car.

Model No. 1. Frequency coverage: Medium wave band 197-560 metres, Long wave band 857-2065 metres. Model No. 2. Frequency coverage: Short wave band 18-50 metres, Medium wave band 197-560 metres.
LASKY'S PRICE £15.19.6
Carriage 10/- extra.
State model required when ordering.

MIDGET YAXLEY SWITCHES. 4 pole 3 way and 2 pole 5 way. Long spindle. **Price 2/11** each.

EXTENSION SPEAKERS. 3in. P.M. Complete with cabinet. Medium walnut veneer. Modern and pleasing design. Ideal for radio extension and intercom. slave units. Fitted with back. **PRICE 21/-.** Postage 2/- extra.

AMPLIFIERS. All fully wired and assembled, ready for operation.

25 Watt Model. By Romac, with radio tuner, long and medium wave. 7 valves, including 2 6L6 in push-pull. Provision for high and low impedance microphone. Absolutely perfect, new and unused. For 200-250 volts 50 c.p.s. mains. £25.

Model J/RA/2. 10-12 watt, 4 valves, including 2 KT61 in push-pull. Brand new and unused. For 200-250 volts 50 c.p.s. mains. Details available on request. £7/19/6.

12 Watt Model. 10 valves, including 2 25L6 in push-pull. Brand new and unused. For 200-250 volts 50 c.p.s. mains. **£10/19/6.**

BRAND NEW AND UNUSED R1132A RECEIVER.

Supplied in makers' original wood transit case. Frequency coverage 100-124 mc/s. 11 Valves: 1 VR65; 1 VR66; 4 VR53; 2 VR54; 1 6J5; 1 VS70; 1 VR57. Large tuning scale with slow motion drive. 0-5 m/a. tuning meter, RF. and LF. gain controls, jack sockets for line and 'phone.

Totally enclosed in metal case, grey enamelled with plated handles. Size: 18 × 10 × 11in. Supplied with all valves, also circuit and calibration chart.
LASKY'S PRICE £3.19.6
Carriage 10/- extra.

R1481 RECEIVER. Soiled condition. Supplied in original wood transit case.

Frequency coverage 66-86 Mc/s. 11 Valves: 1 VR65; 1 VR66; 4 VR53; 2 VR54; 1 6J5; 1 VS70; 1 VR57. Large tuning scale with slow motion drive. 0-5 m/a tuning meter, RF. and LF. gain controls, jack sockets for line and 'phone.

Totally enclosed in metal case, grey enamelled with plated handles. Size: 18 × 10 × 11in. Supplied with all valves, also circuit and calibration chart.
LASKY'S PRICE 59/6
Carriage 10/- extra.

RADIO

ow Road) Ltd.,
DDINGTON, LONDON, W.9.
phones: CUNningham 1979 and 7214
Harrow Rd., Paddington, London, W.10. Tel. LADbroke 4075

TERMS: PRO Forma, Cash with order, or C.O.D. on post items only. Postage and packing on orders value £1—1/- extra, £5—2/- extra, £10—3/6 extra. Over £10 carriage free unless specifically stated otherwise.

ROTHERMEL (DEAF AID) CRYSTAL MICROPHONES.

Diaphragm driven. Extremely sensitive, can be used for tape recording, etc. Miniature, 1⅜in. diameter, ¼in. thick.

LASKY'S PRICE 7/6
POST FREE.

Larger Screen T.V. new Wide Angle Components and Picture Tubes

CIRCUIT DETAILS AND DIAGRAMS SUPPLIED.

C.R.T. MASKS. Brand new

LATEST ASPECT RATIO	
10in.	7/6
12in.	15/-
12in. flat face	15/-
14in. rectangular	21/-
15in. round	25/-
16in. Double-D	30/-
17in. rectangular	27/6
SOILED OLD ASPECT RATIO	
9in.	5/-
12in.	7/6
15in.	10/-
12in. with fitted armour plate glass (new ratio)	11/6

ARMOUR PLATE GLASS

15in. Actual size 18¼in. x 19¼in. x ⅜in. 7/11
12in. Actual size 13in. ×10¼in. x ¼in. 4/-
9in. Actual size 9in. ×8in. x ¼in. 3/-

Multi-Ratio Frame Output Transformer, 10/6.

Frame Blocking Oscillator Transformer, 4/6.

Line EHT Transformer, with EY51 heater winding, 12/6.

Focus Magnet. With Vernier Control. For any type c.r. tube with 35 mm. diam. neck, 21/6.

Scanning Coils. High impedance frame, low line, 12/6. Low impedance line and frame, 14/6. Plessey. Low impedance line and frame, 25/-.

Variable Inductance Width Control, 3/6.

14in. rectangular C.R. tube	£21	5	8
17in. rectangular C.R. tube	£26	19	8
16in. round, metal cone ion trap tube	£24	6	5
Carriage and insurance extra.			
ALLEN WIDE ANGLE COMPONENTS			
Line and frame scan coils. Type DC300	£2	2	0
Width coil. Type GL18		10	0
Line linearity coil. Type GL16		10	0
Focus coil. Type FC302	£1	15	0
Line output and EHT transformer, 10-16 kV. Type L308	£2	10	0
Frame output transformer. Type FO305	£1	1	0
Frame Blocking Osc. Transformer		15	0
ELAC P.M. FOCUS MAGNETS :—			
For 14in. and 16in. Tetrode tubes	£2	12	6
For 14in. and 17in. Triode tubes	£2	17	8

CONVERT YOUR VIEWMASTER TELEVISION RECEIVER TO USE THE LATEST WIDE ANGLE 14, 16 or 17-inch. CATHODE RAY TUBE.

CATHODE RAY TUBE, MASK, VALVES AND ALL OTHER NECESSARY COMPONENTS CAN BE SUPPLIED FROM STOCK FOR IMMEDIATE DELIVERY.

WRITE FOR LIST.

TELEVISION SELENIUM RECTIFIERS

The very latest "Sentercell" S.T.C. range.

K3/40, 3.2 kV.	7/6
K3/45, 3.6 kV.	8/2
K3/50, 4.0 kV.	8/8
K3/100, 8.0 kV	14/8
K3/160, 12.8 kV	21/6

S.T.C. METAL RECTIFIERS

RM1	3/11
RM2	4/6
RM4	21/-

C.R.T. REAR END PROTECTORS

Suitable for fitting to T.V. cabinets, 2/6 each.

CLOSED FIELD LOUDSPEAKERS

Ideal for television receivers. Less o/trans. 3 ohms. Will not affect your C.R. tube.

6½in.	15/-
8in.	17/6

DARK SCREEN FILTERS (LATEST TINT)

12⅛in. × 14½in. For 16 and 17in. c.r. tubes, 25/-. 11in. × 13⅜in. For 9, 10 and 12in. c.r. tubes, 19/11.

BRAND NEW 12in. MASKS. LATEST ASPECT RATIO. Round face, with fitted dark screen filter. Dustproof. **SPECIAL OFFER 29/11. COMPLETE.** Postage 2/- extra.

LARGE STOCKS of RESISTANCES ALWAYS AVAILABLE

All values. Prices: 1/10th and 1/8th watt, 7½d. each. ¼ and ½ watt, 4d. each. 1 watt, 8d. each. Postage extra.

VCR97 C.R. TUBES BRAND NEW AND UNUSED

In maker's original sprung wood transit case.

LASKY'S PRICE 45/-

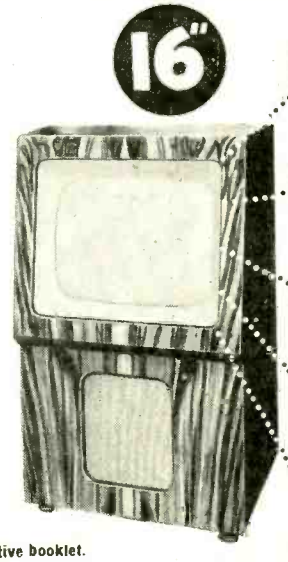
6in. ENLARGER LENSES

Oil-filled plastic 19/6. Carriage 2/6 extra.

Introducing the

TELE-KING

laboratory developed



ALEXANDRA PALACE
SUTTON COLDFIELD
HOLME MOSS
KIRK O'SHOTTS
WENVOE

CHASSIS
Power pack; Sound-vision and Scan chassis. PRICE 16/- each. All other metalwork available from stock.

COILS
13 All exactly as specified. PRICE £2/14/3.

RESISTANCES
72 Resistances, all exactly as specified. 18/-.

CABINET
As illustrated **£8/10/0** plus carriage.

A fully itemised price list of Tele-King components will be supplied free on request. All Tele-King components now in stock, available for immediate delivery.

A practical 5-channel SUPERHET TELEVISION RECEIVER

Using the new 16-inch cathode ray tubes and wide angle components for the home constructor.

Complete instructions, wiring diagrams and 32-page descriptive booklet.

6/- POST FREE

RADIO

ow Road) Ltd.,
DDINGTON, LONDON, W.9.
phones: CUNningham 1979 and 7214
Harrow Rd., Paddington, London, W.10. Tel. LADbroke 4075

TERMS: PRO Forma, Cash with order, or C.O.D. on post items only. Postage and packing on orders value £1 — 1/- extra, £5 — 2/- extra £10 — 3/6 extra. Over £10 carriage free unless specifically stated otherwise.

SOLON-HENLEY ELECTRIC SOLDERING IRONS

Brand new and unused. Oval Bit. For 230/250 volts only. LASKY'S PRICE 19/- Postage 1/- extra.

TELEVISION PRE-AMPLIFIERS

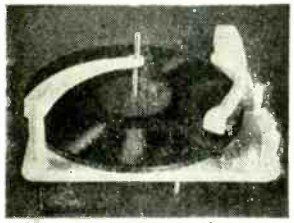
For London frequency, 2 Stage, uses 2 6F13 valves. Completely wired, ready for use. LASKY'S PRICE 10/- (less valves).

E.H.T. TRANSFORMER FOR VCR97

Primary: 200-250 v., 50 c.p.s. Secondary: 2.5 kV., 4 mA.; 4 v., 1.1 a.; 4 v. (CT) 1.5 a. LASKY'S PRICE 45/- Postage 1/6 extra.

BASES FOR VCR97 C.R. TUBES. Fully shrouded and insulated. 4/11.

DECCA RADIO-GRAM. UNITS



A special purchase enables us to offer the famous Decca Record Changer new and unused, at a little over half price. A superb instrument, plays standard 78 r.p.m. and 33 r.p.m. records up to 10 of which of mixed sizes can be loaded at one time. Ideal for modernising an old radiogram or for a new installation, has attractive modern finish and very conveniently located controls. Size, 12⅜in. × 10½in. deep, clearance above board 5in., below board 3in. Each unit is complete with 2 Decca lightweight pick-up heads. Special price £11/17/6, plus 7/6 carr. and ins. £4/1/6 deposit and 12 payments of 17/-.

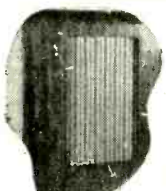
EX-ROYAL NAVY SOUND POWERED TELEPHONE

These require no batteries, and will go for long periods without attention. Complete with generator and sounder which gives a high pitched note, easily heard above any other noise. Also fitted with an indicator lamp which in quiet situations can be used instead of the sounder, or where several 'phones are used together will indicate which one is being called. Size 7¾in. × 9in. × 7½in., wall mounting, designed for ships' use, but equally suitable for home, office, warehouse, factory, garage, etc. Price 57/6 each, plus 4/6 carriage.

ADJUSTABLE THERMOSTAT

250 v. heavy silver contacts can be adjusted to operate between 70°—300° F. These are suitable for aquarium heaters, electric blankets, etc.
1 Amp. Model 3/6.
2 Amp. Model 5/6. Post, etc., 6d. extra.
Don't be cold this winter, make an Electric Blanket, blueprint 1/6, post free.

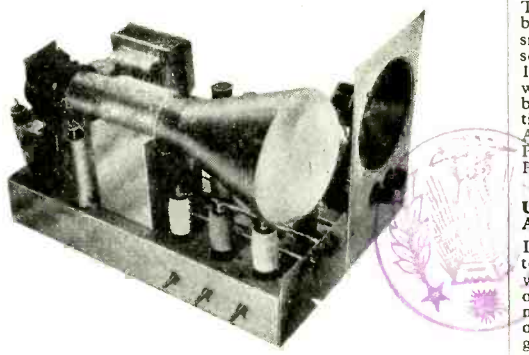
SOMWEAVE



This really lovely loudspeaker fabric we offer at approximately a third of today's cost. It is 42in. wide and our price is 12/- per yard or panels 12in. × 12in., 1/9 each. This is also very suitable for covering plain wooden cases, for portable radio amplifiers, etc.

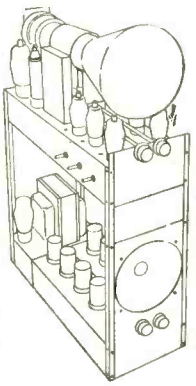
THE "P.T." 'ARGUS' TELEVISION RECEIVER

A 21 Valve 6in. C.R. Tube Unit-built Televisor for the Amateur



Although this televisor costs only about £20, it does not involve the conversion of ex-Government units, and has been designed for construction by the novice. The circuits have been kept straightforward and devoid of "frills," though nothing has been sacrificed which would assist in its efficient and stable operation.

The cathode-ray tube used is a VCR97. This 6in. tube was chosen as it is readily available at a low cost, and is capable of providing pictures of very good quality. The trace is green, but one soon becomes accustomed to the colour, and it is very restful to the eyes.



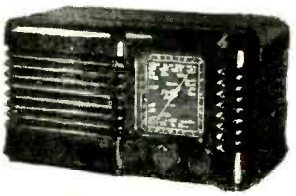
The chassis is divided into five separate units which makes for ease of construction; the units are vision receiver; sound receiver: time base; E.H.T. Supply and C.R.T. network and power unit. Each unit is complete on its own chassis, and when finished all units are bolted together to form the complete televisor.

We can supply all the parts for £20/10/-. H.P. terms are available, deposit being £6/17/6 and 12 monthly payments of £1/7/8. Carriage and packing 10/- extra.

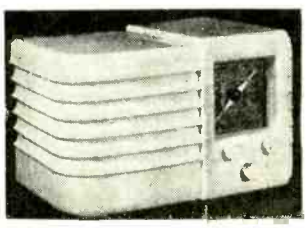
A reprint of the data which originally appeared in "*Practical Television*," together with some additional diagrams and notes produced by our Television engineers are available as a constructor's Envelope. Price 5/-, post free.

THE ARGUS ARRANGED AS A CONSOLE ➔

PROFESSIONAL RADIOS YOU CAN MAKE

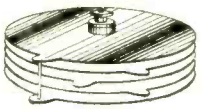


You will find that the building of our all-mains radio receivers is simplicity itself, and the more you make the less time each takes, everything down to the last nut and bolt is supplied, and everything fits together in a professional manner. When finished the receiver looks and plays as well as those being offered in radio shops at anything between £10 and £14. The one illustrated above we call the "Occasional," in a choice of colours, Ivory or Walnut and the T.R.F. costs just less than £6 to make (H.P. terms being £2/1/6 deposit and 10 monthly payments of 10/6), while the superhet costs approximately £9 (H.P. terms £3/2/- deposit and 12 monthly payments of 13/6).



The other radio illustrated we call the "White Lady." This is an extra fine cabinet of pure white. The complete T.R.F. receiver costs about £6/5/- to build, H.P. terms being £2/3/- deposit and 10 monthly payments of 10/9 and the superhet receiver costs about £9/5/- to build, H.P. terms £3/2/- deposit and 12 monthly payments of 13/6. Constructional data for either set is available at 1/6, post free.

METAL RECTIFIERS



The one illustrated is a special bargain being available at considerably below cost. It is a selenium type rectifier rated at 12 v. 2½ amps, it is of course a full wave type highly suitable for battery chargers. Limited quantity. Price 17/6 each.
Also available 6 v. 1 amp. Type. Price 5/- each. 12 v. 1 amp. Type. Price 9/- each.

UNBREAKABLE GLASS

Is a parcel of toughened glass which we can offer at approximately a quarter of its cost. This glass, as many readers will know, can be dropped and will not break. In fact it is most difficult to break and is so useful for dozens of applications in addition to its original purpose of protecting viewers against flying glass in the event of an exploding Cathode Ray tube.
We offer a parcel of five panels each 10¾ × 9¼in. for 7/6, post free.

CONNECTING WIRE SNIP

P.V.C. insulated 23 s.w.g. copper wire in 100ft. coils, 2/9 each. Colours available: Black, Brown, Red, Orange, Pink, Yellow, White, Transparent. 4 coils for 10/-.

AUTO TRANSFORMERS

For working American equipment off our mains. etc., etc.
Input tapped 200-240 v.
Output 115 v.
In addition to those listed below, we have special this month: 150/200 watt totally enclosed in metal box with input and output leads. Price 47/6 plus 2/- post and packing.

Totally enclosed and screened

	Price	Carr.
50 watt	£1/2/6	1/6
100 watt	£1/16/-	1/6
150 watt	£3/-/-	2/-
250 watt	£4/10/-	2/6
500 watt	£5/10/-	2/6

Unscreened

1 KVA (1,000 w.)	£6/10/-	5/-
1.5 KVA (1,500 w.)	£7/17/6	5/-
2 KVA (2,000 w.)	£10/17/6	7/6
3 KVA (3,000 w.)	£12/7/6	10/-
5 KVA(5,000 w.)	£19/5/-	12/6

SLIDER RESISTORS

Heavy Duty Type.
Size 7in. × 1½in. 11 ohms 4.5 amp. 22/-; Size 9in. × 1½in. 1.2 ohms 15 amp. 15/-; Size 13½in. × 1½in. 3 ohms 10 amp., 15/-.

TRANSFORMER BARGAINS

250 mA, 350-0-350 v., 6.3 v. at 6 amps, 5 v. at 3 amps, 4 v. at 5 amps. Price **37/6.**

200 mA, 425-0-425 v., 6.3 v. at 4 amps, 6.3 v. at 4 amps, 5 v. at 3 amps. Price **50/-.**

120 mA, 350-0-350 v., 4 v. at 4 amps C.T., 4 v. at 2 amps C.T. Price **42/6.**

100 mA, 350-0-350 v., 6.3 v. at 4 amps, 5 v. at 3 amps, fully shrouded upright mounting. Price **22/6.**

100 mA, 250-0-250 v., 6.3 v. at 6 amps, 5 v. at 3 amps, fully shrouded upright mounting. Price **27/6.**

85 mA, 350-0-350 v., 4 v. at 2.5 amps C.T., 4 v. at 5 amps C.T. Price **37/-.**

80 mA, 350-0-350 v., 0-4-6.3 v. at 5 amps, 0-4-5 v. at 2 amps. Price **19/6.**

80 mA, 300-0-300 v., 6.3 v. at 4 amps C.T., 5 v. at 2 amps upright mounting. Price **19/6.**

80 mA, 280-0-280 v., 4 v. at 1.5 amps, 4 v. at 6 amps, half shrouded. Price **18/6.**

70 mA, 235-0-235 v., 6.3 v. at 2.5 amps, 5 v. at 2 amps, uprightmounting, price **22/6.** 70 mA, 235-0-235 v., 4 v. at 4 amps, 4 v. at 1 amp, upright mounting. Price **22/6.**

60 mA, 260-0-260 v., 4 v. at 3 amps, 4 v. at 2 amps, upright mounting fully shrouded. Price **18/6.**

40 mA, 325-0-325 v., 6.3 v. at 3 amps, upright mounting. Price **15/6.**

FILAMENT TRANSFORMERS

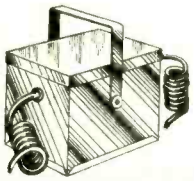
Standard types for receivers, 6.3 v. at 1.5 amps. Price **6/6.** 6.3 v. at 2 amps. Price **8/6.** E.H.T. insulated. 2 v. at 2.5 amps. Price **7/6.**

T.V. TRANSFORMERS

Fixed Primary —H.T.Secondary, 300-0-300 v. at 150 mA, L.T.7.5-0-7.5 v. at 3 amps and 4 v. at 3 amps. Dimensions are 4½in. high × 4in. × 3⅜in. Price **17/6,** plus 2/- postage and packing.

E.H.T. TRANSFORMERS

2,500 v. 5 mA, 2-0-2 v., at 1.1 amps. 2-0-2 v. at 2 amps. Price **37/6.**



WELDING TRANSFORMERS

12 v. 50 amp output from 200-240 v. A.C. mains.

Primary and secondary separated by a special screen to prevent interference, this screen is brought out to the terminal block. Complete in metal case with carrying handle, price **£4/5/-,** plus 5/- carriage and packing.

MAGNETIC TAPE RECORDER KIT— YOURS FOR £11/14/6

Total cost, **£35.**
Cabinet only, **£4/17/6.**
Tape Deck only, **£16/10/-.**

Tape Deck. Fitted with 3 motors giving fast rewind/forward run and no friction. High fidelity record/playback giving approximately 1 hour playing from standard 1,200ft. tape. Tape, **35/-** per reel.

Amplifier. High gain enables recording to be made from microphone, pick-up, or loudspeaker. Separate bass and treble lift controls.

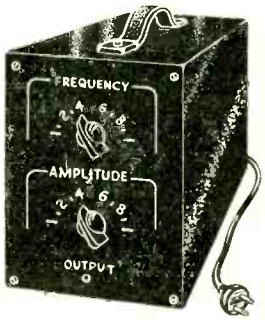
Cabinet. Portable, is rexine covered, table model is polished walnut.

Instruction Booklet. Shows in close detail exactly how to assemble and operate the recorder, is free with kit or available separately at 5/- (credited if you buy kit or complete recorder).

Price **£35.** Complete kit of parts, including 6 B.V.A. valves, loudspeaker and cabinet (state whether portable or table model required), or **£11/14/6** deposit and 12 monthly payments of **£2/6/3.** Carriage/ins. 10/- extra.

T.V. SIGNAL AND PATTERN GENERATOR

Cost of all components, valves, etc., only 29/6.



Although this generator can be built and used by any beginner it is at the same time a most useful instrument for the more advanced worker.

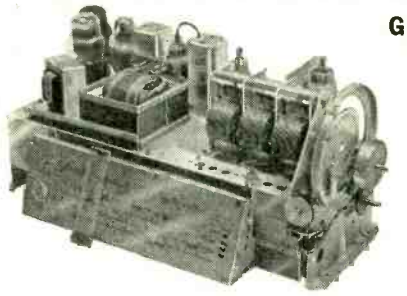
It can be tuned to the vision channel and will produce a pattern on the face of the C.R. tube. Alternatively if tuned to the sound channel it will produce an audible signal in the loudspeaker.

Thus its owner will become independent of B.B.C. transmissions and can fault-find or test at any time. It operates entirely from A.C. mains and is quite suitable for use with superhet or straight receivers.

A complete kit of parts (in fact everything except the cabinet) with full constructional and operational data will be supplied for **29/6,** plus 2/6 post and insurance, alternatively data is available separately, price 2/6 (credited if you buy the kit later).

NOTE. Cabinets as per the illustrated prototype will be available shortly.

7 VALVE 5 WAVEBAND RADIO CHASSIS



GIVE AWAY PRICE

only £6 . 19 . 6

A famous set by a famous manufacturer. Undoubtedly a serious listener's receiver. Among many special features are an H.F. stage and tuning indicator. Tunes up to 11 metre band. Price complete with valves but less speaker, **£14/19/6.** H.P. terms **£5/10/-** deposit and 12 monthly payments of **£1/10/-.**

We have a few left, less valves and power pack, otherwise in good condition; they definitely have never been used. Price **£6/19/6,** or **£2/7/-** deposit and 11 monthly payments of **10/9,** plus 15/- carriage.

ELECTRICAL BARGAINS

In addition to our large range of radio accessories we also carry a good stock of electrical wiring accessories, details of a few of these and of cable can be found below :—

5 AMP SURFACE SWITCHES —HICRAFT
OblongBrown Plastic 1-way, **1/3** each.
Oblong White Plastic 1-way, **1/3** each.

Oblong Brown Plastic 2-way	1/6 each
Oblong White Plastic 2-way	1/6 ,,
Round Brown Plastic 1-way	1/3 ,,
Round White Plastic 1-way	1/3 ,,
Round Brown Plastic 2-way	1/6 ,,
Round White Plastic 2-way	1/6 ,,

SOCKETS— HICRAFT
Flush type for skirtings 5 amp. 3-pin shuttered, **1/3** each; ditto with switch, 2/3 each.

CEILING SWITCHES— HICRAFT
With cord and acorn. Brown or White, 1-way, **3/9** each; 2-way, **4/3** each.

LAMP HOLDERS
Bakelite **1/-** each or **10/6** doz. Bakelite skirted Batten holder **1/6** or **15/-** doz.
Bakelite type threaded for ⅜in. with HO skirt, **1/6.**
10 per cent. discount if bought in dozens.

T.R.S. CABLES, 250 v. CLASS

1/.044 Twin flat	-/9
3/.029 Twin flat	1/-
3/.029 Twin with earth	1/3
3/.029 3 Core flat	1/6
3/.036 Twin flat	1/4
3/.036 Twin with earth	1/7
3/.036 3 core flat	2/-
7/.029 Twin flat	1/6
7/.029 Twin with earth	1/11
7/.036 Twin flat	2/9
7/.036 Twin with earth	3/3
7/.064 Twin flat	4/9

LEAD COVERED CABLES, 250 v. CLASS

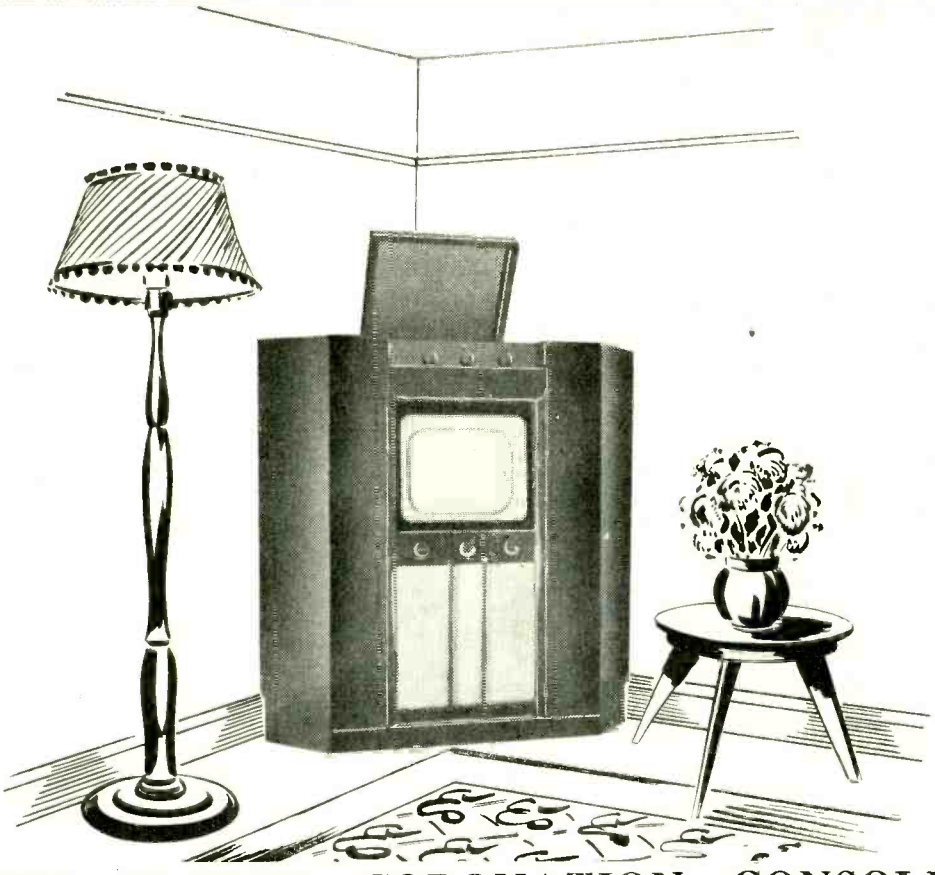
	yard
3/.029 3 core	2/3
3/.036 3 core	3/8
7/.044 Twin	3/3
3/.036 Twin	2/-
7/.029 Twin	2/9
7/.064 Twin	5/-

WAR EMERGENCY TYPE CABLES, 250 v. CLASS
These are P.V.C. or rubber insulated, laid flat then braided with cotton and compounded :

	yard
7/.029 3 core flat	2/-
7/.044 Twin flat	2/-
7/.064 Twin flat	3/3

MULTICORED FLEXIBLES
All are suitable for mains work as the separate conductors are very well insulated, then they are covered overall either with hard rubber, plastic or waterproof braiding :—

	yard
10 core	2/6
7 core	2/-
5 core	1/-



THE ELPREQ CORONATION CONSOLE

A combined Radio, Radiogram and 15in. Televisor valued at a shop price of £300-£400 can be yours for about £75 if you adopt our plan.

THE T.V. CHASSIS. Of the several which will be submitted to us in our "Win £100" Competition the best will be chosen (and we feel sure it will be good), wiring diagrams, plans and constructional details will be printed and be ready early in the New Year. Total cost of this chassis with tube will be less than £35.

THE RADIO UNIT. A 3 station pre-set superhet with special attention to quality is we think the best for the "Console," such a set is being designed and will not cost more than £7 10s. 0d.

THE RADIOGRAM UNIT. The latest 3 speed Collaro or Garrard autochanger will fit in the top. Cost about £15.

THE CABINET. This handsome corner fitting piece (47in. wide, 31in. deep to the corner, and 50in. high) has actually been made. We are having it redesigned so that it can be supplied flat for you to screw together. You can then get a local man in to french polish it. We have not an actual costing but are told that it should not be more than £18.

OUR PLAN. As soon as we are ready to send out the parts we will ask you to forward £12 10s. 0d. upon receipt of which we will send you parts for the Televisor section. From then on you send us 30s. every week and we will send you other sections in the following order: Radio and Audio Chassis, Cabinet and finally Record Changer unit.

WHAT TO DO FIRST. Constructors envelopes will be ready early in January so first send 7s. 6d. for one of these. Upon receipt you can study it, and we feel sure that you will want to make the "Console" but the data will be on 7 days approval and if you wish you can return it within this period and providing it is received in clean condition 7s. will be refunded to you.

ELECTRONIC PRECISION EQUIPMENT LTD.

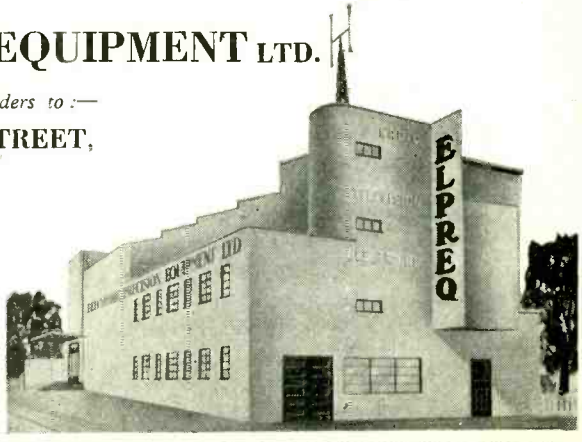
We have moved in at last so you can now address your orders to :—

ELPREQ HOUSE (Ref. 2), HIGH STREET, WEALDSTONE, MIDDX.

Personal shoppers however should continue to call at :—

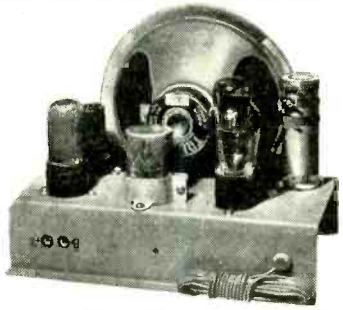
42-46, WINDMILL HILL, RUISLIP, MIDDX.
Phone: RUISLIP 5780
(Half-day, Wednesday).

152-153, FLEET STREET, E.C.4.
Phone: CENTRAL 2833
(Half-day, Saturday).



A Complete Kit of Parts to build a 3-4 WATT HIGH GAIN AMPLIFIER

for operation on A.C. or D.C. Mains, 200-250 volts.



This amplifier will give 3 Watts output for the small input voltage of only 75 millivolts, and is therefore suitable for use with any type of pick-up from the crystal type to the miniature H/F Magnetic type.

A tone control is incorporated and the quality produced is excellent. The overall size of chassis is 9in. × 5in. × 7in. and valve line up 25Y5-6sH7-25L6.

Price of complete kit including drilled chassis and Valves **£4/2/9**, plus 6/4in. P.M. (which fits on chassis), **16/-**, or 8in. P.M., **18/9**.

Price of fully assembled chassis ready for use. **£5/5/-** (plus cost of speaker).

Copy of Assembly Instructions and Components Price List available for **1/3**.

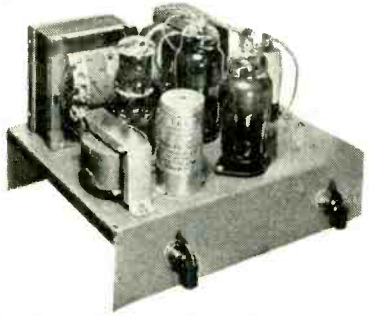
! ! AMPLIFIERS ! !
TWO COMPLETE KITS OF PARTS

(a) **A 6-8 watt QUALITY "PUSH-PULL" DESIGN**, which is the type illustrated below.

(b) **A 12 watt HIGH FIDELITY "PUSH-PULL" AMPLIFIER.** Both for operation on A.C. mains 200 to 250 volts.

THE 6-8 watt AMPLIFIER incorporates a simple arrangement to enable either a Magnetic-Crystal, or Lightweight pick-up to be used and is suitable for use with Standard or Long Playing Records. A Tone Control is incorporated, and the 10 watt Output Transformer is designed to match 2 to 15 ohm speakers.

The overall size of the assembled chassis is 10in. 8in. 7¼in. high, and full practical diagrams are supplied. Price, including drilled chassis and valves, of complete kit, **£9/17/6**. Price of assembled chassis, supplied ready for use, **£8/12/6**. Full descriptive leaflets are available separately for **1/-**.



THE 12 watt HIGH FIDELITY "PUSH-PULL" AMPLIFIER employs 6 valves plus Rectifier, with Negative Feedback, and comprises a main Amplifier Chassis and a Remote Control Unit incorporating four controls—Bass, Treble, Main Volume or Mixing Control, and a Radio, Gram, Microphone, Selector Switch. This Control Unit measures only 7in. × 4in. × 2in.

The measured frequency range of the Amplifier with this Unit shows an excellent response from 14,000 cycles down to 20 cycles, the Bass and Treble Controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 50. It can be seen therefore that ample correction is provided to suit any type of Pick-up with any type of recording.

Input voltage for maximum output is 70 mV. 6.3 volts at 2 amps and 300 mA H.T. is provided for Tuning unit, etc. Price of complete kit, including drilled chassis and valves **£14/10/-**. Complete specification and layout, **1/6**.

THIS AMPLIFIER COMPARES WELL WITH THE WILLIAMSON AND SIMILAR DESIGNS AT A FRACTION OF THE COST.

You're SURE to get it at

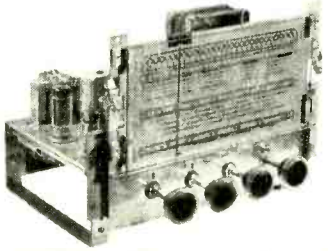
STERN'S

ESTABLISHED 25 YEARS

TWO COMPLETELY ASSEMBLED "ALL-WAVE" SUPERHET CHASSIS

(a) **MODEL B.3.** A 5 Valve 3 Waveband Superhet Receiver.
(b) **MODEL B.** A 5 Valve 6 Waveband (4 bandspread) Superhet Receiver.

Both Receivers are for operation on A.C. Mains 100/120 Volts and 200/250 Volts, and employ the very latest miniature valves. They are designed to the most modern specification, great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both Gram and Radio, making them the ideal replacement Chassis for that "old Radiogram" etc.



Brief Specifications: **Model B.3.**—Valve line up, 6BE6 6BA6, 6AT6, 6BW6, 6X4—Waveband coverage, Short 16-50, Medium 187-550, Long 900-2,000 metres. Controls (1) Volume with on/off; (2) Tuning (Flywheel type); (3) Wavechange and Gram; (4) Tone (3 position switch operative on Gram and Radio).

Negative Feedback is employed over the entire audio stages. Chassis size 11 × 7½ × 8½in. high. Dial size 9in. × 4¾in. Price, complete and READY FOR USE, excluding speaker, **£12 12/-**. (Carr. Pkg. & Ins. 7/6).

Model B employs a similar valve line up as the B.3, but covers 6 Wavebands. Short wave 11-16, 16-25, 22-33, 31-46, and 43-120 metres, and Medium Wave, 187-550 metres. The first four short bands are Bandspread. The Controls employed are as used on the B.3 model but the Tone Control operates a six position switch, having three additional positions for varying Bass and Treble on Gram reproduction.

Negative Feedback is employed over the entire Audio Stage. Size of Chassis and Dial is as given for B.3. Price complete and READY FOR USE, excluding speaker, **£15/15/-**. (Carr. Pkg. & Ins. 7/6 extra).

A Genuine

SPECIAL OFFER ! !

PLESSEY 3-SPEED AUTO CHANGE UNITS

Brand New in maker's Cartons, complete with mounting instructions.

£11 . 19 . 6

(Normal price is £23/10/0)

★ These Units will auto change on all three speeds, 7in., 10in. and 12in.

★ They play MIXED 10in. and 12in. records.

★ They have separate sapphires for L.P. and 78 r.p.m., which are moved into position by a simple switch.

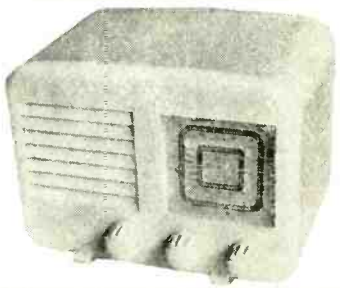
★ The size of the unit deck is 14in. × 11in. with 8in. show deck and 2½in. below.

A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.

Please include 5/- carriage and packing.

A 5-VALVE "ALL-WAVE" SUPERHET RECEIVER

For use on A.C. Mains 200 to 250 volts.



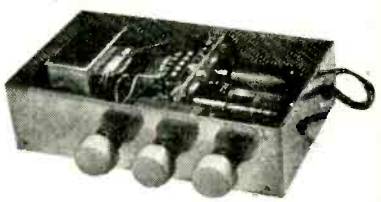
This small attractive Receiver, embodying modern circuit technique is designed to cover Short, Medium and Long wavebands, and incorporates the following outstanding features:

- A superhet circuit designed for high efficiency on all three wavebands.
- A 3½in. P.M. Speaker accurately matched for good quality reproduction.
- The latest range of new 6-volt B.V.A. miniature valves.
- Built-in Frame Aerial with provision for external aerial for distant stations.
- A White Plastic Cabinet of very attractive appearance overall size 7½in. × 5½in. × 5½in.
- THE RECEIVER AS ILLUSTRATED CAN BE BUILT FOR APPROX., **£10/10/-**.

Send 2/6 for the fully descriptive stage by stage assembly and wiring diagrams, with which complete price details are given.

A DUAL CHANNEL PRE-AMPLIFIER and TONE CONTROL UNIT

This comprehensive PRE-AMPLIFIER and TONE CONTROL UNIT provides full control of Bass and Treble, in conjunction with a main Volume/Mixer Control.



It can be used with any Amplifier and with any Pick-Up, the range of frequency control provided by the unit affording ample compensation for all types of Pick-Up and all natures of recordings, i.e., English, American and Long Playing, without recourse to Pick-up correction.

The extreme flexibility of the Bass and Treble Controls is such that the level of Bass and Treble can be set to suit any conditions irrespective of the volume output of the Amplifier.

Response characteristics are given in a 12 watt Amplifier advt.

The Unit measures only 7in. × 4in. × 2in. including self-contained Power Supply, and can be accommodated either on or away from the main Amplifier, i.e., on the front panel of a Cabinet or any other position. Price including drilled chassis, valves (6SN7 and 6L5), **£3/16/9**.

Complete assembly data is available separately for **1/-**.

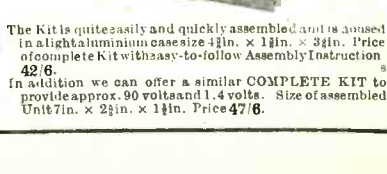
Completely assembled unit ready for use **£5/5/-**

The Viewmaster Televisor.—We have had very considerable experience in assisting customers to build this T/V and can supply all SPECIFIED COMPONENTS EX-STOCK. The Assembly Instructions showing Practical Layouts and Price List are available for **7/6** for London, Sutton Coldfield, Holme Moss, Kirk-o'-Shotts and Wenvoe. Complete Television Price List is contained in our general STOCK LIST at 9d., including Haynes, etc., Components.

"PERSONAL SET" BATTERY ELIMINATOR

A complete Kit of parts to build Midget "Alldry" Battery Eliminator, giving approx. 60 volts and 1.4 volts.

This Eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver requiring H.T. and L.T. voltage as above, or approx. to 60 volts.



The Kit is quite easily and quickly assembled and is housed in a light aluminium case size 4¾in. × 1¾in. × 3¾in. Price of complete Kit with easy-to-follow Assembly Instruction **42/6**.

In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled Unit 7in. × 2¾in. × 1¾in. Price **47/6**.

"hundreds" of ***Wireless and Television Components*** *and many KITS OF*

ordering please include approx. cost of Post and Packing.

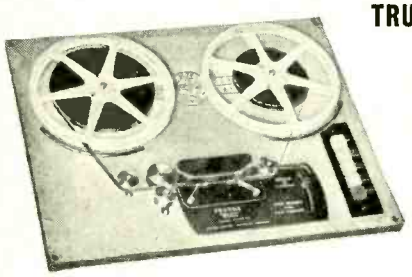
& 115 FLEET STREET, E.C.4

5812-3-4

GARLAND

HIGH-FIDELITY TAPE RECORDING

TRUVOX TAPE DECK MARK III



Incorporating high impedance mu-metal twin-track heads. Two-speed capstan, for tape speeds of 7½ and 3¾ inches per second. Three heavy-duty motors allowing for fast forward and rewind facilities without tape handling. All controls operated by electrically and mechanically interlocked push buttons. Price plus 10/- carriage, etc. **£23.2.0**

Send S.A.E. for full particulars.

GARLAND RECORD-PLAYBACK AMPLIFIER RP8

This amplifier is specially designed for the Truvox Tape Deck. It is built in two cable connected units (pre-amp-control unit and main amplifier), and provision is made to enable the equipment to be used as a gramophone amplifier. Built-in power supplies, bias and erase oscillator, magic-eye record level indicator, 6-watt push-pull output, 8in. P.M. loudspeaker with provision for feeding into external 3 or 15 ohm 'speaker. Formica control panel to match Tape Deck. Standard valves used throughout. Price plus 10/- carriage, etc. **£19.19.0**

Send S.A.E. for full details.

GARLAND TAPE RECORDER LU.7. (C)

Incorporating the Lane Tape Table and the Garland UE.7 amplifier. For direct record and playback from radio, mike or pick-up. Available as Table Model in matched walnut veneer cabinet or in portable form. Price, including a 1,200 ft. reel of "Scotch Boy" Tape and a spare spool, Portable Model **£38/10/-**, plus 15/- carriage, etc. Table Model **£37/10/-**, plus 15/- carriage, etc.

GARLAND UE.7 RECORD PLAYBACK AMPLIFIER (C)

This amplifier is specially designed for the Lane Tape Table but is suitable for use with any high impedance head. Five standard valves are used providing supersonic bias and erase and equalise record and playback facilities. Complete with 8in. loudspeaker. Amplifier wired and tested **12 gns.**, plus 7/6 carriage, etc. *Trade supplied.* **GARLAND KIT** for this Amplifier **£9/15/-**, plus 7/6 carriage, etc.

LANE TAPE TABLE (C)

Three motors; very fast wind-on and re-wind; automatic braking; high impedance, half gap heads; tape speed 7½in. per sec. Price **£16/10/-**, plus 10/- carriage.

SCOTCH BOY MEDIUM COERCIVITY TAPE

We recommend this tape for use with ALL GARLAND Tape Recorders. Now available in the following lengths. 1,200ft. **35/-**; 600ft. **21/-**; 300ft. **12/3**. Spare 7in. spools (1,200ft.) **4/3**.

Garland Oscillator Unit

For magnetic recording. Incorporating 6V6G valve and Garland Oscillator coil, and supplying H.F bias and erase for high impedance leads. Price **£2/2/-**, plus 2/6 post. Trade supplied.

VIEWMASTER AND ELECTRONIC ENGINEERING TELEVISORS, all components in stock as previously advertised.

MICROPHONES

Ronette B110 Crystal microphone, **£2/12/6.** Ronette HM7 Filtercell Microphone, **£3/7/6.** The following stands are suitable for the above microphones. Floor stand, **£4/10/-.** Table Stand, **£2/12/6.** Desk Stand, **15/6.**

GARLAND ACIV AMPLIFIER (C)

Providing exceptionally wide frequency response and low harmonic distortion at a maximum output of 11.5 watts. High and low gain inputs with bass, treble and volume controls. Standard valves throughout. **15 gns.**, plus 15/- carriage, etc. **GARLAND KIT** for ACIV, **£13,** plus 15/- carriage, etc.

AMPLIFIER ACII (C)

Incorporates volume and tone controls, providing 4 watts output. H.T. and L.T. supplies are from mains transformer. Standard valves throughout. Amplifier wired and tested, **£6/2/6,** plus 5/- carriage.
GARLAND KIT for ACII, **£5/2/6,** plus 5/- carriage.

HIGH-QUALITY AMPLIFIERS (C)

LEAK "Point One" TL12/12 watt, **27 guineas.** LEAK RC/PA/U remote control pre-amplifier, **9 gns.** LEAK "Varislope" pre-amplifier, **12 gns.** ACOUSTICAL QUAD 12-watt Amplifier (inculding pre-amplifier), **£35.** ROGERS "WILLIAMSON" AMPLIFIER, **£31.** "WILLIAMSON" PA/TC/UNIT, **£10/7/6.** ROGERS "RD BABY DE LUXE" including pre-amplifier, **£18.** ROGERS "JUNIOR DE LUXE" 10 watt, **£26/10/-.** ROGERS "MINOR" 4 watt, **£11.**

TAPE RECORDER OSCILLATOR COILS. Inductance 6.3 mH, giving frequency of 45 Kc/s with a .002 mfd. condenser. For use with high impedance heads. Made for us by a leading manufacturer. Price **6/9** each. *Trade supplied.*

CLEAREX TELEVISION MAGNIFYING LENS. 9in. clear, **55/-**; 9in. filter, **60/-**; 12in. clear, **75/-**; 12in. filter, **80/-.** Carriage and packing 5/- each on all types. (C)

PORTABLE CABINETS

For Truvox or Lane, with RP8 or UE.7. Write for details.

RECORD PLAYERS (C)

COLLARO RC511 single-speed Autochanger. Magnetic, price **£11/14/11,** incl. P.T. Crystal price **£12/3/2,** incl. P.T.

COLLARO 3/RC511 3-speed Autochanger with two heads, **£18/14/1.**

BSR MONARCH 3-speed Autochanger with reversible pick-up, price **£17/17/-.**

GARRARD RC.75 3-speed Autochanger, **£16/6/6.**

COLLARO AC47 single-speed turntable and motor. Centre driven by heavy induction motor. Price **£6/13/4,** incl. P.T.

COLLARO AC514 Record Player. Single speed rim-drive with pick-up. Price **£6/19/-** inc. P.T.

BSR single-speed motor and turntable MU.15. Price **£3.** Fitted in portable bakelite cabinet, **£4/10/-.**

DECCA 3-speed Gram. motors. Price, incl. P.T., **£6/8/6.**
DECCA Turnover Pick-up for use with above motors. Price, incl. P.T., **£3/19/4**

ACOS G.P.20 Standard or long playing, price **£3/11/5.** Spare heads, **£2/3/4**

B.S.R. GRAMOPHONE UNITS. 3-speed motor with pick-up, mounted on plastic playing table. Price, **£9/19/11,** including purchase tax.

BROS, Ltd.

I.F. TRANSFORMERS. Small size, 2½in. x 1½in. x 1in., **13/6** per pair. Made for us by a leading manufacturer.

UNDRILLED CHASSIS. In 20 s.w.g., bright mild steel : Four-sided size 13in. x 7in. x 2½in., **7/6** each ; two-sided with two straps, size 12in. x 4in. x 2½in., price **3/9** each. Two sided with two straps, size 6 x 5 x 2in., price **2/6** each.

T.R.F. KITS. Three valve and rectifier receiver, in two-tone Walnut veneered cabinet, size, 12in. x 5in. x 7in. Valve line-up 6SH7, 6SH7, 6K6, 2xRM2 metal rectifiers. As is usual all main components are supplied mounted on the chassis. Kit includes circuit diagram, but does not include wiring diagram or instructions. Price, **£6/17/6 (C).**

TWO-GANG TUNING CONDENSERS. Standard size 2-gang of 500pF capacity, with fixing feet. Price **8/6.**

OSMOR COIL PACKS. Type H.O. mains superhet 15-50, 190-520, 800-2,000 metres, **52/-.** Type TRF medium and long waves incorporating a reaction winding, **43/4.** Type B for mains or battery portable receivers using a frame aerial and covering 15-50, 190-560, 800-2,000 metres **54/2.** All the above prices include purchase tax. Note : Included with each coil pack are complete circuits and layout diagrams.

WEARITE 705 COIL PACK. For mains superhets covering long, medium and short waves. An additional position is provided on the switch for gramophone. Price including purchase tax **£2/13/4.**

REACTION CONDENSERS. Solid dielectric also suitable as tuning controls in one-valve receivers. Available in 300 pf and 500 pf sizes with standard ¼in. spindle. Price **3/10.**

TYANA SOLDERING IRONS. Light weight, 40 watt irons with easily interchangeable elements and 3/16in. diameter bits. Voltage ranges, 100/110 v., 200/220 v. and 230/250 v. Price **16/9.** "The iron that makes soldering a pleasure."

ELECTROLYTIC CONDENSER OFFER. 8 mfd. 450 v., **1/9** ; 8-32 mfd. 475 v., **5/-** ; 32-32 mfd. 350 v., **4/9** ; 500 mfd., 15 v., **2/9** ; 1500 mfd., 6 v., **2/-.**

CERAMIC SWITCHES. Single pole, eight-way, **3/6** each.

J.B. SQUAREPLANE DIALS. Printed in two wavebands with station names. 8/1 drive and bronze escutcheon and glass. Price **12/9.**

J.B. FULL VISION DIALS. Similar to above but with 7½ x 3½in. dial printed in three wavebands. Price **13/-.**

DECALS. 500, ⅛in. high white transfer letters and words for marking electronic equipment. Price **4/9** per book.

WIRE WOUND RESISTORS. Open, cement coated or vitreous enamelled. **4 watt,** 21, 50, 90, 100, 200, 1 k. Price **1/-** each. **6 watt,** 30, 145, 250, 270, 10 k., 15 k. Price **1/6** each. **10-15 watt,** 5, 90, 100, 120, 170, 175, 200, 250, 400, 500, 600, 700, 750, 950, 1 k., 1,690, 3.5 k., 3.6 k., 4.5 k., 4.7 k., 11 k., 15 k., 20 k., 25 k., 47 k., 50 k., **1/9** each. **15 watt,** 650 ohm. Price **2/-.**

CARBON RESISTORS

ONE-THIRD TO ONE-HALF WATT : 10, 13, 15, 22, 33, 39, 56, 68, 71, 73, 100, 150, 170, 180, 220, 250, 270, 330, 390, 400, 450, 470, 500, 530, 600, 680, 820, 1k, 1.2k, 1.5k, 2.2k, 3.3k, 3.9k, 4k, 4.7k, 5.6k, 6.2k, 6.8k, 7.5k, 8.2k, 10k, 12k, 15k, 18k, 20k, 22k, 24k, 25k, 27k, 30k, 33k, 39k, 40k, 47k, 50k, 56k, 100k, 150k, 220k, 270k, 330k, 470k, 680k, 1m, 1.2m, 1.5m, 2m, 2.2m, 2.7m, 3.3m, 4.7m, 10m. All at **4d.** each.

ONE WATT : 50, 56, 82, 120, 150, 240, 330, 290, 680, 1k, 1.5k, 2.2k, 3k, 3.9k, 4.7k, 5.1k, 5.6k, 6.8k, 10k, 12k, 18k, 22k, 24k, 27k, 33k, 68k, 70k, 80k, 170k, 330k, 390k, 470k, 680k, 750k, 1m, 2.2m, All at **6d.** each.

TWO WATT : 220, 1k, 2k, 2.2k, 3k, 3.3k, 4.3k, 4.7k, 6k, 10k, 12k, 20k, 22k, 27k, 30k, 47k, 50k, 68k, 2.2m. All at **9d.**

FOUR WATT : 500k, **1/-** each.

L.F. CHOKES. 10 Henry, 70 mA., **5/6** each.

PUSH-PULL OUTPUT TRANSFORMERS. Ratio, 45 : 1 to match 6V6 etc., 10,000 ohm to 2 ohm, **4/6** each.

PULLIN MOTORS. Type A/3R, 24 volt D.C., size, 3½in. x 2½in. x 2in., **8/6** each.

HEAVY DUTY CROCODILE CLIPS. Suitable for use on car battery chargers, price **6d.** each.

JACK PLUGS. 3-way, G.P.O. type, **1/-** each.

LOUDSPEAKERS AT PRE-TAX PRICES

By leading manufacturers. Brand new and fully guaranteed. 5in. p.m. moving coil **12/6.** 8in. p.m. moving coil, **17/6.**

SENSITIVE NEONS : 85 v. striking. SBC with centre contact. Ideal for record level indicator on tape recorders, mains indicator, etc., **2/6** each.

HIGH VOLTAGE MICA CONDENSERS 0.1μF 1,500 v. wkg. Bakelite-cased upright mtg., 3in. x 2½in. x 1⅞in. overall, **2/-** each. Ceramic pot type, 10C/2178, 0.0002μF 5 kv wkg., high H.F. current, **2/6** each. Flat bakelite-cased type, ZA2837, 0.001μF, 5 kv. A.C. test, 0.5 A. at 2-8 mc. ; size 3½in. x 1⅞in. x ⅝in.; suitable tx or tv, **1/9** each. 0.002μF, 2.5 kv. wkg., **1/3.**

T.R.F. COILS. Medium and long wave, aerial and H.F., **6/-** per pair ; with reaction winding, **6/9** per pair.

METAL RECTIFIERS

Type RM2, 125 v. at 100 mA. Two in series required for mains voltage. Price **4/6** each. Type 14D/972, providing 250 v. 25 mA. when used with a reservoir condenser. Small size ideal for test equipment also in place of 14D/36 in T/V circuits. Price **6/6** each. 6 v. 1 a. half-wave (or full wave with C.T. tfmr.), price **5/-** each ; 12 v. 1 a. bridge, price **8/6** each ; 12 v. 4 a. bridge, price **22 6.**

TOROIDAL CERAMIC POTENTIOMETERS. 17k, 100 watt, **8/6.**

TOGGLE SWITCHES. SPCO, 250 v. 2 amp. **1/9** ; DP on-off 250 volt, 1 amp., **2/3.**

ENGRAVING TOOL. Operates from 200-240 volt A.C. for engraving on metal and plastic, price, **12/6.**

WAFER SWITCHES

For ¼in. dia. spindle. Length of spindle quoted from end of bush

3p. 2w. ⅝in. **1/9.**
6w. parallelling ¼in., **1/9.**
4p. 2w. miniature ⅜in., **1/9.**
4p. 3w. miniature 2½in., **3/6.**
4p. 3w. ⅜in., **1/9.**
4p. 2w. 4 bank ¼in., **3/6.**
3p. 3w. 3 bank ¼in., **3/-.**

FIXED CONDENSERS : (pF's) : Ceramic : 2, 4, 15, 20, 27, 30, 50, 220, 350. All at **9d.** 1,000pF. **1/-.** Silver Mica : 10, 30, 50, 160, 170, 180. All at **6d.** 200, 300, 1,500, 8,100, **9d.** Moulded Mica : 50, 75, 100, all at **6d.** 300, 470, 1,000, 2,000, 3,000, 4,000, 4,500, 4,700, 5,000, 10,000, all at **9d.**

CLOSE TOLERANCE SILVER MICA CONDENSERS. All plus or minus 1 per cent. 100pF. 400pF, **9d.** each. 1,000pF, 1,400pF, **1/3** each. 10,000pF, **1/6** each.

MULTI-PURPOSE TOOL. Bends, shears, punches and threads sheet-strip and rod. For all the little workshop jobs that waste your time. Tool price, **10/-.** Jig, gauge and protractor for use with this tool, enabling repetition work to be carried out with precision, **7/6.**

VARLEY MAINS TRANSFORMERS. Primary 10-0-200-220-240 volts. Secondary 300-0-300 volt at 150 mA., 5 volt at 3 amps., 6.3 volt at 4 amps., 6.3 volt at 1 amp. Open type construction. Price **45/-.**

SPECIAL TYPE VALVE OFFER. CV1141 (NGT1), 4 v. THYRATRON. Electronic relay for timers, etc. B5 base, **6/6** each. CV265 4 v. ½-wave high current rectifier. 10 base, **5/-** each. 7193 6.3 v. UHF triode. Plug-in replacement for 6J5G if anode and grid top caps connected to pins 3 and 5. 10 base, **2/6** each. 6SH7 6.3 v. HF pentode. For T/V. amplifiers, receivers, etc. 10 base, **6/6** each. RL18 6.3 v. miniature triode B3G base, **5/-** each. 6U5G 6.3 v. magic eye. Ideal for bridges, recorders, etc. 10 base **7/6** each. U22 2 v. EHT rectifier for T.V. MO base. **8/6** each.

RADIO PACK. Consisting of a walnut Cabinet, size 19in. x 15in. x 8in., complete with Perspex dial ; undrilled chassis size 13in. x 7in. x 3in. ; 8in. Elac speaker ; 500pF twin-gang tuning condenser ; 250-0-250 v., 6.3 v. and 5 v., mains transformer ; L.F. choke ; output transformer ; 16-24 mfd. 350 v. electrolytic condenser. These items are not surplus, but current production goods. Price **£4/15/-** including packing and carriage (G.B. only). **(C).**

METAL-CASED TUBULAR CONDENSERS. 0.01 mfd. 1 kV., **1/-** ; 0.02 mfd. 750 v., **9d.** ; 0.1 mfd. 350 v., **9d.** ; 0.25 mfd. 500 v., **2/-.**

HEATER TRANSFORMERS. Primary 230 v., secondary 6.3 v., 1.5 amp. Wax impregnated. Price **6/-** each.

ALL GOODS NEW AND UNUSED. **ITEMS (C) REQUIRE CRATING FOR SAFE DESPATCH. CRATES ARE NOT CHARGED PROVIDED YOU UNDERTAKE TO RETURN CARRIAGE PAID TO US.**

PLEASE ADD POST OR CARRIAGE ON ALL ITEMS. KINDLY PRINT NAME AND ADDRESS. POST ORDERS TO OUR DEPTFORD ADDRESS. EARLY CLOSING THURSDAY. OPEN ALL DAY SATURDAY.

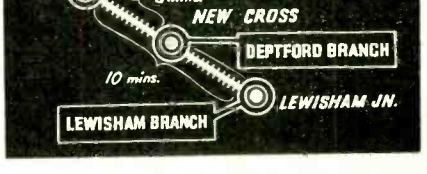
GARLAND BROS, Ltd.

CHESHAM HOUSE, DEPTFORD BROADWAY, S.E.8

Telephone: TIDEWAY 4412/3

5 OBELISK PARADE, LEWISHAM, S.E.13

Telephone: LEE GREEN 4038



MAINS TRANSFORMERS

These transformers are all famous radio manufacturers' surplus and are fully interleaved, impregnated and guaranteed.

Primary 200-250 v. P. & P. on each, **1/6** extra.

300-0-300, 100 mA., 6 volt 3 amp., 5 volt 2 amp., **25/-.**

280-0-280, 80 mA., 6 v. 3 amp., 4 v. 2 amp., drop-through, **14/-.**

Drop-thro' 350-0-350 v. 70 mA., 6 v. 2.5 amp., 5 v. 2 amp., **14/6.**

280-0-280, semi-shrouded drop-through, 80 mA., 6 v. 3 amp., 5 v. 2 amp., **16/6.**

Semi-shrouded, drop-thro', 280-0-280, 80 mA., 4 v. 6 amp., 4 v. 2 amp., **12,6.**

Auto-wound, H.T. 280 volts at 360 mA., 4 v. 3 amp., 2 v. 3 amp., or 6 v. 3 amp. Separates 4 v. 3 amp., rectifier winding (upright or drop-through), **10/6.**

350-0-350, 120 mA., 4 v. 4 amp., 4 v. 3 amp., drop-through, **21/-.**

Auto-transformer, various combinations of voltages including 110 v. 70 watts, and 3/4 volt windings at 1 amp.; 2 volt 1 amp., drop-through or upright mounting, **10/6.**

250-0-250, 60 mA. 6 v. 3 amp., **12/6.**

250-0-250, 80 mA. 6 v. 4 amp., **14/-.**

Pri. 230 v. Sec. 200-0-200 35 mA. 6 v. 1 amp., **8/6.**

Pri. 200/250 v. secondary 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volt at 2 amps., **13/-.**

MAINS TRANSFORMER, semi-shrouded drop-through 200/250 v. primary ; secondary 280-0-280 250 mA., 6 v. 6 amps., 5 v. 3 amps., **29/6.** P. & P. 3/-.

Heater Transformer, Pri. 230-250 v. 6 v. 1½ amp., **6/-** ; 2 v. 2½ amp., **5/-.** 2, 4 or 6 v. at 2 amps. **7/6.** P. and P. each 1/-.

P.M. SPEAKERS

(Closed field)	with trans.	less trans.
2½in.	—	**15/6**
3½in.	—	**13/6**
5in.	**16/6**	**12/6**
6½in.	**16 6**	**12/6**
8in.	**18/6**	**15/-**

P. and P. on the above 1/- each. 10in. less trans., **25/-.** P. and P. 1/6.

R. & A. 8in. M.E. Speaker field coil, 1,600 ohms O.P. trans. 5,000 ohms, impedance, **18/6.** Post and packing 2/-. Rola 5in. P.M. with O.P. trans., **16/6.**

6½in. Energised Television Speaker by PLESSEY. Field resistance 68 ohms with humbucking coil. Will pass up to 300 mA., requires minimum 200 mA. to energise. These are cheaper than a T.V. choke. **9/6** each, 2 for **18/-.**

Volume Controls, by famous manufacturer. Long spindle less switch, 50K, 500K, 1 meg., **2/6** each. P. & P. 3d. each.

B.T.H. Crystal Diode wire ends, **2/3,** post paid.

Expanded aluminium speaker fret, 13¼ x 9in., **2/-.**

Volume Controls by famous manufacturer. Long spindle and switch, ¼, ½, 1 and 2 meg., **4/-.** each ; 50 K., **3/6** each. Ganged control 3 K. and 5 K., **3/6.** Post and packing 3d. each.

Trimmers, 5-40 pf., **5d.** ; 10-110 10-250, 10-450 pf., **10d.**

Ceramic P.F.S. 3 each of the following: 330, 220, 180 and 82, **2/6.**

Twin-Gang .0005 Tuning Condenser, 5/-. With trimmers, **7/6.** P. & P. 1/-.

D. COHEN

RADIO & TELEVISION COMPONENTS

KIT OF PARTS FOR SIGNAL GENERATOR. Coverage 110 Kc/s.-320 Kc/s., 320 Kc/s.-900 Kc/s., 900 Kc/s.-2.75 Mc/s., 2.75 Mc/s.-8.5 Mc/s., 8.5 Mc/s.-20 Mc/s. Metal case 10in. x 6¾in. x 4¼in. size of scale 6½in. x 3¼in. 2 valves and 1 rectifier valve, A.C. mains 230/250. Internal modulation 400 c.p.s. to a depth 30 per cent. Frequency calibration accuracy plus or minus 1 per cent. Modulated or unmodulated R.F. output continuously variable 100 millivolts. **£3/10/-,** P. and P. 4/-. This includes the return to us for checking and calibration. Circuit and point-to-point wiring diagram **3/6.**

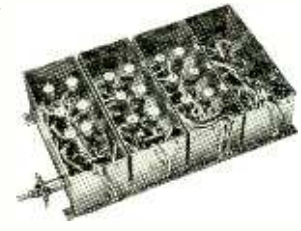
WALNUT BAKELITE CABINET size 17¾ x 12 x 8in., complete with 3-wave-band scale, size 8½ x 3½in., 5-valve superhet chassis with I.F., valve holder and transformer cut-outs, pointer, drum, drive spindle, 4 knobs, 2 scale clips, 3 pulley wheels, two brackets, scale pan and back. **DESPATCHED TO ENGLAND ONLY, 31/-,** post paid.

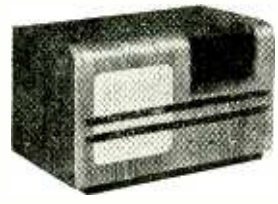
CONSTRUCTOR'S POLISHED CABINET. Size 10 x 6¾ x 5in. approx., supplied in flatted form, grooved and ready to glue together. Complete with plastic front, 3-valve chassis, size 8½ x 4 x 1½in., tuning scale, backplate and back, **10/-.** P. & P. 1/6.

TWIN-GANG AND PAIR OF T.R.F. COILS with circuit to suit above. **8/6.**

CRYSTAL PICK-UP by famous manufacturer complete with sapphire trailer needle and volume control, **23/-.** Less volume control **21/-,** post and packing on each 1/-.

EX-GOVT. RECEIVER TYPE B28 Complete coil unit, 6 bands, 60 kc/s -420 kc/s., 500 kc/s-30 Mc/s. Complete with circuit, **21/-.** Post and packing 2/-. Circuit sold separately, **4/-,** post paid. Four-gang to suit, **7/6.** Coil pack, gang, 5 I.F.s, B.F.O. and crystal, **57/6,** plus 3/- P. & P. 465 Kc. crystal, **12/6.**





RADIO CABINET. In polished walnut size 19 x 11 x 8in. approx., complete with scale. These are slightly soiled and require retouching, **7/6** each, post paid.

WATERHOUSE 5in. EXTENSION SPEAKER, complete with vol. control, in gold and green, **22/6.** P. & P. 1/-.

MAINS OR BATTERY SUPERHET PORTABLE COILS. Comprising medium-wave frame aerial and long-wave loading coil, used as aerial coils. Midget iron-cored screened L/M osc. coils, complete with circuit I.F. frequency 465 Kc., **9/6.**

465 KC. MIDGET I.F.s. Q 120, size 1½in. long, 1in. wide, ⅜in. deep by very famous manufacturer. Pre-aligned adjustable iron-dust cores, per pair, **12/6.** Both these items **£1,** post paid.

CONSTRUCTOR'S PARCEL comprising chassis 8in. x 4in. x 1½in., with speaker and valveholder cut-outs, 5in. P.M. speaker with transformer, twin gang with trimmers, pair T.R.F. coils long and medium, iron-cored, four valveholders, 20 K. volume control and wave-change switch, **23/-.** P. & P. 1/6.

OUTPUT TRANSFORMERS. Standard type 5,000 ohms imp., 2 ohms speech coil, **4/9** ; 42-1 speech coil 2-ohm with extra feed-back winding, **4/3** ; Miniature 42-1 2-ohm speech coil, **3/3.** Multi-ratio 3,500, 7,000 and 14,000 2-ohm speech coil, **5/6.** 10 watt push-pull, 6V6 matching, 2 ohm speech coil, **7/-.**

Twin-gang .0005 with separate 75 pf. on each section for S.W. tuning with feet, size 3¼ x 3 x 1⅜in., **6/6.**

Television Chassis : Size 9¾ x 9½ x 3¼in., 18 guage steel cadmium plated complete with 5-coil cans size 1¼ x 1in. with iron-cored former. These are wound for television frequency, **6/6.** P. & P. 1/6.

Push-back connecting wire. Doz. yds. **1/6** post paid.

Standard Wave-change Switches. 6-pole 3-way, **2/-** ; 4-pole 3-way, **1/9** ; 5-pole 3-way, **1/9** ; 3-pole 3-way, **1/9** ; 9-pole 3-way, **3/6** ; Miniature type, long spindle, 3-pole 4-way, 2-pole 5-way, 4-pole 3-way, **2/6** each. P. & P. 3d.

Line Cord. 3-way 0.3 amp. 180 ohms, per yard, **1/3 per yard.**

Television Coils wound in alican, size 2⅜ x ⅞in. with former and iron core. **1/-** each.

Valve Holders, moulded octal, Mazda, and loctal, **7d.** each. Paxolin, octal, Mazda and loctal, **4d.** each. Moulded B7G, B8A and B9A, **7d.** each. B7G moulded with screening can, **1/6** each.

32 mfd., 350 wkg.	**2/6**
16 x 24, 350 wkg.	**5/-**
4 mfd., 200 wkg.	**1/3**
40 mfd., 450 wkg.	**3/9**
16 x 8 mfd., 500 wkg.	**5/-**
16 x 16 mfd., 500 wkg.	**5/9**
8 x 8 mfd., 450 wkg.	**3/6**
1 mfd., 500 v. wkg.	**1/6**
32 x 32 mfd., 350 wkg.	**6/-**
32 x 32 mfd., 350 wkg. and 25 mfd., 25 wkg.	**6/6**
25 mfd., 25 wkg.	**11d**
250 mfd., 12 v. wkg.	**1/-**
16 mfd., 500 wkg., wire ends	**3/3**
8 mfd., 500 v. wkg., wire ends	**2/6**
8 mfd., 350 v. wkg., tag ends	**1/6**
50 mfd., 25 v. wkg., wire ends	**1/9**
10 x 6 x 2 x 2 mfd., 500 v. wkg.	**5/-**
50 mfd., 250 v. wkg.	**1/9**
Ex-Govt. 8 mfd., 500 v. wkg. size 3½ x 1⅜, 2 for	**2/6**
60+100 mfd., 280 v. wkg.	**7/-**
16 x 32 mfd., 350 wkg.	**6/-**
50 mfd., 180 wkg.	**1/9**
65 mfd., 220 wkg.	**1/6**
4+4+4 mfd., 350 wkg.	**2/6**
8 mfd., 150 wkg.	**1/6**

Frame Oscillator Blocking Transformer, 4/6.

Frame O.P. Transformer. Inductance 10 hy. ratio 10 : 1, **9/6.**

Tube Mounting Bracket, size 9½ x 4¾in., with 4¾in. dia. cut-out. in 18 guage cadmium plated steel and 12in. tube clamps, **2/-.**

Smoothing Choke, 2 henry 150 mA., **3/6.**

Smoothing Choke, 250 mA. 4 henry, **5/-** ; 250 mA. 5 henry, **6/-.**

P.M. Focus Unit for Mazda tube, 15/-. P. & P. 1/6. Similar to above with front adjustment, **2/6** extra.

P.M. Focus Unit for any 9in. or 12in. tube, 35 mm. neck, except Mazda 12in. state, tube, **12/6.**

Similar to above, but with front adjustment, **2/6** each extra.

Ion Traps for Mullard or English Electric Tubes, **5/-** post paid.

Pre-Aligned Midget 465 Kc. Q. 120, **9/-** per pair, post 6d.

465 Kc. I.F.s, size 2½ x 1⅜in. Q.110 removed from American equipment, **5/-** per pair.

Iron-Cored 465 Kc. Whistle Filter, 2/6.

Standard 465 Kc. I.F.S. Q. 120, iron-cored, 3½ x 1⅜ x 1⅜in., per pair, **9/6.**

Television Masks. White Rubber, 9in. with glass, **7/6.** Cream rubber, 12in. with armour-plate glass, **15/-** ; 15in. white rubber mask, soiled, **12/6,** plus 1/6 P. & P.

Two-piece Octal Screening Can, 9d. P. and P. 3d.

Three-bank, 50 pf., **1/3.** Four-bank, 50 pf., **1/8.**

Twin-Gang Midget .00037 with perspex, dust-cover and trimmers, **8/6.** Post and pkg. 6d.

Mains Droppers, 0.3 amp., 460 ohms, tapped 280 and 410, **1/6.** 0.2 amp., 717 ohms, tapped at 100 ohms, vitreous, **1/6** ; 0.3 amps., 950 ohms, tapped 700 and 825, **2/6** ; 0.2 amp., 1,000 ohms, vitreous, tapped, **2/6.** Vitreous .3 amp. 700 tapped 680, 640, 600, **3/6,** P. and P. on each 3d.

3-gang .0005 with separate 75 pf. on each section for S.W. tuning with feet, size 4¾ x 3 x 1⅜in., **7/6.**

Terms of Business: Cash with order. Despatch of goods within 3 days from receipt of order. Where post and packing charge is not stated please add 1/- up to 10/-, 1/6 up to £1, and 2/- up to £2. All enquiries and Lists. S.A.E.

SPECIAL NOTE: NO GOODS SENT WHERE CUSTOMS DECLARATION IS APPLICABLE.

23 HIGH STREET (Uxbridge Road) ACTON, W.3

Hours of Business: Saturdays 9—6 p.m. Wednesday 9—1 p.m. Other days 9—4.30 p.m. Telephone : ACOrn 5901

Wireless World Classified Advertisements

Rate 7/- for 2 lines or less and 3/6 for every additional line or part thereof, average lines 6 words. Box Numbers 2 words plus 1/-. (Address replies: Box 0000 c/o "Wireless World" Dorset House, Stamford St., London, S.E.1.) Trade discount details available on application. Press Day: February, 1953 issue. Thursday, January 1st. No responsibility accepted for errors.

WARNING

Readers are warned that Government surplus components which may be offered for sale through our columns carry no manufacturers' 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

NEW, Quad tape R/replay amp, cost £32; barg. £20 details.—Box 3814. [9383

AMPLIFIERS and radio chassis built to order. TV kits built up.—Farrant Radio 70, Crescent Rd., Stonehouse, Glos. [9339

12-watt high quality amplifiers, bass and treble boost; £12/15; lists.—Broadcast & Acoustic Equipment Co., Ltd., Tombland, Norwich. [0065

AMPLIFIERS built to your specification; Williamson types a speciality.—Espee Electronic Instruments, 9, Queens Rd., Wimbledon, S.W.19. [9337

LEEVERS RICH MAINTENANCE, Ltd.—Service engineers to the recording industry; under personal direction of Bernard J. Brown; design and construction of all types of audio equipment and sound recorders.—80, Wardour St., W.1. Gerrard 4161. [0218

1953 radiogram chassis, 3-waveband, 5-valve superhet, large attractive glass dial, coloured and station-named, 5½-watt output; outstanding bargain at 12gns, incl. 10in P.M. speaker; illustrated leaflet on request; demonstrations daily at Radio Unlimited, Elm Rd., London, E.17. Tel. Key 4813. [0063

C.J.R. ELECTRICAL & ELECTRONIC DEVELOPMENT, Ltd., Bickford Rd., Witton, Birmingham, 6 (Eas. 0435), the Midlands specialist manufacturers of high fidelity sound reproduction equipment for the world-famous Williamson amplifier and associated accessories including tone control stages, loudspeaker crossover units, distortionless contrast expanders and radio feeders; send for details and prices. [0105

RECEIVERS, AMPLIFIERS—SURPLUS AND SECONDHAND

VIDOR miniature portable battery radio; £10, or offer.—Tel. Hounslow 4979. [9396

£9.—New R155 receivers.—E.W.S. Co., 69, Church Rd., Moseley, Birmingham. [9293

E.M.I. model 116 pre-amplifier and 12-watt power amplifier in mahogany finish cabinet; £12.—Box 4017. [9433

FOR sale, British receiver type R308, FM/AM, 20 to 145 mc/s, same size as R107; price £30, or offer.—Box 3841. [9389

AMPLIFIER, 25-watt Pam record player with two 10-watt speakers; £25.—Ashford, Jocks Lodge, Ewhurst, Surrey. [9456

HRO Rx's and coils in stock, also AR88, BC348R, CR100, etc.—Requirements please to R.T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0053

ECHOPHONE E.C.2 communication receiver, band spread, B.F.O. noise limiter, stand by; best offer accepted.—Apply Alford, 50, Richmond Hill Court, Richmond, Surrey. [9352

EDDYSTONE receivers, 640, 740, 750, 680, all in mint condition, £18, £30, £35, £45; wanted, Pye high-band v.h.f. radio-telephone.—G5TZ, 82, High St., Newport. Tel. 2504. [9443

LEAK TL/12 amplifier, Barker natural reproducer, both unused, Marconi receiver, 2 I.F.s separate detector, special Williamson tone control system fitted; what offers?—Box 3958. [9415

A CONNOISSEUR'S receiver, Dynatron Merlin Console, 11 valves, 4-wavebands, 9-watt output, 12in speaker, recently overhauled, cost over £125 in 1947; price £35; delivered free in London area.—Keen's, Sycamore Rd., Amersham. [9458

LOUDSPEAKERS—SURPLUS AND SECONDHAND

HARTLEY 215, £10.—Cryer, 24 Langham Pl., Northampton. [9374

HARTLEY Turner 215, as new and boxed; offers over £10.—Box 4099. [9426

GOODMAN'S, as new 12in Axiom 150 Mk. II, cost £15, accept £9, going abroad.—Box 3911. [9405

GOODMAN'S Axiom 12, £6/10; Wharfedale Super 5, £4; WBS812, 15 ohms, £1/10.—Dougharty, 68, Woodbourne Ave., S.W.16. [9442

LIMITED number of unused Baker triple cone speakers 150hms available at £5/5 12in model and £6/10 18in model; carriage paid passenger train; approximately half present prices.—Box 3532. [9330

NEW DYNAMOS, MOTORS, ETC.

BATTERY chargers, 4 models 2-6-12v, 1-2-4 amp D.C.; any mains voltage; also larger types special transformers, chokes, test gear, interior car heaters, etc.—The Banner Electric Co., Ltd., Hoddesdon, Herts [0122

ALL types of rotating electrical machinery up to 20kva available, including rotary converters, rotary transformers, motors, petrol and diesel-engined generating plants, alternators and d.c. generators. We are also in a position to quote for power transformers; as actual manufacturers we will be glad to quote for any quantity for home or export.
DIESEL Electric generating plants, 3kva, 230v with push-button remote control, starting equipment, ready for use; £255.
ROTARY transformers, input 20v d.c., outputs 6.5v d.c. and 300v d.c., permanent magnet field, 20/-; ditto, input 28v d.c. and 1,200v 70ma d.c. output; energised field, 35/-; ditto, input 12v d.c., output 500v 90ma d.c., energised fields, 35/-; reasonable delivery.
CHAS. F. WARD, Lordscroft Works, Haverhill, Suffolk. Tel. 253. [0039

THE Pearce new model diesel alternator plant, on welded steel frame, 230/1/50 3kva plus 32v 15a d.c., Petters latest AVAI, air-cooled diesel engine, alternator, self-energised, automatic voltage control by winding on stator, at govern, speed 1,500 rpm, d.c. output trickle charges or charges lighting and starter battery up to 15amps, 24v lighting is used when plant is not in use; start and stop by remote control push-button; complete with main switch and fuses, battery cables, 24v 72 amp/hr. batt, instruction book, spares; engine covered by Petters' inspection service £275, free delivery; where remote start and stop not required, but only push start on plant, reduction of £6/10; a few from stock, others quick delivery; if you collect, or we deliver, battery is charged and a 10 cu ft concrete bed given free. SEND p.c. for full description and photographs. ALSO "AUTOMATIC" start & stop plants. Water-cooled "Petters" engine.
ALTERNATORS, 230/1/50, 400VA, self energised, 3,000 rpm, ball bearing, £23/15 del.; also special television model same price; voltage regulator 30/- extra.
TELEVISION, guaranteed interference free, special rotary converters, fitted radio and television filters, wt. 60lb d.c. input, 12v 200va out, 24v, 50v, 110v d.c. to 230v out, 250va, £27/10, del.; also converters for radiogram and general use, inputs, outputs and prices as above; the above also supplied without smoothing, £24/10 del.
THE above are the latest products of British manufacture, and are guaranteed for one year, fullest details of plant, alternators or 400VA alt. or rotary converters, by return post; state which required; terms c.w.o., pro forma invoice c.o.d. (post goods only).
T. W. PEARCE, 66, Great Percy St., W.C.1 (near Angel). [0013

DYNAMOS, MOTORS, ETC.—SURPLUS AND SECONDHAND

EX-W.D. unused rotary converters, 12 and 24v d.c. input, 230v a.c. output, with choke, condenser, leak transformer, for 85watt sodium lamps, the whole enclosed in metal box, £5 to clear.—A. J. Philpott, Fountain Sq., Fenton, Stoke-on-Trent. [9160

TV without mains, picture equal to mains supply, special Chorehorse A.C./D.C. petrol electric generators, self-starting, self-contained, compact, A.C. voltage 220/250, 50/60 cycles, 250/350 watts; will also run radios, vacuum cleaners, small tools, etc.; D.C. output will charge batteries for permanent lighting.
PRICE £47/10 plus 10/- delivery.—Below.
STORAGE batteries, finest possible specification, dry, uncharged, 12v 75 a.h. heavy duty, 19 plates, separate cells, in hardwood cases, price £7/17/6 plus 9/6 delivery.
6V 90 a.h., 15 plate hard rubber cells, also suitable for cars, tractors, lorries; price £5/7/6 plus 7/6 delivery.
TEDDINGTON ENGINEERING Co., Ltd., Dept. "D," High St., Teddington, Middx. [0023

TRANSMITTING EQUIPMENT

ET4332B, BC375E, BC191, TR1143A, T1131, T1408G offered.—E.W.S. Co., 69, Church Rd., Moseley, Birmingham. [9464

RCA A.C. mains ET4336 1.5-20 mcs, £45; international marine transmitters 100Kc to 12 mcs crystal and VFO, any voltage mains, £40; Marconi crystal and VFO 1.5-9 mcs, brand new, 12-24v D.C., 100-260v A.C., £25; many others.—Marine Radio Co., 233 Wood Lane, London, W.12. [9436

NEW TEST EQUIPMENT

ECONOMICAL power units, 250v 60ma, unstabilised, variable to zero, prov.; price £16/10; early delivery; larger types to follow; send for details.—Radiovizier, 377, High Rd., N.2. [0220

TELEVISION.—A 2-valve, 2-range modulated test oscillator, 40/60 and 9/15Mcs, individually calibrated, variable output, uses external power, supplied in chassis form, with valves, wired, 75/-.—Bel Sound Products, Co., Marlborough Yard, London, N.19. Archway 5073 [0187

TEST EQUIPMENT—SURPLUS AND SECONDHAND

BRIDGE, Megger with Varley test, excellent condition; £12.—Box 3598. [9344

COSSOR 1035 oscillograph and 1428 camera, as new; nearest offer £85, trial.—Moss, 232, Peppard Rd., Reading. [9419

VARIACS (100L), 230v/0/230v 8 amps, brand new cond., £16/10 ea., carr. paid.—P. B. Crawshay, 166, Pixmore Way, Letchworth, Herts. [0240

BRIDGE-MEGGERS by E. & V., Ltd., .01ohm to 50 megohms, self-contained, 250v. accuracy tested; each, in leather case, £21.—P. B. Crawshay, 166, Pixmore Way, Letchworth, Herts. [0239

SIGNAL generators, oscilloscopes, output meters, valve voltmeters, frequency meters, multi-range meters in stock; your enquiries are invited.—Requirements to R.T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0086

TEST sets: IE19A, TS34, TS10A/APN, TS238; Du-Mont oscilloscopes, types 168 and 208, also oil-filled electrostatic condenser, 2250F, 25,000 volts D.C.; also H.F. alternators, 80 volts, 25 amps, 1,500 c.p.s.—E.W.S. Co., 69, Church Rd., Moseley, Birmingham. [9292

NEW GRAMOPHONE AND SOUND EQUIPMENT

TAPE recorder motors, 230v. a.c., powerful, quiet, brand new, 13/11; post, etc., 1/1.—K. W. Logan, Westalley, Hitchin, Herts. [0232

BRAND new high quality radiogram, separate bass and treble amplifiers and speakers, automatic record changer, beautiful walnut cab.net; price 70gns.—29, Chaffinch Rd., Beckenham. [9432

MAGNETIC tape recordings heads, complete with tape guide, Mu. metal screened, single pin fixing, 22/6, postage 1/-; why pay more; trade enquiries invited.—E.M. Developments, 50, Grove Lane, Handsworth, Birmingham. [9276

PRECISION made tape desks, 3-3/4in/7-1/2in p.s., double track fast rewind, guaranteed reliability and wow-free operation, assembled desk, £19; easily assembled kits supplied, constructional drawings, high fidelity amplifier; stamp list; GM6LS.—15, Corstorphine Hill Rd., Edinburgh. [9462

TAPE recorder (Unitbilt), pars.; power-drive unit H.D. fan-cooled motor, heavy balanced flywheel, in special bearings mounted in cast alloy frames, 3-hole fixing to panel front speed change 3¾-7½in sec, £6 delivered, plus £1 deposit on packing; control head unit 1-hole fixing cam unit interlocked for motor, stop, rewind, etc., 55/-; pot core oscil.ator coil, with tags, 10/-.
ALSO equaliser pre-amps with EF40, amplifier parts, complete amps; s.a.e. for leaflets.—MIDLAND Radio Coil Products, 28, Winstanley Rd., Wellingborough. [0224

POLLOCK lightweight m/c pick-up, response 40cs to 20kc/s, h.f resonance 25kc/s approx.; complete set of parts for constructing head, 25/-, plus 1/- post and packing; building instructions, 5/-; sapphire stylus .001in or .0025in, 7/6; model also for thorns; 100:1 input transformer, steel case, 20/-, plus 1/- post, etc. —S.a.e. for details to A. M. Pollock, 31, Brooklawn Drive, Manchester, 20. [9368

A FEW Wearite decks available from stock, £35; Vortexion Super 50 amp., £25; Ferrograph tape recorder, complete with ribbon mike and carrying case, just released, £94/10; Emicorda (tape), just received, 90gns; Cossor 10in Console, tube o.k., needs slight attention, £17/10, Viewmaster, complete in cabinet with brand new G.E.C. tube, £35; Goodmans Audium Loudspeaker, £8; Wharfedale Super 8 CSAL, £5. —Rex Radio, 329, Kilburn Lane, W.9. Ladbroke 1770. [9459

GRAMOPHONE AND SOUND EQUIPMENT —SURPLUS AND SECONDHAND

COLLARO 3-speed record changer, 3RC511 c/w two GP27 Hi-Fi heads, 78 and l.p., perfect, cost £18 14s; accept £12.—Box 3842. [9390

VOIGT corner speaker, £16; two recording amplifiers, £15, £20; Vortexion AD47, £22. —8, Hinde St., Manchester Sq., W.1. Wel. 3762, 9.30 a.m.-5.30 p.m. [9449

16MM sound projectors, G.B.L516 and B.T.H. SRB, in excellent condition, complete with valve spares, splicers, record players, etc.; best offer.—Coyle, 11, Hydeway, Hayes, Middx. [9451

M.S.S. portable disc recorder, £40; Leak amplifier matched for above, £32; Vitavox microphone and stand, £10; Wearite tape deck, £28; all guaranteed perfect.—Box 3513. [9309

VOIGT gramophone pick-up and corrector £4; Barker 148a speaker, £12; Baker speaker, £4; Hartley Turner (medium and long) 2HF and detector with circuit handbook, all good condition at above prices or near offers.—Box 3889.

COMPLETE public address system, 25 watts, twin turntables, auditorium and projector speakers, Cross-over network; microphones; portable generator; demonstration.—Ing. 36, Sunny Gardens Rd., N.W.4. Hendon 8583.

QUALTAPE deck, £13/13; S.T.C ball mike, £5/10; Cossor ganging oscillator, £10; Avo valve tester, £10; Avo characteristic valve tester, £35; Ekco pattern TV generator, £10.—Rex Radio, 329, Kilburn Lane, W.9. Ladbroke 1770.

MAGNETIC recorders; all types of magnetic recorders bought, sold, hired and exchanged; comprehensive repair service; mechanical and electronic repairs carried out by specialists; Magnegraph Limpet telephone pick-ups, 25/-.
THE MAGNEGRAPH RENTALS Co., 1, Hanway Place, Oxford St., W.1. [0236

BARGAIN, Recorder (disc) and playback amplifier, absolutely complete in cabinet, professional job, 78 or 33⅓ r.p.m.; inspection invited. Tel. 61635; must sell £35 cash or £12/10 dep. and 52 weekly payments of 10/9.—East Reading Radio, 1, Rupert St., Reading. [9421

PUBLIC address equipment, Phillips type 2857(R), quarter kilowatt output, microphone, record player, twenty 8in loudspeakers and two unused DA 100 output valves; cost £250; bargain at £120.—Electrical Officer (Radio), R.N.A.S. Ford, Arundel, Sussex. Tel. Littlehampton 720. [9412

WORK WANTED

ASSEMBLY, wiring, special equipt.; audio specialist; private or trade.—Radiovizier, 377, High Rd., N.2. [0219

AMPLIFIER manufacturers, specializing in contract work, will have some available capacity for repetitive work from 5 to 50 per week.—Enquiries to Box 4025. [9441

NEW COMPONENTS

SELENIUM rectifiers, 18mm and 25mm, single or qty., many types, state requirements.—Champion Products, 43, Uplands Way, London, N.21. Lab. 4457. [0102

NEW 3-waveband (long, medium, short) superhet coilpacks, 465 Kc/s Osc. Freq. Prealigned 32/6 each; 465 Kc/s I.F. transformers, 15/- pr; trade supplied.—Post orders only please to J. Simpkins, 19, South Molton St., London, W.1.

CRYSTAL microphone inserts (Cosmocord Mic. 6) guaranteed brand new, 15/6 post free; Cosmocord Mic. 30 hand stand microphones, black or white, £4/4 each post free.—Radio-Aid, Ltd. (Retail Dept.), 29, Market St., Watford. [0036

WINDING capacity for all laboratory and production work, including std TV coils, radar deflectors, filter parts and complete, subminiature assemblies, toroidal and strip potentiometer elements, transductors, current transformers.—Bel Sound Products Co., Marlborough Yard, London, N.19. Tel. Arc. 5078. [0183

FM receiver (Oct., '52), following VHF-tested components, coilsets, with diodes and included components, 75/-; new BTH Xtal vlvs., separately, 15/- pair; 6AM6, 6AK5 vlvs. 28/- pair; above plus drilled chassis 100/-; trade invited.—Bel, Mfg. Radio Engrs., Marlborough Yard, London, N.19. Arc. 5078. [0184

COULPHONE RADIO.—As a result of the continued requests for components from all parts of the world the proprietor has decided to restart the business, new goods only, no government or manufacturer's surplus; s.a.e. will bring you a most comprehensive list of radio and television components.—Coulphone Radio, 18, Roper St., Whitehaven, Cumberland. [9366

FOR really good results you can do no better than use Osmor coils and coilpacks, ask anyone of experience! Send 5d (stamps) today for beautifully-drawn free circuits, our new coil-data leaflet, and latest lists of matched radio components. A speedy mail order department is at your service, and remember, all Osmor lines are guaranteed. (Trade enquiries invited.) Dept. C.W.1.
OSMOR RADIO PRODUCTS, Ltd., Bridge View Works, Borough Hill, Croydon Tel. Croydon 5148-9. [0046

MALDEN TRANSFORMER SUPPLIES offers 80W fluorescent chokes, 230v with circuit, 17/6; glow starters, 2/6; 6 and 12v metal rectifiers, 2 amp, 8/6, ½ wave, 250v 300 mili-amp, 13/6, supplied to any specification; ex-Government safety heaters 230v 350W, 12/6; rotary converters, 12v or 24v d.c. input and giving 250v 60 mili-amp and 6.3v at 2.5 amp, 6/8; speaker cases, 5in, bakelite, 5/8.—200, Cambridge Rd., Kingston-on-Thames. Kin. 5501. [0056

TELEVISION. ¾×2½in cored tagged TV formers, 6 for 12/6 or 2/3 ea.; coilsets on above, 5-channel s'het, (12 pc.), 60/-; TRF (PT AC/DC), 50/-; ¼in and ⅜in cored tagged formers, 8/- and 12/- doz.; EF42, EF41, set of 2 ea, with V/H, 85/-; T901 metal CRT, few always stocked, callers preferred; ¾ and ½in OD pax tube, 2/6 per 18in; OBA brass rod, 1/6 ft; Belsol polsterene cement, 10/- pint; the Synchrolock (RCA), intermediate AFC cct, locks linescan with sync., independence from noise, sync. amplitude, this 3 vlv, addition, very worthwhile, special transf. and cct, 55/- (refer VPT Sept., '52); test oscillator, 2-valve chassis, calibrated, 75/- (see "test equipment"); all new, guaranteed goods and trade supplied, approval, terms, and made by—Bel Sound Products Co, Marlborough Yard, London, N.19. Archway 5078. [0186

COMPONENTS—SURPLUS AND SECONDHAND

G. A. RYALL, "Utopia," Mayfield Road Herne Bay, Kent, offers brand new post-free bargains; switches; 2B.SP, 6-way, no stop switch is drilled for this, 1/4; smaller type switch, 3B, TP, 6-way, total five poles only 2/3; also 2B, 3P 3-way with coloured leads, 1/4; one type 2Bank, 4-way five poles total, soldered tags, 1/4, Toggles Bakelite, 250v a.c., close either of two poles, 1/3; and 2P, DT, change over 1/9; all single hole fixing; and Bakelite panel switch marked On/Off, break 10amps, four-hole fixing, 2/6; voltmeters, best make 0-5ma square front 2in meters, 8/9 each; and 0-30ma 2¼in (3¼in overall) 6/9, or best make, 8/9; signal lamps, panel mtg, red or green, with 12-24v bulb brass case and bakelite top with protection 1/6 each; Twin light cable over 3yds length, 1/4, plastic; screened twin, 2yds, in two lengths, 1/4; triple plugs and jacks, 1/4 set; Mansbridge condensers, fixing feet, heavy duty terminals, 250v N.I., 5×3 4/9; ditto oil filled 11×7, 8/9; extra heavy terminals at side; first-class Bakelite fuse boxes, four-way, with two spare fuses, 5 amp cartridge, 5/9, small single 20 amp or 10amp, with spare, 2/6; set four panels with over thirty ¼, ½, 1/2, watt resistors, 3/6; and high grade panel with fixing bolts, 0.1mf and 4,700lw resistor and two ¼w, 2 1/3; 1mf Mansbridge, upright or inverted 2 1/3; radio mains suppressor units, four-division, fixing feet terminals, etc., 7/9; headphone sets high resistance, complete with padded headbands, sponge rubbers on ear caps, and good class microphone, all wired into four cleft plug as illustrated in R.A.F adverts, as new, 8/9 set; meters scaled 0-300v F.S.D. 5ma and 0-5ma, both types slightly defective and suitable for low current continuity meters, no series res., with v/m, square front bakelite 4/9 each [0205

RADIO CLEARANCE, Ltd., 27, Tottenham Court Rd., London, W.1.

SPECIAL offer of electrolytic condensers, capacity, voltage, size, type of mounting, price post paid, in that order.—400, 6v, 1in×2in, lug, 2/6; 250+250, 6v, 1in×2in, lug, 2/6; 500+500, 6v, 1in×3in, lug, 2/6; 1,500, 1in×3in, clip, 3/-; 30+50, 150v, 1⅛in×2in, clip, 3/3; 40+40 150v, 1⅛in×2in, clip, 3/3; 40, 150v, 1in×2in, clip, 2/6; 20+20, 275v, 1in×2in, lug, 4/-; 16+32, 275v, 1in×2in, lug, 4/-; 16+16, 275v, 1in×2in, clip, 4/-; 32+32, 275v+50mf, 25v, 1in×3in, lug, 4/6; 60+100, 275v, 1⅜in×3in, lug, 5/6; 100, 275v, 1¾in×2in, clip, 3/9; 50 350v 1⅛in×2in, clip, 3/6; 32×12, 350v, 1⅜in×2in, clip, 4/9; 16+16+16, 350v, 1⅜in×2in, clip, 5/3; 40+40+20, 350v, 1⅜in×3in, lug, 5/3; 16, 350v, ¾in×2in, lug, 2/3; 40+40, 300v, 1in×3in, lug, 4/6; 10, 450v, ⅝in×2in, lug, 2/-; 16, 450v, ⅞in×2in, 3/3; 20, 450v, 1in×2in, lug, 3/3; 32, 450v 1⅛in×2in, clip, 4/-; 24+12, 450v, 1⅜in×2in, clip, 5/3; 16+16, 450, 1⅜in×2in, clip, 5/6; 32+32, 450v, 1⅜in×3in, clip, 6/-; 30+30, 450v+20mf 25v 1⅜in×3in, lug, 6/-; 15+15, 450v+20mf 25v 1⅛in×3in, lug, 5/3; 200mf, 6v, ⅝in×1⅝in, clip, 2/3; 100mf, 12v, ⅝in×1¾in, wire, 1/9; 1,000mf, 6v, ⅞in×2in, clip, 2/6; 8mf, 450v, 1in×2in, clip, 2/3; 50mf, 12v, ⅜in×1⅝in, wire, 1/9; 150mf, 25v, ⅜in×1⅝in, clip, 2/-; 250mf, 12v, ⅜in×1⅝in, wire, 2/6; 350mf, 25v, 1in×2¼in, clip, 2/9; 16+16mf, 450v, 1⅛in×2in, clip, 4/3; 40+40mf, 275v, 1⅜in×2in, clip, 3/9; 16+32mf, 450/525v, 1⅜×2in, clip, 5/6; 24+24+16mf, 350/425v, 1⅜×2in, clip, 4/9; 60+200mf, 275/350v, 1¾×4½in, clip, 6/6; 24+16+8mf, 450v, 1⅜in×2in, clip, 6/-; 1,000mf, 12v, 1in×2¼in, clip, 3/-; 4mf, 150v, ⅜in×1¾in, 1/-; 60+100mf, 350v, 1⅜in×4½in, clip, 6/6; 500mf, 12v, 1⅜in×2¾in, clip, 2/9; 8mf, 350v, ⅜in×2in, 2/-; 6,000mf, 6v, 1⅜in×3½in, clip, 4/-; all are all. cans. some with cardboard sleeves, all voltages are WKG, all new stock, some limited quantities. Trade supplied most types.

TELEVISION! Set of 3 components, comprising line output trans., with E.H.T. winding to give 7kV, using EY51 (heater winding for EY51 also included), and fitted with width control scanning coils, low impedance line and frame, focus coil (res. 10,000Ω, current approx. 20 mA); the set of 3 for 42/-, plus 1/6 post, diagram of line trans. supplied.

PERSONAL receivers, 3 valve T.R.F. using IT4s, contained in handsome bakelite case with lift-up lid, size 7×6½×5in with lid closed, plastic carrying handle, fram. AE in lid, these receivers cover the medium waveband and operate from self-contained dry batts., standard types, W1435 and U2, output to a pair of lightweight 'phones (H.R.) controls, SM tuning and reaction, opening lid switches on, supplied brand new, with valves, batteries, 'phones, an ideal set for invalids, hosp. patients, etc., these receivers are not Govt. surplus and are offered ready to play; carr. paid; £4/10.

CHASSIS steel, 5¼×5¼×1½in drilled 3 button base holes, 1/9; primary 0-110-210/240v 50c/s, secs 300-0-300 80ma, 4v 2a, 6.3v, 2.5v, 15/6; superhet coils 1½×1¾, formers M. wave H.F. AE, Osc. L. wave H.F., AE, Osc, 1/9 per coil; I.F. trans. 465kc/s 1¾×1½×4in. iron cored, 8/- pair; meters 2in square, bakelite case, 0/5ma, 6/6; Rotary power units, type 104 p.m. rotary mounted on chassis with supp. input 12v d.c. output, 250v 60ma 6:5v, 2.5a, d.c. 7/6, type 87 24v input, outputs as 104, 7/- post paid; plugs and sockets, bakelite with keyway, 5, 7, 1/6 pair; focus coils, low res., 200Ω, standard TV, 8/6, can be had as alternative with kit if required; 6½in loudspeakers p.m., less trans., boxed, 13/6 post paid.

STANDARD Yaxley-type switches, 2¼in spindle, 4P 3w, 2/9; 2¼in spindle, small size, 465kc/s I.F.s iron cored, 2½in×1in×1¼in, 9/- pair; 6¼in P.M. speakers, with transformer (5,000/3Ω), 16/6 post paid; small size O.P. trans., 10,000/3Ω, 2/11.

VITREOUS res., 5k 20w, ⅝in×3in, with clips, 1/6; carbon V.C. 10k small L/S, 3in spindle, 1/9.

E.H.T. trans. pri. 230v, 50c sec, 4,000v, 1ma, 2v, 2a, with U22 valve holder mounted, gives 5,500v, smoothed; 27/6, post paid.

RADIO CLEARANCE, Ltd., 27, Tottenham Court Rd., London, W.1. Tel. Museum 9182. [0015

124 only switches, Wright & Weaire type 210 2-pole, 5-way, non-shorting; free length on ¼in diameter spindle=¾in; length on threaded bush ¾in, unused; offers to.—Box 3848. [9397

SAVE pounds, send for free list to-day; really amazing bargains; guaranteed goods.—Annakin, 25, Ashfield Place, Otley, Yorks. [9450

500 moving coil meters 3¼in diameter calibrated 0-200 ma; basic movement approximately 8 ma; new and unused; £250 the lot.—Box 3686. [9363

MAGSLIP transmitters 3in, No. 5, A.P.10861, large quantity, brand new, in tins; 45/- ea., post free.—P. B. Crawshay, 166, Pixmore Way, Letchworth, Herts. [0241

LOOK!—Plan position indicators containing 17 valves—2 VT60A (807), KTZ41, 2 DDL4, MH4, VR78, 7 VR65A. HVR2, 2 UU4, large 230/1/50 power pack giving 300/0/300v (twice), 6.3v, 2/0/2v, 4v (twice), 4,000v EHT (approx.), M type motor with reduction gearing (worm and spur), scanning coils with slip-rings, large quantity of other parts, including 22 toroidal, WW, and other pots, 24 Mansbridge condensers (11-10mfd 450v and others up to 5,000v), switches, 8 knobs (fluted), 14 jacks, fuses micro-switch, dial light, 70 vitreous and other resistances and condensers, etc.; the whole mounted in handsome heavy gauge steel cabinet, 20½in×27in×60in high, finished in black, with hinged doors and plated handles; price (unused), £8/15 each carr. paid (cabinet alone worth more).—K. M. Logan, Westally, Hitchin, Herts. [0238

RADIO UNLIMITED, Elm Rd., London, E.17.

SELECTED bargains: Miniature 3-wave coil-packs with circuit, 32/6; P.M. spkrs., 3in 11/6, 5in 12/6, 6in 12/6, 10in 19/6, stnd. o/trans., 3/11; p/pull, 5/9; mains trans., 350-0-350, 6v, 5v, 4v, 4v, 80ma, 22/6; t.r.f. coils, w/reac., 5/9 pr.; stnd. 465 kc/s I.F. trans., 9/6 pair; X/tal diodes, W/circ., 3/-; droppers, .2 and .3, 4/6; volume cntrls., all values, 3/-; SP/sw, 4/3; special offer, 500K, 100K, 47K, DP/sw, 4/6; electrolytics, fresh stock, 450 vw 8mf, 2/-, 16 3/-, 8×8 3/-, 8×16 4/3, 16×16 4/6, 32×32 5/3, 500 vw, 8mf 2/6, 16 3/9, 32 4/9, 8×8 4/-; bias, 25/25 1/6, 50/50 1/9; new list, 1½d. stamp.
RADIO UNLIMITED, Elm Rd., London, E.17. Tel. Key 4813. [0062

MAGSLIPS at 1/10 to 1/20 of list prices, huge stocks, please state requirements. K. LOGAN, Westaliey, Hitchin, Herts. [0233

SEE our displayed advertisement on page 110 for surplus bargains.—Radio Exchange, Bedford. [0012

NOTICES

BRITISH SOUND RECORDING ASSOCIATION.
MEMBERSHIP is essential to all actively engaged or interested in really high quality sound recording and reproduction and is world wide. Fees are most reasonable and benefits considerable. First-class programmes of lectures and demonstrations have been arranged for the 1952-53 season and the new Northern Centre, meeting in Manchester, is making very good progress. The Portsmouth Centre is now well established. Information may be obtained from the Membership Secretary, H. King, 48, Mount View Rd., North Chingford, London, E.4, England. [0119

CABINETS

WALNUT radiogram cabinets; details.—Cabinetware, 1a, Heyes St., Blackburn. [0091

WALNUT radiogram cabinets, stamp details. —E. Wisker, 501, Hale End Rd., Highams Park, E.4. [9427

WALNUT radiogram and television cabinets, soundly constructed, stamp details.—R. Shaw, 69, Fairlop Rd., Leytonstone, E.11. [8897

WANTED, EXCHANGE, ETC.

WANTED.
BC610 Hallicrafters, also spares; RCA ET 4336 series with spares; BC348 receivers, also TCS6, TCS12 and components.
McELROY ADAMS MFG. GROUP, Ltd., 46, Greyhound Rd., W.6. Tel. Fulham 1138-9. [0194

WANTED, receivers A.P.R.4, also T.N. 16, 17, 18, 19, etc., and any radio test gear.
LESLIE DIXON & Co., 214, Queenstown Rd., Battersea, S.W.8. Macaulay 2159. [0176

WANTED, 2 R.I. micron inductance coils.—Deadman, 6, Abingdon Rd., Kensington, W.8. [9410

VALVES, type 813 (R.C.A.), urgently required by manufacturing concern.—Box 1642. [8892

WANTED, general purpose coil winder, wave winder, motor and accessories; details to—Box 4098. [9425

WANTED, quantity valves, type 805 and 866A, 805 must be either R.C.A. or G.E. manufacture.—Box 8783. [8765

WANTED, RCA 4551 transmitters.—P.C.A. Radio, Cambridge Grove, Hammersmith W.6. Tel. Riverside 3279. [0093

WANTED, Cossor oscilloscopes, type 339 or 3339, state condition and price.—Ritson, Red Lion House, Hexham. [9394

WANTED, second-hand Ferrograph tape recording machine.—A. O. Watkin, 116, Shortmead St., Biggleswade, Beds. [9395

1155N, Eddystones, marine receivers, any Marconi transmitters, TV5, etc.—Marine Radio Co., 233, Wood Lane, London, W.12. [9435

WANTED, laboratory test equipment, including standard signal generator, watt meter, oscilloscope, bridges, recorders; send price and details to:
HATFIELD INSTRUMENTS, 175, Uxbridge Rd., Hanwell, W.7. Tel. Ealing 0779. [0037

WANTED, HRO coils, Rxs, etc., A.R.88s, BC348s, S27s, etc.—Details to R.T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0163

WANTED set manufacturers' or ex-Government radio equipment, large or small quantities of valves, electrolytics, speakers, meters, also components.
LOWE BROS., 199, Mile End Rd., London, E.1 Ste. 2579. [6554

WANTED, VCR139, a tube holder and screen in indicator type 87, reference 10QB/176, with or without tube.—R.E.P. Ltd., 33, Much Park St., Coventry. [9367

WANTED.—EC-610 Hallicrafters, R.C.A. ET-4336 transmitters, 5X-28, AR-88, 6-27 H.R.P. receivers and spare parts for above; best prices.—P.C.A. Radio, The Arches, Cambridge Grove, W.6. [0081

SCR 536 Handie Talkie (also known as BC 611 transmitter receiver) spare parts wanted, including cases, top and bottom lids, microphones, earphones, crystals and coils.—Details to Box 3520. [8525

ALTHAM RADIO Co. pay highest prices in the trade for all American equipment, including test sets, transmitters, receivers, teleprinting gear, etc.—Tel. transfer charge, Manchester, Deansgate 5387. [0228

WE purchase all types of domestic or ex-Government radio receivers and equipment; send full details or call and collect cash; large or small quantities.—Walton's Wireless Stores, 48, Stafford St., Wolverhampton. [0116

WANTED.—R.C.A. speech amplifiers, type MI-11220 J or K and Ariel tuning units BC939A; Hallicrafters speech amplifiers BC614; owners stating quantity and price to P.C.A. Radio, The Arches, Cambridge Grove, W.6. [0080

WANTED, AN/APR-4 receiver, any units; any other good quality U.S. surplus radio and radar tubes, test sets; laboratory equipments, etc.; give condition and price in first letter.—Engineering Associates, 434, Patterson Rd., Dayton, 9, Ohio, U.S.A. [0234

WANTED, good quality communication rxs., domestic radios, test equipment, etc.; top prices paid; established since 1937.—Miller's Radio, 38a, Newport Court, 1 min. from Leicester Sq. Tube. Tel. Ger. 4638. Call, write or send. Hours of business 10-6 p.m. Open all day Saturday. [9147

WANTED; we will pay 10% more for the following American equipment; test sets with TS prefix, BC221, APR4 receivers, APR4 tuning units, BC342, BC312, power units No. 15 and PE98, teleprinter equipment.—Tel. immediately, transfer charge, Manchester, Deansgate 5387. Altham Radio Co. [0227

WANTED, new surplus valves of all descriptions, large or small quantities, types 723A/B, 805, 807, 813, 832, 100th, 250th, 2C40, 2C43, test instruments receivers, transmitters, BC610, etc., best prices paid.—Write Pype-Hayes Radio, 606, Kingsbury Rd., Birmingham, 24. (Phone: Erdington 4942.) [8811

WANTED, crystals IN23, CV253, CS3A, 100kc 3-pin; tubes 2AP1, EF50, 807, 829, 6AC7, 6AG7, VR150/30 2X2, IB24, 723A/B; any 3 cm parts, Cannon plugs, screened sleeving or multi-core flex up to 1in dia., 1155N unmodified, acoustical amplifier; sale B.B.C. recorder, £12.—33, Abbey Rd., Grimsby. [9428

URGENTLY wanted.—VHF test equipment TS47AP, TS174U, TS34, TS148/UP, TSX-4SE, BC221s and any other types; valves, klystrons, magnetrons 723/AB, receivers, APR4 and TN-16-17-18 tuning units, RCA, AR88s, S27s, SX28s, S27CA and any late types; microwave equipment or spares; highest prices given; please write, call or telephone Gerrard 8410; prompt attention assured.—Universal Electronics, 27, Lisle St., Leicester Square, London, W.C.2. [0219

REPAIRS AND SERVICE

ARMATURE Re-winding Service to the Trade. VACUUMS, drills, grinders, hood dryers, dental motors, vacuum cleaner armatures replaced from stock; 24-hour service; every job guaranteed; all vacuum cleaner parts, hoses, etc., in stock for any make.
REGAM ELECTRIC, 95, Park Lane, Leeds, 1. [0221

MAINS transformers rewound, new transformers to any specification.
MOTOR rewinds and complete overhauls; first-class workmanship, fully guaranteed.
F.M. ELECTRIC Co., Ltd., Potters Bldgs., Warser Gate, Nottingham. Est. 1917. Tel. 3855 [0113

OUR speciality, amplifier repairs.—Send, Parrant Radio, 70, Crescent Rd., Stonehouse, Glos. [9340

REPAIRS.—E.H.T. mains and O.P. transformers, field coils and chokes; also armatures and motors; new transformers designed to any specification; all work fully guaranteed.
WILLESDEN TRANSFORMER Co., Ltd., Rear of 21, Church Lane, Church Rd., N.W.10. Tel. Willesden 7093. [0076

MAINS transformers rewound or constructed to any specification; prompt delivery.—Bede Transformer Co. Ltd., Bedeswaý, Bede Trading Estate, Jarrow. [3198

CAPACITY available for assembly and wiring, also reconditioning radio transmitter receiver equipments and units all types, amplifiers, etc.; South London area.—Write Box 4023. [9438

ELECTRICAL test instruments repaired and standardised all types British or American, ammeters, voltmeters, ohmmeters, DC/AC multirange meters, etc. Meters converted to specification.
THE ELECTRICAL INSTRUMENT REPAIR SERVICE, 329, Kilburn Lane, London, W.9. Tel. Lad. 4168. [9175

ALL types of transformers, chokes and field coils for radio and television, etc.; promptly and efficiently rewound or manufactured to any specification.—Ladbroke Re-wind Service, Ltd., 34, Rainham Rd., Kensal Rise, N.W.10. [0222

LEEVERS RICH MAINTENANCE, Ltd.—Service engineers to the recording industry; under personal direction of Bernard J. Brown; modification or repair of all types of audio equipment and sound recorders.—80, Wardour St., W.1. Gerrard 4161. [0217

24-HOUR service, 6 months' guarantee, any transformer; rewind, mains outputs and i.f.s., etc.; all types of new trans., etc., supplied to specification; business heading or service card for trade prices.—Majestic Winding Co., 180, Windham Rd., Bournemouth. [6520

MISCELLANEOUS

METALWORK, all types cabinets, chassis, racks, etc., to your own specifications.
PHILPOTT'S METAL WORKS, Ltd. (G4B1), Chapman St., Loughborough. [0208

WESTINGHOUSE metal rectifier battery charger, £10; radiometer valve tester, bridge, data books, £8.—26, Eastwood Rd., Rayleigh, Essex. [9429

FOR sale.—One second-hand Marconi telegraph/telephone equipment type TGS 501A/CR100/2 complete with six sets additional frequency components.—Detail and inspection, apply Colonial Development Corporation, 33, Dover St., W.1. [9200

DICTAPHONES, 1 mains operated, £7/10; 1 spring operated, £6; both with headphones. Wax cylinder skimmer, precision job, 50/-, quick sale.—East Reading Radio, 1, Rupert St., Reading. Tel. 61635. [9422

ALLSCREWS, Ltd., for B.A. screws, nuts, washers, studding, grub-screws, bolts, soldering tags, woodscrews, etc., plain or nickel or cadmium plated, one-gross packets or large quantities; stamp for lists.—270a, King St., Hammersmith, W.6. Riv. 7762. [0225

DECALS, the modern method of marking panels, controls, etc., in book form, each book containing approx. 500 words and abbreviations, etc., covering every aspect of electronics, price 4/9 and 3d postage.—Alexander Equipment, Ltd., Child's Place, Earls Court, S.W.5. [0243

ENGRAVING amateurs and trade could take the opportunity of engraving problems in the future by getting in touch with A.G. Engraving, 19a, Windmill Rd., London, S.W.18. Bat. 5793. Brass, bronze, erinoid, Perspex dials; one knob or repetition equally retained. [0034

COPPER wires enamelled, tinned, Litz, cotton, silk covered, all gauges; B.A. screws, nuts, washers, soldering tags, eyelets, ebonite and laminated bakelite panels, tubes coil formers; Tufnol rod; headphones, flexes, etc.; latest radio publications, full range available; list, s.a.e.; trade supplied.—Post Radio Supplies, 33, Bourne Gardens, London, E.4. [0138

LOUDSPEAKERS, P.A. twin moulded horn, Parmeko Admiralty type, new, 75/- each; Tannoy Military type, 17/6 each; Bendix transmitters TA-12C, £10 each; receivers RA-10, £10 each; radio compass receivers, MN-26, £12/10; Magslip Hunters, 3-inch, 12/6 each; transmitters, 3-inch, 20/- each; Canadian type 58 Walkie-Talkie sets, £15; 5-line switchboards, terminal boxes, teleprinter keyboard perforators, re-perforators, morse tape printers, smoothing units, filters, line carrier units; all in new condition.—R. Gilfillan & Co., 52, South St., Worthing. Tel. Worthing 8719. [9430

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 *or a woman aged* 18-59 *inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order* 1952.

RESEARCH.

A TYNESIDE engineering establishment has openings for electronic engineers on design, development and maintenance of electronic instruments and control gear.

CANDIDATES should have degree or equivalent and experience.

GIVE full details education, experience, etc.—Write Box 3734. [9371

SILVER CITY AIRWAYS. Ltd.

INVITE applications for positions as ground radio engineers from experienced persons keen to return to the aviation industry.—Blackbushe Airport, Camberley, Surrey. [9331

CROWN Agents for the Colonies.

WIRELESS Station Superintendent (Temporary) required by the Gold Coast Government Posts and Telegraphs Department for two tours of 18 to 24 months in the first instance. Commencing salary, according to qualifications and experience in the consolidated scale £955 rising to £1,180 a year, with gratuity of £25 or £37/10 according to salary for each completed period of three months' service. Outfit allowance £60. Liberal leave on full salary. Free passages. Candidates must possess a Higher National Certificate in Electrical Engineering or equivalent, and have had practical experience in two or more of the following fields: V.H.F. link systems, H.F. communication network; Frequency shift keying and teleprinter maintenance; V.H.F. and H.F. Direction finding systems; Aeronautical navigation aids (ground); manufacture of light engineering equipment. Apply at once by letter, stating age, full names in block letters, 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 on letter M.29100.B. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. [9338

CROWN AGENTS FOR THE COLONIES.

RADIO officer required by Nigeria Government Posts and Telegraphs Department for one tour of 18-24 months in the first instance with prospect of permanency. Commencing salary in scale £750 rising to £1,175 a year (including expatriation pay). Outfit allowance £60. Free passages for officer and wife and assistance towards cost of children's passages or their maintenance in this country. Liberal leave on full salary. Candidates must possess a Postmaster-General's Certificate in Radio Telegraphy, or an Air-Operator's Certificate or an equivalent Service qualification. They must have a thorough grounding in I.C.A.O. codes and procedures and have had recent experience with an administration or air operating company outside West Africa in operating wireless and direction finding ground stations for air services. Apply at once by letter, stating age, full names in block letters, 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 on letter M.29270.B. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. [9356

CROWN AGENTS FOR THE COLONIES.

ASSISTANT signals officer required by the Government of Nigeria for the aviation department for one tour of 18 to 24 months in the first instance. Commencing salary (including allowances) according to qualifications and experience, either (a) in scale £750 rising to £1,515 a year, with the prospect of permanency; or (b) in scale £807 rising to £1,453 a year, on a temporary basis with gratuity of £25 for each period of three months' satisfactory service. Outfit allowance £60. Free passages for officer and wife, and assistance towards cost of children's passages, or their maintenance in the United Kingdom. Liberal leave on full salary. Candidates must be Associate Members of the Institute of British Radio Engineers, or possess City and Guilds certificates in radio communication, or technical electricity, or a satisfactory pass in the Ministry of Civil Aviation Radio Mechanics course. APPLY at once by letter, stating age, full names in block letters, 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 on letter M.29637/G. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. [9455

ADMIRALTY.—Royal Naval Scientific Service. ENGINEERS and Physicists (particularly with electronics) required for appointments in (a) Senior Scientific Officer and Scientific Officer grades (Ref. A246/52A) and (b) Senior Experimental Officer, Experimental Officer and Assistant Experimental Officer grades (Ref. A247/52A) in Experimental Establishments in London, Portsmouth, Weymouth areas and Scotland. Candidates, British subjects, for (a) must possess first- or second-class honours degree in Physics of Engineering, or high professional attainments such as corporate membership of appropriate professional institution with suitable experience and responsibility and for (b) should possess one of the following qualifications: University degree in Science, Engineering or Mathematics, Graduate membership of appropriate professional institution, Higher National Certificate, Final certificate of five-year grouped course in relevant subject at City & Guilds of London Institute or comparable institution, Higher School Certificate with Mathematics or Science as principal subject or equivalent qualification. S.S.O.s at least 26 years of age with at least three years' approved experience, London salary scale (men) £750-£950 per annum; S.O.s at least 21 years £400-£650; S.E.O.s at least 35 years £780-£1,000; E.O.s at least 26 years £575-£725; A.E.O.s at least 17½ years £250-£535. Rates for women and posts in Provinces somewhat lower. Starting salaries above minima may be granted according to age and experience. Salaries carry pay addition of approximately 10% on the first £500 plus 5% on second £500. All appointments unestablished (with F.S.S.U. for S.S.O. and S.O.) but with some opportunities to compete for established posts. Application forms, etc., from M. of L. & N.S. Technical and Scientific Register (K), Almack House, 26, King St., London, S.W.1, quoting appropriate reference. [9373

KINGSTON UPON HULL EDUCATION AUTHORITY.
MUNICIPAL TECHNICAL COLLEGE.
PRINCIPAL: Emlyn Jones, M.Sc., F.R.I.C.
REQUIRED, to commence duty in April, 1953. Teacher (Assistant Grade B) for Radar and electronic engineering. Applicants must possess the Ministry of Transport Radar Maintenance Certificate or an equivalent qualification. Considerable practical experience in marine radar engineering is essential and applicants should preferably have had teaching experience. The person appointed will be required to conduct correspondence courses as part of the normal teaching duties.
SALARY: £490×£25—£765 per annum, plus additions for training and/or graduate qualifications.
FURTHER particulars and application forms, to be returned within 14 days of the date of this issue, will be supplied by the Chief Education Officer, Guildhall, Kingston upon Hull on receipt of stamped, addressed, foolscap envelope. [9454

ASSISTANTS (Scientific) required by Government Department in Eastcote.
APPLICATIONS are invited from men and women between the ages of 16 and 25, possessing the equivalent of the General Certificate of Education or who are competent of reaching this standard within two years.
A PASS in Maths or Science an advantage.
OLDER candidates may be considered exceptionally on the grounds of experience in an industrial or technical branch of the Services.
THE work will be concerned with physics and electronics applying to communications.
IMMEDIATE appointments will be to unestablished rank but opportunities to compete for established appointments will be given later.
SALARY (Intermediate)
MEN £198 (age 16) to £379 (age 28).
WOMEN £198 (age 16) to £340 (age 28).
WRITE:
ESTABLISHMENT Officer (B.19A1),
GOVERNMENT Communications Headquarters,
LIME Grove,
EASTCOTE,
RUISLIP. [9413

RADIO and television testers, good rates, 5-day week.—Ace Radio, Ltd., Tower Rd., N.W.10. Wil. 3904. [9127

EXPERIENCED capstan setter for milling and drilling; state age, experience and salary required.—Box 3815. [9386

S. S. ELECTRONICS, Ltd., invite applications for the following vacancies:—
(1) JUNIOR test engineers who have completed N.S. Technical background, minimum qualification O.N.C.
(2) FOREMAN for small transformer shop, to take charge production and testing.
(3) WIREMAN capable of working from diagram to P.O. and similar standards.
APPLY, giving full details salary, etc., to Byron Rd., Harrow, Middx. [9444

MINISTRY OF SUPPLY has vacancies at R.A.F. Signals Establishment to assist in one of following:—
1. RUISLIP (3 posts). General experimental work and tests in connection with design of radio communication and radar systems.
2. MEDMENHAM. (a) (6 posts). Installation design of airfield communications and landing air systems, equipment investigations and siting problems. (b) (1 post). Design of installations for large radio receiving and transmitting stations. (c) (1 post). Design of aerial and feeder systems. (d) (6 posts). Design development or test of prototype mobile and portable radio and radar installations. (e) (1 post). Reconstruction of a radar landing aid and organization of associated experimental investigations.
3. WATTON, Norfolk. Development of highly specialised radio and radar equipment. Minimum qualification H.S.C. (Science) but higher qualifications in Physics or Electrical Engineering may be advantage. Experience in duties outlined desirable and knowledge R.A.F. Signals equipment an advantage. Salary according to age, experience, etc., within ranges. Experimental officer (minimum age 26), £597-£754. Assistant experimental officer £264 (at age 18) to £555. Women somewhat less. Posts are unestablished. Application forms from M.O.L.N.S., Technical and Scientific Register (K), Almack House, 26, King St., London, S.W.1, quoting D.416/52A. Closing date January 12, 1953. [9354

CAPABLE senior and junior engineers required for development work on radio and television; apply by letter with full particulars: PILOT RADIO, Ltd., Park Royal Rd., N.W.10. [9409

A. V. ROE & Co., Ltd., have a vacancy in their engineering research department on interesting development work for an ELECTRONIC engineer.
PREFERABLY with knowledge of electronic equipment used in vibration testing; some knowledge of vibration and fatigue an asset.
APPLICANTS for the above post should possess at least Higher National Certificate or equivalent.
GOOD salary and prospects.
PENSION and life assurance scheme.
APPLY, stating age, qualifications and experience, to
THE Labour Manager, A. V. Roe & Co., Ltd., Greengate, Middleton, Manchester. [9251

ENGINEER manager required with experience in the layout of new works for production of batch and mass-produced articles connected with electrical industry.
APPLICANTS should have had similar experience, where modern methods have been employed for machining and assembly and able to produce satisfactory results essential; only those capable of commanding a substantial salary need apply for the post, which is permanent and pensionable.—Full details of experience and age should be sent in confidence to Box 3885. [9398

RADIO and television service engineers required for City radio factory, 5-day week, staff canteen.—Apply A. J. Balcombe, Ltd., 52-58, Tabernacle St., London, E.C.2. [9364

PROGRESS engineer required; familiar with radar equipment; electronic prototype work and service specifications; driving licence an advantage; state age, experience, salary required.—Box 3816. [9387

E. K. COLE, Ltd. (Malmesbury Division), invite applications from electronic engineers for permanent posts in development laboratories engaged on long-term projects involving the following techniques:—
1. PULSE Generation and Transmission.
2. SERVO Mechanism.
3. CENTIMETRIC and V.H.F. Systems.
4. VIDEO and Feedback Amplifiers.
5. V.H.F. Transmission and Reception.
6. ELECTRONICS as applied to Atomic Physics.
THERE are vacancies in the Senior Engineer, Engineers and Junior Grades. Candidates should have had at least 3 years' industrial experience in the above types of work, together with educational qualifications equivalent to A.M.I.E.E. examination standard. Commencing salary and status will be commensurate with qualifications and experience. Excellent opportunities for advancement are offered with entry into a pension scheme after a period of service.—Forms of application may be obtained from Personnel Manager, Ekco Works, Malmesbury, Wilts. [8719

EXPERT T/V service engineer wanted for South Bedfordshire (Dunstable) dealer; good accommodation provided at reasonable rent after 3 months' trial if satisfactory; state salary, experience; enclose copy references.
CHATTELL, Murphy and Pye Dealer, 40, High St. North, Dunstable. Tel. 340. [9400

WIREMAN required, experienced wiring electronic equipment including radar, etc., must be capable of working direct from theoretical circuits without supervision, some workshop experience an advantage.—Box 3688. [9365

DNAPIER & SON, Ltd., Luton Airport, Beds. require electronics laboratory assistant, familiar with C.R.O. practice, keen on development of new techniques for experimental work on aero engine development and allied projects. APPLICATIONS stating age, experience and salary required should be made to the local Employment Exchange. [9304

RADIO engineers, marine radio operators and ex-radar mechanics required for positions as testers and inspectors: excellent conditions and good pay; apply in first instant to—Masteradio, Ltd., Treforest Trading Estate, Glam. [9407

WORKS manager wanted by light electrical engineers in S.E. London with coil-winding, machine and assembly shops and employing 450.—Write, stating age, qualifications, detailed experience and salary expected Box 3266. [9254

ENGINEERS and Assistants required in Test Room for the manufacture and adjustment of Precision electrical apparatus; write or apply in person to—H. Tinsley & Co., Ltd., Werndee Hall, Stanger Rd., S. Norwood, London, S.E.25. [0222

INSPECTOR, used to radio components; applicants must have high standards and ability to maintain discipline and improve quality; state full details of experience, salary required and salary now received; replies strictly confidential.—Box 4096. [9465

WANTED by Radiomobile Agents, radio mechanic with thorough knowledge of installations and repairs of all radiomobile receivers; write giving experience and salary required.—Lindsay Bros., Ltd., 925, High Rd., North Finchley. [9448

TECHNICAL assistants required for development of electro-mechanical and electronic instruments (marine). Work involves initial experiments, seagoing trials, pre-production models and factory liaison. Occasional visits overseas are arranged.
QUALIFICATIONS: Practical, 5 years' workshop or drawing office experience. Academic, City & Guilds Telecommunications Final Group Certificate, or equivalent.
APPLY Personnel Dept., Kelvin & Hughes, Ltd., Barkingside, Essex. [9351

THE Research Laboratories of The General Electric Co., Ltd., propose to set up an organization near Adelaide, South Australia, for trials and further development of guided weapon equipment which is at present under development in this country.
APPLICATIONS are invited from men with qualifications suitable to fill the following vacancies:—
(a) AN engineer to take charge of trials teams.
(b) AN engineer or physicist to take charge of a laboratory engaged on the development and use of special test equipment.
(c) A PHYSICIST or mathematician to take charge of a small group on the analysis and assessment of trials results.
CANDIDATES should have an honours degree or equivalent qualification. For post (a) and (b) they should have had experience of modern radar or similar equipment and of supervising the work of a small number of experimental results is desirable, together with ability to write clear concise reports and supervise the work of a small number of assistants.
THE successful applicants will commence employment in this country on the work they will ultimately be doing in Australia, and will be transferred to that country in due course.
DETAILS of conditions of employment, housing, passages to Australia, etc., will be given to candidates who are selected for interview.
REPLY, quoting reference KTH/AUST. to the Staff Manager, G.E.C. Stanmore Laboratories, The Grove, Stanmore Common, Stanmore, Middlesex, stating age, qualifications and experience. [9350

VACANCIES exist at the Stanmore Laboratories of The General Electric Co., Ltd., as under. Applicants should write to the Staff Manager, The Grove, Stanmore Common, Stanmore, Middlesex, quoting the reference against the vacancy and stating age, qualifications and experience.
i. GRADUATE mechanical engineer is required for work on light engineering mechanisms of a reciprocating type; three to five years' experience or more is required.—(Ref. SS/WW.1.)
ii. ENGINEER with Higher National Certificate in Mechanical Engineering is required with practical experience of small mechanisms.—(Ref. SS/WW.2.)
iii. SENIOR engineer or physicist with Honours degree is required for design of system test equipment required in connection with airborne radar; previous experience in the field is essential; applicants should be between 30 and 35 years of age.—(Ref. SS/RA.1.)
iv. SENIOR assistant is required for flight trials and assessment of airborne radar equipment; experience of radar and similar work in the laboratory and in the air under operational conditions is essential; candidates must be prepared to travel and work away from the Laboratories.—(Ref. SS/LK.1.)
v. PHYSICISTS and engineers with Higher National Certificate or degree are required for electronic circuitry and servo mechanisms and smaller electro mechanical devices.—(Ref. SS/JM.1.)
vi. PHYSICISTS and engineers are required for the microwave field to work on aerials and components.—(Ref. SS/AH.1.)
vii. PHYSICISTS and engineers with degrees and Higher National Certificates are required for a field trials team and for assessment work in connection with the trials; candidates must be prepared to travel and work away from the Laboratories.—(Ref. SS/JP.1.)
viii. ENGINEERS and physicists with Higher National Certificates are required for the design of small quantities of transformers for experimental apparatus.—(Ref. SS/NB.2.)
ix. ENGINEERS and physicists with experience on magnetic amplifiers or small power electric motors are also required.—(Ref. SS/NB.3.)
x. THERE is a vacancy for an engineer or physicist for work on transistors and cold cathode valve circuitry.—(Ref. SS/NB.4.) [9348

EXPERIENCED TV engineers required for retail service. permanent positions at good salary.—Full details to Shenstones (op. Town Hall), Leyton, E.10. Ley 1362. [9266

RADIO engineer with practical knowledge of R.A.F. or Fleet Air Arm radio or radar equipment, required; post-war experience an advantage.—Applicants should apply in writing to Chief Inspector, A. J. Whittemore (Aeradio), Ltd., Croydon Airport. [9388

ENGINEER required to undertake the development of low frequency iron-cored components; previous experience desirable; salary according to qualifications and experience.—Apply in writing to Advance Components, Ltd., Back Rd., Shernhall St., E.17. [9392

TELEVISION and radio service engineer required; must be fully experienced; telecommunication knowledge an advantage, also driving ability desirable; excellent wages and prospects to the right man.—Apply Vallance & Davison, Ltd., 144, Briggate, Leeds, 1. [9347

COMPETENT radio and television engineer required for service in Bedford area, one with limited television experience may be acceptable. good rates of pay and working conditions; assistance given to find accommodation.—Write Radio Service Manager, Box 3957. [9414

RADIO and television engineers required immediately by well-known firm of wireless manufacturers in the S.E. London area; men must have good knowledge of television servicing.—Apply, giving details of experience and qualifications, to Box 4022. [9437

FERRANTI, Ltd., have immediate vacancies for men with electrical engineering qualifications to undertake the advanced testing of Naval anti-aircraft fire control equipment involving electronics and servo mechanisms either in firms, workshops or or board H.M. Ships in home ports.
SALARY in accordance with age and experience between £356 and £650 per annum, normal expenses plus a generous allowance are paid when working out; previous experience of this type of work though desirable, is not essential. Forms of application from Mr. R. J. Hebbert, Staff Manager, Ferranti, Ltd., Hollinwood, Lancs.
PLEASE quote reference HGN/X. [9322

FERRANTI, Ltd., require for their Radio and Television Department a radio engineer to design production test gear and to be responsible for maintenance and modification of existing equipment; a man of H.N.C. or equivalent qualifications with some experience of modern radio practice is needed.
PERMANENT staff appointment with pension benefits and good prospects of advancement; salary in the region of £8-£11 per week.
FORMS of application from Mr. R. J. Hebbert, Staff Manager, Ferranti, Ltd., Hollinwood, Lancs.
PLEASE quote reference HW/T [9314

LABORATORY assistant, preferably with some experience, required to construct and use specialised electronic equipment.—Apply in writing, giving details of experience, to Personnel Officer, Associated Electrical Industries, Ltd., Research Laboratory, Aldermaston Court, Aldermaston, nr. Reading, Berks. [9362

RADIO service mechanics are required by S. Smith & Sons (England), Ltd., of Cricklewood, N.W.2; starting at £8/5 per week, plus profit sharing bonus, there are good prospects of advancement together with canteen facilities and a five-day week.—Write for interview to Personnel Officer (Radiomobile). [0242

PYE TELECOMMUNICATIONS, Ltd., Ditton Works, Cambridge, will shortly have vacancies for senior and junior engineers, experience in V.H.F. design and engineering is essential. vacancies also exist for engineers with specialist experience in multi-channel V.H.F. Telephony; salary according to qualifications and experience. PLEASE apply, stating age, qualifications and experience to the Personnel Manager. [0209

TECHNICAL assistants required for work in electronics laboratory, National Certificate standard, experience in development of v.h.f. equipment and pulse and wide band amplifier technique, good prospects.—Write, stating age, qualifications and experience, to Personnel Manager, Burndept., Ltd., Erith, Kent. [9461

ENGINEER required for theoretical and experimental work on aircraft fuel contents gauging; qualifications, electrical engineering or physics degree or equivalent; experience of measurements problems advantageous; south-west of London.—Send tabulated details of experience, quoting Ref. E9, to Box 3771. [9379

REQUIRED, mechanical inspectors, experienced in the inspection of high quality scientific instruments; also electrical inspectors and testers, preferably with experience in small transformers and/or electronic equipment.—Apply by letter to E.M.I. Engineering Development, Ltd., Penleigh Works, Wells, Somerset. [9346

SENIOR radio designer required; an interesting and responsible job with excellent future prospects is waiting for an engineer with several years' experience in development of home and export radio receivers.—Applications may be addressed in confidence to the Personnel Manager, Murphy Radio, Ltd., Welwyn Garden City, Herts. [9401

DECCA RADAR, Ltd., invites applications from microwave, electronic and mechanical engineers to join the Company in its extensive work in a wide field of microwave link and radar development, the Company offers excellent starting salaries and first rate opportunities for men to exploit their initiative and to rise rapidly to responsible posts; graduates without industrial experience who are prepared to undertake intensive training are also invited to apply for junior posts—Apply in writing to Research Director, Radar Laboratory, 2 Tolworth Rise Surbiton, Surrey. [0240

SENIOR Draughtsmen required for checking in a large engineering company situated in the East London area. Applicants should have had previous experience of electronic equipment. Good salaries and staff conditions; pension scheme in operation.—Please write, giving details of experience, to Box 4047, quoting reference N.98. [9446

ELECTRICAL assistant required for an industrial metallurgical research laboratory in the S.E. London area, to help with problems connected with furnaces and control equipment; national certificate in electrical engineering a minimum requirement, with some knowledge of electronics an advantage.—Write, giving full details, to Box 2675. [9110

TRANSFORMER designer required; an excellent opportunity exists for an engineer with thorough practical experience of radio mains transformer design and preferably some experience of R.F. coils and I.F. transformers; applications may be addressed in confidence to the Personnel Manager, Murphy Radio, Ltd., Welwyn Garden City, Herts. [9402

TEST gear design engineers required with practical experience of this class of work, based on sound knowledge of electronic principles; these vacancies are permanent and progressive; a Company pension scheme in operation; London area; please write, in confidence, giving full details of qualifications, to Box 3819, quoting reference No. N.24. [9384

BOULTON PAUL AIRCRAFT, Ltd., Wolverhampton, require senior electronics engineer or physicist with adequate theoretical and practical design experience to take charge of department engaged in development of precision electronic instruments, servo mechanisms, analogue computors, etc.; applications should detail qualifications and experience and state salary required. [9343

ELECTRICAL insulation varnishes; technologist, aged 25-40, with experience in radar, radio or electrical equipment, required to specialise in insulating varnishes; previous experience of varnish preferable, but not essential; training will be given for service and laboratory work; based in London.—Please reply, stating age, technical qualifications and experience, to Box 3843. [9391

AIR MINISTRY requires Civilian Instructors, Class 1 (Radio Fitter) for temporary posts, with prospects of permanency, at R.A.F. Radio Schools, Yatesbury (Wilts), and Locking (Somerset); qualifications: at least 5 years' practical experience and ability to instruct; trade test before entry; pay is £480 at 26, rising to £597.—Apply to: Air Ministry, S.5(g), Cornwall House, Stamford St., London, S.E.1. [9424

M.R.G., Ltd., have vacancies for development engineers for design work on radio and television, the openings cover a wide field from basic technical research to construction of experimental receivers and models; superannuation scheme, etc., for suitable applicants.—Application must be by letter in the first instance, giving all relevant details to Mains Radio Gramophones, Ltd., 359, Manchester Rd., Bradford. [9418

MARCONI'S WIRELESS TELEGRAPH Co., Ltd., is opening a new works in about 9 months' time at Basildon (New Town) Essex, and now has the undermentioned vacancies. Houses of a standard type are available to rent for suitable applicants. Initial training and employment will be at Chelmsford, and fares from Basildon will be paid. Salaries commensurate with ability and experience. Pension scheme.

REF. 992/3. Methods superintendent. Applicants should have a sound technical education and previous experience preferably in an electrical, radio or electronic concern working on batch production. Responsibilities may include methods planning (including metal finishing), tool design, toolroom, time and motion study, plant layout. Experience in rate-fixing and formulating bonus schemes, both for production and indirect workers, is essential. Age limits 30-40.

REF. 994/2. Test superintendent. Applicants should be of degree standard, preferably with a sound knowledge of most of the following techniques: M.F., H.F. and V.H.F. transmitting, vision transmitting, radar and electronic measurements. Previous experience in charge of inspection and test of service requirements is essential. Responsibilities could include inspection and test of piece parts, components, subassemblies and full equipments, manufacture and/or provisioning of test gear, electro chemical, physical and/or metallurgical control of processes, liaison with development and outside bodies. Must be keen on integrating test planning with methods planning and inspection with production. Age limits 30-45.

PLEASE reply giving details and quoting appropriate reference to English Electric Co., Ltd., Central Personnel Services, Marconi House, 336-7, Strand, W.C.2. [9560

ELECTRONIC Engineers are required for development work on aircraft instruments, they should possess a degree in electrical engineering or physics or higher national certificate or similar qualifications, previous laboratory experience in physics, electrical engineering or instrument technology would be an advantage; Guildford area.—Send details of qualifications and experience, quoting Ref. E10, to Box No. 3770. [9378

ELECTRONIC junior test engineer required with experience in motor control; National Certificate standard or equivalent, ex-H.M. Forces personnel with radar experience will be considered; permanent position, good working conditions, life insurance and pension scheme.—Apply, stating age, experience and qualifications, quoting reference 13.11.2, to the Personnel Superintendent, English Electric Co., Ltd., Stafford. [9393

SENIOR television receiver design engineer required.—Write stating experience and salary required to the Technical Director, Pye, Ltd., Haig Rd., Cambridge. [9341

MURPHY RADIO, Ltd., have vacancies for experienced testers and inspectors for work on radio and electronic equipment, with a subsidiary company at Ruislip, Middlesex; a number of qualified project supervisors are also required.—Applicants should write in first instance, giving full particulars of their experience and qualifications, to Personnel Dept., Murphy Radio, Ltd., Welwyn Garden City. [9382

VIBRATION engineer required for work on an important defence project; experience of monitoring techniques essential, together with some theoretical knowledge of mechanical vibrations and shock; H.N.C. or equivalent preferred, but O.N.C. acceptable in special cases; write, stating salary required, age and details of qualifications and experience, to—Central Personnel Services, the English Electric Co., Ltd., 336-7, Strand, London, W.C.2. [9385

DEVELOPMENT engineers. International Aeradio, Ltd., specialists in equipment design for aviation service, due to expansion of development section at Bovingdon Airport near Watford, require junior and senior radio and telegraph engineers. Salary according to experience; single quarters provided, pension scheme, 5-day week, canteen facilities.—Please apply through Local Labour Exchange to Personnel Officer, 40, Park St., London, W.1. [0235

BUSH RADIO, Ltd., have vacancies at Chiswick for senior and assistant radio and television engineers: applicants for senior positions must have 4 years practical experience in design of radio/television receivers; assistants should have 2 years' practical experience in laboratory and be familiar with radio/television measurement technique.—Apply stating age, qualifications, experience and salary to Personnel Manager, Bush Radio, Ltd., Power Rd., W.4. [9342

THE ENGLISH ELECTRIC Co., Ltd., Luton, requires a qualified radar engineer with good experience in centimetre radar and/or radar circuits; this work is of special importance and interest and is under laboratory conditions; permanent, progressive post for the successful applicant; salary £600-£900 p.a. according to experience.—Please reply, quoting reference 815H, to Central Personnel Services, English Electric Co., Ltd., 336-7, Strand, London, W.C.2. [9370

McMICHAEL RADIO, Ltd., require senior and junior engineers in their equipment division development laboratory at Slough. Training and experience in the field of applied electronics (including communications) and experience of working with Government departments are the chief qualifications required.—Write, stating age and full details of training, qualifications and experience, to the Chief Engineer, Equipment Division, McMichael Radio, Ltd., Slough, Bucks. [9174

ENGINEER required to run modern toolroom (about 10 men) also small drawing office; must have ability to design cheap short run press tools as well as high quality long run tools; for man with initiative and drive, able to assist in manufacturing press parts, radio components, etc., and improve methods all round in factory; a four-figure salary will be paid; state full details, past experience, education, present salary and salary required; all replies in confidence.—Box 4097. [9466

NORWOOD TECHNICAL COLLEGE, Knight's Hill, West Norwood, S.E.27.—Laboratory technician in physics and telecommunications Dept.; sal. scale (inc. current percentage addition) 69s weekly at 16 to 96s at 19; £270 a year at 20; addit. incs. of £18 for each full year of age above 20 years on entry (comm. sal. on entry not to exceed £342); rising by annual incs. of £18 to £378 and with addt. incs. for specif. qualifs. to £414. Appl. forms from college sec. ret. within 14 days. (1180) [9361

BELLING & LEE, Ltd., Cambridge Arterial Rd., Enfield, Middlesex, require research assistants in connection with work on electronic components, fuses, interference suppressors and television aerials; applicants must be graduates of the I.E.E., or possess equivalent qualifications together with similar laboratory experience; salary will be commensurate with previous experience; 5-day week contributory pension scheme.—Applications must be detailed and concise, and will be treated as confidential. [0230

PROJECT Engineer required to be responsible for a laboratory engaged on development of aircraft fuel contents gauges and associated equipment; applicants should possess qualifications in electrical engineering and/or physics, and have had design and laboratory experience in the application of electronic techniques to airborne equipment.—Apply, in writing, quoting Ref. E8 and giving details of qualifications and experience, to the Chief Development Engineer, Waymouth Gauges & Instruments, Ltd., Station Rd., Godalming, Surrey. [9377

FERRANTI, Ltd. (Moston), have a vacancy in the Circuits Section of the Physical Laboratory for a circuit development engineer to work on specialised test equipment for investigation of cathode-ray tube and valve characteristics. Applicants should be graduates in electrical engineering or possess a H.N.C. or equivalent qualification and have had at least three years experience of the design and construction of this type of equipment. A sound theoretical and practical knowledge of television and radar circuit techniques is essential.
PERMANENT staff appointment with pension benefits.
FORMS of application from Mr. R. J. Hebbert, Staff Manager, Ferranti, Ltd., Hollinwood, Lancs.
PLEASE quote reference LA. [9411

ELECTRONIC engineer required by manufacturers North-west London, practical knowledge of television and pulse circuitry essential.—Write, stating age, experience and salary required, to Box 4076. [9463

EXPERIENCED radio testers and inspectors required for production of communication and radio apparatus also instrument makers, wirers and assemblers for factory test apparatus.—Apply Personnel Manager, E. K. Cole, Ltd., Ekco Works, Malmesbury, Wilts. [0238

A JUNIOR Technical Assistant is required for secretarial staff of Manufacturers' Association in London; essential qualifications, B.Sc. Grad. or equivalent, good personality and general education; interesting work in excellent conditions; commencing salary £450.—Box 4016. [9431

ELECTRONIC engineers required at Nelson Research Laboratories, English Electric Co., Ltd., Stafford for work on high speed automatic electronic digital computors; applicants should possess: (a) Honours degree in physics or engineering with a sound knowledge of the principles of circuit design, or (b) H.N.C. in electrical engineering and have had three or four years' experience in radar or electronic development; please reply quoting ref. 1051, to—Central Personnel Services, English Electric Co., Ltd., 336/7, Strand, London, W.C.2. [9406

AN engineer with production experience, trained in the electro-chemical and light engineering field is required by a manufacturer of electronic components to take charge of a unit engaged primarily in the pre-production of new products. Candidates must have ability to co-operate with the laboratory on questions of design for manufacture and with the factory in solving production problems and should preferably possess an engineering degree or near equivalent. Write in confidence giving age, summary of experience and other relevant information to Box 3655. [9358

B.B.C. requires a limited number of Technical Assistants, aged 21 or over, in operations and maintenance department, for service at transmitter, studio and television centres throughout the United Kingdom. Knowledge of mathematics, electricity and magnetism to School Certificate standard; experience in electrical or radio engineering an advantage. Salary £360 p.a. with annual increments to £470 p.a. maximum. Promotion prospects.—Application forms from Engineering Establishment Officer, Broadcasting House, London, W.1 (enclosing addressed foolscap envelope). [9353

DECCA RADAR, Ltd., require draughtsmen and junior draughtsmen for research drawing office, preferably experienced in any of the following fields: radar, radio and electronic circuits, electro-mechanical devices, light mechanical engineering; knowledge of workshop practice essential; applicants must possess Ordinary National Certificate or equivalent; positions are permanent and progressive; salaries based on A.E.S.D. rates; tracers (female) also required.—Write giving full details to Chief Draughtsman, Decca Radar, Ltd., 2, Tolworth Rise, Surbiton, Surrey [0241

TECHNICIANS between 20 and 30 years of age required for the initial and routine testing of relay wireless equipment including 1 kw audio amplifiers; applicants should have had some experience in the wire broadcasting, telephone or radio industries; possession of C. & G. and/or National certificates an advantage; commencing wage between £5/10 and £9 per week according to qualifications, etc.; 5½-day week, superannuation scheme and active sports and social club.—Applications in writing to Personnel Manager, British Relay Wireless, Ltd., 343-5, Walworth Rd., Southwark, S.E.17. [9336

SENIOR physicist or engineer with wide experience of radio communications and radar is required to direct a research team in these fields at the Stanmore Laboratories of The General Electric Co., Ltd.; familiarity with centimetric techniques, circuitry and propagation is essential, together with a real knowledge of the fundamental aspects of such work; this is an appointment for a first-class research man and carries an attractive salary commensurate with experience.—Applications should be sent to the Staff Manager (Ref. SS/NB.1), The Grove, Stanmore Common, Stanmore, Middlesex, giving full details of age, qualifications and experience. [9349

DRAUGHTSMEN.—Bush Radio, Ltd., have vacancies in their W. London and Plymouth drawing offices for senior and junior designer/draughtsmen; applications for senior posts are invited from men with experience in electronic, radio or light electro-mechanical engineering; applicants for junior posts should have at least 2 years' D.O. experience; positions offered are permanent and pensionable, and are concerned with television development, commercial radio and long-term defence projects; appointments may be arranged for Saturday mornings.—Apply, giving details of experience and age, or telephone the Personnel Manager, Bush Radio Ltd., Power Rd., W.4 (Chiswick 6491). [9380

MURPHY RADIO have vacancies in their electronics division for a first-class senior design draughtsman and a senior mechanical designer; applicants should be up to at least National Certificate standard and have had experience in design of electronic equipment, small mechanisms or similar work and must be capable of working on their own initiative; employment is permanent and pensionable and offers excellent opportunity of broadening experience in this interesting field of work; full details of experience and qualifications should be included in applications which may be forwarded in confidence to—Personnel Manager, Murphy Radio, Limited, Welwyn Garden City. [9275

THE GENERAL ELECTRIC Co., Ltd., Brown's Lane, Coventry, require for work on guided weapons and like projects, development engineers, senior development engineers, mechanical and electronic, for their development laboratories; fields include microwave and pulse applications; salary range £400-£1,250 per annum; vacancies also exist for specialist engineers in component design, valve applications, electro-mechanical devices and small mechanisms; the company's laboratories provide excellent working conditions with social and welfare facilities; superannuation scheme, assistance with housing in special cases; apply by letter stating age and experience, to—The Personnel Manager (Ref. CHC). [0239

MINISTRY OF SUPPLY require Physicist or Electrical Engineer at outstation of R.A.E., Woodbridge, Suffolk, to lead section engaged on application of radar to ballistics and other trials, including responsibility for conduct of trials, maintenance of ground radar equipment, plotting tables, etc., and development of techniques. Experience of operating and maintaining ground radar equipments essential. Minimum qualification H.S.C. (Science) but higher qualifications in Physics or Electrical Engineering may be an advantage. Salary within range—Experimental Officer (min. age 26) £597-£754. Women somewhat less. Post unestablished. Application forms from M.O.L.N.S., Technical & Scientific Register (K), 26, King St., London, S.W.1, quoting A291/52/A. [9369

GOLD COAST, Nigeria.—British company established throughout West Africa require the services of a qualified radio engineer. Some knowledge of refrigeration servicing an asset but applicants would receive preliminary training in this and other sections of the service departments before sailing. Excellent openings for the right man covering selling and administrative side of business as well as actual servicing. Good salary, prospects, first-class passage, free furnished quarters, pension scheme. Applications should be in own hand writing, stating age (preferably between 21 and 26), whether married or single, full details education, qualifications, national service, and business experience. Original references should not be sent.—Apply Box 4024. [9440

THE ENGLISH ELECTRIC Co., Ltd., Luton, invites applications for permanent posts in a laboratory engaged in development work involving radar techniques; senior and junior positions are available to candidates possessing suitable qualifications and a knowledge of one or more of the following: (1) Centimetric systems and measurements; (2) radar or television receiver practice; (3) mechanical layout and design work in connection with the above; salaries according to qualifications and experience from £450 upwards; the laboratories are new and pleasantly situated; the company also encourages further study in the case of juniors.—Please reply, quoting ref. 815G, to Central Personnel Services, English Electric Co., Ltd., 336, Strand, London, W.C.2. [9245

THE PLESSEY Co., Ltd., has vacancies in its Telecommunications Engineering Department for Senior Engineers and Draughtsmen to work on long-term private ventures and defence projects; qualifications for senior engineers are a degree in physics or engineering and at least two years' experience in electronic, radio or radar development work; six or more years' experience of advanced work in the above field will be accepted as an alternative to a degree; qualifications for draughtsmen are at least two years' drawing office experience on electronic, radio or electro-mechanical devices; the positions are permanent and pensionable and very good salaries are available for experienced men; applicants should be of British birth and nationality.—Apply, in confidence, to the Personnel Manager, The Plessey Company, Vicarage Lane, Ilford, quoting reference T.E.D. [9447

TRANSFORMER engineer is required to take charge of a group dealing with the design, construction and testing of a wide range of transformers and coils in a research and development company. The range includes medium power, hermetically sealed, C type transformers, filter assemblies, and high-frequency coils and transformers. The applicant must possess the necessary technical knowledge and be able to lead a fair-sized team. The position is permanent and pensionable. A good salary will be paid, depending upon the qualifications and experience of the applicant. Working conditions are exceptionally pleasant in congenial surroundings; there is a good canteen on the premises, and there is an active social and sports club. Five-day week.—Applicants should write, stating qualifications, experience, age and nationality, to the Technical Director, Cottage Laboratories, Ltd., Portsmouth Rd., Cobham, Surrey. [9439

MINISTRY OF SUPPLY has following vacancies at R.A.E. Signals Experimental Establishment at Bedfordshire. Senior experimental officer for development of calibration procedure for radio test equipment and preparation of calibration publications. Also specialist advice to Radio Equipment Calibration Centres and liaison wth Radio Measurements Divisions in Experimental Establishments of Ministry. Assistant Experimental Officers for the calibration of transfer standards involving (a) frequency and pulse measurements or (b) bridge and miscellaneous measurements. Candidates must have minimum H.S.C. (science) or equivalent but higher qualifications in Physics or Elec. Eng. may be advantage. Salary within ranges S.E.O. (minimum age 35) £803—1,033; A.E.O. £264 (at age 18)—555. Women somewhat less. Posts are unestablished. Application forms from M.O.L.N.S. Technical and Scientific Register (K), Almack House, 26, King St., S.W.1, quoting D.415/52A. Closing date January 11th, 1953. [9345

THE GENERAL ELECTRIC Co., Ltd., has a vacancy on their staff at Head Office for a young man in the age group 25/32 years who has a good personality and initiative; applicants must have had a good general education and obtained an ordinary national certificate in electrical engineering, it is desirable that the applicant should have a knowledge of electronics and ability to read engineering drawings, also some previous experience in handling Government contracts would be an asset.—Apply, in writing, quoting reference "G & R/KS," to the Staff Manager, Magnet House, Kingsway, W.C.2. [9375

SITUATIONS WANTED

EXPERIENCED radio and TV engineer desires change, with accom.—Box 4064. [9453

ARMATURE winder (24), experienced in considerable range of windings, and also in maintenance and repair of elec. installations; home or abroad.—Box 4063. [9452

RADIO production foreman, 20 years' experience, requires outdoor work, wiring, assembly, cable forms, etc., experience of Government specifications, A.I.D standards; any proposal considered.—Box 3912. [9408

ELECTRICAL engineer (radio communications), Grad.I.E.E., aged 25, available from June, 4 years' experience in all branches of radio teleprinting and by most systems, S.S.B., F.S.K., tone mod., etc., 2 years' i/c TX site, 1 year i/c operating room; married; willing to go anywhere providing wife accompanies.—Box 3769, c/o W.W. [9376

BUSINESSES FOR SALE AND WANTED

FOR sale, radio, TV and electrical business, any investigation.—Particss., M. Collinson, 3, Horse Market Middleton in Teesdale, Durham. [9372

FOR sale, wireless, television and electrical business in main road, North West London Suburb, with very little opposition; lock-up shop, lease nearly 14 years to run, at £300, rising to £325 per annum; fixtures and fittings £2,300; stock at valuation.—Write Box 2990. [9166

PAINTS, CELLULOSE, ETC.

MILLER'S "Pan" air-drying black crackle enamel, 4/6 4oz. jar.—8, Kenton Park Crescent, Kenton, Mdx. [9357

PAINT spraying handbook 3/6, post free; cellulose and synthetic paints and all spraying requisites supplied; catalogue free.—Leonard Brooks, 53, Harold Wood, Romford. [0207

PATENTS

THE proprietor of British Patent No. 573313, entitled "Multiple Section Electronic Tube and Method of Making it," offers same for licence or otherwise to ensure practical working in Great Britain.—Enquiries to Singer, Stern & Carlberg, 14, East Jackson Boulevard, Chicago 4, Illinois, U.S.A. [9445

TECHNICAL TRAINING

CITY & Guilds (Electrical, etc.) on "no pass no fee" terms; over 95% successes; for full details of modern courses in all branches of electrical technology send for our 144-page handbook—free and post free.—B.I.E.T. (Dept. 388A), 17, Stratford Place, London, W.1. [0117

INDUSTRY needs trained men; send for free brochure giving details of our Home Study Courses in radio, television and all branches of electronics; we prepare students for the A.M.Brit.I.R.E., City and Guilds Telecommunications, R.T.E.B., and other professional examinations; train with the college backed by Britain's largest electronic industry.—Write to E.M.I. Institutes, Postal Division, Dept. WW33, 43, Grove Park Rd., London, W.4 (Associated with H.M.V.). [0179

TUITION

RADIO training.—P.M.G. exams and I.E.E. Diploma; prospectus free.—Technical College, Hull. [0111

NOTHING succeeds like success! What we have done a thousand times we can do again for you—seee the B.N.R.S. advt., page 114.

WIRELESS operating; attendance and postal courses.—Stamp for reply to Manager, The Wireless School, Manor Gdns., London, N.7.

A.M.I.Mech.E., A.M.Brit.I.R.E., City and Guilds, etc., on "no pass—no fee" terms; over 95% successes; for details of exams. and courses in all branches of engineering, building, etc., write for 144-page handbook—free.—B.I.E.T. (Dept. 387B), 17, Stratford Place, W.1. [0118

SEE the world; radio officers urgently required; we train most in shortest period; training fees payable after appointments secured; scholarships available; boarders accepted; 2d stamp for prospectus from Britain's leading college.—Wireless College, Colwyn Bay. [0018

WIRELESS Telegraphy. — Merchant Navy offers to youths 15½ upwards when qualified, lucrative positions as radio officers.—Apply British School of Telegraphy, Ltd., 179, Clapham Rd., London, S.W.9. Also postal courses in theory of wireless for P.M.G. Certificates, and Amateur Transmitting Licence. [0124

THE Institute of Practical Radio Engineers have available home study courses in every phase of radio and television engineering, specialising in the practical training of apprentices in the retail trade; enrolments limited, fees moderate.—The Syllabus of Instructional Text may be obtained post free from the Secretary, I.P.R.E., Fairfield House, 20, Fairfield Rd., Crouch End, London, N.8. [0088

FREE! Brochure giving details of Home Study Training in Radio, Television, and all branches of Electronics. Courses for the hobby enthusiast or for those aiming at the A.M.Brit.I.R.E., City and Guilds Telecommunications, R.T.E.B., and other professional examinations. Train with the College operated by Britain's largest electronic organisation; moderate fees.—Write to E.M.I. Institutes, Postal Division, Dept. WW28, 43, Grove Park Rd., London, W.4. (Associated with H.M.V.) [0001

INDEX TO ADVERTISERS

Printed in Great Britain for the Publishers, ILIFFE & SONS, LTD., Dorset House, Stamford St., London, S.E.1, by THE CORNWALL PRESS LTD., Paris Garden, London, S.E.1. *Wireless World* can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd., William Dawson & Sons (S.A.), Ltd. UNITED STATES: The International News Co.