A PREFERRED VALUE BRIDGE

1/-

Vol. 30 No. 577
NOVEMBER, 1954

EDITOR:
F. J. CAMM

PRACTICAL WIRELESS

IN THIS ISSUE:

A VARIABLE H.T. UNIT
MULTIPLE SPEAKERS
MODULATION HUM
SIMPLE MAINS CIRCUITS
AMPLIFIER DESIGN
FREQUENCY MODULATION

Volume Controls

Midget Ediswan type. Long spindles. Guaranteed 1 year. All values 10,000 ohms to 2 Meg-ohms.

No Sw.	S.P.Sw.	D.P.Sw.
3/-	4/-	4/9

COAX PLUGS ... 1/2
SOCKETS 1/-
LINE CONNECTOR 1/2
OUTLET BOXES ... 4/6

80 ohm CABLE COAX

STANDARD ¼in. diam. Polythene insulated. GRADE "A" ONLY

8d. yd.

SPECIAL.—Semi-air-spaced polythene, 80 ohm **Coax**, ¼in. diam. Stranded core. Losses cut 50% (just released) **9d.** yd.

BALANCED TWIN FEEDER per yd. 6d. } 80
TWIN SCREENED FEEDER per yd. 1/- } ohms
50 OHM COAX CABLE, 8d. per yd. ¼in. dia.
TRIMMERS, Ceramic, 30, 70 pf., **9d.** 100 pf., 150 pf., **1/3** ; 250 pf., **1/6** ; 600 pf., **1/9.**
RESISTORS.—All values : 10 ohms to 10 meg., ¼ w., **4d.** ; ½ w., **6d.** ; 1 w., **8d.** ; 2 w., **1/-** ; High Stability, ½ w. 1%, **2/-**. Preferred values 100 ohms to 10 Meg.
WIRE-WOUND RESISTORS.—Best Makes Miniature Ceramic Type—5 w., 15 ohm to 4 K., **1/9** ; 10 w., 20 ohm to 6 K., **2/3** ; 15 w., 30 ohm to 10 K., **2/9** ; 5 w. Vitreous, 12 K. to 25 K., **3/-**.

WIRE-WOUND POTS. 3 WATT. FAMOUS MAKE

Pre-Set Min. TV. Type. Knurled Slotted Knob. All values 25 ohms to 30 K., **3/-** ea. 50 K., **4/-**. Ditto Carbon Track 50K. to 2 Meg., **3/-**.

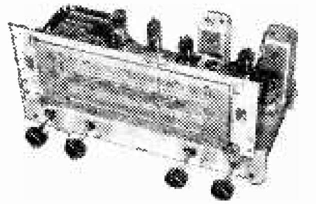
Standard Size Pots, 2¼in. Spindle. High Grade. All Values. 100 ohms to 50 K., **5/6** ; 100 K., **6/6**. **W/W EXT. SPEAKER CONTROL** 10Ω, **3/-**.

O/P TRANSFORMERS.—Heavy duty 70 ma., **4/6**. Small Tapped pentode, **3/9**.
L.F. CHOKES 10 h. 65 ma., **5/-**. 20/25 h. 100/150 ma., **12/6**. 5 h. 250 ma., **15/-**. 15 h. 100 ma., **10/6**. **LYNX,** 3h. 250 ma., **13/6**. **SIMPLEX,** 10h. 150 ma., **10/6**. **MAINS TRANS.**—Made in our own workshops to high grade specification. Fully inter-leaved and impregnated. Tapped prim. 200 v./250 v., Heater Trans., 6.3 v., 1½ amp., **7/6** ; ditto 6.3 v., 3 amp., **10/6** ; ditto, 12 v., .75 amp., **7/6**. 350-0-350, 80 ma., 6.3 v., 4 a., 5 v., 2 a., ditto 300-0-300, ditto 250-0-250, **21/-**. **AMPLIFIER TRANS.** 250 v. 50 ma. ½ wave, 6.3 v. 2 a. Fully Shrouded, **17/6**. Viewmaster, Auto Type, **35/-**. Telcking, **30/-**. Lynx, **30/-**. Coronet, **30/-**. Simplex, **35/-**. Rewinds and Specials to requirements.
SOUNDMASTER SPECIALS.—Mains Trans., **35/-**. L.F. Choke, **10/6**. O/P Trans., **5/6**. Envelope, **6/6**. Specified Wafer Switches, **22/6** per set of 3.
GOODMANS.—Latest Wide Angle Duomag type, Focus Unit. Vernier Focus and adjustable Picture Shift, **35/-**. **ELAC.**—C.R.T. Ion Traps, **2/6**.

TAPE RECORDING BARGAIN

LIGHTWEIGHT XTAL HAND MIKES. Chrome finish—Quality and sensitivity for only **25/-**.
ELECTRODYNAMIC MIKE INSERT.—U.S.A. make, precision engineered. Size only 1in. diam. by ½in. Bargain Price **3/9**. Matching Trans. **3/9**.

WOODEN WALNUT CABINET.—12in. x 7in. x 5in. TRF or superhet, comp. punched chassis, dial, back-plate, drive, pointer, etc., **28/6**, plus post 2/-.
TYANA.—Midget Soldering Iron. 200/250 v. or 230/250 v., **14/11**. **TYANA TRIPLE THREE.**—Complete with detachable bench stand, **19/6**.
NEW SOLON MIDGET IRON.—25 w., **19/6**. IDEAL FOR RADIO CONSTRUCTORS.
C.R.T. HEATER ISOLATION TRANSFORMER.—Low leakage winding with 25% sec. boost. Ratio 1 : 1.25, 2 v., **10/6** ; 4 v., **10/6** ; 6.3 v., **10/6** ; 12 v., **10/6**. **MAINS PRIMARIES** and Specials to Order.
MIKE TRANSF.—New. Ratio 50 : 1, **3/9** ea.
V'HOLDERS.—**Pax.** : Int. Oct., **4d.** ; EF50, EA50, **6d.** ; B12A CRT, **1/3**. **Moulded** : Int. Oct., **6d.** ; B7G, **9d.** ; with screening can, **1/6** ; B8A, B8G, B9A, **1/-** ; VCR97, **2/6**. **Ceramic** : EF50, B7G, **1/-**. **ENG.** and **AMER.** 5-, 7- and 9-pin, etc., 1/-.
TAG STRIPS.—2- or 3-way, **2d.** ; 4- or 5-way, **3d.** ; 6-way, **4d.** ; 9- or 10-way, **6d.**, etc.
T/V PRE-AMP.—Channel 1. Easily modified for other Channels or Converter use. Midget Chassis, 4¼ x 2¼ x 1¼. Complete with EF42 valve, coax. lead and plug. Ready for use. Brand New Mfrs. Surplus. Listed £3 15s. Special Clearance Price, **27/6** ; p. & p., 1/6.
TOGGLE SWITCHES EX-GOVT.—"On-Off." **9d.** Ersin M'core solder 60/40, 16 g. or 18 g., **5/6** ½ lb., **4d.** yd. T.C. wire, 18 to 22 s.w.g., per yd., **2d.** PVC Connecting wire, 10 colours. Single or Stranded, **2d.** yd. 2 K. 5 w. H.D. w/w Pots, **4/6**. 10 K., 25 K., Colvern w/w Pot, 1in. spindle, **3/6**. **SCREENED GRID CAPS** I. Oct., or Mazda, **6d.** ea. **BULGIN HIGH VOLTAGE VALVE CAPS,** I.Oct., **1/-**.
FUSES.—1¼in. all values 60 ma. to 10 a., **6d.**
ALADDIN FORMERS and cores, ¼in., **8d.** ; ⅜in., **10d.**
SLOW MOTION DRIVES.—Epicyclic ratio 4 : 1, **2/3**.
INT. OCTAL CABLE PLUG (8-pin), with cover, **1/3**.
200-250 Volt SELECTOR SOCKET (2in. x 1in.) with Plug, **1/-**. **PILOT LAMPS.**- 6.3 v. .3a., **8d.**
SPEAKER FRET.—Expanded anodised metal, 14in. by 9in., **3/-**. **EXT. L.S.**—Switched Socket, on-off and parallel switching, complete with plug, **2/-**.
COPPER PLATED AERIAL RODS. ½in. x 12in. push fitting, **2/6** doz., p. & p. 9d. **MAINS LEAD.**—3 yds. Twin Twisted Maroon Flex. Top Quality 23/0076 Core, **1/-**. 2 yd. Non-kink Appliance Leads. Suitable irons, etc., braided ends. Bargain **1/3**.



ALL WAVE RADIOGRAM CHASSIS

THREE WAVEBANDS — S.W. 16 m.—50 m. M.W. 200 m.—550 m. L.W. 800 m.—2,000 m.

FIVE VALVES — LATEST OSRAM X79, W77, DH77, N78, U78.

Brand New and Guaranteed, with 10in. P.M. Speaker, A.C. 200/250 v. Four position Wave-change Switch. Short-Medium-Long-Gram. Slow Motion Tuning. Speaker and Pick-up connections. High Q iron-dust cored coils, 465 kc/s. I.F. Latest circuit technique delayed. A.V.C. and Negative feedback. Output 4.2 watts. 3 ohms output transformer on chassis. Chassis size 13½ x 5½ x 2¼in., Glass Dial—10in. x 4½in., horizontal or vertical type available, lit by 2 Pilot Lamps. Colour Black Station names, L.W. Green, M.W. Red, S.W. White. Four Knobs supplied. Walnut or Ivory to choice, aligned and calibrated. Chassis isolated from mains. PRICE **£10/15/0**. Carriage and Insurance, 4/6. (Without 10in. Speaker, **£9/15/0**. Carr. & Ins., 4/6.)

BARGAIN OFFERS
RECOMMENDED FOR ABOVE CHASSIS
GREAT REDUCTIONS

Brand New Plessey 3-speed Autochanger Mixer Unit for 7, 10 and 12in. Records. Twin Hi-Fi Xtal Head with Duopoint sapphire stylus. Plays 4,000 records. Sprung mounting. Superb Quality. Bargain Price 9½ gns., post free.

NEW BOXED — VALVES — ALL GUARANTEED

1R5	8/-	6J7	8/6	12BA6	8/6	EB91	7/6
1S5	8/-	6K7M	8/6	12Q7	10/6	EBC33	9/6
1S4	8/-	6K7G	6/6	12SH7	5/6	EC91	7/6
1R5	8/-	6K8	9/-	35L6	10/6	EF36	7/6
3S4	9/-	VT127 }	9/-	OZ4	8/6	EF39	9/-
3V4	8/-	Pen46 }		807	10/6	EF50 Equip	
3D6	2/6	EF80	10/6	ECH42			5/6
5U4	10/6	6L6	10/6		12/6	British	7/6
5Z4	9/-	6P25	15/-	6C9	12/6	Sylvania	
6X4	7/6	6Q7	9/6	6BG6	12/6	Red	10/6
6AC7	8/6	6SA7	8/6	UF41	11/6	EF91	8/-
6AG5	7/6	6SH7	6/6	EF41	11/6	EF92	9/6
6AM6	9/-	6SK7	8/6	8D3	9/-	7C6	9/6
6AT6	10/6	6SL7	9/-	CV6	3/6	EY51	12/6
6B8	7/6	6SN7	11/-	DK91	8/-	HVR2a	7/6
6BA6	8/6	6U5(Y63)	8/-	DF91	8/-	PY80	11/6
6BE6	10/6	6V6	8/-	DAF91	8/-	PY82	10/6
6BW6	10/6	6X5	9/-	DL92	9/-	PEN25	8/6
6C4	7/6	6AK5	10/6	DL94	8/-	SP61	8/6
6C6	7/6	7S7	9/6	E1148	4/6	U22	9/6
6D6	7/6	9D2	5/6	EA50	2/-	U25	12/6
6F6	9/6	12A6	7/6	6AL5	7/6	MU14	9/6
6H6M	3/6	12AX7	10/6	EB34	2/6	ECL80	12/6
6J5	7/6	12AT7	10/6				

Huge Stock B.V.A. Valves at 1951 low tax prices.

SPECIAL PRICE PER SET
1R5, IT4, 1S5 and 3S4 or 3V4 ... ... 30/-
6K8, 6K7, 6Q7, 6V6, 5Z4 or 6X5 ... 37/6

SUB MINIATURE VALVES
WIRE ENDS

★ R.F. Pent. .625 v. Fil.
● L.F. Pent. 1.25 v. Fil.

Brand New, Ex Deaf Aid Apparatus, by Mullard, Hivac and American. Types :—

★ XFW 10 ● XFY11
★ XFW 20 ● XFY32
★ 505 AX ● DL66
★ DF66 ● DL72
★ DF70 ● 503AX
● 505AX

all at **7/6** each post free

VCR97 £2
TESTED FULL PICTURE
P. & P. 2/-

CRYSTAL DIODE.—Very sensitive. G.E.C., **3/6**.
H.R. PHONES.—(Hi-grade Amer.), **15/6** pr. **S. G. BROWN'S,** 4,000 ohms, **15/6** pr.

T.R.S. RADIO COMPONENT SPECIALISTS

THO 1665. Buses 133 or 68 pass door.
307, WHITEHORSE ROAD, WEST CROYDON
open all day SATURDAY
P. and P., 6d. £1 orders post free. Lists 3d.
ALL MAINS TRANS.—1/- extra postage.

PYE Aerial Plug and Socket, **1/6** pr.
5in. RADIO SCREWDRIVERS.—Sheffield made blade, 2½in. x ¼in. Ins. handle, 5,000 v., **4½d.** each.
CONDENSERS.—New Stock .001 mfd. 6 kV. T.C.C., **5/6**. Ditto, 12.5 kV., **9/6** ; 2 pf. to 500 pf. Mica, **6d.** ; .001, Mica or Tub. T.C.C. 500 v., .01 Sprague 500 v., .02 N.S.F. 500 v. .1 mfd. 350 v. Micamould Tub., **9d.** ; Hunts Moldseal 500 v. .005, .01 mfd., **9d.** ; .05 mfd. and .1 mfd., **1/-**. .25 mfd., **1/6** ; .1 mfd., 600 v., **1/3** ; Tubular .5 mfd., 350 v., **1/9**.
SILVER MICA CONDENSERS.—10%. 5 pf. to 500 pf., **1/-**. 600 pf. to 3,000 pf., **1/3**.
DITTO 1% (ex stock). 1.5 pf. to 500 pf., **1/9**. 515 pf. to 1,000 pf., **2/-**.

ELECTROLYTICS ALL TYPES NEW STOCK.

Tubular Wire ends		50/25 v. Plessey	1/9
8+16/500 v. Dubilier	5/6	50/50 v. Plessey	2/-
16+16/500 v. Dub.	6/-	**Can Types, Clips, 3d. ea.**	
32+32/500 v. Dub.	7/6	32+32/350 v. B.E.C.	4/6
1/275 v. B.E.C.	2/-	32+32/275 v. B.E.C.	4/6
2/450 v. B.E.C.	2/3	16/450 v. T.C.C.	3/6
4/350 v. Dub.	1/6	32/350 v. Dubilier	4/-
4/500 v. Hunts	2/-	60/350 v. T.C.C.	6/6
8/450 v. B.E.C.	2/3	250/350 v. B.E.C.	8/6
8/450 v. T.C.C.	2/9	8+16/450 v. B.E.C.	5/-
8/500 v. Dubilier	2/9	8+16/500 v. Dubilier	5/6
10/500 v. Dubilier	2/6	16+16/450 v. B.E.D.	5/6
16/500 v. Dubilier	4/-	16+32/350 v. T.C.C.	4/6
8+8/500 v. Dubilier	4/6	32+32/450 v. B.E.C.	6/6
16/350 v. B.E.C.	3/-	32+32/350 v. + 25/25 v.	
32/350 v. Dubilier	4/-	in same can B.E.C.	6/6
32/500 v. Dubilier	5/-	60+100/350 v. Hunts	11/6
32+32/350 v. Dub.	5/6	100+200/275 v. B.E.C.	
25/25 v. Dubilier	1/9		12/6

SPECIALS.—Can Types. 500 mfd. 12 v., **3/-** ; 1,000 mfd.+1,000 mfd., 6 v., **6/6** ; 6,000 mfd. 6 v., **5/6** ; 1,500 mfd. 6 v., **4/6** ; .1 mfd. 1.5 kV., **3/6** ;
SENTERCEL RECTIFIERS. E.H.T. TYPE FLY-BACK VOLTAGES.—K3/25 2 kV., **4/3** ; K3/40 3.2 kV., **6/-** ; K3/45, 3.6 kV., **6/6** ; K3/50 4 kV., **7/3** ; K3/100 8 kV., **12/6** ; K3/160 14 kV., **18/-**. **MAINS TYPE.**—RM1, 125 v., 60 ma., **4/-** ; RM2, 100 ma., **4/9** ; RM3, 120 ma., **5/9** ; RM4 250 v. 275 ma., **16/-**.
KNOBS, GOLD ENGRAVED.—Walnut or Ivory, 1⅝ in. diam., **1/6** each. "Focus," "Contrast," "Brilliant," "Brilliance—On-Off," "On-Off," "Volume," "Vol.—On-Off," "Tone," "Tuning," "Treble," "Bass," "Wavechange," "Radio-Gram," "S., M., L., Gram.," "Record-Play," "Brightness," Ditto not engraved, **1/-** each.
POINTER KNOBS.—Brown with white marking line, small, **9d.**, large, **1/-**.
COILS.—Wearite "P" type, **2/6** each. Osmor "Q" Type, adj. dust core, **3/6** each. All ranges.
REACTION COND.—.0001, .0003, .0005 mfd., **3/6** ea.
E.H.T. TRANSF. 4 kV. A.C., 2 v. 2 a., **45/-**.
VIBRATOR TRANS.—6 v. input, 250 v. 50 ma. output, **9/6**. P. & P., **1/-**.
VIBRATORS.—4-pin 6 v. and 12 v. Mallory, etc., **7/6**.

ALUMINIUM CHASSIS.—18 swg. Plain undrilled, folded 4 sides and riveted corners, lattice fixing holes. Strong and soundly constructed with 2½in. sides. 7in. x 4in., 4/6 ; 11in. x 7in., 6/9 ; 13in. x 9in., 8/6 ; 14in. x 11in., 10/6 ; and 18in. x 16in. x 3in., 16/6.

CHARGER TRANS. PRIM.—0/200/250 v., Sec., 0-9 v.-15 v. (for charging 6 v. and 12 v.) 1.5a., **13/6** ; 2a., **16/-** ; 3 a., **18/6** & 4 a., **21/-**. 6 a., **26/-**.
FULL WAVE BRIDGE SELENIUM RECTIFIERS.—6 or 12 v. 1½ amp., **8/9** ; 3 a., **12/6** ; 4 a., **15/-** ; 6 a., **23/6**. Ditto F.W. only 6 v., 1 a. (9 v.-0-9 v. A.C.), **5/6**.
ACID HYDROMETER.—New ex-Govt. Unbreakable. Packed in metal case, 7in. x 1¼in. dia., **4/6**.
H.F. MIDGET CHOKES.—14 M.H., **2/6** each.
BRIMISTORS.—CZ1 for 3 a. heater chains, **3/6**. CZ2 for .15 a., or .2 a., **2/6**. CZ3 (Pilot Lamp), **1/6**.
COPPER ENAMEL WIRE.—¼ lb. 14 to 20 s.w.g., **2/-** ; 22 to 28 s.w.g., **2/6** ; 30 to 40 s.w.g., **3/6**.
SWITCH CLEANER Fluid, squirt spout, **3/9** tin.
TWIN GANG TUNING CONDENSERS.—.0005 mfd. midget with trimmers, **8/6** ; 375 pf. midget less trimmers, **6/6** ; .0005 Standard size with trimmers and feet, **9/-** ; less trimmers, **8/-** ; ditto, soiled, **2/6**.
VIBRATOR POWER PACK (Jeff-Travis-U.S.A.).—Compact Steel Case 7in. x 6in. x 4in. 12 v. Input. Output, 90 v. H.T., 6 v. and 1.5 v. L.T. Complete, **25/-** ; p. & p., **2/6**. Suitable Battery Portable Sets.
LOUDSPEAKERS P.M., 3 OHM
3in. Plessey, **12/6**. Goodmans 4in., (square) **15/6** ; 5in., **14/6**, 6½in., **16/-**. 8in. R. & A., **17/6**. 10in. R. & A., **25/-**. 6½in. with trans., 7,000 ohms to 3, **19/6**

I.F. TRANSFORMERS

465 Kc/s Slug tuning Miniature Circular Can, 2½in. by 1¼in. diam. Fits octal V-holder cut out. High Q and good bandwidth. By Pye Radio. Two mounting feet.

BRAND NEW, 6/9 PAIR

Positively the 2 BEST T/Vs yet built for the Home Constructor!

The STERN'S "TELE-VIEWERS"

5 CHANNEL SUPERHET RECEIVERS

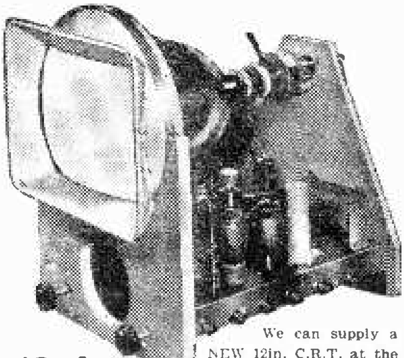
Suitable for any transmitting channel and for which commercial adaptors will be available.

PERFECT PICTURE QUALITY

SIMPLE DIAGRAMS MAKE CONSTRUCTION EASY

PERFECT FRINGE AREA RECEPTION

BETTER RECEPTION AT HALF COMMERCIAL COST



This is the 12" **TELE-VIEWER** and can be completely built for only **£28-16-4** (Plus cost of C.R.T.)

We can supply a NEW 12in. C.R.T. at the specially reduced price of £12.19.6. (Carr. & Ins., 15/- extra.)

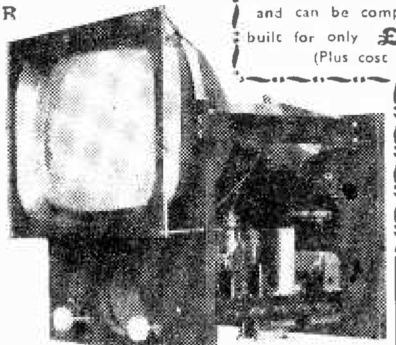
The "WIDE-ANGLE" TELE-VIEWER

- ★ This is the most efficient large screen TV yet offered to constructors.
- ★ Excellent Time Base efficiency producing 15 to 16 Kv with ample scanning power for C.R.T.'s up to 17 inch.

CAN BE COMPLETELY BUILT FOR

£33-0-0

(Plus cost of C.R.T.)



The complete set of ASSEMBLY INSTRUCTIONS for these T Vs are available for 5/- each. They include really detailed PRACTICAL LAYOUTS, WIRING DATA AND COMPONENT PRICE LIST. ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE. AN ATTRACTIVE TABLE MODEL CABINET FOR THE 12in. Model IS AVAILABLE FOR £6.19.6.

STERN RADIO LTD.

109 & 115, FLEET STREET, E.C.4.

Tel.: CENTRAL 5812-3-4.

ALPHA — BARGAINS FOR EVERYONE

ROTARY SWITCH
4 position 30 amp. ... ... 4/- ea.

SPINDLE COUPLERS
Brass for ¼in. spindles, with two Grub Screws ... ... 6½d. ea.

IRON ELEMENTS
H.M.V. Replacement Element 3/- ea.
Standard Elements will fit most makes ... ... 1/3 ea.

RUBBER GROMMETS
Mixed sizes ... ... 6d. doz.

GRID CAPS
I. Octal Push-on type ... 6d. doz.
British Screened type ... 3d. ea.
I. Octal Screened type ... 3d. ea.

ARMOUR PLATED GLASS
Size 13in. x 10½in. rounded corners ... ... 4/- ea.

INDICATOR LAMPS
Single hole fixing (Red only) 1/9 ea.
Spring fixing type ... ... 9d. ea.

LATEST TYPE PRE AMPLIFIER
Well known maker. Chassis size 4¼ x 2¼ x 1. Co-axial input and output. With valve EF42 ... ... 29/- ea.
Post 1/6

ION TRAPS
Type IT6 for Tubes with 35 mm. neck diameter ... 2/6 ea.

42in. EXPONENTIAL HORNS
New and unused, 1½in. fitting. 28in. square flare, weight approx. 25 lbs. ... 59/6 ea.
Carriage 8/6

VITAVOX PRESSURE UNIT
20 watts heavy duty, to fit the above horns ... ... 87/6 ea.
Carriage 5/6

"RECTAFORMA" Battery Charger
Size 10in. x 5in. x 7in. in Gray crackle case with switch for switching to either 6V or 12V at half or full charge. Two Fuses are also incorporated, a 1 amp. fuse for mains and a 5 amp. fuse for L.T., and are accessible from outside, a mounted ammeter is also affixed to show rate of charge ... 84/- ea.

"CLEM" Travelling Iron with Asbestos Stand
Size 4in. x 2in. x 2¾in., including handle, complete with lead and switch to enable it to be used on any voltage between 110 and 250 v. A.B.C. adaptor is fitted on the lead. (Colour as available: Blue, Green, etc.) ... 21/- ea.

4 mfd. Block Condensers 1,500 v. ... ... 4/- ea.

SELF TAPPING SCREWS (PK)
No. 4. ½in. long ... ... 3½d. doz.

Paxolin Sheet, 6in. x 6in. x 1/32in. ... ... 1/6 ea.

TORCHES
2 Cell Torch complete with bulb and 2 U2 type batteries 2/- ea.
Cycle Rear Lamps complete with bulb and battery ... 1/6 ea.
Electric Light Check Meters. 10 amp. type in good condition ... ... 15/- ea.

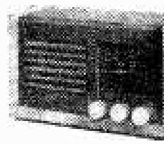
HEADPHONES—MICROPHONES, Etc.
Ex Government Headphones by S. G. Brown, Etc.
CLR Low resistance type 120 ohms ... ... 7/6 pr.
CHR High resistance type 4,000 ohms ... ... 11/- pr.
DHR a super phone ... 13/6 pr.
American phones by Trimm Mfg. Co. of Chicago, U.S.A., 1,200 ohms, each earpiece ... 13/9 pr.
Headbands wide type ... 1/3 ea.
Throat microphones, American surplus. Complete with strap, lead and plug type T30B ... ... 4/- set
"Regent" Hand Microphone Crystal insert, nickel chrome plated head complete with lead and Jack plug listed at 2 Gns. Our price ... ... 21/- ea.
Throat Microphones type Za.21095. 2 units per box. 1/8 per box
Acos Microphone insert type MIC 18 ... ... 3/9 ea.

FUSES
½, 1, 1½, 2, 3, 5 amp. 1¼in. Standard Cartridge Fuses ... 3½d. ea.
Panel Mounting Press Switch 1/3 ea.

"SATCHWELL" THERMOSTAT
Complete with mounting bracket and including 2 space heating units, 230 v., 230 w. ... ... 35/- set

CARRYING CASE
Suitable for use as a projector or recording case, size 15in. x 9¾in. x 13in. Internal dimensions: 14in. long, 11¾ in. deep, 5¾in. front HT. 8¾in. rear HT. With a black rexine finish. Weight 8¾ lbs. 13/6 ea.
Post and Packing 2/6.

FOR BUILDING—T.R.F. OR SUPERHET, THIS IS THE MOST POPULAR CABINET ON SALE TO-DAY.



Complete with drilled chassis, dial, back plate, pointer, dial drive and drum, etc. Price 27/6. Post 2/-.

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5/6 VINCES CHAMBERS, VICTORIA SQUARE, LEEDS 1.

RADIO SUPPLY CO. (Leeds) LTD.

32, THE CALLS, LEEDS, 2

Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/- extra under 10/-. 1/6 extra under £1. 2/- extra under £2, 2/6 extra under £3. Open 9 to 5.30, Sats. until 1 p.m. Catalogue 6d. Trade List 5d. S.A.E. please with enquiries.

SELENIUM RECTIFIERS

L.T. Types
2/6 v. ½ a. H.W.. **1/9**
6/12 v. ½ a. H.W., **2/9**

F.W. Bridge Type
6/12 v. 1 a. **4/9**
6 12 v. 2 a. **8/9**
6,12 v. 4 a. **14/9**
6 12 v. 6 a. **19/9**
6/12 v. 10 a. **29/9**

H.T. Types H.W.
120 v. 40 mA. **3/9**
RM2 125 v. 100 m/A, **3/11**
RM3 125 v. 124 mA. **4 9**
250 v. 50 mA, **5/9**
250 v. 80 mA. **6/11**
RM4 250 v. 250 mA. **10/11**

EX-GOVT. TRANSFS. 230 v 50 c/cs. Following suitable for chargers, etc., 8.8 v. 4 a., **9/9** ; 0-11-22 v. 30 a., **72/6** ; 0-11-22 v. 15 a., **35/9** ; 0-16-18-20 v. 35 a., **79/6** ; 7.7 v. 7 a. C.T. 4 times, **25/9**.

Misc. Types 250-0-250 v. 40 mA. 6.3 v. 2 a. 5 v. 2 a., **9/11** ; 48 v. 1 a., **9/9** ; 460 v. 200 mA. 6.3 v. 5 a., **27/9** ; 400 v. C.T. 150 mA, 4 v. 6 a., 6.3 v. 6 a, 6.3 v. 0.6 a, 4 v. 6 a, 4 v. 3 a, 4 v. 3 a, 4 v. 3 a, 5 v. 2 a, **22/9** ; 1,220 v. 350 mA, 610-0-610 v. 150 mA, 300-0-300 v. 150 mA, **29/9** ; 865-775-690-0-690-775-865 v. 500 mA. **29/6** ; 4 v. 2.5 a, **4/9** ; 4 v. 6 a, High Ins., **7/9**. 250-0-250 v. 200 mA. 6.3 v. 8 a, 5 v. 3 a, **22/9**.

EX-GOVT. AUTO TRANSFORMERS Double Wound. 50 c/cs. 0-230 v. to 15-10-5-0-195-215-235 v. 200 watts, **26/9** ; 10-0-200-220-240 v. to 10-0-275-295-315 v. 500 watts, **69/6** ; 0-230 v. to 0-230 v. tapped every 11 volts ; from 57.5 v. 5,000 watts (21 amps.), **£6/15/-**. Where 110 v. input or output is required primary and secondary windings can be connected in series.
Single winding 0-110-190-230 v. 1,400 watts. **49/6.**

RHEOSTATS (Variable Resistors) Suitable chargers, speed control, etc. 2 ohm, 5 a, **7/9** ; 7.5 ohm, 5 a, **7/9** ; 0.4 ohm, 25 a, **8/9** ; 50 ohm, 1.5 a, **11/9**. Complete with Control Knob.

AMPLIFIER OR CHARGER CASES Size approx. 15 x 5½ x 7in. high. Strongly made in perforated steel. Finished in grey enamel, **9/6**.

AMMETERS Moving Coil G.E.C. 0-5 amps, 2in. scale, **11/9**.

EX-GOVT. SMOOTHING CHOKES

250 mA, 10 H 50 ohms	**14/9**
250 mA, 10 H 100 ohms	**14 9**
150 mA, 10 H 100 ohms	**11/9**
100 mA, 10 H 150 ohms Trop.	**6/9**
50 mA, 5-10 H 200 ohms	**2/9**
L.T. type 1 amp.	**2/9**

EX-GOVT. METAL BLOCK (PAPER) CONDENSERS 4 mfd. 500 v., **2/9** ; 4 mfd. 750 v., **3/9** ; 4 mfd. 1,500 v., **4/9** ; 4 mfd. 2,000 v., **7/9** ; 6-6 mfd. 400 v., **5/11** ; 8-8 mfd. 500 v., **6/11** ; 4 mfd. 400 v., plus 2 mfd. 250 v., **1/11** ; 8 mfd. 500 v., **4/9** ; 15 mfd. 500 v., **6/9**.

EX-GOVT. E.H.T. SMOOTHERS .02 mfd. 8,000 v. cans, **1/11** ; .25 mfd. 4,000 v. Blocks, **4/9** ; .5 mfd. 2,500 v. Blocks, **3/9** ; .5 mfd. 3,500 v. cans, **3/3** ; 1.5 mfd. 4,000 v. Blocks, **5/9** ; .1 mfd., plus .1 mfd. large Blocks 8,000 v., **9/6**.

RF26 UNITS, BRAND NEW, CARTONED. Only **39/6**. Carr. 2/6.

EX-GOVT. TRANSMITTER-RECEIVERS. Type TR9D, complete with all valves, **47/6**, carr. 5/-.

EX-GOVT. ACCUMULATORS With Non-Spill Vents. Unused and guaranteed 2 v. 16 A.H., **5/9** each or 3 in. wood carrying case 9 x 7 x 5ins., **14/9**, plus 5/- carr.

MIDGET MAINS TRANSFORMER. Manufacturers' Surplus. Primary 220/240 v. Secs. 250-0-250 v. 50 mA, 6.3 v 2 a. Only **8/9**.

TV. PREAMPLIFIER (Plessey) For Fringe Areas. Brand New. Complete with 6F13 valve. Only **22/6**.

LONDEX RELAYS. For 230 v. 50 c/cs. mains input, **4/9**.

R.S.C. MASTER INTERCOMM. UNIT, with provision for up to 4 " Listen—Talk Back units " individually switched. A high gain amplifier allows speech emanating from the rooms containing remote control units to be heard at the master control. The unit is in kit form and point-to-point wiring, diagrams are supplied. A walnut veneered wood or Brown-Bakelite cabinet is included. Mains input is 200-250 v. 50 c/s. H.T. line 300 v. CHASSIS IS NOT " ALIVE." Ideal also for use as " Baby Alarm." Sound amplification 4 watts. Price only **£5/19/6**. " Listen—Talk Back Unit " in walnut veneer or bakelite cabinet can be supplied at **30/-** each. Full descriptive leaflet 10d. The Master Unit can be supplied assembled and tested for **30/-** extra.

EX-GOVT. VALVES (NEW)

	Each		Each		Each
IT4	7/9	6SK7Met	7/9	35Z4GT	10/6
IR5	7/9	6Q7G	9/11	AC5PenDD	9/9
1S5	7/9	6SN7GT	9/9		
3V4	7/9	6V6G	8/9	EBC33	7 9
3S4	7/9	6V6GT	7/9	EF36	5/9
5Y3G	8/9	6X5GT	8/9	EB91	8/9
5U4G	10/6	8D2	2/11	EF91	6/9
5Z4G	9/6	807	7/11	EL33	9/6
6F6G	7/9	9D2	2/11	MU14	8/9
6AM6	6/9	12A6	7/9	MS/Pen	5/9
6J5G	5/9	12K7GT	10/6	SP4	5/9
6J7G	6/6	12Q7GT	10/6	SP41	1/11
6K7G	5/11	15D2	4/9	SP61	2/9
6K8G	8/11	25Z4G	9/6	VU120	2/11

H.T. ELIMINATOR AND TRICKLE CHARGER KIT. Input 200-250 v. A.C. Output 120 v. 40 mA, fully smoothed, and rectified supply to charge 2 v. acc. Price with steel case and circuit, **29/6**. Or ready for use, **8/9** extra.

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 40, 50, 100, 120, 150, 200, 230, 300, 400, 500, 1,000 (.001 mfd.), 2,000 pfd. (.002 mfd.), **5d.** each ; **3/9** doz. One type.

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1070 Harrow Road, London, N.W.10.

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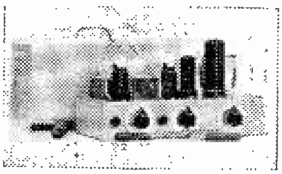

AMPLIFIERS College General Purpose, ready to use, units. **Model AC10E** (as illustrated). 10 watt, 4 valve unit, Neg. Feedback, **Separate Pentode** mike Stage and **Separate Mike** and Gram Inputs, 2 Faders and Tone Control, **£10.7.6. Model AC15E** 6 Valve Unit with P/Pull Output of 14-15 watts. **Separate Pentode** Mike Stage and **Separate** Mike and Gram Inputs, 2 Faders and Tone Control. Feedback over 3 Stages **£14.14.0. Model AC32E** larger version of AC15E with output of 32 watts **£19.15.0. Model U10E** for D.C./A.C. Mains. SPEC. as AC15E output 9-10 watts, 6 valves, **£12.19.6.** All the above amplifiers are **complete with cases** and chrome handles. Outputs match 3, 8 or 15 ohm speaker. All A.C. models (inc. Q9C) have H.T., L.T. outlet for tuning unit, etc. All amplifiers are enclosed and have sectionalised output transformers with Super Silcor Laminations.

QUALITY AMPLIFIER CHASSIS for Records/Radio and Crystal Pick-up. **Model Q9C** 6 Valve Unit with Bass and Treble Controls. Williamson 18 Section Output Transformer. Output 9 watts push-pull. Input switching for L.P./Standard/Radio. Adjustable Neg. Feedback. **£14.14.0.** Stamp for fuller details of above Amplifiers.

MICROPHONES AND PLAYERS. Full range for use with our Amplifiers. Latest ACOS, Collaro, B.S.R. and Garrard types available. B.S.R. 3-speed Single Player in Rexine Case, **£9.9.0.** Three-Speed Auto-Changer (mixed) version, Monarch Changer **£16.16.0.**

SPEAKERS QUALITY TYPES. W.B. H.F. 8in. **60/6** ; 9in. **67/-** ; 10in. **73/6.** Goodmans Axiom 150 **£10.7.6.** Audiom 60 **£8.12.6.**

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ALL GOODS AVAILABLE ON ONE-THIRD DEPOSIT. BALANCE OVER 12 MONTHS. ALL GOODS ARE BRAND NEW AND CARRIAGE FREE. DEMONSTRATIONS DAILY. NEAREST STATION KENSAL GREEN.

CUT PRICE RADIO VALVES

2/- each

Pen220	SP41	EA50	D1
RK34	7193	VR135	EB34
CV18	HL2	VU133	954

2/6 each

SP61	VU111	CV73	EF36
VP41	2X2	6H6	ML6

5/- each

EF54	EC52	EC54	1299A
CV188	PT15	12J5	12H6
6SK7GT	6B4	CV63	S130
TT11	CV201	CV283	CV287

EF50	4/-	6V6	8/6	6Q7	8/6	6K7	6/-
6J5	5/-	6K8	11/-	6SA7	8/6	6AM6	7/6
9BW6	9/-	6BW6	7/6	6SN7	9/-	5Z4	8/6
5Z3	8/6	5U4G	9/-	EF39	7/6	EL32	6/6
EBC33	7/6	1T4	7/-	1S4	7/-	1S5	7/6
1R5	7/-	3S4	8/-	3V4	7/6	3A4	7/6
6AC7	7/6	6SL7	7/6	VR116	3/-	6X5	7/6

TR38 Set. Complete with Valves. **38/-.**
TR48 Set. Complete with Valves. **£4.**
Write for details of TX and RX in stock. T1403, 18 Set, 19 Set, Type 2, etc.

CONDENSERS.—Electrolytic B.E.C. 450 volt wkg. 8 mfd., 2/-. 8+8 mfd., 3/9. 16+16 mfd., 4/6. 32+32 mfd., 6/-. Dubilier 500 volt wkg. 20 mfd., 3/-. 32 mfd., 5/-. Bias Condensers, 25/25 or 50/50 volt, 2/- each.

POTENTIOMETER.—All values to 2 Meg., 2/6 each. ¼, ½, 1, 2 Meg. with Switch, 4/- each.

MIXED CONDENSERS.—pf.—.1 mfd., 3/- dozen. Mixed.

RESISTORS.—Our Selection, ¼-2 w., 2/6 doz., 12/6 100.

POTENTIOMETERS.—Mixed Dozen, 18/-.

SIEMEN HIGH SPEED RELAYS.—1,700-1,700 W, 10/- each. Crystal Diode, R.C.A., etc., Sylvania, 3/- each.

VINER'S (Middlesbrough),
26, EAST STREET, MIDDLESBROUGH,
Telephone : MID 3418

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(Dept. PW) 42 TOTTENHAM CT. RD., LONDON, W.1. Telephones : LANGHAM 1151/2

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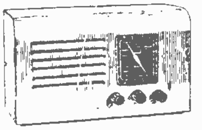
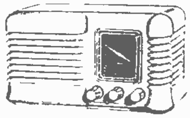


We can supply all the parts (including valves, 5in. moving coil speaker, cabinet, chassis, and everything down to the last nut and bolt) to enable YOU to build a professional-looking radio. The chassis is punched and drilled ready to mount the components. There is a choice of any of three attractive cabinets 12in. long, 5in. wide by 6in. high, as follows: either ivory or brown bakelite, or wooden, finished in walnut. Complete and easy-to-follow point-to-point and circuit wiring diagrams supplied.



MODEL 1. T.R.F. RECEIVER

This is a 3 valve plus metal rectifier T.R.F. receiver with a valve line-up as follows : 6K7 (HF), 6J7 (Det) and 6V6 (Output). The dial is illuminated and when assembled the receiver presents a very attractive appearance. Coverage is for the Medium and Long Wave bands. Operates on 200/250 volts A.C. Mains.

Plus 2/6 Packing, Carriage, Insur. **£5.10.0**

MODEL 2. SUPERHET RECEIVER

This is a powerful midget 4 valve plus metal rectifier Superhet Receiver with a valve line-up as follows : 6K8, 6K7, 6Q7 6V6. The dial is illuminated and coverage is for the Short Wave bands between 16-50 metres, the Medium Wave bands between 190-540 metres, and the Long Wave bands between 1,000-2,000 metres. Operates on 200/250 volts A.C. mains.

Plus 2/6 Packing, Carriage, Insur. **£7.19.6**

T.R.F. RECEIVER We can supply this Receiver ready built at £6 15s. 6d. plus 3/6 p.c.

ALL COMPONENTS SUPPLIED ARE GUARANTEED FOR ONE YEAR

NOTE : We would respectfully suggest to those interested in building this receiver that they send for OUR Instruction Booklet. Intending constructors can then judge for THEMSELVES how comprehensive this Booklet is.

Instruction Booklet and priced Parts List for either of the above available separately at 1/-. This money will be refunded if circuit diagram is returned as NEW within 7 days.

When ordering please state Model No.

MAINS NOISE SUPPRESSOR KIT

Consisting of 2 specially designed chokes and 3 condensers. Extremely effective, cuts out all mains noise. Can be assembled in existing receiver or separately as desired. Complete with circuit diagram **4/3** plus 1/- P.C.

BATTERY CHARGER KIT

Incorporates metal rectifier. Transformer is suitable for A.C. mains 200/250 volts. Charges either 12, 6 or 2 volt accumulator at 1 amp. Complete with circuit diagram. Price **19/11** plus 1/6 post and packing.

WE CARRY LARGE STOCKS OF COMPONENTS AND WELCOME YOUR ENQUIRIES.

TERMS OF BUSINESS : Cash with order (or C.O.D. Post items only) : all orders for small items totalling over £2 post free unless otherwise stated.

4-watt AMPLIFIER KIT

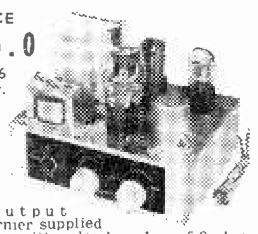
This is a 3 valve 3 stage Amplifier for use with Gramophone, Microphone or Radio. *The line-up is as follows :* 6SL7, 6V6, 5Z4. Negative feed-back. Tone control. Voltage adjustment panel incorporated. 4 watts output. For operation on A.C. Mains 200/250 volts.

The complete Kit includes every item down to the last nut and bolt, drilled and punched chassis, and comprehensive point-to-point wiring circuit diagram. Chassis dimens. : 8in. x 6in. x 2½in.

ALL COMPONENTS SUPPLIED ARE GUARANTEED FOR ONE YEAR

PRICE **£4.5.0**

Plus 2/6 Pkg. Carr. & Ins.



The Output Transformer supplied is for use with a loudspeaker of 3 ohms impedance and we would suggest that the output of the completed amplifier justifies the use of one of the latest W.B. H.F. Speakers which can be supplied as follows: 8in., 60/6 ; 9in., 67/- ; 10in., 73/6. All plus 2/6 pkg., carr. ins.

Circuit Diagram only, available separately at 1/-. To those who require this Amplifier ready-built we can supply it at £5.1.0 plus 3/6 pkg., carr., ins.

NOW OPEN ALL DAY SATURDAYS 9-6 p.m. ● PERSONAL SHOPPERS ALWAYS WELCOMED

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AMERICAN SURPLUS ELECTRONIC EQUIPMENT

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Receiver R54/APR4, complete ...	£200
Transmitter ET4336 ...	£110
Test Set TS13 ...	£100
Frequency Meter TS175/U ...	£80
Frequency Meter BC221 ...	£28
Receiver BC348R ...	£25
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Receivers :	R111/APR5, R5/ARN7, AR88D BC348
Transceivers :	ARC1, TCS, BC800, RT1/APN2
Transmitters :	T11/APN3, ART13
Indicators :	ID17/APN3, BC1151, BC1152
Test Sets :	Any unit with prefix "TS" also IE19, I-208, I-100.
Modulators :	BC1091, BC1142
Synchroniser :	BC1148
Power Units :	RA34, RA42, RA62, RA88, RA90, MG149, PE158, DM28
Tuning Units :	TN17, TN18, TN19, TN54, TU57, TU58, TU59
Control Gear :	BC1150, BC1145, JB91, JB95, JB98, JB102, C45-ARC1.

And almost every American made unit even if not mentioned above.

'Phone us immediately, transfer charge.

TO HAMS WHO PURCHASED BC348, BC342, BC312, etc. Post to us all the bits and pieces which you removed, i.e., plugs, sockets, dynamotors, etc. We will pay you several pounds for this junk. You need not write ; just send it.

TO OVERSEAS BUYERS

We have the largest stock in Europe of American Government surplus electronic equipment and we would be pleased to quote by return of post against your enquiries. The following are a few examples only of the equipment which we can supply from stock.

ET4336 Transmitter **SCR720C Search Radar, complete**
BC348 Receiver **ART13 Transmitter**

Deal with the firm that has been established for twenty-five years.

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JERSEY HOUSE, JERSEY STREET, MANCHESTER 4

Telephone : Central 7834/5/6

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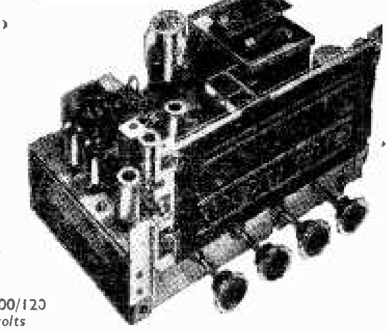


All chassis 11½in. x 7in. x 8½in. high. Latest type valves 6BE6, 6BA6, 6AT6, 6BW6, 6X4. Flywheel tuning. Negative feedback over entire audio section. Engraved knobs. 3 tone positions for radio and gram.

For A.C. Mains 100/120 and 200/250 volts

Model B3.—Long, Medium, Short 5 Valves. Output 3½ watt	**£12/12/0**
Model B3.—Plus Push Pull Stage 6 Valves. Output 6 watt	**£15/15/0**
Model B3.—Double Feature with P Pull & R.F. Stage. 7 Valves. Output 6 watt	**£18/18/0**
Model B6.—Six Wavebands. Med., Long, 4 Short. (3 Bandspread.) 5 valves. Output 3½ w.	**£15/15/0**
Model B6.—Plus Push Pull Stage 6 Valves. Output 6 watt	**£18/18/0**
Model B6.—Double Feature with P/Pull & R.F. Stage. 7 Valves. Output 6 watt	**£23/2/0**

ALL PRICES TAX PAID

Escutcheon for 9in. x 5in. dial, 4/9 extra. Matching speakers P.M. type 3 ohms, 8in. or 10in. available. **Chassis sent under money back guarantee conditions against remittance.** Free particulars from the manufacturers.

THE DULCI CO. LTD.,

99 VILLIERS RD., LONDON, N.W.2. *Telephone : Willesden 7778*

Practical Wireless

EVERY MONTH
VOL. XXX, No. 577, NOVEMBER, 1954

Editor : F. J. CAMM

22nd YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

British Sponsored Programmes

IN our October issue it was stated that we had sponsored radio programmes in this country, but because the BBC merely gave a one-line mention to the advertiser who had bought the programme time the BBC sponsored programmes failed.

As a result of this paragraph several readers have challenged its accuracy, but I can assure them that it is perfectly correct. It is a matter for surprise that no one seems to have remembered this particular era in Britain's broadcasting, and it was never brought out in the Beveridge Report. As a matter, therefore, of historical interest, and to set the matter on record for all time, I give below the history of BBC sponsored programmes :—

A series of three in the spring of 1925 :

March 10th, 1925, 7.30 p.m. *Evening Standard* Programme, with Tetrazzini.

April 21st, 1925, 8 p.m. *News of the World* Concert with Rosina Buckman, Norman Allin and others.

May 19th, 1925, 8 p.m. Concert arranged by the Proprietors of *Answers*, with Moiseiwitsch, Forbes Robertson and Landon Ronald, et al.

There were two further programmes :

October 27th, 1925, 8 p.m. Concert arranged by the *Daily Herald*, introduced by the then Editor of the *Herald*, with John Goss, Hilda Saxe, Miles Malleson, the London Labour Choral Union, the William Morris Choir, the C.W.S. Male Voice Choir, et al.

April 30th, 1926, 6.45 p.m. *Daily Graphic* £500 Mystery Concert, with Gladys Cooper, Gerald du Maurier, Henry Ainley, George Grossmith, Nelson Keys, Father Ronald Knox, Prof. Daniel Jones, de Groot and his Piccadilly Orchestra.

INTERFERENCE

AN important decision which does not seem to have received the publicity it deserves is that the Post Office has made it clear that as from October 1st, 1954, complaints of certain types of TV interference will be investigated only if the receiver complies with the new standard intermediate frequency of 35 Mc/s. This frequency is designed to avoid certain types of interference. Many TV receivers are being sold which do not comply with this frequency, and purchasers should ascertain whether the receiver they intend to purchase does do so. They should find out if the IF is 35 Mc/s, and if it is not they are likely to experience severe interference. The R.S.G.B. has already drawn attention to this matter.

AWARDS FOR TECHNICAL WRITING

A LEAFLET publicising the third year of the Radio Industry Council's awards for outstanding technical writing is being distributed throughout the industry.

The object of the scheme is to encourage the writing and publication of articles reporting the technical progress and development of radio, television and electronics in Great Britain.

The awards will be made at the end of the year and the council, it is stated, looks forward to receiving entries between now and December 31st, from editors and authors.

An editor may call attention to an article in his own journal if he thinks it should be considered for an award. The judges may select an article for an award without their attention being called to it. The writer, however, is asked to take the initiative. He can take no action until his article is published in a journal that is eligible for the competition. On publication he should write to the Secretary of the Radio Industry Council, 59 Russell Square, W.C.1, enclosing five copies of the journal, or of the relevant pages, proofs or reprints, with a request that the article should be considered and a signed declaration that he is eligible under the terms of the competition.

IN NEXT MONTH'S ISSUE

THE first details of the eagerly-awaited 1954 version of the famous " Fury Four " will appear in next month's issue. The original version was first produced in 1933, and many thousands of them have been built and are still in operation. The modern version, however, takes advantage of the new and improved components now available to constructors. The new " Fury Four " will undoubtedly be built in its thousands.

We shall also describe in next month's issue the construction of a new A.C. valve tester, for which readers have been persistently asking during the past year.

Remember, a regular order with your newsagent is the only certain means of ensuring your copy.—F. J. C.

Round the world of WIRELESS

By "QUESTOR"

Broadcast Receiving Licences

THE following statement shows the approximate number of broadcast receiving licences issued during the year ended July, 1954. The grand total of wireless and television licences was 13,477,263.

Region	Number
London Postal ...	1,592,438
Home Counties ...	1,436,959
Midland	1,241,392
North-eastern	1,609,289
North-western... ...	1,248,159
South-western ...	1,008,688
Wales and Border Counties	622,440
Total England and Wales	8,759,365
Scotland	1,040.274
Northern Ireland ...	220,896
Grand Total	10,020,535

25 Years' Service

IN July Mr. C. H. Gardner completed 25 years' service with Mullard, Ltd., and to mark the occasion he was presented with a gold watch and cheque by Mr. L. A. Sawtell, commercial manager, Mullard Entertainment Valve Department, on behalf of the board of directors.

Mr. Gardner handles technical-commercial liaison work with Mullard dealers, to most of whom he is well known personally, having travelled widely over the country. He is also a Fellow and Past President of the Incorporated Practical Radio Engineers, Ltd.

B.I.R.E.

THE following meetings of the British Institution of Radio Engineers will be held during October:

Scottish Section.—Thursday, October 7th, 6.30 p.m., at the Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow. Annual general meeting to be followed at 7 p.m. by a debate—" Does Industry Want Electronics ? "

Merseyside Section.—Thursday, October 7th, 7 p.m., at Liverpool University Buildings, Liverpool, 1. " The Liverpool University Cyclotron "—M. J. Moore. To be followed by a visit of inspection.

North-eastern Section.—Wednesday, October 13th, 6 p.m., at the Neville Hall, Westgate Road, Newcastle-upon-Tyne. " Radio Production "—H. G. Wood, M.A., B.Sc. (British Productivity Council).

London Section.—Wednesday, October 27th, 6 p.m., at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1. Annual general meeting of the Institution to be followed at 7 p.m. by the presidential address of Rear Admiral (L.) Sir Philip Clarke, K.B.E., C.B., D.S.O. Non-members are invited to hear the presidential address.

Mr. C. H. Gardner chats with guests at a celebration of twenty-five years' service with Mullard, Ltd. Left to right: Mr. L. A. Sawtell, Mrs. C. H. Gardner, Mr. C. H. Gardner, Miss H. Perkins, Mr. T. E. Goldup, C.B.E., M.I.E.E.

Show Boosts Sales

ALTHOUGH radio and television manufacturers and dealers were expecting the usual increase in sales after the Radio Show, the big leap in orders this year has been larger than ever before.

Radiograms, too, have sold at an exceptional rate and it is estimated that they will surpass the already high level of sales in the next few months. The main reasons for the " boom " in the buying of wireless sets are the raising of hire-purchase restrictions and the replacing of old pre-war sets since improved models have been demonstrated.

Pye Extension

THE Northern Ireland Ministry of Commerce has agreed to build a further extension to the Government factory at Larne, occupied by Corran Works, Ltd., a subsidiary company of Pye, Ltd.

As Corran Works, Ltd., intends doubling its present output of radio receivers it will mean doubling the production space and the number of workers employed in Larne as well. The expansion is hoped to provide additional jobs for 100 men and 400 women. Mr. J. Gregg, manager of the Larne factory, has stated that one of the reasons for Pye's decision to expand at Larne was the quality of the local labour.

Staff Appointment

GROUP CAPTAIN R. C. RICHMOND has been appointed to the London office of Marconi's Wireless Telegraph Co., Ltd., for duties in connection with that company's aeronautical radio business. His office will be in Marconi House, Strand, London.

Group Captain Richmond was educated at Westminster School and the City and Guilds (Engineering) College and joined the R.A.F. in 1929, taking the specialist signals course.

Listening in Italy

IT is reported from Italy that the number of radio receivers in use in that country now exceeds five million.

In 1939 there were only one million.

New G.P.O. Position

A NEW post, that of Deputy Director-General, has been created for a limited period by the G.P.O. to help cope with the extra amount of broadcasting work.

As from October 18th the position will be filled by Sir Ben Barnett, who will devote all his time to broadcasting, assisted by a second Deputy Director-General, Sir Gordon Radley, who was previously engineer-in-chief.

Radio Telescope

THE biggest radio telescope in the world has been built by the Carnegie Institution of Washington and is being used for the survey of radio noise received on earth from space within the 20 Mc/s range.

The telescope is made up of dipole aerial strung out in a straight line for 2,000 ft. All the dipoles are joined to the recording point by a coaxial cable and consist of two poles 25 ft. apart and 15 ft. high, connected together by very taut wire.

Council's Warning

MR. FRANK SHUTE, an amateur radio transmitter of Wick Farm Road, Littlehampton, has been warned by Littlehampton Urban Council that unless he removes the 250 ft. aerial that he has erected at the back of his council flat he will be given notice to leave.

Mr. Shute transmits regularly and is in contact with other amateurs all over the world. His aerial of thin copper wire stretches from the back bedroom to a 40 ft. pole at the bottom of the garden and on to a bush on waste land behind the house. The council once sent a workman to take down the aerial but Mr. Shute immediately put it back again.

Mobile Radio Users' Association

IN its first six months the above association has succeeded in obtaining official recognition as the appropriate body to negotiate on behalf of users of mobile radio and has played quite a large part in securing the recently announced reduction of licence fees from £5 to £3.

The Mobile Radio Users' Association has now been invited by the Postmaster-General to nominate two members to serve on an informal committee specially set up to advise him on matters concerning mobile radio.

Jubilee of the Valve

NOVEMBER 16th will mark the end of the fiftieth year of the valve, for it was on that date in 1904 that Sir Ambrose Fleming took out the fundamental thermionic valve patent, number 24850, entitled "Improvements in Instruments for Detecting and Measuring Alternating Electric Currents."

The I.E.E. are arranging an exhibition of apparatus and equipment used over the period and three lectures on the development of the valve will be given by Sir Edward Appleton, Professor G. W. O. Howe and Dr. J. Thomson. These lectures are to be delivered on November 16th and the proceedings will be opened by the Lord President of the Council, the Marquess of Salisbury.

Radio Control for Vans

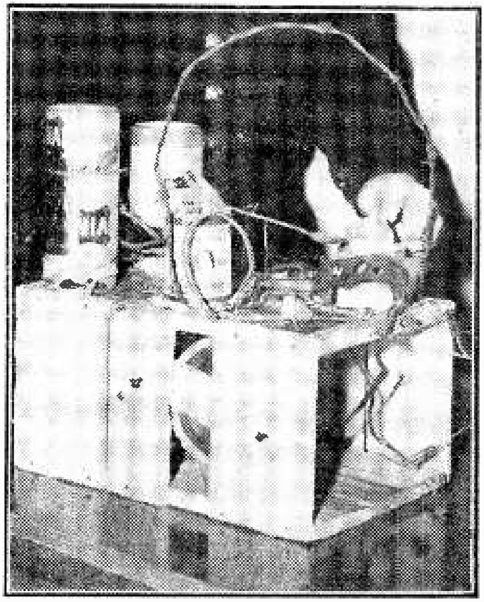
GILLIES AND HENDERSON, LTD., agricultural engineers, of Cupar, Fifeshire, are using mobile radio control to keep all their vans in contact with headquarters.

The radio control is two-way and engineers can now be directed straight from one job to another without the tedious task of reporting "home" first.

"Mailspool"

GRUNDIG, LTD., has produced a miniature spool of 120ft. of tape which permits six minutes of recording on each track. It is known as the "Mailspool" as it is exceptionally convenient for recording messages on and sending through the post.

The spool costs 6s. 9d. (export price 4s.).



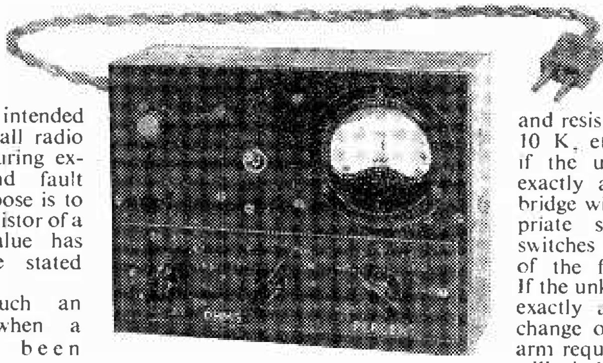
This desert island emergency wireless receiver made from everyday components was demonstrated at the National Radio Show.

Rumours Unfounded

THE rumours that were being circulated during the final period of the Radio Show concerning the selling of the business of Pilot Radio, Ltd., have been strongly denied and may be considered as completely false.

It is reported that there is not the slightest foundation for such rumours and a Pilot official has stated: "No negotiations have taken place in respect of same, nor are they likely to."

A Preferred-Value 'R' Bridge



A USEFUL SERVICE ACCESSORY

By P. W. Ward, B.Sc.(Eng.), A.M.I.E.E.

(Research Laboratories of the General Electric Co., Ltd., Wembley, England)

THIS instrument is intended for testing small radio components during experimental work and fault finding. Its main purpose is to determine whether a resistor of a nominal preferred value has resistance within the stated limits.

One need for such an instrument occurs when a circuit which has been designed on paper does not come up to expectation in practice. It is then desirable to check all components before condemning the design. With complex circuits this is normally a laborious process, but recent experience has shown that its omission may send an investigation seriously astray.

Practical determination of the most suitable preferred value and tolerance of a resistor in a comparatively critical part of a circuit may also be tedious unless resistance can be measured quickly with reasonable accuracy. Again, used components are often employed in experimental work, and it is desirable that these should be tested before they are wired into the circuit.

The instrument is portable, and is to give results quickly and with a minimum of distraction. It has, therefore, had to be made robust and foolproof and its controls have had to be simple. Resistors of 60 preferred values between 100 ohms and 8.2 megohms may be tested. Without extra controls, and with the inclusion internally of only two extra resistors, two additional facilities are incorporated. Coils and transformer windings can be tested for continuity, and capacitors up to one microfarad can be tested at 400 volts to show leakage resistances up to 200 megohms.

While a form of Wheatstone bridge has obviously been required, some modifications of the normal forms of the bridge have been necessary. In particular, numerous decade knobs, a delicate galvanometer, and a galvanometer sensitivity control would all have been undesirable.

The Circuit

The general scheme is to make the unknown resistance one arm of the bridge, to switch resistors of 12 preferred values, 10 K, 12K, 15 K, etc., in a second arm, and resistors of 100 ohms, 1 K, 10 K, etc., in a third. Then if the unknown resistance is exactly a preferred value the bridge will balance with appropriate settings of the two switches when the resistance of the fourth arm is 10 K. If the unknown resistance is not exactly a preferred value the change of value of the fourth arm required to obtain balance will indicate the percentage error of the unknown resistance independently of its nominal value. It would have been convenient if the deflection of the galvanometer could have been made to indicate the percentage error while the fourth arm was fixed, but this is not practicable.

The design then depends upon the theoretical expression for the galvanometer current of a simple Wheatstone bridge as represented by Fig. 1. This expression is :

$$\frac{E(PQ-RS)}{BG\Sigma P+\Sigma QRS+B(P+R)(Q+S)+G(P+S)(Q+R)}$$

where the sigmas involve P, Q, R and S. From this expression it may be deduced that if B is greater than G the two arms of greatest resistance should be either P & R or Q & S ; conversely if B is less than G they should be P & S or Q & R.

Since a very sensitive galvanometer is to be avoided a fairly large value of applied voltage is required for the measurement of resistances of several megohms. To prevent overheating of resistors when lower values of resistance are being measured it is convenient to make B large. We then have a suitable arrangement when R is the unknown resistance, P is switched by factors of 10, Q contains the preferred values and S gives the final balance. Balance then occurs when R=PQ/S. Consequently the calibration of the final balance control must be non-linear unless a specially wound potentiometer is used. This could be avoided by interchanging S & Q, but then irrational resistance values would have to be substituted for the preferred values.

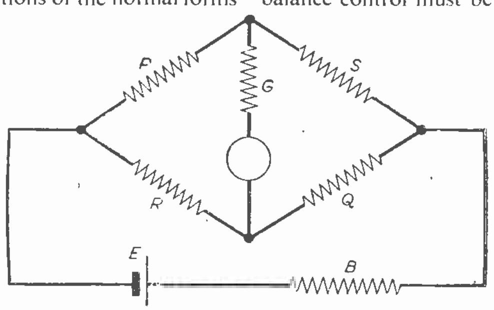


Fig. 1.—Basic bridge circuit.

Supply Volts

The supply voltage for the bridge is obtained from the mains by the transformer T and selenium rectifier W3. A transformer giving approximately 300 volts

R.M.S. on the secondary winding allows 350 volt working condensers to be tested for insulation at 20 per cent. over voltage, and makes the bridge amply sensitive. There is no need for primary taps, since with a primary wound for 240 volts the instrument will work satisfactorily with lower mains voltages. Elaborate smoothing is not necessary, although the 2 μF condenser C is requir d to boost the voltage and to prevent excessive oscillatory torque in the microammeter.

The resistors R19, R20 and R21 limit the voltage applied to the bridge, the appropriate resistors being switched into circuit with the decade resistors R1 to R5. The values of these resistors are calculated to give nearly equal sensitivity for all ranges, and all are sufficient always to prevent appreciable power dissipation in the component being tested. For the highest resistance range the sensitivity is almost independent of the value of the limiting resistance provided that this is reasonably small. This is because the terms PQR and SPQ in the denominator of the theoretical expression for sensitivity then predominate. This range then determines the sensitivity, approximately 10 microamps for 10 per cent. off balance, which is aimed at for all ranges.

At some time during its life the instrument is likely to be switched on with either an open or a short circuit between its terminals. Unless some precaution were taken this would cause excessive current to flow in the microammeter. The conventional variable or by-passed series resistor would involve an extra control and would not completely eliminate the risk of accidental damage. Instead, the microammeter is protected by W1, W2 and R6.

The theoretical law governing the behaviour of germanium diodes with small values of applied voltage shows that within the range of approximately —10mV to +10mV the static resistance of a germanium diode is nearly constant. Since heating effects are negligible in this range the law is followed closely in practice, the resistance of a suitable diode being about 100 K. When the sum of R6 and the resistance of the microammeter is made about 10 K for microammeter currents up to 10 microamps the shunting effect of the germanium diodes then reduces the sensitivity by about only 15 per cent. About one milliamp in the combination of microamneter and diodes will give full-scale deflection of 50 microamps, while about 20 milliamps would be required to cause 100 per cent. overload. The characteristics of the germanium diodes are not critical, and the use of a selected matched pair is not necessary. Type GEX 45/1 has the required characteristics and is inexpensive and readily available.

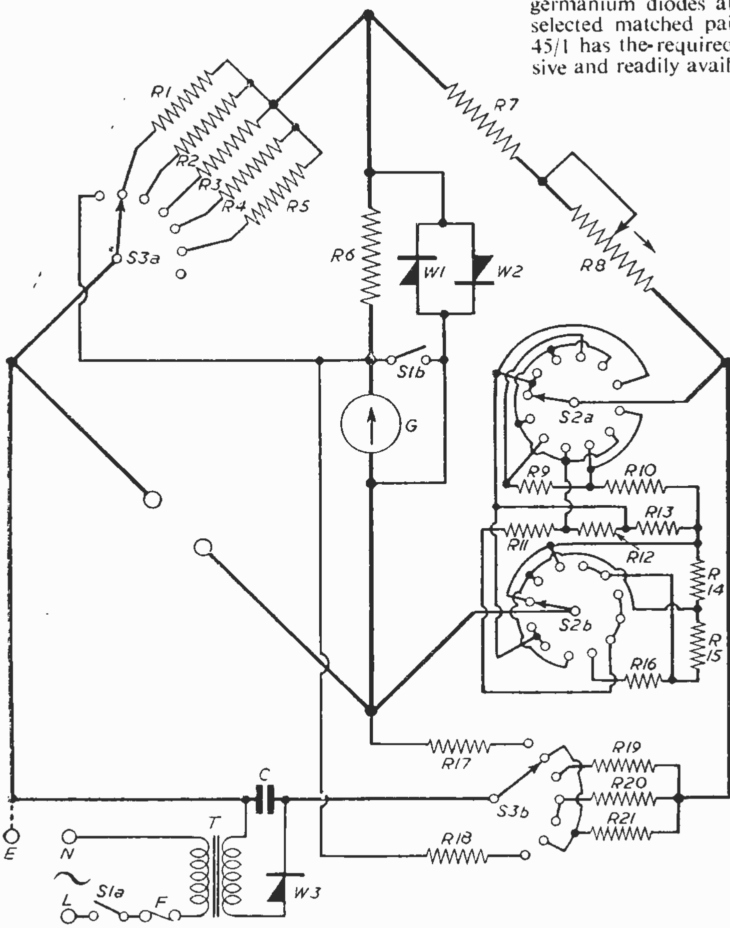


Fig. 2.—Circuit of the bridge described here.

LIST OF COMPONENTS

R1—100Ω ½ w. (1%).
R2—1K ½ w. (1%).
R3, 16—10 K ½ w. (1%).
R4—100 K ½ w. (1%).
R5—1 M ½ w. (1%).
R6—8.2 K ½ w. (10%).
R7—8 K 1 w. (2%).
R8—4.7 K 3 w. wire wound pot.
R9, 10—4 K ½ w. (2%).
R11—56 K ½ w. (1%).
R12—12 K 1 w. (1%).
R13—10 K 1 w. (1%).
R14—5 K ½ w. (1%).
R15—20 K ½ w. (1%).
R17, 18—8.2 M ½ w. (10%).
R19—150 K 1 w. (10%).
R20—470 K 1 w. (10%).
R21—22 K 3 w. (10)%.

C—2 μF 450 v. wkg.

F—100 mA.

G—50-0-50 μA.

W1, 2—Germanium Diodes GEX03 or GEX45/1.
W3—Selenium 28 18mm. plates.

T—240 v., 300 v., 25 mA.

S1—Spring-loaded toggle, 1 make, 1 break.
S2—Wafer, 2 pole, 12 way.
S3—Wafer, 2 pole, 7 way.

Additional protection of the microammeter is provided by contact Slb of the mains switch. This ensures that the movement is damped when the instrument is carried.

There is no need to use 12 resistors for the 12 preferred valves of the arm Q. Seven resistors could be used, or six with extra switch contacts. The net work of eight resistors shown in Fig. 2 is considered preferable, however. Statistical consideration shows probability of greater accuracy with most ranges, while only two one-watt resistors are required for continuous operation on any range. The photograph of the prototype shows resistance coils as used by the Post Office forming the arm Q.

Continuity is detected by setting S3 to the position marked "O." The microammeter pointer is then deflected by current through R17 until a short-circuit is connected between the terminals. Resistances between about 50 ohms and 5,000 ohms give intermediate values of deflection.

Insulation is checked by setting S3 to the position marked "∞" Leakage resistances up to 200 megohms between the terminals then give appreciable deflection.

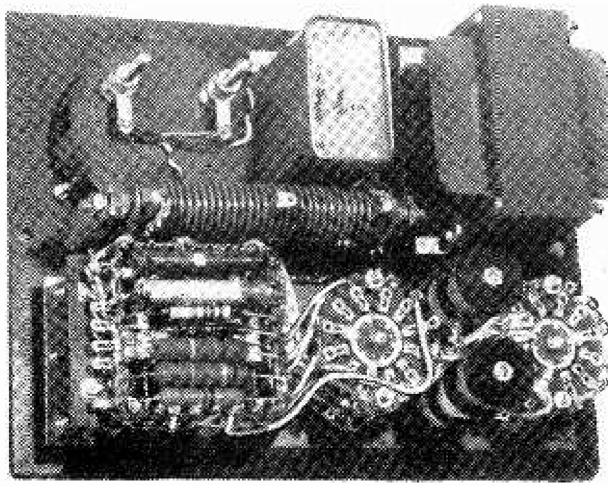


Fig. 3.—Underside view of the bridge.

R18 protects the microammeter if a short circuit is connected.

B.S. for Loudspeakers

THE British Standards Institution has recently issued a standard dealing with methods of "Ascertaining and expressing the performance of loudspeakers by objective measurements." The main aim of the document is not to lay down standards of excellence or figures of merit but to encourage among electro-acoustics laboratories a common approach and a common view-point. Without these it is notoriously difficult for laboratories to exchange information and to build up experience. By defining, however, as closely as practicable, the methods of objective measurement to be followed in ascertaining loudspeaker performance it is hoped to promote interchange of information so that data collected in one laboratory may supplement data collected in another, and be capable of assessment by all, so that the significance to the ear of the various types and degrees of distortion to which loudspeakers are subject may become better understood and more widely documented.

The kind of measurements envisaged are those which might be made, for example, when considering the approval of a production type; they are thus fairly extensive but it is not sought to make them exhaustive. In particular, only objective measurements are considered, but any testing organization approving a type would certainly wish to supplement these by subjective tests.

It is well known that the performance of a loudspeaker is conditioned by its acoustical environment, by the programme material, and by other factors difficult to define, including the listener himself. Accordingly, tests made in the artificially simplified environment of a dead room can convey only a part, though an important part, of the information sought.

Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Price 3s.

TRANSMITTING TOPICS

ECONOMY MODULATORS

By O. J. Russell, B.Sc.(Hons.), G3BHJ

THE subject of economy is not a stranger to the radio amateur. In fact, an acute example usually confronts the transmitting newcomer after his first year of operation. When telephony becomes permissible, the amateur is naturally anxious to experiment with telephony. It is at this point, after calculating the cost of high-power modulators, that he comes up against the economic factors of amateur radio!

A high-power C.W. transmitter may be constructed quite cheaply, even for the full 150 watts now permitted to the beginner. However, a modulator is likely to prove expensive, both on the score of modulation transformers, and on the score of valves and other components. Previous articles have suggested means of avoiding the cost of modulation transformers by using mains transformers. It is also possible to avoid some of the other costs of a modulator by cutting down the non-essentials of conventional modulator designs.

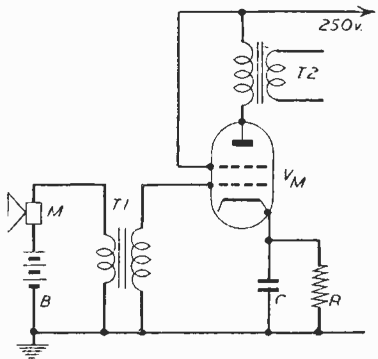


Fig. 1.—The simplest modulator.

T1—High ratio microphone transformer.
T2—Intervalve or small modulation transformer.
M—Carbon microphone.
R—Cathode resistor as recommended by valve maker.
C—2 μF paper or electrolytic. 50 volts working.
B—Microphone battery (1½ to 6 volts).
V_M—6F6, 6V6, 6L6, 6K6, 6Y6, etc.

The "simplest" modulator is the circuit shown in Fig. 1. This uses a carbon microphone fed directly into a sensitive pentode or tetrode output power valve. With a good microphone transformer of the type giving a high step-up ratio, good output may be obtained. The output, in fact, is enough for modulating a small top-band rig, if a 6F6, 6Y6, 6V6 or 6L6 is used as the power valve. Such a unit will anode modulate a small top-band or a small portable rig, or may be used to grid or screen modulate a rig running at much high power. For screen or grid modulation, a small L.F. "intervalve" type of transformer may be used quite satisfactorily in many cases, so that an expensive modulation transformer is not necessary.

Pre-Amplifier

However, while good audio power may be obtained with the circuit of Fig. 1, the addition of a small pre-amplifier stage as in Fig. 2 ensures that adequate grid-driving power is available to swing the tetrode modulator fully, and also saves one from having to shout into an insensitive mike if a high-sensitivity single-button mike is not available. The modulator is then capable of fully swinging a top-band rig for anode modulation, and is adequate for grid or screen modulation of a rig running 150 watts input. Efficiency modulation systems of the grid and screen type were dealt with in these pages in the November, 1953, issue, and beginners may like to refer to that article for information on efficiency modulation systems only requiring a watt or so of audio to modulate large P.A. inputs. An interesting point is that the Mullard valve type ECL80 actually consists of a small triode and an output pentode in the same envelope. By using the triode section as a drive for the pentode section, a sensitive "one valve" modulator on the lines of the Fig. 2 circuit may be evolved.

This brings us to the "efficiency modulator" of Fig. 3. This will produce round about a watt of audio, and uses a 6SN7. One section is used as the pre-amplifier, and the other as the modulator. The output is adequate, if a carbon microphone is used, to efficiency modulate a 50- or 60-watt P.A. input by screen or grid modulation. The output is insufficient

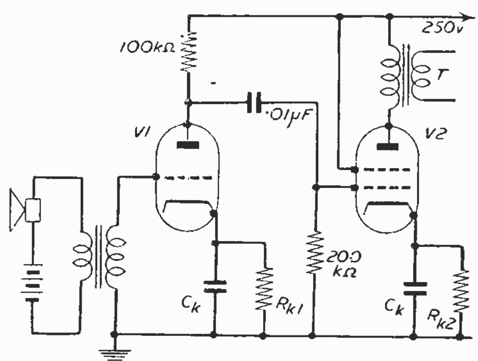


Fig. 2.—A simple two-stage modulator.

R_{K1}, R_{K2}—To suit valves types used. C_K—25 μF, 50 v. electrolytics. V1—6C4, 6C5, 6J5, etc. V2—6F6, 6V6, 5K6, 6Y6, 6L6, etc.

For anode modulation T is a small modulation transformer. For efficiency modulation a small "intervalve" L.F. transformer will be suitable generally.

to anode modulate other than a very low power stage. However, as it is intended only for efficiency modulation work this is unimportant, and inputs up to 60 watts or so may be readily modulated.

Economy may be carried a step further if the popular "clamp" system of screen modulation is employed. The modulation transformer may then be eliminated, so that we are left with the circuit of Fig. 4. This is derived from Fig. 3 by converting to clamp modulation. The value of the resistor used to couple into the P.A. screen circuit will depend upon operating conditions, so that clamp modulator designs should be consulted for the P.A. in use.

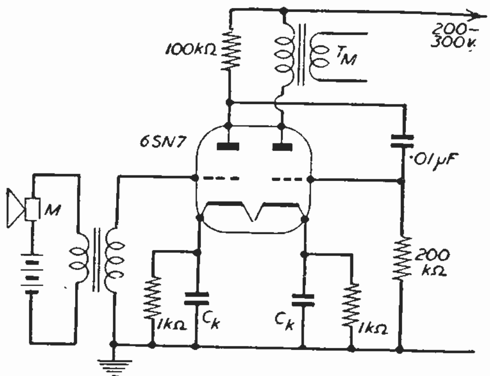


Fig. 3.—A modulator suitable for "efficiency" modulation. An easily obtainable double triode gives a two-stage modulator.
C_K—25 μF 25 v. electrolytics. T_M—"Intervalve" L.F. transformer. M—Carbon microphone.

Despite the simplicity and cheapness of "efficiency" systems, many amateurs require a full-dress push-pull anode modulator. Provided a carbon microphone is used, the circuit of Fig. 5 provides a solution at the minimum expenditure on components. The microphone transformer is resistance centre-tapped, thus providing push-pull drive to a 6SN7 or a 6SL7 stage used in push-pull. This then provides adequate drive for a pair of tetrode modulators. If a pair of 6L6s are used in Class A or Class AB1, then some 25

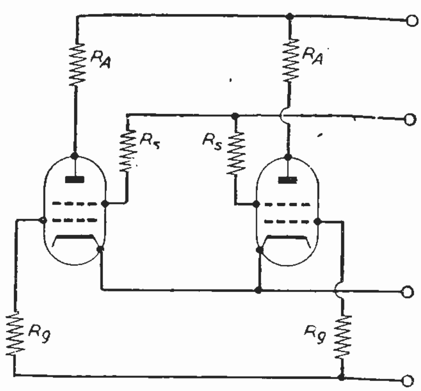


Fig. 6.—Method of paralleling 6L6s or 807s for greater output.
R_A—10 ohms. R_S—47 ohms. R_g—220 ohms.

watts of audio are immediately available. This suffices to anode modulate a 50-watt input Class C P.A., and this is actually as much modulated carrier output as a 100-watt efficiency modulated P.A. stage. Thus without much complication, and provided a suitable modulation transformer capable of handling 25 watts of audio is on hand, a quite respectable performance may be achieved.

More Audio

The amateur may now be fired with ambition, and desire to obtain even more audio. One solution is to replace the 6L6s by 807s when somewhat more

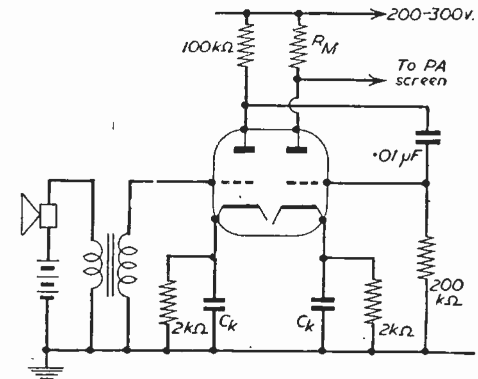


Fig. 4.—A "clamp-tube" version of the 6SN7 modulator for screen modulation of tetrode stages. No modulation transformer is needed.
C_K—25 μF, 2v.w. electrolytics. R_M—Value depends on P.A. valve and operating conditions.

audio still is available. The beginner is warned, however, that the high level Class AB2 and Class B outputs for 6L6 and 807 stages cannot be obtained without special driver transformers and a standard driver stage fed by a pre-amplifier.

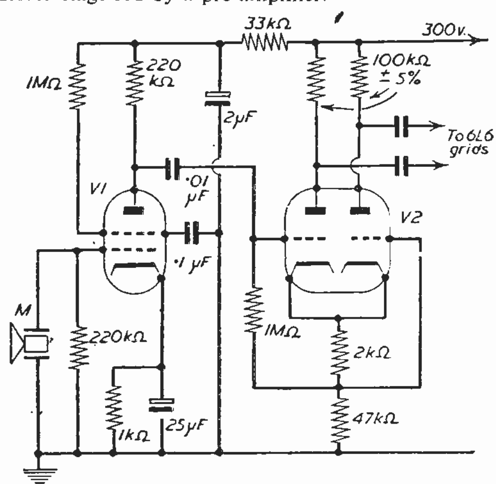


Fig. 7.—Method of modifying the circuit of Fig. 5 to allow a pre-amplifier to be used with a low-level microphone.
V1—6J7, V2—6SN7. M—Crystal Microphone.

This does not prevent still more audio being obtained, however, as the simplest solution is to use four 6L6s or 807s in parallel push-pull as shown in Fig. 6. This enables some 50 watts of audio to be obtained, so that a Class C P.A. running at 100 watts may be modulated. The actual R.F. output will, in fact, be equal to that of a 200-watt stage efficiency-modulated. Hence, the circuit of Fig. 6 provides for a very good power level without complexity. In fact, brave spirits may like to attempt paralleling three valves per side in triple parallel push-pull. This offers enough audio to anode modulate the full legal limit of a 150-watt input P.A. stage. Naturally, of course, a power pack capable of the drain of some 300 mA is required, but this is not a difficult matter.

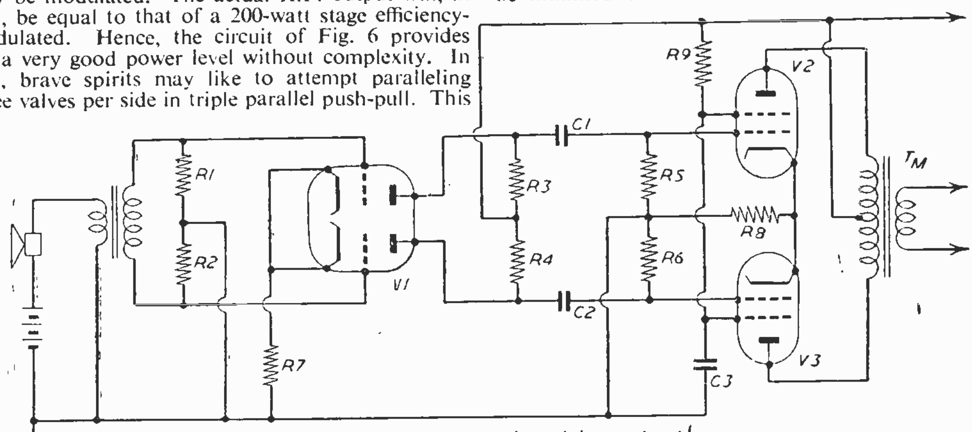


Fig. 5.—A good modulator circuit.

R1, R2, R5, R6—220 K. R3, R4—100 K. (±5%) R7—2 K. R8—250 ohms. R9—10 K. C1, C2—.01. C3—0.1 V1—6SN7. V2, V3—6L6 (or 807). TM—25-watt modulation transformer.

It will be noted that the popular valve types such as the 6SN7 and the 6L6 and 807 have been used for many of these circuits, as they are readily available on the surplus market.

In fact the ingenuity of the amateur will often enable good results to be achieved without any undue expenditure of cash. No difficulty should be found in utilising other valve types than the readily available surplus market types. In fact many of the new valve types might be employed.

Microphone

A final point is that the circuits use a carbon microphone. Good quality may be obtained from single button carbon microphones, but many amateurs prefer something capable of higher quality, or may in fact be prejudiced against the carbon microphones of the single button type. There are, of course, a number of alternatives. On the surplus market, crystal microphone inserts may be obtained from time to time at a very low figure. Also there are many firms now marketing crystal mikes of excellent quality at a very low figure, such as the Cosmocord and the Ronette microphones. Again where the expense of actually buying a microphone is to be avoided, the old standby is the use of a moving-coil loudspeaker as a microphone. This dodge may be new to a number, so that it is repeated here. It is necessary to point out that the speaker should not be mounted on a baffle, but should be used unmounted. If used on a baffle, the bass frequencies are unduly accentuated, and speech sounds very "boomy." In fact good results may be most readily obtained with miniature 3in. or 4in. speakers. However, a larger 6in. or 8in. speaker unmounted gives very good quality when used as a microphone. Small Service surplus moving-coil mikes may, of course, also be obtained very cheaply.

However, for any of these "low-level" microphones, a high-gain pre-amplifier stage is needed before enough output can be obtained to swing any of the modulators described. Furthermore, the "push-pull" modulator cannot be operated directly from a pentode pre-amplifier. A modification is necessary in this case, and the circuit of Fig. 7 should enable a push-pull modulator to be swung from a crystal microphone with the minimum of complications. The double-triode stage shown is actually a self-balancing phase splitter giving push-pull drive from a single-ended input, and should be of assistance in proceeding from the simple modulators to an "economic" modulator employing a crystal microphone for high-quality speech.

Naturally some of the snags inevitable in audio equipment may arise, but fortunately the simple modulators do not present much difficulty from this aspect. Faults from components or layout should be easily diagnosed, especially as these are few in number!

SIMPLE MAINS CIRCUITS

SOME USEFUL CIRCUITS FOR THE EXPERIMENTER

By F. G. Rayer

CONSTRUCTORS who have built a number of battery-operated receivers of simple type appear to regard most mains-operated circuits as rather complicated, and sometimes hesitate to make up such a receiver, even when mains are available. Compared with the "straight" detector-L.F. type of battery receiver, most mains receivers are indeed complex from the beginner's point of view. Superhet circuits are often used; even if the set is of T.R.F. type it will probably have a R.F. stage, while some kind of power-supply circuit will be present, and also screen-grid and cathode resistors and condensers not found in simple battery sets.

Actually, however, there are numerous quite straightforward 1, 2 and 3 valve mains circuits which may be used, and which can give good results. The detector-output type of 2-valver is a good example of a simple mains circuit which can give really satisfactory loudspeaker reception from a fair number of stations. Volume and sensitivity will generally exceed that obtained from the detector-2 L.F. type of battery set. The convenience and economy of mains operation may be had even with a 1-valver, and Fig. 1 shows a highly satisfactory circuit of this type. The beginner would do well to consider this circuit as consisting of two sections—receiver, and power-supply. The same power-supply circuit may be retained if an additional valve is subsequently added to give loudspeaker results.

Receiver Circuit

This is a simple 1-valver, with reaction, and will easily be followed by those who have built even the smallest battery set of T.R.F. type. The tuning coil may be for medium waves only, or for both medium and long waves. Or one or more short wave ranges may be added, as with a battery set. The only departures from battery set design are the presence of a cathode, wired to H.T. negative, and resistance capacity coupling, to keep high voltages and currents out of the headphones.

Any detector type triode can be used, either with a 4 v. or 6.3 v. heater. Or one of the popular octal-based pentodes such as the 6J7 or 6K7 can be employed. These may be used as triodes by wiring together screen grid and anode, and using this as the anode connection. The suppressor grid is wired to the cathode. With such a valve the heater secondary should be rated at 6.3 v. If desired, a 6.3 v. dial light may be added, wired in parallel with the valve heater.

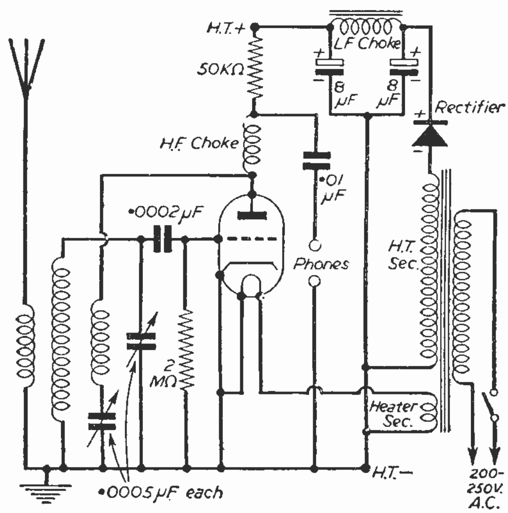


Fig. 1.—A 1-valver for A.C. mains.

Power Supplies

The valve heater is operated from A.C. derived from a transformer winding of suitable voltage. D.C. is necessary for H.T. supply, and is obtained by means of the metal rectifier in Fig. 1, ripple (which would cause hum) being removed by the smoothing condensers and choke.

The H.T. secondary may be rated at 125 to 250 v. If a 2-valver is subsequently to be made up, a 250 v. winding is recommended. The rectifier should be rated as having a working voltage equal to, or higher than, the transformer secondary (e.g., a 250 v. rectifier can be used with any voltage up to 250 v.). A 250 v. 60 mA rectifier would give sufficient power for a 2-valver. If progress beyond the 1-valver is not intended, a 10 mA rectifier is suitable.

The smoothing condensers should have a rating higher than the voltage present. Separate 350 v. condensers (or an 8 plus 8 μF condenser) are suitable for 250 v. H.T. supplies. It is absolutely essential rectifier and condensers be connected in the correct polarity, as shown, or they will probably be damaged. Any small smoothing choke is suitable.

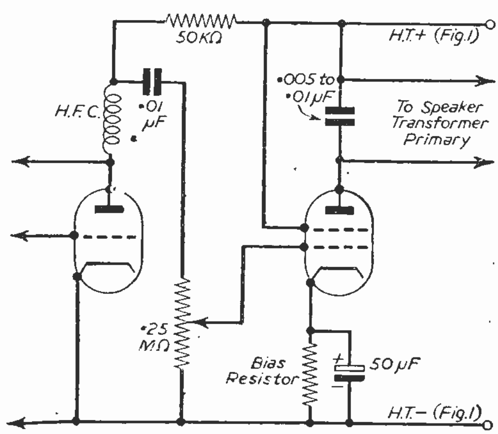


Fig. 2.—An output stage for speaker operation.

Speaker Operation

If a power output stage is added, ample speaker volume can be expected from local stations. A suitable stage is shown in Fig. 2, and may be added to the 1-valver already described. A .25 megohm potentiometer is used for volume control, and the points marked H.T. positive and H.T. negative are taken to these points in Fig. 1.

The 6V6 is a good valve to use, and requires a bias resistor of approximately 240 ohms. The heater of this valve may be wired in parallel with any other 6.3 v. valve. If a 4 v. valve is used for detector, with 4 v. heater winding, then a 4 v. output valve should be used. With valves other than that mentioned, a different value of bias resistor may be necessary.

Any permanent magnet speaker, with output transformer, can be used. The transformer primary should be able to carry 50 mA, which means that small transformers intended for battery sets are not suitable. The primary should give a load impedance of about 5,000 ohms, and the secondary should be rated at 2 to 3 ohms, for the usual 2 to 3 ohm speaker. For proper reproduction, the speaker must be mounted on a baffle board or in a cabinet.

" Universal " 2-Valver

Fig. 3 shows how a screen grid or pentode valve such as the 6J7 or 6K7 may be used in its proper manner, and this gives an increase in sensitivity, compared with the form of triode connection mentioned. The circuits in Figs. 1 and 2 may be modified to take advantage of this.

This circuit is suitable for A.C. or D.C. operation, but is not recommended in 1-valve form because one mains lead is common to H.T. negative. Here, the valves are of the same *current* rating, and have heaters wired in series for .3 amp operation. Valves and dial light total approximately 35 v., and the remaining voltage is dissipated in the mains dropper.

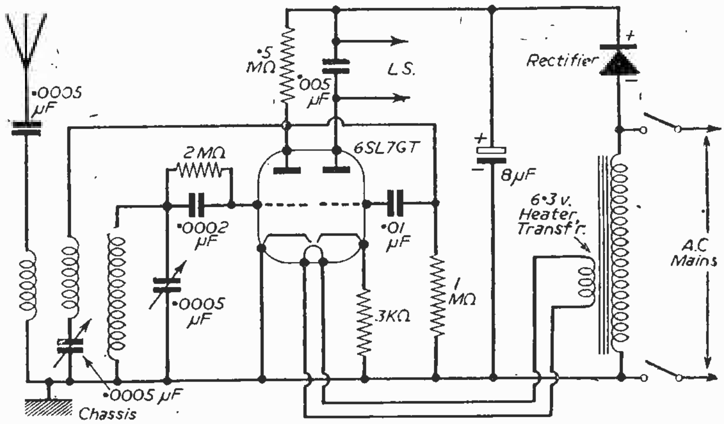


Fig. 4.—A " loud-speaker " 1-valver.

(A .5 amp dial light is suggested for long life. If a .3 amp. bulb is used, a resistor of about 40 ohms should be wired in parallel with it.)

Rectifier and smoothing components are as already mentioned, but the rectifier must be rated at at least 250 v. If a valve rectifier with .3 amp heater is available, it can be used instead of the metal rectifier, its heater being wired between the output valve and dial light. Valves of this type are the 25Z4G, 25Z5, 25Y5, etc. Cathode is wired to smoothing choke, and anode to 100 ohm resistor. Where two anodes and cathodes are present (e.g., in the 25Y5) wire both anodes together for anode connection, and both cathodes together for cathode connection.

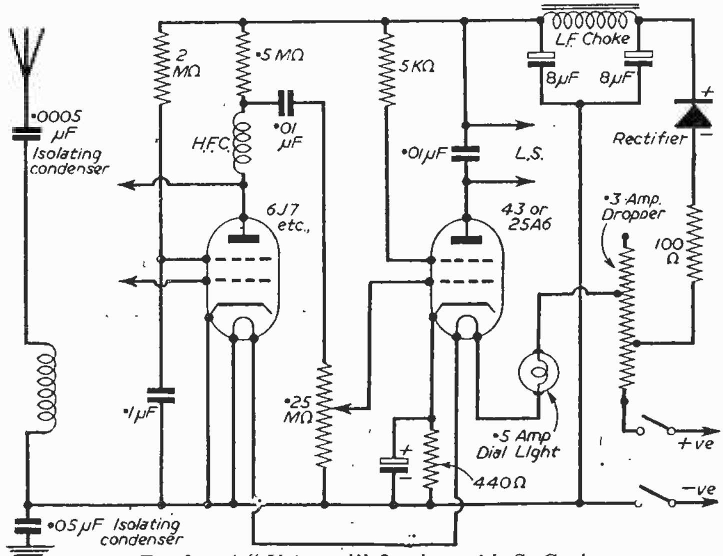


Fig. 3.—A " Universal " 2-valver with S. G. detector.

With A.C./D.C. circuits, isolating condensers of 500 to 750 v. working are used to keep mains voltages out of aerial and earth, as shown. Their capacity is not critical, but large capacities are not suitable. Generally, there is little need to use any earth connection at all. Except for these points, construction follows the lines already set out. An insulated cabinet is recommended, with matters arranged so that the chassis, or any metal part contacting it, cannot be touched.

Double-Triode 1-Valver

A simple receiver to give moderate speaker volume from local stations may be made up from the circuit in Fig. 4, using a 6SL7GT or 6SN7GT in a resistance capacity coupled detector-L.F. combination. A standard medium-wave or dual-wave coil is suitable. Heater current is derived from a small 6.3 v. transformer. The H.T. circuit is much simplified, the smoothing choke and one condenser being omitted. Even so, the hum level is low because of the comparatively low degree of amplification and small current consumption, which result in a single 8 μF condenser being adequate.

This circuit may be used with separate triodes such as the 6C5. Results are similar to those obtained from a small battery 2-valver, and volume equal to that from the circuits in Figs. 2 and 3 must not be expected. The circuit is worth trying, however, in the interests of simplicity and low initial cost.

All-Wave A.C.2

The complete circuit for a superior 3-waveband 2-valver is given in Fig. 5. Here, three valves are actually employed, but the third replaces the metal rectifier previously suggested, and is not part of the actual receiver circuit. It will be seen that full-wave rectification is used and this has advantages over the simpler rectifier circuits so far shown.

A standard dual-valve coil is used for long and medium waves, with a separate coil for the short-wave band. Good reproduction from a fair number of stations may be expected, while volume from local stations is ample.

The detector H.T. circuit is decoupled to avoid hum and instability. This is worth while, as is the provision of a simple tone-control. If the latter is omitted, a condenser of about .005 or .01 μF should be wired in parallel with the speaker transformer primary.

As with all A.C. circuits deriving heater and H.T. current from a transformer, a direct earth may be used, the chassis not being "alive" as with A.D./D.C. circuits. If the 6.3 v. winding has no centre-tapping, one end may be returned to the chassis instead. One or more 6.3 v. .3 amp. dial-lights may be added if the 6.3 v. winding is rated at more than 1 amp.

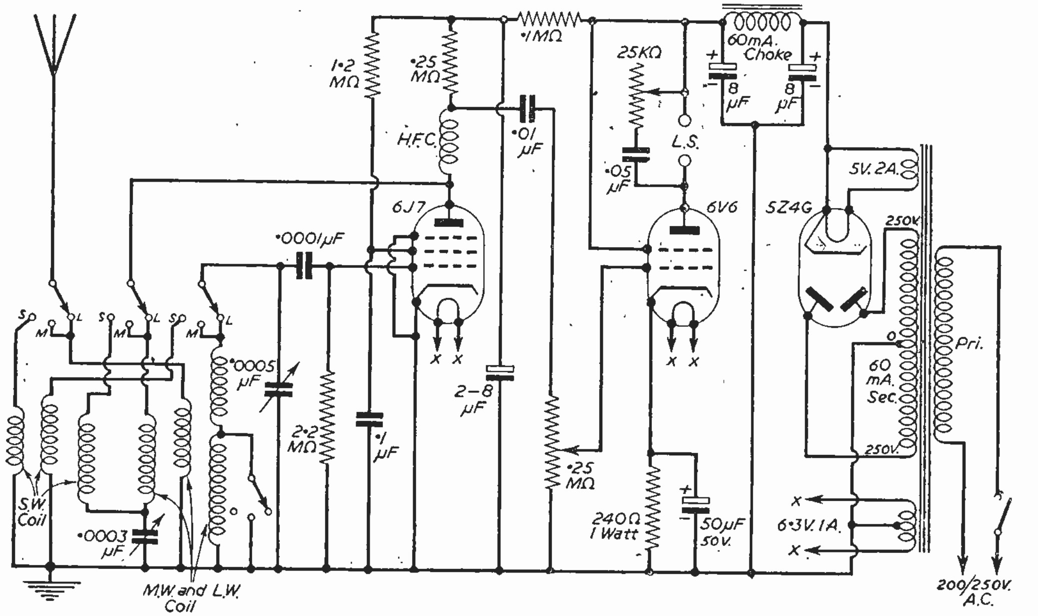


Fig. 5.—A complete All-wave A.C.2.

"Communications and Electronics"

AN important event in technical journalism is signalised by the appearance on September 16th, of a new monthly, "Communications and Electronics." The prime aim of this new journal, published by Heywood & Co., Ltd., one of the National Trade Press Group, is to provide a link between the designer and manufacturer of British communications and electronic equipment on the one hand and the user on the other.

A special appeal will be made to users of British communications and electronic equipment overseas.

The emphasis throughout is on the practical applications of new communications and electronic techniques, rather than on advanced theory and circuit design. The presentation and layout, which are new in conception, make extensive use of explanatory charts to show the relationship between various developments in particular fields. As a further aid to the practical interpretation of new developments, wide use is made of working diagrams and photographs.

Unlike many technical journals—particularly those published in the U.S.A.—the editorial sections are, in the main, separated from the advertising sections.

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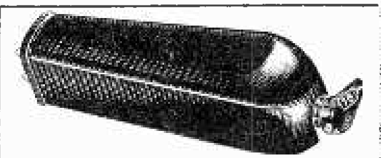

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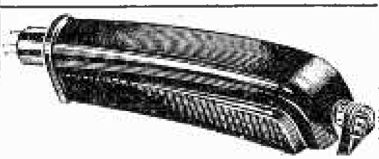

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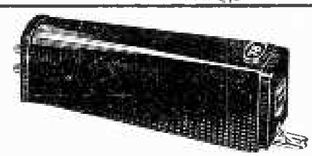
HGP 41-1



Separate Hi-g plug-in type heads for standard and microgroove records incorporating the crystal unit as used in the HGP 39 pick-up head. Will fit Collaro units RC 532; AC 534; AC3/534; 3RC 532. Available in cream or walnut.

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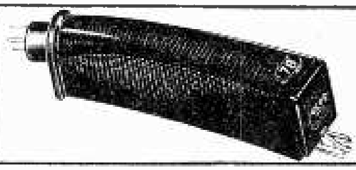
HGP 45



Separate Hi-g pick-up heads for either standard or microgroove records. The crystal unit is identical to that used in the HGP 39-1 head. Will fit Garrard units RC 80; RC 72A; RC 75A; and the Model M player. Can be used on any unit which at present uses the Garrard C adaptor with GP 19 heads.

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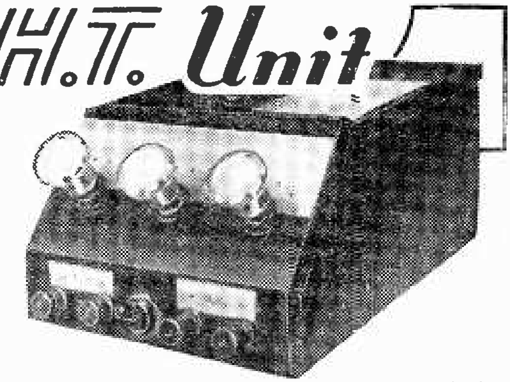


A USEFUL ADDITION TO THE EXPERIMENTER'S BENCH OR SERVICE WORKSHOP

By J. R. Stewart, B.Sc.

THIS unit was constructed to meet a need for students measuring the anode volts/anode current characteristics of a valve, preparatory to designing their own L.F. amplifier. At the same time, its full power output of around 340 volts 60 mA. and 6.3 volts 3 amps is sufficient to operate the normal four- to five-valve radio set, or to serve as a power unit on the test bench. In addition, all the output terminals are isolated from chassis, so that it can be made to provide a negative bias, adjustable in value for experimental work.

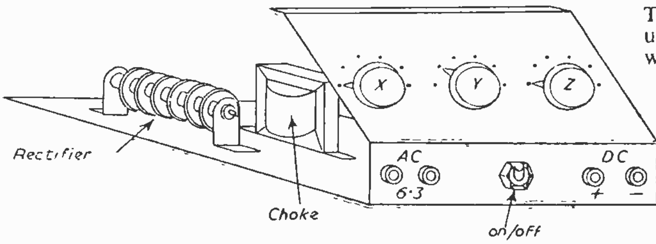


Fig. 3.—Showing layout and the control panel.

The unit is based on the well-known principle that two transformer windings giving, say, 20 and 60 volts output separately, can be connected together to give either 60+20=80 volts, or 60−20=40 volts, depending on the way they are connected. Thus, the two windings can be switched to give any of 20, 40, 60 or 80 volts. By adding a third winding of 180 volts, the range can be extended from 0 to 260 volts R.M.S. in steps of 20 volts. Further regulation of the H.T. voltage is provided by the wire-wound variable resistor R (see Fig. 2).

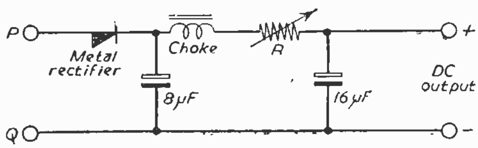


Fig. 2.—Output from the switches in Fig. 1 is connected to points P and Q.

Fig. 1 shows the transformer and the switch connections. The transformer is wound for normal mains primary and secondary windings of 20 volts, 60 volts and 180 volts, all at 60 mA, and a 6.3 volt 3 amp. heater winding. This can either be wound at home or can be done by a winding service firm at a cost comparable to that of the conventional radio set transformer. All windings are insulated from each other and from the frame, and in Fig. 1 have been labelled so that with B connected to C and D to E all three are in series aiding and the full 260 volts R.M.S. is then obtained between A and F. The windings should be tested for this polarity before wiring and temporary name-tags attached to the ends of windings.

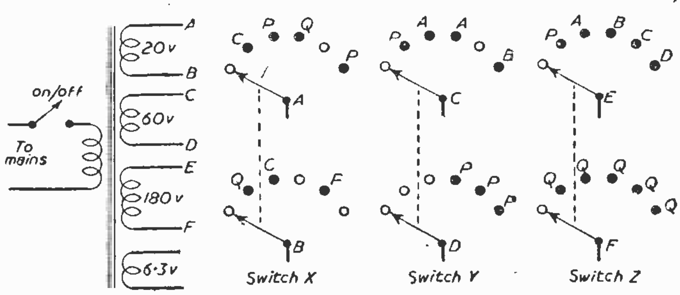


Fig. 1.—Connections between mains transformer and the three two-pole, six-way switches. Points marked P, Q are joined to the same points on Fig. 2.

Switching

Three two-pole, six-way switches are used to control each of the three windings, the output going to points labelled P and Q in Fig. 2. Table 1 shows the required connections and switch positions for each of the 20-volt steps. The last column of the table gives the measured maximum (no load) D.C. output voltage from the circuit. In Fig. 1 the switch terminals are labelled with the letter showing to which point they should be wired ; where there is no letter, no connection should be made. Position 1 for each bank is on the left-hand side ; it will be seen that this position is unconnected for all of the six banks, so that with the switches on 111, there is no output. Switches should not be left in positions other than those shown in the table ; if they are, some of the windings may be shorted with consequent damage to the transformer. Momentary shorting when switching from one position to another will not cause damage apart from some sparking at the switch contacts. If unskilled personnel are to use the completed unit, a word of warning about switching may be necessary on the control panel.

Referring to Fig. 2, the amount of regulation provided by the variable resistance R depends on the load current. The average increase in D.C. volts

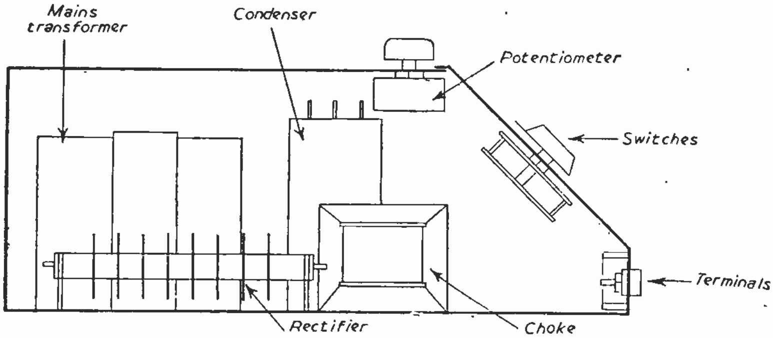


Fig. 5.—An elevation view of the H.T. unit.

output per step is 30, so that for a continuously variable supply, $R \times i = 30$, where i is the load current. If $R = 3{,}000$ ohms full control will be obtained for $i = 10$ mA or over ; if $R = 5{,}000$ ohms the full regulation current is 6 mA or over. R must be wire-wound in order to dissipate the watts without damage. The

TABLE 1

R.M.S. voltage selected	Inter-winding connections	Points P & Q connected to	Switch positions X	Y	Z	Output voltage D.C.
20	Nil	A & B	2	2	1	17
40	A to C	D & B	2	4	1	43
60	Nil	D & C	4	4	1	72
80	B to C	D & A	4	6	1	98
100	B to C ; A to E	D & F	1	6	3	135
120	C to E	D & F	1	5	5	165
140	A to C ; B to E	D & F	1	4	4	190
160	A to E	B & F	5	1	3	220
180	Nil	E & F	1	1	2	255
200	B to E	A & F	6	1	4	280
220	A to C ; D to E	B & F	5	3	6	310
240	D to E	C & F	1	2	6	335
260	B to C ; D to E	A & F	3	1	6	355

remainder of the components—listed in Table 2—present no difficulty.

Construction

The constructional details are straightforward, and the layout can be altered to suit individual requirements. In the writer's case, the unit was built into an old H.T. eliminator case, which had a sloping front panel and sliding base. A wise precaution, if the transformer is supplied with flying leads, is to include a labelled tag-strip or panel for all the transformer connections ; in this way there is no danger of confusion when wiring the connections between transformer and switches. The diagrams show the general layout used ; all the controls are on the front panel except the potentiometer R which is fixed on top. The tag-strip referred to was fixed to one side of the case above the metal rectifier.

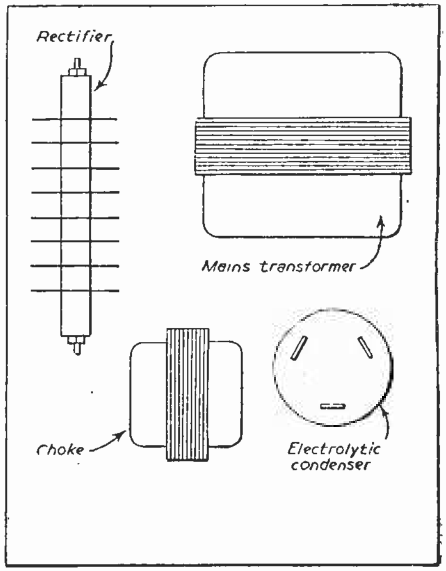


Fig. 4.—Showing layout of components on the base.

TABLE 2

LIST OF COMPONENTS

- 1 Mains transformer, see text.
- 1 Metal half-wave rectifier, 250 v. 60 mA.
- 1 Electrolytic condenser, 8+16μF 450 v.
- 1 Smoothing choke, 5 H. 300 ohms.
- 1 Wirewound potentiometer, 3,000 or 5,000 ohms, see text.
- 3 2-pole, 6-way wafer switches.
- 1 On/Off toggle switch.
- 4 Chassis-insulated terminals.
- 4 Panel knobs.

On Your Wavelength

BY THERMION

Hi-Fi Tape Recordings

IT is a sign of the changing times that H.M.V. are now marketing high fidelity tape recordings and I regard this as a major development in musical reproduction. No doubt the great advance of tape recording and the continually advancing sales in tape recorders have persuaded this pioneer company to embark upon this new venture. It is unlikely, of course, that tape will replace discs entirely for many years to come. But no record manufacturing company can afford to ignore the large number of home tape recorders now in use. It is obvious, however, that tape must eventually entirely oust the wax disc, with its inherent disadvantages. No matter what form of stylus is used on a wax disc it is bound to wear the disc after a comparatively short number of playings. In other words the quality of the recording gradually declines from the first playing. With tape the quality remains practically unimpaired for many years.

In the future, no doubt, our radiograms will all be modified to accommodate tape decks instead of disc apparatus.

For the first time listeners are now able to buy actual copies of the original master tapes as made in the recording studio, on which the full range of frequencies known to the human ear (the audible frequencies) has been faithfully captured and recorded.

Hitherto these master tapes have been used only for transferring to discs. It is now commercially possible to produce copies of these original tapes, and owners of high-quality tape reproducers now have the opportunity of enjoying in their homes some of the finest recorded music in all its natural beauty and fidelity, free from distortion, needle scratch and with constant quality of reproduction from beginning to end of the recording, because of the constant speed of the tape past the reproducing head.

The modern technique of recording on magnetic tape was developed immediately after the war, a fundamental technical advance resulting in a considerable increase in the recorded frequency range and the realism of the records. This new achievement is a logical step forward in bringing studio quality into the home.

The first release includes recordings by Yehudi Menuhin, Furtwängler, Solomon, Cantelli and Kubelik with the Philharmonia Orchestra; Robert Irving with the Royal Opera House Orchestra; the Melachrino Strings; Joe Loss and his Orchestra. This list comprises two series: "Celebrity," with maximum playing times of approximately 60 and 40 minutes, at 4 guineas and 3 guineas each respectively; and "Standard," with similar playing times, at 73/6 and 55/- each.

These tapes require to be played on a high-quality dual track reducer with a tape speed of $7\frac{1}{2}$in. per second. Their introduction does not affect the future issues of all types of records. It would take several years to re-record on tape all of those disc recordings at present in stock, and so the normal 78, 45 and $33\frac{1}{3}$ r.p.m. records will be with us for many years yet, and so therefore will the gramophone. We may expect, however, within the next quarter of a century to find it on its way out, replaced by tape machines and the celluloid sound track operating a photo-electric cell.

On Joining a Club

ALTHOUGH I have dealt with this matter before I issue a strong warning to my readers not to join any club claiming world-wide membership unless they are quite certain that it is run on bona fide lines. I consider the following to be bona fide lines. The officers should be elected at an annual general meeting at which the accounts for the previous year, properly audited by an independent auditor, are presented for analysis, criticism or approval. Avoid those clubs where you have no opportunity of electing a new secretary. In many cases clubs are merely started by some individual with the idea of making an easy living for himself, and nearly always trouble ensues. The benefits offered by such clubs for an annual subscription of a few shillings are quite nebulous and often non-existent. Usually you are offered free technical advice, which is obtainable from this journal free of charge. One such secretary, whom I was sent to investigate a few years ago as a result of a complaint from one of our readers, was making over £1,000 a year in this way. He was adopting the trick of sending the technical enquiries he received from his members in to us! Needless to say appropriate action was taken to put a period to the activities of this smart Alec. I was responsible for getting the members' subscriptions refunded to them and an undertaking that the "secretary" disbanded the club forthwith by means of a circular letter, the terms of which I dictated.

Readers will remember not so many years ago the stand this journal took in relation to another club, which claimed world-wide membership. Investigation showed that it had a membership of about 100. I had misgivings about it and so had the authorities. I pressed the secretary, who seemed to have appointed himself for life, to produce the balance sheets to which I was entitled as, for purposes of investigation, I had joined the club myself. He failed to do so and I asked him what happened to the money received as subscriptions. He told me some rambling story, but produced no receipts, upon which I informed him that it was obvious the money was going into his own pocket. Worse than this the club, I suspected, was politically tainted and was merely run in the interests of a political party. Further investigation showed that Scotland Yard were also interested in this club. However the publicity was responsible for a complete change in the affairs of this specious Club whose notices we consistently refused to print.

Of course, old established clubs like the R.S.G.B., are worthy of all the support they can get. They are run on sound lines, and readers do get something in return for a very modest annual subscription.

AMPLIFIER DESIGN

8.—UNTUNED AMPLIFIERS—CONTINUED

By R. Hindle

(*Continued from page 600 October issue*)

A Series of Articles Dealing with the Theoretical Considerations of Amplifier Design, and Containing at a Later Stage Constructional Details of Various Types of Amplifier.

The Output Stage

IT has been assumed in the previous discussion that voltage amplification is required, i.e., that the circuit into which the output of the amplifier has to be fed is operated by virtue of voltage. A valve, it was pointed out, is basically not an amplifier but a converter of voltage fluctuations into current fluctuations and voltage amplification came about only if the correct associated circuit and component values were used. If the output of one valve is being fed to the grid of a second valve then the first valve must be set up as a voltage amplifier because the second valve requires voltage to drive it. (There are exceptions to the rule that valves are voltage driven, by the way, but for the time being the more usual kind of circuitry is considered.) Supposing, however, that the second valve is itself feeding the loudspeaker. Now what is wanted is not necessarily the highest possible voltage but rather the maximum amount of power to drive the cone of the speaker forcibly against the resistance of the air.

There is nothing basically different about the operation of a power output valve as compared with a voltage amplifier valve; they are both basically converters of voltage fluctuations into current fluctuations. Electrical power is measured in watts, of course, and the power in watts equals the voltage multiplied by the current flowing. A condition of maximum voltage output such as was sought after previously is not necessarily the condition of maximum power output because the current fluctuations under those conditions may be very small and a reduction in voltage output may be accompanied by a proportionately much larger increase in current so that the wattage is larger.

With regard to the situation at the grid of the power valve the picture is very similar to that examined in the case of voltage amplifiers. The aim is to get the maximum control of current by swinging the grid as far as possible but all the time keeping the grid on the straight part of the characteristic to avoid distortion. Consequently, the characteristic is examined and the grid voltage range covered by the straight part of the grid volts/anode current curve is read. It is necessary, then, to provide a fixed bias to bring the static condition of the valve (i.e., the no-signal condition) to the mid-point of the straight portion of the curve.

The situation in the anode circuit is quite different, however. For voltage amplification it was found that, other things being equal, the larger the anode load the greater the output. From the point of view of power output, though, there is an optimum load for maximum power. Taking the case of a generator feeding a resistive circuit it is well known that the maximum power is obtained when the load is equal to the generator internal resistance; a lower resistive load increases the current flowing but the voltage across the load is reduced in a greater proportion, whilst a higher resistive load gives a higher voltage across the load, but the current is reduced in a greater proportion so that the product is again less. If any reader doubts this he has only to do a few simple calculations assuming a generator with a given voltage output and a given internal resistance, and by the use of Ohm's Law to calculate the power in various loads. The valve load does not work out quite the same because there is the complication of keeping the distortion to a minimum in a system that is not truly linear. In actual practice the load of a triode output valve should be at least twice the r_a of the valve, and in the case of a tetrode or pentode it will be less than the r_a.

Anode Characteristic

As with voltage amplification, however, one has to turn to the anode voltage/anode current characteristics to really get to grips with the problem of power amplification, and Fig. 31 gives typical curves for a triode output valve. In choosing a valve for output purposes one looks, naturally, for one that will pass a respectably large current and withstand a reasonably high anode voltage, right up to the available voltage from the power supply to be used, so that sufficient power is available. For instance, if 10 watts of output power were needed it would be useless to use a valve of which the maximum permitted anode dissipation was less than 10 watts.

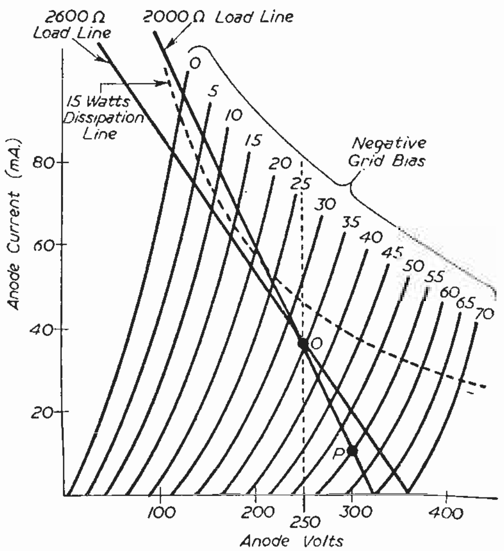


Fig. 31.—Triode output valve characteristic with load lines.

This limitation is set by the valve makers, as we saw in the case of voltage amplification, and clearly the valve for our present purpose will have to have a larger anode dissipation than was needed for the voltage case. This means that the cathode must be larger to give off sufficient electrons to sustain the larger current needed and the spacing of the electrodes will have to be greater to withstand the higher voltages. The structure will have to be designed also to give up the heat generated and so the valve electrodes have inevitably to be bigger. This meant, until recently, that the valve had to be contained in an appreciably larger envelope, but the makers have since discovered the secret of putting a quart into a pint pot and some very useful miniatures are now available.

In fact, when one starts to look into the matter one finds that the valve is really relatively inefficient, and for 10 watts audio output a valve with a dissipation considerably greater than 10 watts is necessary. The maximum anode dissipation is, for class A, the maximum power that may be fed into a valve from the H.T. source when no signal is being applied, i.e., in what is called the quiescent state. Call the maximum permissible anode voltage E_{HT} and the maximum permissible current with such voltage I_{HT} so that $E_{HT} \times I_{HT}$ is the maximum dissipation. Then the maximum power output for a given degree of distortion will depend on how near to zero the anode voltage can swing without causing more than the permissible distortion and also on how near to zero the anode current can swing on the other half-cycle of signal, again without causing excessive distortion. Call these limiting conditions E_{min} and I_{min} respectively. Then the peak signal voltage at the anode is $E_{HT}-E_{min}$ (distinguish between the peak signal and the *peak-to-peak* signal ; the signal will swing as far above the static anode voltage as below it, and so the *peak-to-peak* signal is twice the peak value) and the peak signal current is similarly $I_{HT}-I_{min}$. The power output in watts is the signal voltage multiplied by the signal current (in amps), but in the case of alternating voltages it is necessary to use the RMS values of voltage and current to calculate power, and in the case of sine wave signals such as are now being considered, the RMS value is the peak value divided by $\sqrt{2}$ (or the peak-to-peak value divided by $2\sqrt{2}$, which is the same thing) so :—

$$\text{Power output} = \left(\frac{E_{HT}-E_{min}}{\sqrt{2}}\right) \times \left(\frac{I_{HT}-I_{min}}{\sqrt{2}}\right)$$

$$= \frac{(E_{HT}-E_{min}) \,.\, (I_{HT}-I_{min})}{2}$$

or more conveniently (by dividing the first expression in the numerator by E_{HT} and the second expression by I_{HT} and bringing these factors with the denominator into a third expression) :—

$$\left(\frac{E_{HT} \,.\, I_{HT}}{2}\right) \,.\, \left(1-\frac{E_{min}}{E_{HT}}\right) \,.\, \left(1-\frac{I_{min}}{I_{HT}}\right)$$

and the efficiency of the valve from the point of power consumed is the signal power output divided by the power, drawn from the H.T. supply ($E_{HT} \,.\, I_{HT}$), i.e. :—

$$\tfrac{1}{2}\left(1-\frac{E_{min}}{E_{HT}}\right) \,.\, \left(1-\frac{I_{min}}{I_{HT}}\right)$$

Now the best that the valve could do would be to allow the anode voltage to fall to zero and the anode current on the next half cycle to fall to zero when each of the brackets would become unity and the efficiency would become 50 per cent. In actual practice such a swing cannot be permitted because of the resulting distortion and so the efficiency of the output valve must be less than 50 per cent. ; 20 per cent. is more likely in the case of a triode but in the case of a tetrode or pentode the zero current and voltage conditions can be more nearly approached and consequently these valves are more efficient or in other words they give greater power output for a given amount of H.T. power fed in.

Now examine the curves for a triode in Fig. 31. The maximum permitted dissipation in this case is 15 watts and the points giving such a dissipation (i.e., where anode volts x anode milliamperes is 15,000), are plotted and give the dotted curve. Working conditions then must not allow a movement to above this line.

The maximum permissible H.T. is 250 volts and as we want the maximum possible power output this voltage will be used. A load line has now to be drawn and the reader will probably remember the procedure as followed for the voltage amplifier. The first step is to determine the working condition without signal input. Under these conditions the secondary of the output transformer has no effect and the primary only needs consideration. As only D.C. is flowing at this quiescent condition the inductance of the winding can also be neglected and only the D.C. resistance of the primary considered. As a matter of fact the resistance is quite low and can generally be completely neglected for the present purpose and this is very convenient because it means that there is no drop in voltage and the anode of the valve gets the whole 250 volts of the H.T. supply. Consequently the working point must be on the vertical line representing 250 volts on the diagram. How far up this line it will be depends on the grid bias to be applied and if we knew no more about the valve we would have to try various points, and draw various load lines from each point, before determining the best one. As a matter of fact, however, we know that such a valve is likely to be operated at a bias of about 35 volts and if we did not know the valve data would tell us, so we can mark in the point at O.

The r_a of this valve is, say, 1,000 ohms and it has already been stated that the load should be at least twice r_a so we could first try a load line for 2,000 ohms. Now in a resistance of 2,000 ohms a drop of voltage of 100 volts causes a drop in current of 50 mA ; a drop in voltage across the load means an increase in voltage (i.e., to 300 volts) at the anode of the valve with respect to earth, and a drop in current of 25 mA from 35 mA as shown on the curves for the quiescent condition at O leaves 10 mA. So we can plot point P at 300 volts, 10 mA and join O to P, extending in both directions to give the 2,000 ohm load line.

It seems that, before going further, another point that may be puzzling the reader should be cleared up. We have said that the primary of the output transformer presents what amounts practically to zero resistive load to the valve so that there is no voltage drop, and now we are talking about a 2,000 ohms load and anode voltage and current fluctuations. The fluctuations arise from the signal input and the quiescent conditions must be modified. If the output transformer is a good one the primary inductance will still be negligible for our present purpose, but the effect of the speaker speech coil connected to the secondary is fortunately not negligible or it would be useless. The purpose of the speech coil is to drive the cone against the resistance of the air and in the process power is used up. We know that power is used up electrically only when resistance is present; for both inductance and capacitance no power is permanently used up but is only borrowed and given back later. So clearly the effect of the speech coil is inclined to be resistive. It is not entirely so, but that is a complication best left alone for the time being, to be returned to later. Now the effect of this resistance so far as the primary is considered, depends on the ratio of the transformer but if the ratio is correctly chosen to match the speech coil to the valve the effective resistance in the anode circuit of the valve will be equal to the chosen load, in our present case 2,000 ohms. But, let it be reiterated, this occurs only so far as the signals go and it has no effect on the quiescent conditions.

The next point requiring elucidation is how can the anode swing both above and below the quiescent condition, as is required if distortion (amounting in fact to perfect rectification) due to the complete cut-off of one half-cycle is to be avoided, when the anode starts off at full H.T. voltage? Now the inductive effect is brought into use because the inductance can produce a voltage in the same sign as the H.T. supply which thus augments momentarily the H.T. voltage and enables the valve anode to be at a voltage higher than the power supply for the sine wave peaks.

So back to the 2,000 ohms load in Fig. 31. It looks quite reasonable though at the high grid bias region it runs into the curvature of the characteristics and a slightly higher load giving a less steep line would be better. As a matter of fact the recommended load in this case is 2,600 load and this line is also drawn in on the illustration.

Effect of Mismatch

Now consider the effect of applying the wrong load to a triode power stage. We have seen that the valve represented by the characteristics in Fig. 31 requires a load of 2,600 ohms and a reduction to 2,000 ohms was bordering on the excessive distortion stage. Clearly, any further reduction in the load will cause the load line to run further into the regions of curvature and so there will be greater distortion unless the input grid swing is restricted to a short portion of the load line so that the power output is small. The load can be increased, however, to some degree and it will be seen that a less steep load line (which means a higher load resistance) will actually be better from the distortion point of view for a large input because at the high voltage end of the line a less curved part of the characteristic is encountered. There is a price to pay, however, for the improved characteristic because the power output is reduced. The preferred load of 2,600 ohms for this valve is calculated to give the maximum possible output with a distortion within the generally accepted limit of 5 per cent. The slight improvement at the larger load is not very great because the distortion reduced actually only takes place with the preferred load at the extreme limit of the grid swing, which occurs but rarely in practice, and would not be too objectionable for any purpose for which the simple amplifier in question might be used. A very considerable increase in load would, however, begin to increase the distortion again and so the process must not be overdone.

The conclusion, therefore, so far as a single triode output valve is concerned, is that the load is not very critical, but if the recommended value is not to be used the load should be greater rather than less than the specification. A comparatively small increase in load will improve the distortion characteristic at the expense of power output but a considerable deviation from the value specified is likely to cause an increase in distortion.

Bias

The working conditions chosen for this valve required a bias of 35-volts negative to the grid. The normal method is again by means of self-bias produced across a resistor in the cathode lead, in effect biasing the cathode positively instead of the grid negatively. The valve current fluctuates when

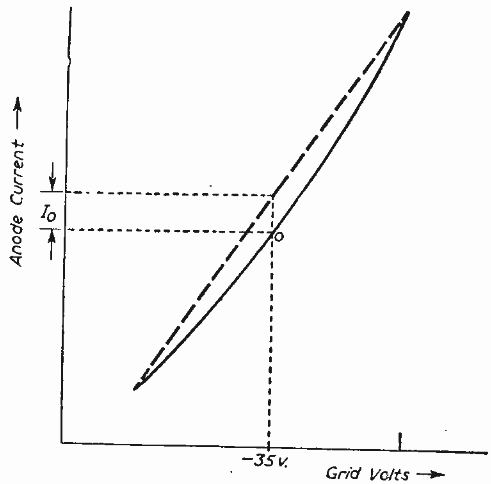


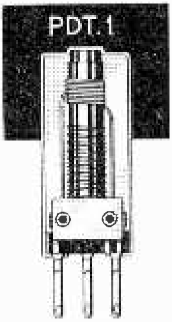
Fig. 32.—Distortion curve for triode showing second harmonic distortion. The divergence of Io indicated by O indicates the degree of distortion.

signals are handled but its average value is the same as the value for the static condition without signal and so the no-signal state can be used to decide on the size of resistor. The valve manufacturers state that a bias of 35 volts is required, as already said, and the curves in Fig. 31 show that at this working point the anode current is 37 mA. By Ohm's Law the resistance will be about 950 ohms and as it is not critical the standard value of 1,000 ohms is used. This resistor requires by-passing so far as the audio signals are concerned just as did the resistor used for the voltage amplifier or otherwise negative feedback will take place reducing the gain of the valve and requiring a larger input signal for a given output power and the value is chosen, as before, so that the time constant (the product of resistance and capacitance) is reasonable compared with the lowest frequenc yto be handled. An inadequate capacitance will be effective at the higher frequencies but will restrict the gain of the lower frequencies and will thus act as a bass cut circuit. Generally the output valve requires a smaller bias resistor and so the capacitance must be larger for the same bass response. A consideration of the exact values required was given in the earlier article but generally speaking 50μF is satisfactory

(To be continued)

MAXI-Q F.M. COMPONENTS

REGD.



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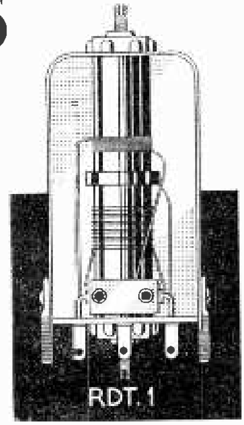

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The Beginner's Guide to Radio

The Nineteenth Article of a Series Explaining the Fundamentals of Radio Transmission and Reception. This Month Characteristic Curves are Further Considered

By F. J. CAMM

PROCEED in this way with various H.T. and G.B. values, joining up all dots for each H.T. value. The result of this will be a set of curves similar to those supplied by the valve makers. and the various figures such as amplification ratio, slope etc., may now be found.

Amplification Ratio

Amplification ratio is the ratio of change in anode voltage to change in grid volts. In preparing the characteristic curves you will have noticed that as the grid bias was increased, the H.T. volts being left unaltered, the anode current decreased. For example, it may have been found that with 100 volts H.T. and no volts on the grid the anode current was approximately 15 milliamps. When the grid bias was increased by three volts, the anode current dropped to just under 10 milliamps, a drop of approximately 6 milliamps. It is obvious that to obtain the same anode current without altering the bias, it will be necessary to increase the H.T. In this case, it will be found that about 24 volts are required to obtain the same anode current, and we must add 24 volts H.T. for every 3 volts G.B. added, and this ratio 24/3 is the amplification ratio, in this case 8.

Slope

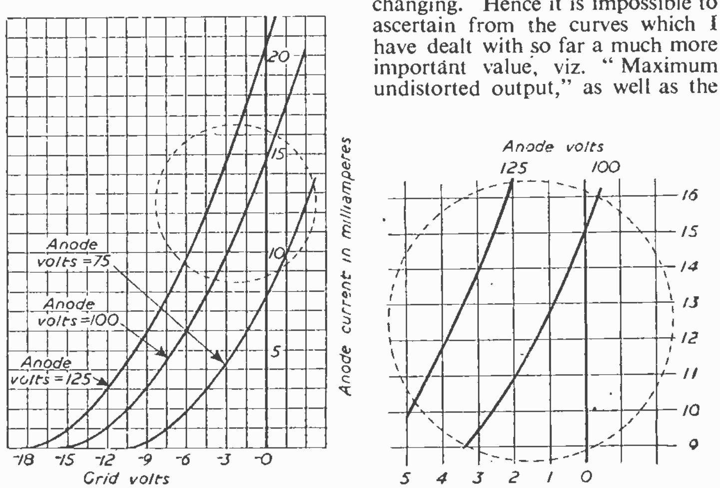
The slope refers to the mutual conduction. and is the change in anode current divided by change in grid volts, or to put it in another way, the anode current change per volt grid potential change. To obtain this factor the anode potential or H.T. must be left unaltered, and the grid-bias only varied. As the bias is increased we have already noted that the anode current decreases, and therefore we can obtain a set of figures from which it will be observed that the anode current in the example given above decreased 2 milliamps for every volt that the grid-bias was increased, and therefore the slope is two milliamps per volt, or as it is expressed on the valve chart, 2.0 mA/V.

Impedance

The impedance of a valve is one of its most important characteristics, for upon it depends the value of resistance. condensers, etc., which is to be used in coupling the valve to a subsequent stage. No further calculation is necessary in order to obtain the impedance value, as the two previous items discussed, namely, slope and amplification ratio, are used to ascertain the impedance value.

It is only necessary to divide the amplification ratio by the slope and multiply the answer by 1,000, which in the example I have used is $\frac{8}{2}\times\frac{1,000}{1}=4,000$ and this gives the value in Ohms. The diagrams in this article should make these points clear. It is a simple matter to build the apparatus necessary for the measurements required to plot a characteristic curve.

It is important, however, to remember that the characteristic curves as supplied by the makers are what is known as "static characteristics," which in other words mean that they are only applicable to a valve which receives constant voltages I have already explained that when the valve is receiving signals the grid and anode voltages are constantly changing. Hence it is impossible to ascertain from the curves which I have dealt with so far a much more important value, viz. "Maximum undistorted output," as well as the



Figs. 84 and 85.—(Left) The grid-volts anode curve. (Right) An enlarged view of the circled section.

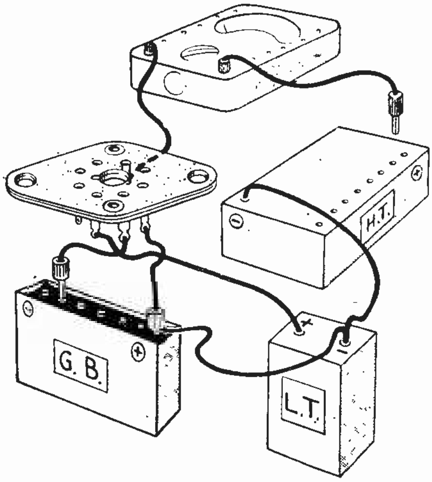


Fig. 86.—Set-up for taking valve measurements.

correct anode load and the percentage of second harmonic distortion.

Dynamic Curves

We must, therefore, prepare a new set of curves known as dynamic curves. These curves are much more difficult to prepare, and it is unfortunate that some valve manufacturers hesitate to give them. Fig. 84 shows the way in which dynamic curves are drawn, and it will be observed that the values of both grid bias and H.T. are carried to a value higher than that which is normally used. In fact, in order to make use of these curves we must show the current at the correct working point, i.e., at correct anode volts and correct grid volts, and in addition at half and double these values.

During the operation of the valve (remember we are dealing with the valve as an L.F. amplifier) the grid potential varies, when the valve is operating on the proper part of its characteristic curve, from half the applied bias to double that bias. If it does not do this, distortion is taking place. The effect of the variation in bias is, as our other curves have shown us, equivalent to a change in anode volts, and therefore the dynamic curves will show the anode current at various grid and anode volts.

Undistorted Output

The curves shown in Fig. 84 may be expressed in a much simpler way for the purpose of explaining the method of ascertaining the undistorted output of the valve, and Fig. 85 is an indication of how the curves may be simplified. It shows the anode current curve at normal grid bias, double and half grid bias, all the other lines in Fig. 84 being omitted.

The diagonal line running across the curves is known as the "load line," and this gives the value of the resistance which must be included in the anode lead to obtain the maximum undistorted output from the valve—in other words, the correct matching resistance. The line is drawn by placing a ruler on the curves with its edge at the point where the normal grid bias line, normal anode current line, and normal anode voltage line all intersect. The ruler is then swung about this point until an equal distance separates the O grid volts line and the line corresponding to double the normal grid bias. In practice the distances should not be equal, one side being slightly larger than the other to obtain what is known as a 5 per cent. distortion scale. We can, however, ignore this for the moment.

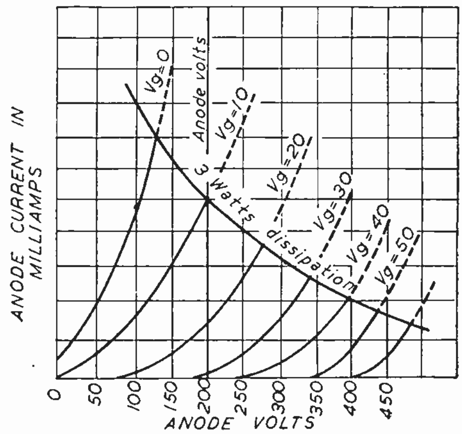


Fig. 87.—Dynamic valve curves.

Having drawn this line we drop a vertical line at the point of intersection of 0 grid volts and draw a horizontal line at the point of intersection of the load line and the line corresponding to double grid bias. This gives us a triangle as shown in Fig. 86. Now the formula for finding the undistorted output is:

$$\left(I_{max}-I_{min}\right)\times\frac{(E_{max}-E_{min})}{8}.$$

Expressed in another way, it is the anode current difference multiplied by the anode voltage difference, divided by 8. *(To be continued)*

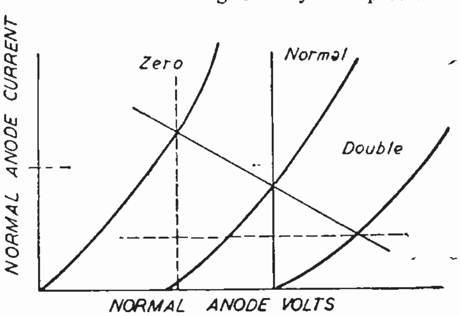


Fig. 88.—Dynamic curves simplified.

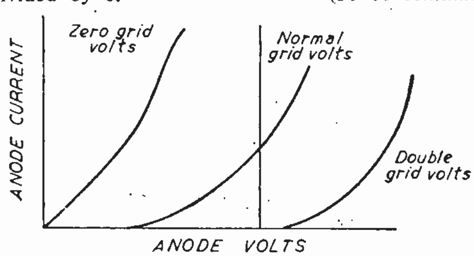
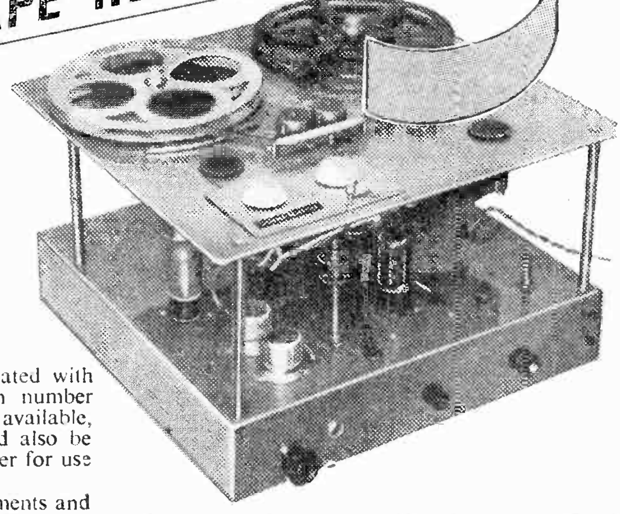


Fig. 89.—The power triangle marked out.

THE PW TAPE RECORDER



A NEW ECONOMICAL AMPLIFIER DESIGN FOR USE WITH THE "SOUNDMASTER" DESK

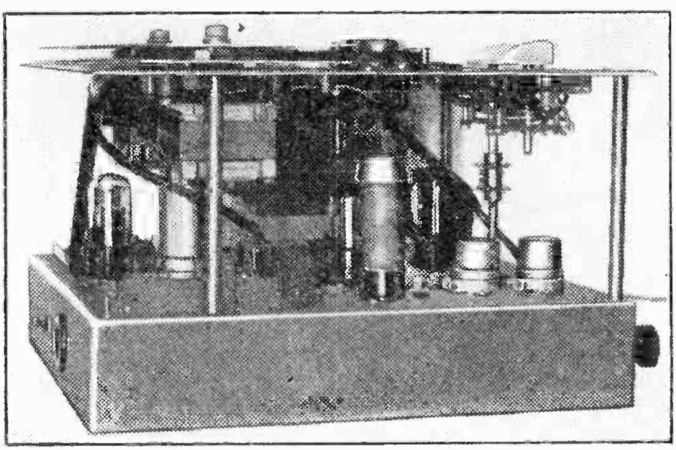
WITH a view to building a tape recorder capable of giving good quality reproduction yet economical and reliable and having additional facilities which would enhance its usefulness, a large number of designs already published were examined and considered. It was thought desirable that the amplifier associated with the tape desk should have the minimum number of valves preferably of a type readily available, be easy to build and operate, and should also be capable of being used as a straight amplifier for use with radiogram or microphone.

No published design had all the requirements and facilities deemed necessary, but after consideration it was thought that the "SoundMaster" amplifier could be adapted to conform with the above ideas by omitting certain features which, if necessary, could be added at some later date, and by modifying the basic circuit and physical arrangement of the chassis. In particular a single flat chassis construction could be employed, the treble and bass tone controls could be omitted as could also the magic eye tuning indicator, the additional gain then available enabling one valve stage to be cut out. The "SoundMaster" amplifier was therefore chosen as the basis for the new amplifier, and the "SoundMaster" tape desk which had many useful features and an excellent performance was also incorporated.

Amongst the interesting points (see also circuit diagram, Fig. 1) is the fact that only three valves are used in the complete record and playback amplifiers (four valve stages) and these give more than adequate volume with a first rate standard of reproduction. The valves used are an EF37A for the high-gain low-noise input stage, a 6SN7 double triode for the two intermediate stages and a 6L6GT for the oscillator and output stage, the respective functions being switched in a similar manner to that originated in the "SoundMaster."

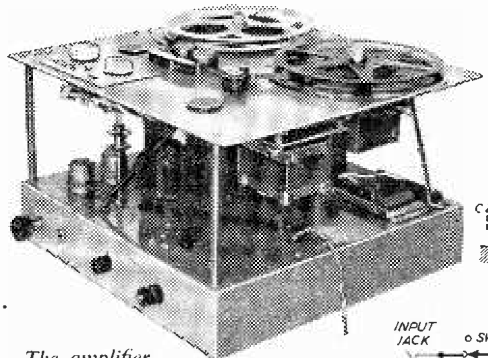
Response

As already mentioned, tone controls have not been included, the amplifier response being maintained level, apart from the correction required for magnetic recording, but no difficulty would arise if tone controls were thought necessary so long as the change in response does not necessitate an additional amplifier stage. The omission of the magic eye tuning indicator gives an appreciable economy in design, though an alternative system of level indication has to be incorporated, the method chosen being to use a miniature neon indicator which is caused to flash on audio peaks. Whilst this method of level control is satisfactory in practice, its limitation is that severe distortion occurs whenever the neon strikes, and to obviate this it is necessary for the indicator circuit to be switched in only during the setting-up period. For this reason a press-button switch is included, the method of using the level indicator being to switch it into circuit when preparing to record, adjust



A view of the complete recorder.

the level until the neon flashes on peaks only, then release the push-button switch, and so long as there is no large variation in the audio input the recording level will be satisfactory. Some little experience will probably be necessary in setting up and adjusting,



The amplifier assembled on the Tape Desk.

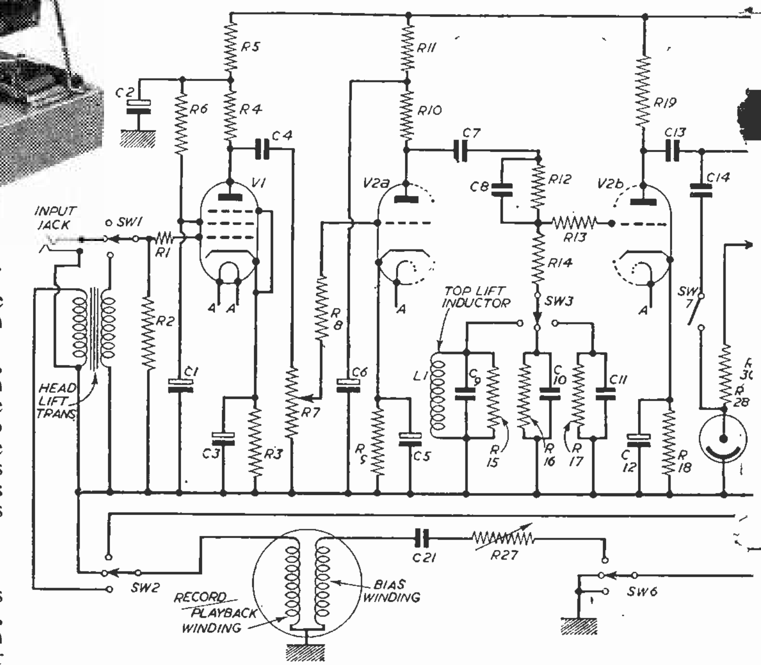
but it has proved completely reliable and excellent recordings have been made with its aid.

The bias and erase oscillator, which uses a 6V6GT, is switched in a similar manner to that of the "SoundMaster," but the audio output is somewhat greater. The oscillator coil used, Type 579, is made by Wright & Weaire since this matches the bias and erase windings on the record and erase heads.

Switching

The record-playback switch has three positions, record, playback, straight amplifier, the central position giving a straight line response for use with radio, gram, or microphone. The circuit arrangement evolved has enabled this change-over to be carried out with the aid of only six poles, and this enables only two switch wafers to be used. There are three poles on each wafer, the latter being spaced by at least $1\frac{1}{2}$in. and having a screen between them. (See also switch diagram next month).

As Wright & Weaire heads are used, a step-up transformer is necessary on playback, and this is shown in the photographs adjacent to the switch and the top-lift choke. The volume control, which also acts as the level control on record, regulates the input to V2a, whilst between the output of V2a and the input of V2b are the correction networks which are respectively switched in the record and playback positions, and which modify the frequency characteristic so as to make the amplifier suitable for use with magnetic tape. In the record position a



LIST OF

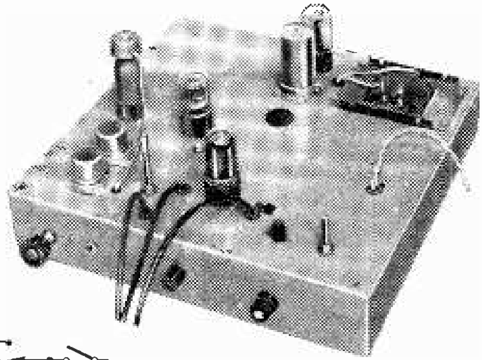
R1—3.3 KΩ Morgan Type T.
R2—.47 MΩ Morgan Type T.
R3—2.2 KΩ Morgan Type T.
R4—220 KΩ Morgan Type R.
R5—33 KΩ Morgan Type R.
R6—330 KΩ Morgan Type R.
R7—.5 MΩ Morgan Variable.
R8—3.3 KΩ Morgan Type T.
R9—2.2 KΩ Morgan Type T.
R10—100 KΩ Morgan Type R.
R11—10 KΩ Morgan Type T.
R12—330 KΩ Morgan Type T.
R13—3.5 KΩ Morgan Type T.
R14—17.2 KΩ (15 KΩ + 2.2 KΩ) Morgan Type T.
R15—330 KΩ Morgan Type T.
R16—100 KΩ Morgan Type T.
R17—330 KΩ Morgan Type T.
R18—2.2 KΩ Morgan Type T.
R19—68 KΩ Morgan Type R.
R20—47 KΩ Morgan Type T.
R21—1 KΩ Morgan, Type T.
R22—27 KΩ Morgan Type R.
R23—470 KΩ Morgan Type T.
R24—220 KΩ Morgan Type T.
R25—47 KΩ Morgan Type R.
R26—4.7 KΩ Morgan Type R.
R27—2.5 KΩ Morgan Variable.
R28—150 KΩ Morgan Type R.
R29—50 KΩ Morgan Variable.
R30—39 KΩ Morgan Type R.

C1—1 μF 350 v. Electrolytic T.C.C. Type CE30N.
C2—32 μF 350 v. Electrolytic T.C.C. Type CE27LE.
C3—50 μF 12 v. Electrolytic T.C.C. Type CE73B.
C4—.1 μF 350 v. Paper T.C.C. Type CP37N.
C5—50 μF 12 v. Electrolytic T.C.C. Type CE73B.
C6—32 μF 12 v. Electrolytic T.C.C. in same can as C2.
C7—.1 μF 350 v. Paper T.C.C. Type CE37N.
C8—33 pF Ceramic T.C.C. Type SCT1.
C9—.002 μF Mica T.C.C. Type M2N.
C10—100 pF Mica T.C.C. Type CM20N.

C11—
C
C12—
C13—
C
C14—
C15—
C16—
C17—
C18—
C19—
C20—
C21—
C22
C23

Head
Oscill-
Top L
Recor
Erase

peaking circuit is used (L1, C9, R15, R12, R14), to raise the output from the turnover point to the highest frequency which is to be reproduced, in this case around 11 Kc/s, whilst on playback a filter circuit (C11, R17, R12, R14) is switched in to give a rise of 6dB per octave from the turnover point to the lowest frequency being reproduced. In the mid position of the selector switch the response is linear, and in place of the correction networks switched in by SW3 a resistor of 0.1 MΩ is included, by-passed by a 100 pF condenser, thereby compensating for the rise at the higher frequencies due to C8 and R12. It may be desirable to fit a shorting switch across this resistance for muting purposes to prevent blasting occurring. If a microphone is connected to the input



The completed amplifier

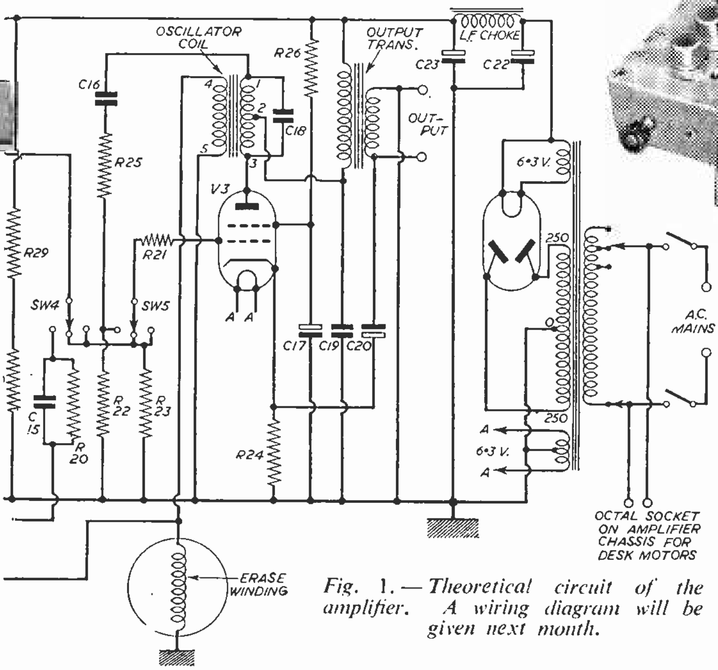


Fig. 1.—Theoretical circuit of the amplifier. A wiring diagram will be given next month.

of V1, and when a recording has been made the selector switch is switched straight over to playback, the selector switch will pass through the centre position and with the microphone still in circuit either blasting or acoustic feedback will occur.

Tape Desk

As mentioned on page 671 the amplifier is designed for use with the "SoundMaster" Desk, and this can be obtained as a kit of parts for assembly at home, or completely wired up. In this connection it would probably be worth while obtaining one of the Constructional Envelopes dealing with the original "SoundMaster" in order to make use of the assembly details for this desk. Comparison may be made between the two amplifier designs. There are three motors on the desk, one for each of the spools and one for the capstan drive. This incorporates a double pulley device and rubber belt by means of which, various speeds are obtained.

(To be continued)

TAPES

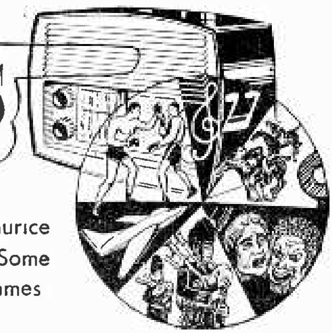
.006 μF (.005 + .001) Paper T.C.C. Type P111H CP110N.
50 μF 12 v. Electrolytic T.C.C. Type CE37B.
.5 μF Paper Stud Mounting T.C.C. Type P15N.
.01 μF Paper T.C.C. Type CP32N.
500 pF Mica T.C.C. Type CM20N.
.002 μF Mica T.C.C. Type M2N.
16 μF Electrolytic T.C.C. Type CE19L.
.003 μF Mica T.C.C. Type M3N.
.005 μF Paper T.C.C. Type CP31N.
50 μF 12 v. Electrolytic T.C.C. Type CE73B.
005 μF Paper T.C.C. Type CP31N.
5 μF Electrolytic T.C.C. Type CE28LE.
32 μF Electrolytic T.C.C. In same can C23.

Lift Transformer—Wearite Type 977.
ator Coil—Wearite Type 579.
ift Inductor—Wearite Type 647.
l/Playback Head—Wearite Type Red Seal.
Head—Wearite Type Red Seal.

Mains Transformer—
Primary—10-0-200-220-240 v.
Secondaries—250-0-250 v. 60 mA ; 6.3 v. 1 amp. 3.15-0-3.15.2 amps.
Smoothing Choke—20 H. 60 mA.
Output Transformer—Pentode type to suit speaker.
6-pole 3-way switch on two wafers—SW1-SW6 British N.S.F.
Neon bulb—Osram Type G.
Jack plug socket—Bulgin.
Switch Coupling—Bulgin.
Double pole Mains Switch—Bulgin.
Octal Valve Holders (Seven).
V1—EF37A. V2—6SN7.
V3—6L6GT V4—6X5GT.

Brass Support Pillars—3 off 5½in. long.
Brass Support Bracket to suit.
Press Button Switch—Microswitch or similar S.W.7.
Metal Chassis—14in. x 13⅜in. x 2⅜in.
Various nuts, bolts, insulated sleeving and screened sleeving.

Programme Pointers



Our Critic, Maurice Reeve, Reviews Some Recent Programmes

Down On The Farm

ONE of the most efficiently run and, in consequence, pleasant to hear, regular features is "Farm Fare," on Wednesdays in the Home Service at 12.30. If your definition of "entertainment" is the very commonly held one that (*a*) it must contain nothing cerebral, (*b*) it must have crooning or some other reprehensible form of music, preferably to an accompaniment on an electric organ, and (*c*) its humour must be as broadly personal as possible, indiscriminately involving wives, daughters, mothers-in-law and all females generally considered personable, give "Farm Fare" a try. You will see how wrong you are. You will hear all about how our most important industry lives and works. Our bread, meat and milk are discussed by people who really know. The very reality of the byre, the pigsty and the corn stook are brought to us. Can anything be more "entertaining" in the truest meaning of that oft misused word? One doesn't have to be a farmer or a poultry-keeper to get the tang and flavour from the programme. It is of a uniformly high standard, usually introduced by George Villiers with commentary by Alistair Dunnett and is very rewarding.

Plays

One of the few really interesting plays given us recently was Ben Levy's "Return to Tyassi." Receiving a unanimously good press on its production in the West End, its failure to win public support was a complete mystery to one and all. The story deals with a young wife, married a second time, who on learning of her first husband's death, feels such a resurgence of her love for him—in spite, so she tells us, of his having treated her very badly—that she is impelled to try and "return to Tyassi" to continue his work as an archæologist there with his brother who unexpectedly turns up and declares his love for her. That she does not, is one of the play's original twists. I found it quite absorbing, at any rate by recent standards. It was spoken at a tremendous, breath-taking, "to the red light" speed, but every word's enunciation was crystal clear. Yvonne Mitchell, Robert Harris, Cathleen Nesbitt, Rachel Kempson, Geoffrey Dunn, Michael Goff and Susan Richards made it effective and realistic.

By way of contrast, "High Tension," a modern melodrama for broadcasting, by Lester Powell was, by any standards, low, vulgar and brash in the extreme. Prefaced by a warning that it should not be listened to either by the young or the weak of heart, I could not see that in this respect it was any worse than what the entire adult nation sees at the films of an evening and the juvenile sections of it on a Saturday morning at, I believe, half price. This story concerns another young wife of a "certain" type who believes in frequent changes of husband companionship. Her method of disposing of them is to get her boy friend to fix up electric currents which will do their work at the given time with little fear of discovery. The piece opened with love passages that persuaded the weak and unsuspecting young electrician to so dispose of the existing husband. It closed with exactly the same endearments and a similar murder about to be repeated, creating the impression that we are looking on at a chain of such events. But our young Lochinvar-Bywaters wakes up to realities and determines that two and not just one shall feel the effects of the shock. This very unedifying story was quite brilliantly played by Joan Miller and Geoffrey Hibbert.

Continuing what would appear to be a series of "Tudor portraits," we had another such play in "A Man for All Seasons," by R. O. Bolt, being the story and times of Sir Thomas More. Here again we had intelligent and enlightened entertainment of a high order which, personally, I greatly enjoyed. I hope more of them are in the offing. A distinguished cast was headed by Leon Quartermain as More, with Abraham Sofaer, Susan Richards, Noel Johnson, Howard Rose and many others.

An hour's programme on Liverpool was, up to a point, rewarding. Produced by Robert Hudson and Denis Mitchell, it dealt interestingly with this famous city. Many of the best-known commentators took us round and about, up and down, here and there. I am not sure that this sort of programme should not be confined to television.

The "Blenheim" programme was very good, too. Better, in fact. It marked the 250th anniversary of the famous battle and concluded with some magnificent passages from Sir W. Churchill's "Marlborough: His Life and Times," beautifully read by James McKechnie.

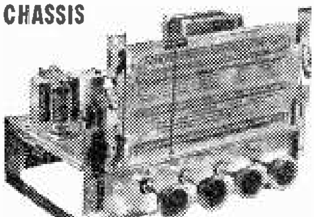
Bad Cricket Commentaries

Another cricket season is behind us, but the problem of the commentaries of Test Matches is not. They are truly dreadful, which is bad luck on the thousands of fans who, like myself, can usually only follow the games at home.

The standard Test Match rate of play of forty or fewer runs per hour has completely defeated everyone, with the honourable exception of Mr. Swanton, who always has something interesting and apposite to say. In the Oval test in August, we were told three things at least a dozen times a day. Firstly, that the Pakistanis always played better when the sun shone on them. Secondly, that they were a team that never gave up and batted right down the line. And, thirdly, that no one would grudge them a bit of luck if it came their way. As Mr. Arlott took over from Mr. Alston and Mr. Alston from Mr. Arlott, so each repeated these obvious truths. Both commentators, being completely stuck for something fresh to say, had no other recourse or alternative than to read the score.

A COMPLETELY ASSEMBLED

"ALL-WAVE" SUPERHET CHASSIS



MODERNISE YOUR OLD RADIOGRAM FOR £23

We offer this Auto-changer complete with Model B.3 3-waveband as advertised together with 10in. p.m. Speaker for £23/6/- plus 10/- carr. and ins., or H.P. Terms £5/16/- Dep. and 12 months of £1/12/10, or with B3PP Model for £26/9/-, plus 10/- carr. and ins. or H.P. Terms £6/11/- Dep. and 12 months of £1/17/4.

MODEL B.3—A 5-valve 3 waveband Superhet Receiver for operation on A.C. mains 100-120 volts and 200-250 volts employing the very latest miniature valves. It is 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 it 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) Wave change and Gram ; (4) Tone Control operative on Gram and Radio.
Negative Feedback is employed over the entire audio stages. Chassis size, 11in. x 7½in. x 8½in. high. Dial size, 9½in. x 4½in. Price, complete and READY FOR USE excluding speaker, £12/12/- (Carr. and Pkg. 7/6 extra). Or H.P. Terms £3/4/- Dep. 12 Months at 17/6. MODEL B.3 P.P.—This model is the B.3. Receiver but incorporates two 6BW6 VALVES in PUSH-PULL, resulting in really excellent quality reproduction up to approximately 6 watts. Price £15/15/-. (Plus 7/6 carr. and ins.) or H.P. Terms £3/19/- Dep. 12 months at £1/2/2.

A GENUINE SPECIAL OFFER !

The COLLARO 3RC/521 3-SPEED AUTO-CHANGE UNIT

£9/19/6 H.P. Terms £2/10/- Dep. and 11 months at 15/9 (plus 7/6 carr. and ins.)

Normal price £18/10/-.

- These units will auto-change on all three speeds. 7in., 10in. and 12in.
- Incorporating Hi-fi Crystal "Turnover" Head.
- They have separate sapphires for L.P. and 78 r.p.m. which are moved into position by a simple switch.
- Minimum base-board size required 13½in. x 12½in. with height above 5½in. and height below baseboard 2½in. A bulk purchase enables us to offer these BRAND-NEW UNITS, including mounting instructions, at this exceptional price.

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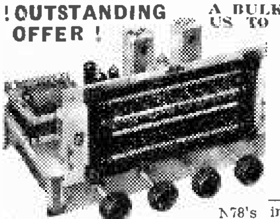
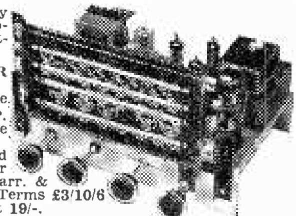


A BULK PURCHASE ENABLES US TO OFFER THIS "PUSH-PULL" 7 VALVE SUPERHET RECEIVER

For only £12/19/6 (Carr. and Ins. 7/6 extra). H.P. Terms £3/4/6 Dep. 12 months at 18/4.

These receivers Model AW3-7 are made by a well-known set manufacturer and incorporate the lastest Osram Valve Line-up of X79—W77—DH77—H77—U78 and two N78's in Push-Pull for approx. 7 watts output. They cover 3 wavebands 18-50 metres, 190-550 and 800-2,000 metres, and are for operation on A.C. mains 200-250 volts They make an excellent replacement Radiogram Chassis having a P.U. connection on the chassis. Extension speaker connection is also provided.
Overall size of chassis : 12in. long x 7½in. x 6½in. high, dial aperture 8½in. x 4½in. (Dial Escutcheon available for 4/9).
THESE RECEIVERS ARE BRAND NEW, FULLY GUARANTEED.

The "SUPER-SIX" FOR HOME CONSTRUCTORS



A compact and highly efficient superhet Radio-Radiogram chassis of outstanding quality.

YOU CAN BUILD IT FOR £10/7/6 Including the OCTAL VALVE LINE-UP. (£12/7/6 with the miniature valves.)
We will supply it assembled and READY FOR USE for £13/13/0 (Plus 7/6 Carr. & Ins.) H.P. Terms £3/10/6 deposit and 12 months at 19/-.

Incorporating the new B.V.A. Miniature Valve Line-up. This receiver is designed to the very latest specification and provision is made to incorporate either the standard Octal Valve Line-up or the new B.V.A. range of miniature valves. Great attention has been paid to the quality of the reproduction of both Radio reception and Record playings, and excellent clarity of speech and music is obtained.
A few brief details :

- Covers 3 wavebands 18-50 metres, 190-550, and 800-2,000 metres.
- Employs 6 valves having PUSH-PULL for 5-6 watts output.
- Incorporates delayed A.V.C. on all wavebands and pre-selective feedback.
- A 4 position Tone Control operates on both Radio and Gram.
- Has independent mains supply socket for a Record Player.
- Size of Assembled Chassis 12in. x 8in. x 8in. Dial aperture 8½in. x 4½in.
- For operation on A.C. mains 200-250 volts 50 cycles.

THE INSTRUCTION and ASSEMBLY MANUAL is available for 2/-, it contains very detailed practical drawings and circuit diagrams and a complete Component Price List.

A 12 WATT "HIGH FIDELITY" Push-Pull AMPLIFIER

Comprising a Main Amplifier Chassis and a Remote Control Pre-Amplifier - Tone Control Unit. The remote control unit measures only 7in. x 4in. x 2in. and contains four controls, being : Bass-Treble-Volume and a Radio, Gram, Microphone Switch control. It incorporates its own feedback circuit on the Bass Channel. Loop negative feedback is employed on the Main Amplifier which has a valve line up of 6J5-6N7-5U4 with two PX25's in push-pull and 6J5 and 6SN7 are used in the remote control unit.

THE COMPLETE KIT IS AVAILABLE FOR £14 (Carr. & Ins. 3/- extra.)
THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £17/0/0 (Carr. & Ins. 5/- extra.)
H.P. Terms £4/5/- Deposit. 12 Months at £1/3/11.

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 30 mA. H.T. is provided for tuning unit, etc. **This Amplifier compares well with the Williamson and similar designs at a fraction of their cost. The complete set of assembly instructions are available for 2/-.**

A HIGH QUALITY 8-10 WATT AMPLIFIER

THE IDEAL AMPLIFIER FOR GENERAL HOME USE AND FOR SMALL HALLS, ETC.

Price of COMPLETE KIT including Valves and Drilled Chassis, etc. £7/10/0 (Plus 2/6 Carr. & Ins.)
We will supply it Completely Built for £9/0/0 (Plus 3/- Carr. & Ins.)

Designed for high quality reproduction up to an output of 10 watts, having 6V6s in Push-Pull and incorporating negative feedback. It is suitable for use with all types of Pick-ups and most types of microphones and the output transformer provides for use of 3 and 15 ohm speakers. BRIEF FEATURES

- Valve line up 6J5, 6SN7, 5Z4, with 6V6's in push-pull.
- The undistorted output level of up to 10 watts is produced from an input of 25 volts.
- First-class reproduction of Radio (where a Tuning Unit is used) and Record Playing.
- Separate Bass Boost and Treble Controls provide an excellent range of frequency control.
- Very satisfactory results are obtained with an average type of high impedance Moving Coil or Crystal Microphone, a clear speech level of approx. 5 watts output being obtained.
- Power supplies (HT and GT) are available for a Tuning Unit.
- For operation on A.C. Mains 200-250 volts 50 cycles.

THE ASSEMBLY MANUAL is available for 1/- and includes detailed layouts and component Price List.

STERN RADIO Ltd.

109 & 115, FLEET STREET, E.C.4
TELEPHONE : CENtral 5812/3/4

MULTIPLE SPEAKERS

SOLVING THE PROBLEMS OF USING TWO OR MORE LOUDSPEAKERS IN EITHER EXTENSION POSITION OR HI-FI EQUIPMENT By W. J. Delaney

ONE of the most frequent questions we were asked at the Radio Show was how to use more than one loudspeaker on a domestic receiver. Apart from questions of impedance-matching networks, there appears to be a considerable amount of difficulty in adding one or more loudspeakers for use in different rooms, and although various aspects of this have been covered in past issues certain points appear to present difficulty to the average user. It may be pointed out right away that there is no real difficulty in adding a second or third speaker, and in many cases this may be connected directly across the existing speaker without any ill-effects. If the receiver is a commercial model and has extension speaker sockets or terminals, the additional speaker may be connected at this point, but it must be of the correct type. Usually this is indicated either on the set or in the maker's instructional leaflet or handbook. There are two types of speaker—high-impedance and low-impedance, and if the wrong type is connected to the additional point it will either produce a very weak output or cut down the volume of the existing speaker. However, if a speaker is already available and is of the wrong type, it may be used by connecting a standard loudspeaker transformer between it and the extension sockets, connecting it so that it corrects the mismatch. That is, using it either way round—as a step-up or a step-down component. Experiments will soon show which is the correct way.

Matching

Where it is desired to obtain the correct matching, for instance with a good quality amplifier or high-quality receiver, some care is required. In the recent article on impedance matching networks it was mentioned that the two speakers used should be of the same impedance. If they differ it is extremely difficult to use them. The addition of matching transformers will upset the whole performance of the network, and if they are used without any form of matching they will produce uneven outputs. It is, however, possible to use speakers of the same impedance with an output impedance of a different value—simply by using series or parallel connections. In Fig. 1, for instance, is shown a 6-ohm output point of an amplifier or receiver. Two 3-ohm speakers may be used in series, or four 6-ohm speakers in series-parallel. It should be remembered for calculation purposes that impedances may be regarded as resistances, and that resistances in series are additive, and in parallel the formula is complicated and expressed $\frac{1}{R}=\frac{1}{R1}+\frac{1}{R2}$, etc., or, in other words, the reciprocal of the total impedance is the sum of the reciprocals. In the case of only two resistances or impedances this simplifies to $R=\frac{R1 \times R2}{R1+R2}$. Again, considering the impedances as resistances, the lower value will act as a partial short-circuit across a higher value and this means that the output volume will be reduced on the one speaker and louder on the other.

Multiple Outputs

Where, however, some form of matching is required in order to make use of two or more speakers of different impedance, and high quality is not essential (that is to say, a certain amount of distortion due to mismatching can be tolerated), a standard tapped output-matching transformer may be used, with the separate speakers connected across various tappings, choosing those which give the required results. Fig. 2 illustrates the idea, and although only three speakers and two tappings are shown on the transformer it may be extended for any number of speakers and tapping points. It would be difficult to work out the correct ratio for such mixing, but it is an idea which will enable existing speakers to be used in various parts of the house. A more exact arrangement is depicted in Fig. 3 where transformers are used with each speaker, these providing a match for each speaker, but the impedances of the primaries of T1 and T2

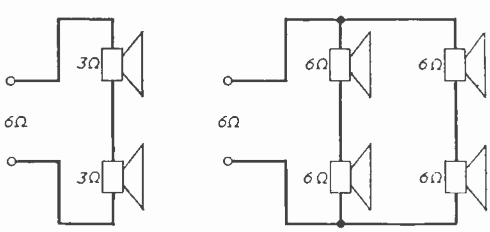


Fig. 1.—Matching the output when using more than one speaker.

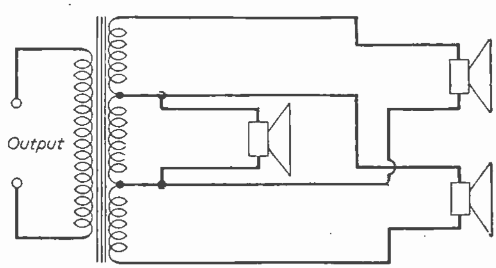


Fig. 2.—One form of rough matching using a single multi-section output transformer.

are in parallel across the output, and again this must be borne in mind from a matching point of view.

Volume Controls

Volume controls for the extension speakers are simply arranged if the speakers are of the low-

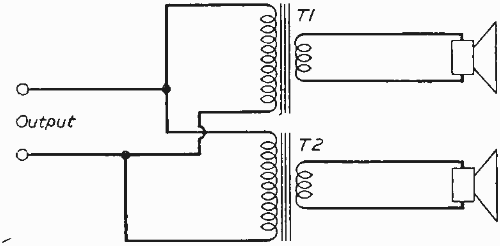


Fig. 3.—Using separate matching transformers.

impedance type. A variable resistance should be connected directly across the speaker, and although for correct matching the value should be carefully worked out, in general practice it will be found quite satisfactory to use a resistance of not less than five times the impedance of the speaker. That is, with a 5 ohm speech coil or speaker the variable should be 25 ohms or more. The disadvantage of this arrangement, (a) in Fig. 4, is that it may affect considerably the volume given by the set speaker. The alternative arrangement shown at (b) in Fig. 4 will not have such a marked effect on the set speaker, but will affect quality more, and the value of the resistance in this case should be 20 or more times the speaker impedance. This arrangement will hardly ever be capable of silencing completely the speaker, whereas the arrangement in (a) will enable the extension speaker to be "killed."

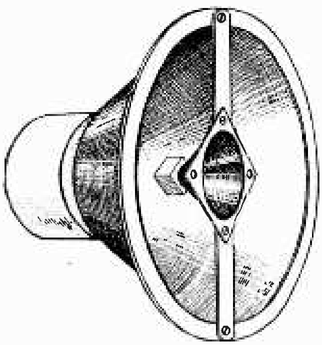


Fig. 5.—A suggestion for making up a concentric loudspeaker.

Simple Matching

Several readers were interested in using pairs of speakers in a good radio or radiogram, but did not feel that the expense of a proper impedance cross-over network was justified. They enquired whether there was a simple method of using two speakers under such conditions. It is, of course, extremely easy to use two speakers and in many cases they may simply be connected in series or parallel (according to their impedance) across the output circuit. Such an arrangement will, however, not produce a very marked effect if the two speakers are more or less identical. Where some attempt is to be made to give high-quality reproduction, one speaker should be a large unit 10in. or more in diameter, while the other should be a small tweeter or cone, say not larger than 5in. The drawback to the use of two such speakers is that all frequencies are fed to both, and the small unit may be damaged or even destroyed by large amplitudes of bass fed into it. This may be

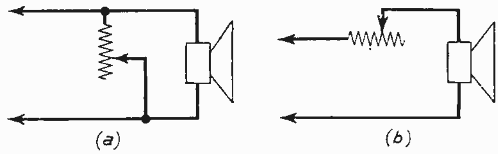


Fig. 4.—Methods of using a volume-control on an extension speaker.

avoided simply by connecting a large capacity condenser in series with it—say 2 or 4 μF (paper, not electrolytic). One idea suggested by a reader is illustrated in Fig. 5, a standard 12in. model having a strap of wood across it, to which is mounted a small 5in. moving coil. The two are thus concentric and avoid difficulties in making speaker openings in the cabinet, but the small speaker may affect the reproduction from the large model due to its position. However, it is an idea worth passing on. In this connection one other point is worthy of mention, and that is the question of phasing of two speakers when they are mounted near each other. It is essential that they both move together or the air vibrations from them will cancel each other out. To find the correct phase, the speakers should be placed on a table or bench and a 1.5 volt cell touched to the two leads. It will be found that when the connection is made the cone will jump outwards or inwards and remain there, and when the cell is removed the cone will return to its original position. The two terminals may then be identified with a plus or minus sign, or painted red and green so that the speakers perform in the same manner when positive is joined to plus (or red). They may then be connected in circuit in the certain knowledge that they will be correctly phased—regarding the marked terminals in exactly the same way as if using batteries.

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FREQUENCY MODULATION

AN EXPLANATION OF THE PRINCIPLES AND CIRCUITS COMMONLY USED

By A. Thomson

THE BBC have announced that nine V.H.F. stations operating in Band 2 (87.5 to 100 Mc/s) are to be in operation in the near future. Most experimenters know that a service on V.H.F. is already operating from the experimental station at Wrotham, in Kent. This station was set up by the BBC to test the advantages of and the disadvantages of a V.H.F. service using amplitude modulation and frequency modulation. Very exhaustive tests were carried out (see BBC Quarterly, Autumn, 1951) and it has been finally decided that the V.H.F. broadcast service will use frequency modulation ; therefore the radio-engineer will be called upon to service and install this type of receiver.

This article attempts to explain in simple language the why's and wherefore's of frequency modulation as against our present amplitude modulation system and also to indicate the trend of design that receivers will most likely follow as has been evidenced in the U.S.A. and Germany.

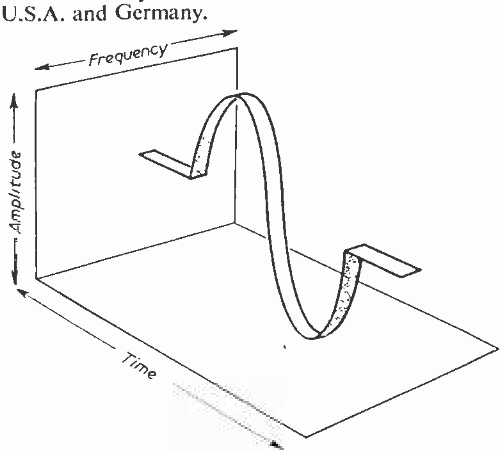

Fig. 1.—Diagram illustrating amplitude modulation.

There are many people who think that FM is the answer to cheap high fidelity, and all that is necessary is to have a FM receiver for high-quality reception. High-fidelity reception is possible on AM on V.H.F. as well as on a FM receiver. Our present AM sound transmissions of television sound are of really high quality and if an amplifier, speaker, etc., to do full justice to these transmissions is used, a very high quality of reproduction can be achieved. In fact, our present MW and LW transmitters radiate a very high quality of transmission, and if one takes pains over choosing a first-class tuner unit, high-fidelity amplifier and loudspeaker, an extremely high quality of reproduction is obtainable. High quality on MW or V.H.F. with AM or FM is not cheap ; the listener must pay the same price for quality whatever the system. What frequency modulation does do is to give us a system which allows us to get away from the 9 kc/s separation between stations that we have on MW ; also it allows the reduction of receiver hiss and is said virtually to eliminate noise. Do not let this last item mislead you. Noise can still be a problem in certain areas, especially when we meet our old friend, ignition interference, on the V.H.F. bands, whether we use AM or FM. However, more of this later. One point which should be stressed here is that the high quality of transmission is mainly due to the shift to the V.H.F. band, and it is hoped that high-fidelity receivers will get the scope they richly deserve on this new broadcast band.

The distinguishing features between a FM system and an AM system lie in the modulating circuits at the transmitter, and the detector circuits at the receiver. Therefore it is to the detector circuit that most of our attention will be focused.

When a transmitter is modulated the radio wave is altered in accordance with the matter to be transmitted. It does not matter what is the nature of the intelligence so far as the process of modulation is concerned : it is the method by which this matter gives the radio wave a distinguishing characteristic, and so enables the radio receiver to convert the transmitted matter back into intelligence, that determines the type of modulation being used.

Figs. 1 and 2 show the representation of amplitude modulation and frequency modulation. This shows

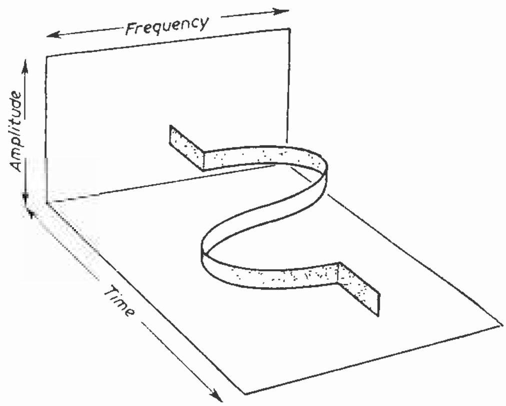

Fig. 2.—Diagram illustrating frequency modulation.

a carrier wave being modulated by a sine-wave signal. Fig. 1 shows a carrier of constant radio frequency and varying amplitude. (This is not theoretically correct, but for the purpose of illustration it is convenient to think of the radio carrier and sidebands combined to give a resultant carrier of constant radio frequency.)

Fig. 2 shows the carrier of Fig. 1 frequency modulated by the same sine-wave modulating voltage. The amount the frequency varies from its unmodulated value when modulation is applied is governed by the amplitude of the modulating signal. The rate at which the frequency varies back and forth about the carrier frequency is determined by the frequency of the modulating signal.

How It Works

A study of Figs. 1 and 2 will show one of the principal advantages of FM over AM. It will be seen that it is not necessary to vary the transmitter output power to secure modulation with a FM system. This advantage from the transmitting and receiving point of view is indeed great, and will no doubt have a bearing on the design of future communication installations. It is due to this constancy of carrier level and the wide bandwidth that a FM system gives an extremely low noise level in the service areas of a transmitter.

One of the greatest benefits of a FM system is the reduction of noise at the receiver. Noise does not cause appreciable frequency modulation, and as the receiver is made responsive to frequency changes only, a considerable increase in the signal-to-noise ratio is made possible by using FM when the signal is of greater strength than the noise. This makes it possible for a FM transmitter to serve a greater service area than an AM transmitter. From field tests it has been shown that FM reception is possible with a signal-to-noise ratio of five to one, whereas with an AM system the signal-to-noise ratio would have to be 100 to one to obtain the same results.

When we are dealing with FM we refer to such terms as Deviation and the Deviation Ratio, which tells us what we want to know about the FM wave.

Deviation

This is the amount of frequency change each side of the unmodulated carrier frequency which occurs when the transmitter is modulated. Deviation is expressed in kc/s and refers to the maximum or peak deviation.

Deviation Ratio

This is the ratio between the peak deviation under full modulation, and the maximum audio frequency transmitted. Both are expressed in the same units. For instance, if a transmitter has a deviation of 75 kc/s and the highest audio frequency to be transmitted is 15 kc/s, then the transmitter has a deviation ratio of 75/15, which is 5. Therefore the deviation ratio is 5 to 1.

It has been announced that the new BBC frequency-modulated stations in Band 2 will have a peak deviation of ± 75 kc/s with a pre-emphasis time of 50 microseconds. They are to have a deviation ratio of 5 to 1.

From this specification it will be gathered that the quality of programme material to be transmitted will be extremely high, with the highest audio frequency at 15 kc/s (Peak Deviation divided by Deviation Ratio 75/5=15). Therefore, the limit of reproduction at the receiver will be governed by the design of the audio output stages and the loudspeaker itself. We shall deal more fully with this when we come to discuss the design of a FM receiver.

Noise

We have already mentioned that a FM receiver has the ability to discriminate against noise to a greater extent than an AM receiver. The two types of noise most commonly met with are receiver hiss and impulsive interference from motor-cars and some domestic appliances. It has been shown that receiver hiss is far less with an FM receiver than with an AM receiver, in fact it is about 25 to 28 db down compared with AM. Translating the above into a practical example, it would be necessary to have an input of 1,000 microvolts to an AM receiver to give the same results that would be given by a FM receiver with only 50 microvolts input.

It is hoped by using simple dipole aerials only that a good signal strength of approximately 250 microvolts per meter will be provided in the second-class service area of a FM transmitter. These figures are based on the height of the receiving aerial being roughly 30ft. above ground level.

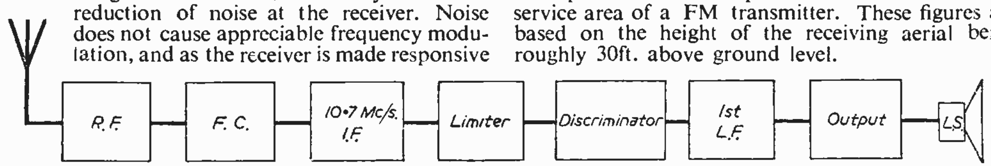

Fig. 3.—Block diagram of a FM receiver.

The requirements of a FM receiver can be summed up as follows :

1. The design of the R.F. and I.F. stages must be made to have sufficient bandwidth to enable the range of frequencies transmitted to be received and passed to the discriminator. Most FM receivers will most likely be of the superhet type to obtain the necessary sensitivity on Band 2, and therefore the design of the I.F. stages will be of great importance.
2. To convert frequency changes into amplitude changes we have to incorporate a detector or discriminator which will operate on frequency variations instead of on amplitude variations as do our present AM systems. In FM we refer to the detector as a discriminator.
3. In order to obtain the full advantages of a FM system over other types of transmission, it is essential that we include a device to remove any amplitude variations of the signal before they reach the discriminator. This device is called a limiter. By removing the amplitude variations, the limiter passes on to the discriminator a FM signal of constant amplitude.

Fig. 3 shows a block diagram of a FM superhet receiver. It will be seen from this diagram that the layout is very similar to a conventional type superhet receiver, except that we have a limiter after the I.F. stage, and we have a discriminator where we had a detector. Apart from these changes it looks as though there is very little difference between the two types of receivers. Therefore, let us take a closer look at the various parts of a FM receiver from both the theoretical and practical point of view, and find out what the requirements of the receiver are.

The R.F. stages are very similar to those used in television receiver design, where we deal with V.H.F.,

(*Continued on page* 685)

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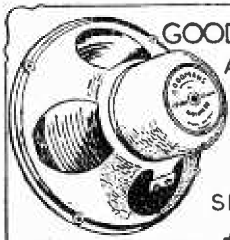

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and in the FM receiver we meet low-loss coils and valveholders. We also have the invisible components the stray capacities, self-inductances, etc., and all these must be taken into consideration in the design of a FM receiver. We must also be able to tune the oscillator over a range of frequencies to enable us to tune the receiver over the band 87.5 to 100 Mc/s. The oscillator circuit must be very carefully designed, as oscillator drift will be serious at V.H.F. and therefore we must aim at a high degree of stability in FM receiver design. Again, we have a wide bandwidth being transmitted, the deviation being 75 kc/s, which

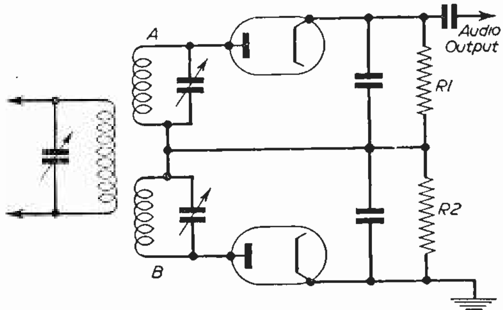

Fig. 4.—An amplitude discriminator.

makes a total of 150 kc/s. To this we have to add a certain amount to allow for frequency drift ; also an amount for loss of alignment at discriminator, so that altogether we shall have a bandwidth approximating 200 kc/s. To pass a bandwidth of this amount we must use an I.F. well above the present 465 kc/s used in standard receivers, and must go up to the region of 5 to 12 Mc/s. From experience and components available it seems an I.F. of 10.7 Mc/s is going to become a popular choice, and transformers for this frequency are available to constructors for the building of FM receivers. Special valves have also been developed for use in commercial FM sets and these will be dealt with later. To obtain the full quality of a FM system we must have a high-fidelity audio amplifier system capable of passing audio frequencies up to 15 kc/s with a minimum of distortion.

In discussing the requirements of a FM receiver we mentioned that a discriminator was necessary to convert frequency changes into amplitude changes, and as this is one of the most important parts of a FM receiver, we shall discuss the various types of discriminators in detail.

Amplitude Discriminator

This type of discriminator is often referred to as the Travis discriminator (Fig. 4). The transformer is the coupling transformer between the limiter valve and the rectifier valve. We have two tuned secondary windings A and B. Each circuit is tuned to the outer edges of the transmitter frequency swing. Their outputs are combined in a differential rectifier so that the voltage across the load resistors R1 and R2 is equal to the algebraic sum of the individual output voltage of each rectifier. The working of an amplitude discriminator is thus : When a signal is received at the mid-I.F. the voltage across the load resistors R1 and R2 is equal and of opposite polarity and, therefore, the sum voltage must be zero. As the input voltage varies from the mid-I.F., these individual voltages become unequal and a voltage having the polarity of the largest voltage and equal to the difference between the two voltages appears across the series resistors, and it is this voltage which is applied to the audio circuit. Fig. 7 is a graph representing the relationship between frequency and discriminator output voltage.

The amplitude discriminator is not used a great deal in modern FM receivers, as it is difficult to align and it is hard to achieve linearity over a wide frequency band.

Phase Discriminator

This type of detector, demodulator or discriminator may be referred to as the Foster-Seeley type, and it is one of the most widely used types of discriminators (Fig. 5). A limiter valve is necessary with a phase discriminator and in Fig. 5 the valve V1 is the limiter valve. The transformer is the coupling transformer between limiter valve V1 and the rectifier valve V2. The whole function of a discriminator circuit is first to convert frequency variations into amplitude variations and then to rectify the amplitude variations in the more or less conventional manner. Here again the output voltage/frequency characteristic is similar to that shown in Fig. 7. The load resistors R1 and R2 are connected in series to earth. The two rectifiers diodes are in series opposing. This type of circuit only requires two tuned circuits, and the operation of the circuit results from the phase relationships that exist in coupled circuits which are tuned to the same frequency. A study of the circuit shows that as far as R.F. is concerned the primary circuit of T is in series with each half of the secondary to earth. When the received signal is at the mid-I.F., or resonant frequency, the R.F. voltage across the secondary is 90 degrees out of phase with that across the primary, due to the inductive coupling between the two circuits. Since

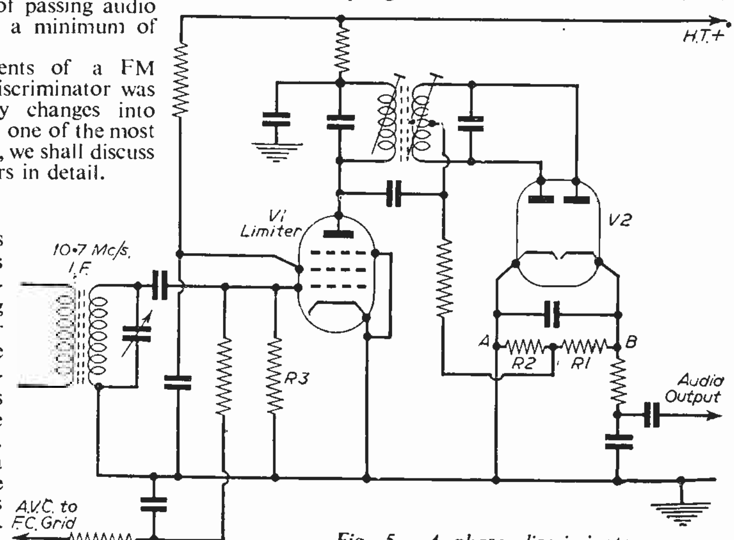

Fig. 5.—A phase discriminator.

each diode is connected across one-half of the secondary winding and the primary winding in series the resultant R.F. voltages applied to each are equal and of opposite polarity. Hence the net voltage between the points A and B is zero at mid-I.F. However, when the signal varies from the mid-I.F., the 90 degrees relationship no longer exists between primary and secondary. The resultant voltages applied to the two diodes are now no longer equal, and a D.C. voltage proportional to the difference between the R.F. voltages applied to the two diodes will exist across the series resistors, between points A and B. This output voltage is dependent on the secondary phase which in turn is dependent upon the primary frequency and so we have a detector of frequency modulation.

Ratio Discriminator

As was mentioned above when describing the phase discriminator a limiter is essential to its correct working because it is sensitive to undesired amplitude modulation of the signal voltage. The ratio discriminator is an adaptation of the balanced phase discriminator rendered unresponsive to amplitude modulation and, therefore, does not require a limiter stage to precede the discriminator. It will be seen from Fig. 6 that the two diodes are in series aiding instead of series opposing as was the case in the phase discriminator. If a ratio discriminator is used one does not necessarily save on the number of valves used in the receiver. The ratio discriminator must have a large amount of signal fed to it, and it is likely that to obtain this amount of signal it will be necessary to employ an extra I.F. stage, unless, of course, the receiver is used close to the transmitter. However, the ratio discriminator has its advantages and its disadvantages the same as the other types of discriminators, and it will be met a great deal in the combined AM/FM receivers. When using a ratio detector type discriminator, A.V.C. can be used with advantage.

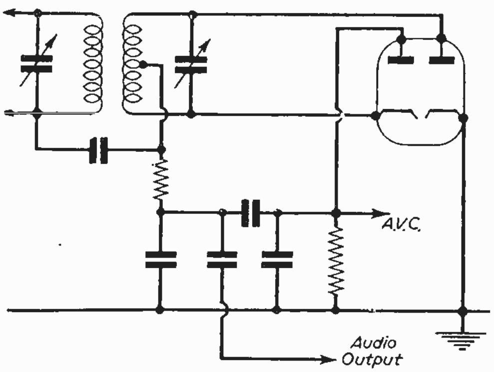

Fig. 6.—A ratio discriminator.

Limiters

When we were discussing the requirements of a FM receiver we said that it was necessary to have a device to remove any amplitude variations before they reach the discriminator. This device is known as the limiter and precedes the discriminator in a phase type. The limiter is operated as an I.F. stage with low anode and screen voltages and so is very easily overloaded. It will be noticed from Fig. 6 that it also uses grid leak bias. When a signal is received the limiter output will increase with an increase of signal until it reaches the point of overload, when any increase in signal is not accompanied by an increase in output from the limiter valve. From this short description it will be gathered that to operate a limiter stage successfully it must be supplied with a large amount of signal, so that the amplitude of its output will not change for rather wide variations in amplitude of signal. Thus the limiter does its job of removing any unwanted amplitude modulation from the signal and passes on to the discriminator a frequency modulated signal which is of constant amplitude. Noise which has very little effect on FM, but affects AM to a great extent, is much less when

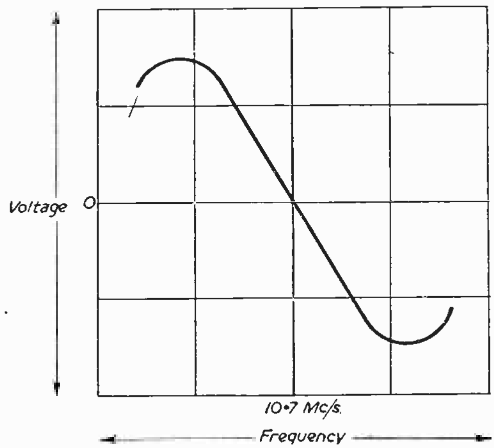

Fig. 7.—Graph showing discriminator output V frequency characteristic.

receiving FM signals. The voltage across R3, the grid resistor, varies with the amplitude of the received signal, and for this reason conventional AM signals may be received on the FM receiver by connecting the input to the audio circuit to this resistor instead of to the discriminator output. When properly filtered by a simple R-C circuit the voltage across R3 may also be used as an A.V.C. voltage for the receiver. It is not really necessary to use A.V.C. voltage in a FM receiver if all the grid circuit discharge time constants are kept low (below about 2 micro-seconds).

(*To be continued.*)

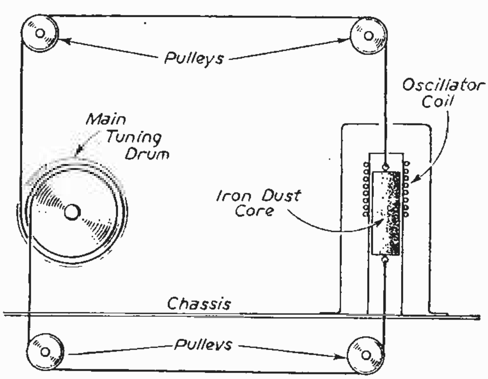

Fig. 8.—One method of mechanical tuning.

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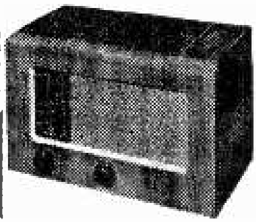

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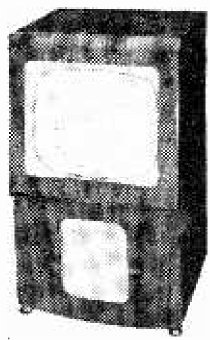

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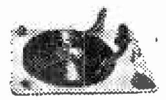

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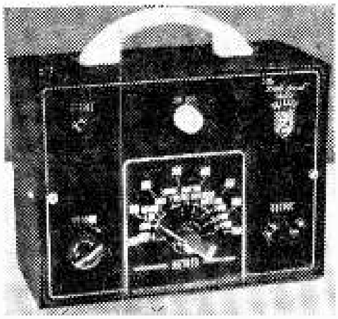

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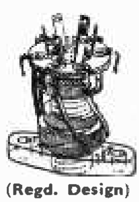

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Modulation Hum

THE CAUSES AND CURES OF A VERY COMMON TROUBLE IN MAINS RECEIVERS

By W. N. Stevens (G3AKA)

MODULATION hum is a common fault, and yet in its own way is unusual. It can be experienced in a perfectly efficient receiver and it presents one of the few instances where the circuitry of a commercial receiver should be modified to effect a cure. Although poor design and chassis layout can cause the trouble, the presence of modulation hum does not usually imply bad construction.

It manifests itself as a distorting hum which appears when a carrier is tuned in and so is often referred to as Tunable Hum. A normal quiet background is experienced when no station is being received. It does not necessarily appear on all stations, but is generally more pronounced on the louder signals.

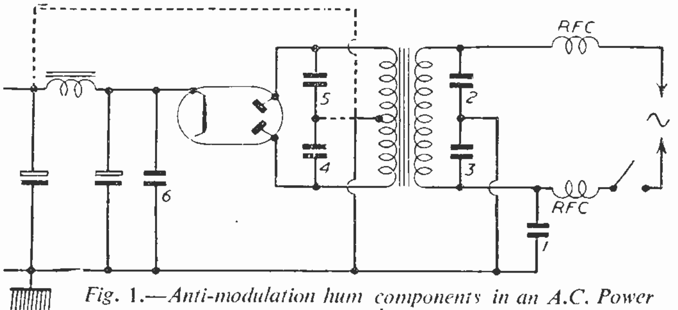


Fig. 1.—Anti-modulation hum components in an A.C. Power pack.

Although the effect can be caused by a heater/cathode breakdown in a pre-detector stage, or an open circuit screen or a.g.c. decoupling capacitor, it is generally due to an R.F. field in a pre-detector stage (giving non-linear amplification) being affected by a conductor carrying current at mains frequency or rectified ripple frequency and thereby introducing modulation. It can also be caused by the reception of a mains-borne signal, modulated by the action of the rectifier valve and being passed back to the R.F. section of the receiver.

If the receiver is tuned to the R.F. in the mains wiring, and coupling of some form exists between the aerial and the mains wiring, amplification and rectification of the hum-modulated signals will take place. In A.C./D.C. circuits the hum will be at mains frequency, whilst in A.C. powered circuits using full-wave rectification the hum will be at double the mains frequency.

Effects

Let us now consider causes and effects. However elaborate may be the "front end" of a receiver, the basic aerial circuit remains a tuned rejector circuit of a coil and capacitor in parallel. This circuit is nowadays rarely taken to a good "natural earth," reliance being placed on earthing via the mains. The result is that the tuned aerial circuit is actually earthed via the chassis, the power supply, the rectifier and the power transformer (or the breakdown resistor in the mains circuit). The most significant item in this chain is the rectifier, because it will now be obvious that we have the remarkable but undisputed fact that between the aerial and earth is a varying impedance device.

Naturally, the first step in curing modulation hum is the installation of a good low-resistance natural earthing system, to short-circuit the varying impedance rectifier at R.F. and thereby mitigate the trouble in a great many cases. This, however, is not always possible or practicable especially in blocks of flats, and there is the additional possibility of a "mains earth" being noisy, or the mains wiring having a high R.F. content. In such cases the receiver must be modified to reduce the trouble and, in severe cases, existing precautions in a commercial set may have to be augmented.

There are two alternatives—to decouple the R.F. components to by-pass the spurious mains voltages or to decouple the mains voltages to by-pass the R.F. content. The latter is the simpler and is the method generally adopted.

In A.C./D.C. chassis it is customary to shunt a capacitor across the cathode and anode of the rectifier, it having such a value (between 0.01 μF—0.05 μF) that it presents a negligible impedance to R.F., thus effectively short-circuiting the varying impedance effect of the rectifier and preventing the R.F. from getting into the aerial circuit.

In cases where a mains-borne signal causes the trouble it is fed back to the aerial partly or completely via the power rectifier varying in amplitude with the rectifier's variation in impedance. R.F. can be prevented from reaching the rectifier by the insertion of R.F. chokes in the arms of the mains supply leads. As a further precaution, or necessity, by-pass capacitors may be fitted between the rectifier anode and chassis. In A.C./D.C. circuits it may also be necessary to insert capacitors from each side of the mains supply to chassis. D.C.

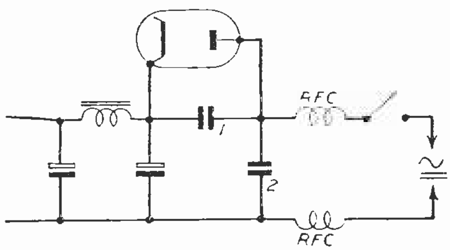


Fig. 2.—Anti-hum condensers in an A.C./D.C. circuit.

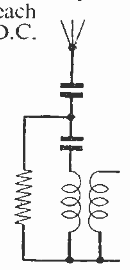


Fig. 3.—Aerial circuit hum suppressors.

mains are usually much worse than A.C. mains supplies and R.F. chokes are frequently necessary.

In A.C. operated receivers, an effective procedure is to connect capacitors from the rectifier anodes to the smoothed H.T. positive rail (or to chassis) or shunted across the mains supply. Fig. 1 shows the positions of anti-modulation-hum components in A.C. power packs. Usually, only one of the precautions is necessary and should effect a cure—sometimes two combinations may be required. The reference numbers on the capacitors indicate the order in which it is recommended that tests should be made. Firstly, a capacitor may be connected from one side of the mains line (preferably that which is switched) to chassis. If this fails to cure the hum, each side of the mains line should be by-passed (components 2 and 3). Should this be ineffective try fitting components 4 and 5 across the rectifier anodes to chassis, as shown, or to the smoothed H.T. line. As a final attempt—a last resort—a capacitor (6) can be tried across the cathode of the rectifier to chassis. The R.F. chokes are only necessary in cases where the trouble is due to mains-borne signals.

In A.C./D.C. arrangements (Fig. 2) the first step is to try shunting a capacitor across the mains supply. Next, try one connected across the anode and cathode of the rectifier—although it will be found that in commercial receivers this is now usually a standard fitment.

Here it is necessary to point out that the capacitors used in the position indicated must be capable of withstanding the combined rectified H.T. voltage plus the back e.m.f. of the A.C. mains input during the negative half-cycles and are thus usually of 1,000 volt D.C. rating. The R.F. chokes should be of the heavy duty type and capable of carrying the full load current of the receiver.

It sometimes happens that the trouble is at the input end of the receiver, especially in circuits where tightly-coupled aerial circuits are used. Receivers using "bottom end" coupling in the aerial tuning circuit are noticeably prone to this trouble. A simple method to overcome the trouble is shown in Fig. 3, the capacitors being of around 0.01 μF and the resistor may be between 10,000-4,700 ohms. Occasionally, the trouble can be cured simply by the addition of the resistor, but usually the complete filter is required.

No one arrangement will cure any given case of modulation hum and the various ideas should be tried in the sequences suggested. It often happens that a receiver showing severe modulation hum will perform quite free from the effect in another building, since the trouble is due to a peculiar combination of circumstances existing in the position it usually occupies. Trial and error is the only way out.

Radio for Ship's Lifeboat

FOLLOWING the recent introduction of the "Salvita" portable radio equipment for use in lifeboats The Marconi International Marine Communication Co., Ltd., has now produced a new fixed transmitter and receiver for permanent installation in the larger type of motor-propelled lifeboat.

Like the portable "Salvita," the new fixed equipment, which has been named the "Salvare," has been type-approved by the Ministry of Transport and the General Post Office. A ship's wireless station in miniature, it is a completely self-contained medium- and short-wave transmitting and receiving installation built into metal racking which is enclosed in a canvas-covered wooden cabinet. A detachable front cover keeps the "Salvare" spray and weatherproof.

When the "Salvare" is opened up for operation a sliding shelf beneath the transmitter is withdrawn. This serves as a support for a message pad but also carries the simple instructions for operating the installation. The controls are numbered consecutively in the order in which they are to be manipulated, and any unskilled person can operate the "Salvare" simply by following these numbers through. For instance the figure 1, painted on the front panel, indicates the setting of the send/receive switch to the receiving position, figure 2 indicates the switching-on of the power from the batteries, figure 3 shows the switching of power through to the transmitter, and so on throughout the complete sequence of operation. A built-in meter provides for rapid checking of battery voltage and transmitter valve feed current.

Automatic keying is incorporated as well as a hand key for use by a skilled Morse operator or radio officer, and the "Salvare" can be used with a mast-rigged aerial or kite-supported aerial.

Both transmitter and receiver are powered by a 24-volt 144-ampere/hour battery charged by a generator driven off the lifeboat's motor. The "Salvare" can thus be operated on the "floating battery" principle without diminishing the battery potential, so that as long as the lifeboat's motor can run the battery is virtually inexhaustible. While the lifeboat is on board its parent ship the battery is, of course, charged periodically from ship's mains, which are also available for the operation of drying heaters incorporated in the "Salvare."

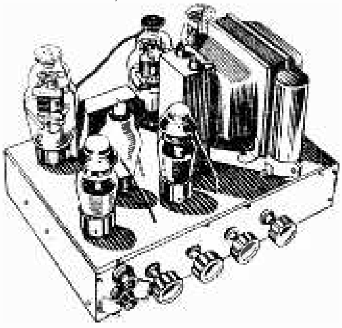
Pre-tuned

The transmitter is pre-tuned to a spot frequency of 500 kc/s on medium frequency and to 8364 kc/s on high frequency, power outputs being 50 and 60 watts respectively. An L.C. master oscillator is used for medium-frequency control, crystal control being employed for H.F. transmission. Automatic keying provides for either "Alarm" or "Distress" transmission, or for both when used on 500 kc/s. Setting the switch to the "Alarm" position actuates the mechanism for the transmission of the international auto-alarm signal of 12 four-second dashes, at the end of which the transmitter switches itself off. When set to "Distress" the "Salvare" send SOS three times followed by a long dash of 54-seconds, and will continue to transmit the distress sequence at 12-minute intervals until switched off. While it is kept in this condition the auto-sender "Ready" lamp lights at intervals of 87-seconds throughout the non-transmitting periods to indicate that the set is still functioning. Provision has been made for later inclusion in the distress sequence of the lifeboat's call-sign.

Overall dimensions of the "Salvare" are: Height 2ft. 4in., width 2ft. 10½in., depth 1ft. 6in. It weighs approximately 200lb.

The Marconi Marine "Salvare" is already in production and has been ordered for installation in the motor-propelled lifeboats of several large vessels, among them prominent liners such as the *Orsova*, *Arcadia*, *Iberia* and *Southern Cross*.

R.S.C. 25 WATT QUALITY AMPLIFIER 9 Gns.



We firmly believe our A11 " Push-Pull " Quality Amplifier to be by far the best value in amplifiers offered to-day. The volume of its high fidelity reproduction is completely controllable, from the sound of a quiet intimate conversation to the full, glorious volume of a great orchestra. Its sensitivity is so high that in areas of fair signal strength it can be operated straight from a crystal receiver. Entirely suitable for standard or long playing records in small homes or in large auditoriums. For electronic organ or guitar or for garden parties or dance bands. The kit is complete to the last detail, and includes easy to follow point-to-point wiring diagrams.

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32 µF 350 v.	3/6	8-8 µF 350 v.	3/9
25 µF 25v.	1/3	8-8 µF 450 v.	3/9
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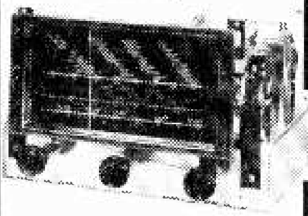

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VALVES.—Fully guaranteed, all post free : 954, **1/9** ; 9004, **2/-** ; 6K7, **4/-** ; 6V6GT, **6/6** ; VR91, **3/6** ; VR65, **1/6** ; VU111, **2/-** ; EL32, 4/- ; U14, **8/-** ; KTZ41, **1/9** ; 8D2, **1/9** ; VR54, **1/3** ; VR92, **1/3** ; VR78, **1/-** ; MH4, **3/6** ; P2SJ7, **3/6** ; 12SC7, **3/6** ; 12H6, **1/9**, Type 46, 5/- ; 12AH7, **3/6**. Any of the above valves in lots of six 10% extra reduction.

SELENIUM METAL RECTIFIERS.—250 volts at 100 m/a, **6/6** each ; **50/-** doz., post free.

LINE CORD.—2- or 3-, 2-3- or 4-way, 1,000 ohms, in length, **3/6**, or **1/-** per yd., post free.

NEW COAXIAL CABLE.—¼in., 80 ohms, 6d. yd. ; 20 yds., **8/6**, post free.

CRYSTAL DIODES.—2 for **2/2** ; **12/-** per doz., post free.

MIXED RADIO PANELS.—Very popular, full of resistors and condensers, 12 panels, 4/6, post free, not to be missed.

.1 CONDENSERS.—12 kV., paper, 2/6, post free.

.00004 SINGLE GANG TUNING CONDENSERS.—With slate sides. Ali. plates made to stand large flash over, 1/9, post free.

INDEPENDANCE MATCHING UNIT.—Type 176, complete in case, with 0-2.5 R.F. amp. meter. Brand new, 7/6, post free.

Mail Order Dept.

GLOBE WAREHOUSE,

GLOBE COURT, LIVERSEDGE, YORKS.

(Tel. : Cleckheaton 99)

D.C. MULTIMETER KIT

Converts any 1 mA. or 500 μA. meter into a useful 17 range Multimeter. Complete with instructions. The kit consists of 6 High Stability 1% Resistors, 3 other Resistors, a Potentiometer, and Shunt S51 or S505 as required. These give 10 Voltage, 6 Current, and 1 Resistance Ranges. Price **26/-**.

A.C./D.C. MULTIMETER KIT

As above, but with 4 extra High Stability 1% Resistors and Westinghouse Meter Rectifier to give an additional 4 A.C. Voltage Ranges. Price **45/6**. Plugs, Sockets, Terminals, Switches and Croc. Clips are available for above.

UNIVERSAL SHUNTS

1% accuracy for any 1 mA. or 500 μA. meter. Only one simple adjustment to make, no calibrating meter being required. Boxed with instructions. Guaranteed one year. S505 (½ mA.) covers 1, 5, 25, 100 and 500 mA. S51 (1 mA.) covers 2, 10, 50, 200 mA. and 1 Amp. Price **15/-**.

FIXED UNIVERSAL SHUNTS

For 1 mA. 100 Ohm and 500 μA 500 Ohm meters. No calibrating or adjustment, just wire up and use. Ranges as S51 and S505. Price **15/-**.

RESISTANCE BOXES

Set of 12 Wirewound Resistors, accuracy 0.5%, values 1, 2, 2, 5, 10, 20, 20, 50, 100, 200, 200, 500 Ohms to give all values of resistance from 1 to 1,110 Ohms in 1 Ohm steps. For Plug type boxes. Price **30/-** per set.

PRECISION RESISTORS

Any value, 1 Ohm to 1,000 Ohms, accuracy 0.5%. Eureka wound on flat strip. Price **2/9**.

VIEWMASTER ASSEMBLED SOUND/VISION CHASSIS,

£4-12-6 to **£7-18-6** assembled, aligned and tested. Complete kits from **£18-10-0**.

CLEARANCE BARGAIN

This month we are offering parcels of assorted radio components. Really amazing value. New Volume Controls, Switches, etc., 10/- and £1.

MASSEY, 58, Wakefield Ave., HULL

M.W. Attachment to Amplifier

SUGGESTED CIRCUITS FOR USE AS BROADCAST RECEIVERS

By W. Nimmons

QUITE often one needs an attachment to an existing amplifier which will enable the Home and Light—and possibly the Third—programmes to be easily and quickly obtained. The attachment of an existing receiver, possibly with several L.F. stages, is seldom satisfactory—at least to a powerful amplifier which can deal with only a small voltage input. The receiver then has to be "throttled back" so severely that the tonal response may possibly be ruined.

A simple receiver can be made up using a double-diode-triode valve of the battery class. This only needs a small accumulator to run it and will provide the stations mentioned in most localities, the circuit being surprisingly selective.

As will be seen from Fig. 1, full-wave rectification is employed, each diode dealing with one half of the signal. A tapping at the centre point of the coil collects the rectified energy which is then available for driving the amplifier. An aerial coil is included, fairly loosely coupled to the main coil; the manner of coupling is interesting, and will be found very effective in varying the selectivity so as to separate the Home and Light programmes in those localities where these are close together on the dial.

The method of winding the coil is first to wind 50 turns of No. 28 d.s.c. wire on a 2in. former as a main winding, making the centre tap at the 25th turn. This will give a coil with a rather low inductance, but as the Third programme is below 200 metres this is essential. The coil may not tune above 500 metres, but this is not important. The primary coil consists of 30 turns of No. 30 d.s.c. wire, wound on a separate small former which is about 1/8in. larger than the other, so that it can be slid up and down on the main former; the purpose of this is to find a spot where the stations are nicely separated, when it can be made a fixture with tape or a spot of glue. If the former is 3in. long and the main winding is on one half, the other half can be used to vary the position of the primary winding. The small former can be made by winding fairly thick paper around a mandrel of the requisite diameter, securing the last inch with glue. This will give a former with the necessary stiffness for the purpose.

Volume Control

A load resistance of 250 kΩ is shown in Fig. 1. No volume control is shown, as this will probably be incorporated in the amplifier and the signal input is not strong enough to warrant a volume control. But if one is desired the load should take the form of a potentiometer, with the slider going to the grid of the first valve of the amplifier. A condenser of .0001 μF is shunted across the load to by-pass the H.F. energy. This combination should provide excellent quality in the resultant signal.

In the coil provided, the electrical centre is not necessarily the mechanical centre; nevertheless, by making the centre-tap at the mechanical centre a compromise is achieved which functions well. The two diodes are excited by the incoming signals, and current flows from only one diode at any instant. When one diode is made positive by the signal voltages the other is made correspondingly negative. Thus the current flows through one half of the coil and through the load resistance to filament. On the next half-swing of the wave the process is repeated at the other diode. Thus full-wave rectification is achieved by this circuit.

An Alternative

This receiver is extremely simple and can be made up in a small wooden box, no screening being necessary. As no H.T. is required for its operation this is

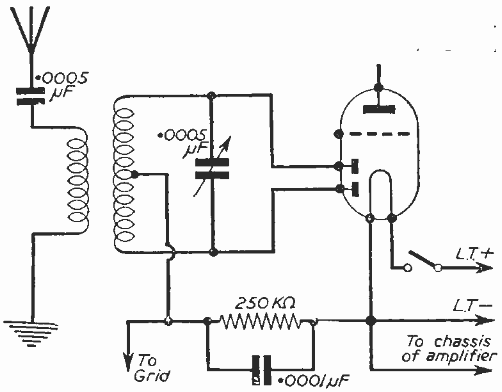


Fig. 1.—The diodes of a double-diode-triode valve are used to provide full-wave rectification.

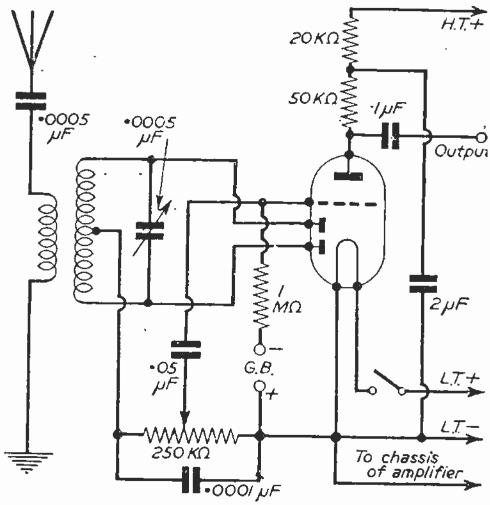


Fig. 2.—An attachment for either a mains or battery amplifier is provided by this circuit.

a further simplification. In Fig. 2, however, we have a slightly more ambitious circuit, in which the whole of the double-diode-triode valve is used and not simply the diodes. With this we have the amplification of the triode section, which may amount to 20 or more.

The coil is the same as in the previous circuit, and again the load is provided by a 250 KΩ resistance, shunted by a .0001 μF condenser. In this circuit some form of volume control is advisable, hence the load takes the form of a potentiometer. The slider of the potentiometer goes, via a .05 μF condenser, to the grid of the triode section of the valve. As the triode needs grid-bias, this is provided through a 1-megohm resistance direct to the grid of the valve. Only 1½ or 3 volts grid-bias is needed, depending on the particular valve used.

At the anode circuit we have a load resistance of 50,000 ohms. Since it is desirable to decouple the valve, this is done by means of an additional 20,000 ohms resistance and a 2 μF condenser. The H.T. for operation of the valve can be provided by a separate battery; but as there is already an ample supply of H.T. provided for the amplifier this can be used by tapping on the H.T. line to the positive side of the supply to the amplifier, providing this is not unduly high. If in the region of 200 volts, in the case of a mains amplifier, the resistance in the anode circuit will break down the voltage to a value suitable for the operation of the valve.

The output is taken from the anode and is intended to go direct to the grid of the first valve of the amplifier. It is presumed that provision is made in the amplifier for grid-bias to this valve. As a precaution a .1 μF condenser is included in the output line, so that whether or not there is a similar condenser incorporated in the amplifier no damage will be done by the splashing about of H.T.

As already mentioned, both Fig. 1 and Fig. 2 are suitable for mains amplifiers as well as battery ones. The line marked "Chassis of amplifier" should be suitably connected. Although a battery valve may seem odd when allied to mains valves, there is nothing against it from the theoretical point of view of the behaviour of electrons. As it stands, the battery valve outlined above provides a simple and convenient way of making the broadcast programmes available on an amplifier.

News from the Clubs

TORBAY AMATEUR RADIO SOCIETY

Hon. Sec.: L. H. Webber (G3GDW), 43, Lime Tree Walk, Newton Abbot.

AT the meeting—held in August under the chairmanship of G2GK—an interesting talk was given by G3FHI on "Aspects of Crystal Grinding," which was much appreciated.

A hearty welcome home was extended to Derek Webber (ex-ZC4LW), son of our hon. secretary, and who has now finished his Army service, and now hoping to get a "G" licence.

We were glad to meet G3FPJ, whose home is now in the district, but who at present is working in Nottingham.

At the next meeting a talk on "Transistors" will be given by G3AVF. We hope this will be well attended.

Meetings are held on the third Saturday each month, at 7.30 p.m., at the Y.M.C.A., Castle Road, Torquay. All visitors are welcome.

SOUTHEND AND DISTRICT RADIO SOCIETY

Hon. Sec.: J. H. Barrance, M.B.E. (G3BUJ), 49, Swanage Road, Southend-on-sea, Essex.

LOCAL radio amateur enthusiasts, both transmitters and listeners, met members of the Medway Radio Society on the occasion of their annual visit to Southend recently.

Over 60 sat down to tea. They came from as far away as Clacton, Croydon, Faversham and Swanley. The oldest member, Jimmie Stubbs (84), welcomed the youngest member, Kenneth Plimmer (2½), who is up every morning at 7.30 and greets his favourites.

READING RADIO SOCIETY

Hon. Sec.: L. A. Hensford (G2BHS), 30, Boston Avenue, Reading, Berks.

THE society's outing to Sandbanks and Swanage took place in fine weather and everybody enjoyed themselves.

October's programme includes films on the 9th and a lecture by Mr. Edwards, of A.E.I., Aldermaston, on 30th. In November there will be a junk sale on the 13th, and on the 27th Messrs. Dynatron Radio, of Maidenhead, will give a demonstration of their latest equipment.

CLIFTON AMATEUR RADIO SOCIETY

Hon. Sec.: C. H. Bullivant (G3DIC), 25, St. Fillans Road, Catford, S.E.6.

ALTHOUGH at the height of the holiday season, attendances during August remained high and at the junk sale held on Friday, August 13th, over 50 members and friends were present.

Constructional evenings were held on August 7th and 21st whilst on the 28th J. Lambert (G3FNZ) presented a quiz.

The winners of the transmitting and listening contest, held during the week-end August 7th/8th, were:

Transmitting: C. Bullivant. Listening: N. Moore.

Programme for October: 8th, junk sale: 15th and 29th, constructional evening; 22nd, "Miniaturisation," by D. Deacon (G3BCM).

Meetings are held every Friday, at 7.30 p.m., at the club headquarters, 225, New Cross Road, London, S.E.14.

THE HOUNSLOW AND DISTRICT RADIO SOCIETY

Hon. Sec.: R. J. Parsons, 16, Cypress Avenue, Whitton, Middlesex.

THE autumn session opened on September 16th, 1954, with a meeting at Grove Road Junior School, Hounslow, at 7.30 p.m. Meetings take place at fortnightly intervals and alternate meetings are devoted to R.S.G.B. group business.

WIRRAL AMATEUR RADIO SOCIETY

Hon. Sec.: A. C. Wattleworth, 17, Iris Avenue, Claughton, Birkenhead

THE above society meets at 7.30 p.m. on the first and third Wednesdays of each month at the Y.M.C.A., Whetstone Lane, Charing Cross, Birkenhead.

S.W.Ls and novices particularly welcome.

CHESTER AND DISTRICT AMATEUR RADIO SOCIETY (G3GIZ)

Hon. Press Sec.: E. Yates (G3ITY), 210, Stamford Road, Blacon, Chester, Cheshire.

DURING August the C & DARS had two outings. The first being to Hope Mountain, south-west of Mold in North Wales. The WX was not too kind.

Tuesday, October 12th. A U.S.I.F. film strip will be shown, subject to be notified later.

Membership is growing again and, at the same time, we will welcome any new member.

WEST LANCASHIRE RADIO SOCIETY

Hon Sec.: S. Turner (G3JUB), 3, Balfe Street, Seaforth, Liverpool, 21.

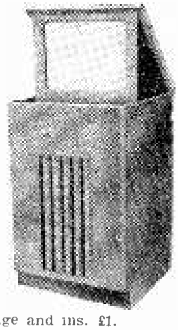
THE society meets as usual every Tuesday evening at 8 p.m., over Gordon's Sweetshop, corner of St. John's Road, Waterloo. The activity has not been very great during the summer period, but there have been a few junk sales, and informal talks by club members on radio. The committee will soon be making out the winter programme, and it is hoped to be very active both on and off the air. The club call-sign is G3JQA. There is plenty of test gear available for members wishing to test sets, components, etc., and new members and visitors are welcome at any time. All inquiries to hon. sec.

PORTSMOUTH AND DISTRICT RADIO SOCIETY

Hon. Sec.: L. B. Rooms (G8BU), 51, Locksway Road, Milton, Portsmouth.

THE club has been fortunate in acquiring new premises of its own at the British Legion Club, Queen's Crescent, Southsea. Regular meetings are held each Tuesday at 19.30 hours, the last Tuesday in each month being devoted to a business meeting. However, the club rooms are available to members *every* night until 22.00 or later, and at the moment a Morse class is held each Friday under the direction of G3JLO, and any new students would be most welcome.

THE PROJECTOR



An impressive cabinet, originally designed for T.V. but slight modification makes it into an unusual, but most dignified, radiogram or amplifier. Size 23in. wide, 22in. deep, 37½ in. high. Price £8/15/-, or £2/18/4 deposit. Carriage and ins. £1.

THE SIMPLEX

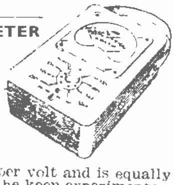
for £5 deposit

Constructors please send for detailed Price List. H.P. Terms available. Deposit £5. Balance over 12 months.

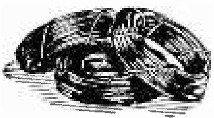
VARIABLE POWER RESISTORS

Mounted on substantial framework—overall dimensions approximately 11in. x 3½in. x 6½in. high—25 amps. .4 ohms. Quite suitable for rewinding for other values. Power rating exceeds 250 watts. Adjustment is by twisting protruding knob which is the only part that needs to show in front of panel. Price 17/6—carriage and packing 2/- extra.

MULTI-METER KIT



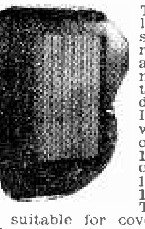
The Multi-meter illustrated measures D.C volts, D.C m/amps and ohms. It has a sensitivity of 500 ohms per volt and is equally suitable for the keen experimenter, service engineer or student. All the essential parts including 2in. moving coil meter, selected resistors, wire for shunts, 8-point range selector, calibrated scale, stick on range indicator and full instructions for making are available as a kit, price 15/- plus 9d. post and packing.



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/-.

SOMWEAVE



This really lovely loudspeaker fabric we offer at approximately a third of today's cost. It is 12in. wide and our price is 12/- per yard or panels 12in. x 12in., 1/9 each. This is also very suitable for covering plain wooden cases, for portable radio amplifiers, etc.

A FEW REMAIN

This cabinet is offered below cost. It is suitable for a televisor using Tube sizes varying from 12in. to 17in., its overall dimensions being 3ft. 5in. high, 1ft. 4in. deep, 1ft. 10in. wide. It is complete with plywood back and "Bowler Hat." Originally made for a very expensive Televisor, and really good quality. Unrepeatable. Offered at £6/19/6, carr. and packing 12/6.

Note.—These are cut for 12in. Tubes, but the holes for the controls are not drilled.

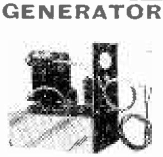
THIS MONTH'S SNIP

Unit for breaking down—offered at only a little over the price of the Aladdin Coil Formers it contains. Note.—All parts can easily be removed as they are all bolted together. The unit contains :—

- 6 Aladdin ¼in. Coil Formers with dust cores.
- 6 Metal cans for above coil formers.
- 1 4-position 12-pole switch.
- 6 Miniature R.F. chokes.
- 2 25 mf. 25 v. electrolytics.
- 30 Paper tubular condensers .002 to .1 mostly for 450 v.
- 56 Carbon resistors values from ¼ watt to 2 watt.
- 2 Medium size R.F. chokes.
- 7 Moulded octal valve holders.
- 1 Moulded diode valve holder.
- 20 Mica condensers (moulded, silver and ceramic).
- 7 Insulated top caps for valves.
- 4 Components Strips (1 40-way, 1 11-way, 1 5-way and 1 3-way).
- 1 Very useful chassis size 18 x 5 x 3½. Plus dozens of nuts, bolts, screws, washers, and other useful items such as ¼in. spindle extenders, etc., etc.

Price only 7/6—post and packing 2/6.

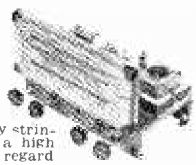
THE ELPREQ E.H.T. GENERATOR



This is a made up unit working on the blocking oscillator/overwound amplifying stage principle. It is of moderate power consumption (6.3 volt .8 amp. filament and approx. .59 mA. H.T.) and contains three BVA valves. Output obtainable ranges from 6 kV. to 9 kV. with normal H.T. rail input but somewhat higher outputs can be obtained with higher H.T. supply. Valve rectification is employed in the output stage. The dimensions are 6½ x 4½ x 7in. Price 69/6—post, packing, etc., 5/-.

COMBINED RADIO WITH YOUR T.V.

THE CLEVELAND "ORGANTONE"



The Cleveland "ORGANTONE" is a 5-valve, 3-wave band superhet covering long wave (1,020-1,875 metres) medium wave (187.5-545.5 metres) and short wave (16-50 metres). Built to a very stringent specification, it attains a high level of performance both with regard to sensitivity and fidelity.

Osram all-glass miniature valves are employed throughout and low loss iron cored coils in both aerial and oscillator sections together with permeability tuned I.F.'s account for an excellent signal to noise ratio. Full A.V.C. is applied to both frequency changer and I.F. stages, and particular care has been taken to ensure freedom from frequency drift.

The output stage utilises variable negative feedback for tone control, and, but for standard pentode correction, no cut in the ordinary sense is applied. A gram. position is provided on the wave change switch and reproduction of records is particularly good. An amply proportioned power transformer with a primary tapped for 110-280 volts gives complete isolation from the mains.

Chassis size is 12in. x 7in. x 7in.—scale size is 10½in. x 4½in.

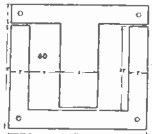
This receiver has been tested in particularly difficult areas and its stability and noise rejection have produced exceptional results. It is an instrument which could fairly be described as a custom-built chassis. Price £11/10/- or £3/16/8 deposit—carriage, etc., 7/6. A circuit diagram and photograph available, price 2/-, post free.

ELECTRONIC PRECISION EQUIPMENT
42-46 WINDMILL HILL, RUISLIP, MIDDLESEX. 152-3 FLEET ST LONDON E C 4
Dept. 7.
also 29, STROUD GREEN ROAD, FINSBURY PARK.

MULLARD AMPLIFIER

A High Quality Amplifier designed by Mullard engineers. Robust, high fidelity, with a power output exceeding 10 watts and a harmonic distortion less than .4% at 10 watts. Its frequency response is extremely wide and level being almost flat from 10 to 20,000 c.p.s. —three controls are provided and the whole unit is very suitable for use with the Collaro Studio and most other good pickups. The total cost of the amplifier is around £10. For 30/- extra a unit completely made up and tested will be supplied. Carriage in either case is 10/- extra. Data will be provided with all orders for components. Send for the "Mullard Amplifier Shopping List."

TRANSFORMER LAMINATIONS



Ideal for making up experimental and special purpose jobs. Dimensions as drawing. Price 1/6 per lb. or 1/6 per dozen pairs (approximately 48 required for 1in. stack)—(size 2½in. x 2½in. approx.) Suitable for output transformers, etc.—price 6d. per dozen pairs.

MAKING A CONVECTOR HEATER ?

250 watt elements ideal for use with home-built convectors, towel rails, airers, etc. Price only 2/6 each—post and packing 6d.

METER FOR BATTERY CHARGER, etc.

2in. square bakelite cased meter, reading 0-5 amps. Price 9/6—post and packing 9d.

HEAVY DUTY CHOKE

300 milliamp—7 Henry—50 ohm D.C. size, approximately, 4½in. x 4½in. x 3in. New, not Government surplus—price 10/-—plus 2/- post and packing.

UNIVERSAL METER

2 milliamps moving coil meter square bakelite case flush mounting. Complete with sheet of printed scales, covering most ranges of volts, milliamps, amps. Price 9/6—post and packing 9d.

VALVE FOR V.H.F.

Type C.V.64 and C.V.186 Magnetrons unused and guaranteed. Price £2/10/- — post and insurance 10/-.

HEAVY DUTY MAINS TRANSFORMER

400-0-400 at 200 mA with two 4-volt L.T. windings, both rated at 6 amps. A really massive job made for services equipment—limited quantity 19/6 each.

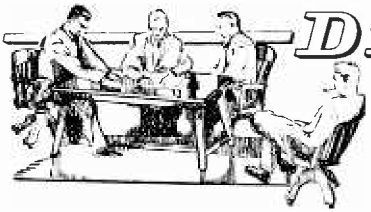
CHARGER TRANSFORMERS

0-9-15 v. with tapped primary—suitable for 6- and 12-v. batteries. Charging rate up to 6 amps. Amply rated—price 21/6—post and packing 2/6.

1in. MICROMETER

Exceptional purchase enables us to offer a 1in. precision micrometer at the very low price of 10/-. A micrometer is an essential part of an engineer's equipment. You, no doubt, will have found the need for one on many occasions in the past for measuring wire gauge, etc. If you act quickly you can acquire one now at the remarkably low price of 10/-, post free.

Open to Discussion



Recording Contact Wanted

SIR,—I would like to contact, through the medium of your excellent magazine, an enthusiast of my own age, sixteen years, who is more interested in amplifiers and sound reproduction from records or tape recordings, etc., rather than radio transmission and reception, with a view to correspondence.—J. R. LAVER, 4, High Storrs Crescent, Sheffield, 11.

Audio Pentodes

SIR,—There is a tendency these days for some designers to use R.F. pentodes as audio output valves. My own commercial TV receiver is an example, and the quality of reproduction leaves much to be desired when compared with sets using a conventional audio valve.

There are also some designs of so-called "Hi-Fi" amplifiers which use transmitting valves in the output stage.

Can some more knowledgeable reader than I put forward an explanation for this, in view of the fact that there is no shortage of excellent valves designed specially for the job ?—D. WARDEN (West Bromwich).

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for receivers described in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of cover.

The P.R.S.

SIR,—Your articles have been an enjoyment to me from the early days of amateur wireless, and though on a few topics I have not always seen eye to eye with your opinions, I usually find them logical, interesting and sensible.

I am, therefore, surprised to note what you say about the Performing Rights Society, and I think that possibly you do not quite understand the matter, but you are not alone—not by any means ! I have been a member of that body, as a composer and songwriter, for 38 years and a member of the outside staff for 20 years, and I may say that, out of 100 persons, 50 say immediately that authors and composers are entitled to all the rights which, in every civilized country, are accorded to them in exactly the same way, and 50 people say "It's a racket" or "They are already paid," etc. Nothing whatever will convince the latter that they are wrong and if they are "public music users" they sometimes find that the attitude of being a law unto themselves is a disastrous one ! However, in your article you seem to concede that we are entitled to these rights in respect of "canned" music, but think it is wrong in regard to "songs on the piano" in a bar, when "used to entertain the public."

Seeing that the P.R.S. was formed in 1914, before the universal use of radio and records in public, the performance of songs on the piano has been of much longer standing and the licence for this has always been necessary. Prior to that, one had to deal direct with the author and composer or publisher, and the Society was formed merely to facilitate what was becoming a headache to music users (public) owing to the complexity of approaching an increasing number of "tunesmiths."

Nowadays, this licence is all the more necessary, for most pianists in public houses hear a tune on the radio and play it by ear, in public, and the writers do not receive anything at all ! Unlike the old ballads, which were not just a repetition of a few phrases, but continuous and changing melodies, the modern songs are so simple and can be easily played without buying the copy.

Your simile to the teacher of mathematics is answered by your previous paragraph in the words : "which is used to entertain the public," i.e., for the purpose of increasing business in the public house.—FRED N. HART (W.2).

Modern Reflex Receiver

SIR,—With regard to the modern reflex receiver circuit published in PRACTICAL WIRELESS, No. 573, I must say this is a really amazing receiver ; I built it in a matter of five hours and, with very little trouble, got it working. Much to my amazement it pulled in all the foreigners.

This receiver can be made to operate quite well on long waves ; all that is required is one aerial, one H.F. coil and a wave-change switch.—N. LYCETT (Sheffield).

Test Gear

SIR,—You recently described "Comprehensive Test Unit."

Although I have put off writing before this the urge to convey to all concerned in the production of various gadgets, from time to time, my sincere thanks and appreciation for their assistance in enabling such persons as myself to "carry on" is sent in this letter.

Perhaps when I say, as an ex-Serviceman, finished completely, unable to listen to or look at radio and television for any period, the only help obtained is fiddling with the bits and pieces obtained from the junk boxes (the pension is small) and watching the needles move up and down or neon light flash etc.

I could mention by name the individuals who have from time to time helped me, but, as you realize, all employed on the job of getting out the book are just as worthy of consideration, for we are as we are ; and so, in conclusion, please convey the thanks of one reader for assistance in playing about with these very useful but, in this case, "grown-up toys," who is lost to the world and the disability as he watches the needles move and lights flash as some old junk-box condenser is being fixed (in a kidding sort of way). There must be many such as this one who would like to say "Thanks," but just can't even make that effort and yet you must also have their best wishes.

To convey the picture correctly: the various items that are printed from time to time are "mocked up" on a small table with lots of wire. condensers, an odd transformer, etc., while adjustments are made here and there with a meter. In a way, we don't get far, but it's absorbing!—W. KENT (Hounslow).

Beginner's Results

SIR,—I have just bought a copy of your excellent book, "Practical Wireless Circuits," and I must say that it really is useful, especially to me, as I am only 16 and have only built fairly simple receivers. The same day that I got the book I went to work and constructed the "Class B Detector Two Valver," using mainly parts taken from an old set that I bought at a junk shop. The finished result quite surprised me, especially as my coil was made from a cardboard cocoa container, a portion of the centre of a toilet roll and a pencil for the spindle. The quality is *excellent* and I have been receiving stations that I would have thought quite impossible for a two-valve set. Our local Home Service can be heard all over the village if I turn the reaction up to oscillating point.—D. GRAHAM (Swanage).

"Filter Circuits"

SIR,—D. Howe forgot to reverse his vector diagram for the second resistance and condenser added to Fig. 1, to make Fig. 3. Had he done so, he would have seen that the A.C. voltage existing between points A and B would be proportional to a line drawn from one apex to the other apex of each triangle. Which, assuming sinusoidal ripple and equal values of resistance and reactance, would be considerably more than half that across the supply, i.e.. $\sqrt{VR^2+Vc^2}$. (September issue, page 523)

Using his final circuit. Fig. 5, with 8μF and 16μF condensers and comparing it with a 16 henry choke, D.C. resistance 200 ohms and A.C. inductance 24 henry, and the same amount of capacity, the ripple was found to be 16 times worse than the conventional circuit when delivering 50 m/A D.C.

D. Howe's good smoothing is due to the very large values of condensers used, but with a small choke it would be better still with no more voltage drop. —KENNETH HOLFORD (Walsall).

(*The author states:—With reference to my article on filter circuits, I must agree that Mr. Holford is correct. Vectorally, the voltages across R and C are not equal in the two branches shown in Fig. 3 and this vector displacement does affect the potential across A and B, as he pointed out.*

I am not too clear on the details of the components used by Mr. Holford for his comparison of the two circuits; however, as he states the choke has a D.C. resistance of 200 *ohms, I assume he used resistances of that value with the condensers of* 8μF *and* 16μF *when using the final circuit, Fig. 5.*

As the value of C used was 8μF, *R should have a value of* 400 *ohms, which would put a total resistance of* 800 *ohms in circuit which, in any case, would have made the circuit impracticable because of the volt drop. This was the reason large capacity condensers were used.*

Feeders or Receivers

SIR,—I have been a reader of your magazine for some years now. I have built different sets right from the first transmission of the BBC when we only had the crystal to worry about, and reading through the article on page 593 of the October issue I have reached the stage where I have begun to wonder.

Are there many more people who are beginning to think in the same strain, that radio as an entertainment is getting so complicated that it is not worth such an expense? Is it just another trade racket to create business? Because I can foresee the time when we shall have to have a special room set aside for all the receiving sets to be arranged in a row together with the 'gram and recorder and necessary amplifying equipment.

I almost wish we were back to the days when it was a case of: "Ssssh—I've got a good spot this time" (and not much Q.R.M. either).

And, by the way, what's happened to all the trans-Atlantic stations we used to receive in the pre-war days?

Oh, for a simple reaction controlled set with a large dial marked in frequencies only, from 2,000 metres to 2,000 megs, with a row of knobs all along the bottom which would switch A.M., F.M., V.H.F.; in fact, the lot (even if it did fill the top of the side-board). Oh, well! It's just a lovely dream, but it's nice to get it off my chest.—W. R. WILLIAMS (Ewell).

Measuring Voltages With a 'Scope

SIR,—With reference to my article on the above subject I would draw your attention to an unfortunate error on page 538, where I say that "the method yields the peak value of alternate voltages." As readers who have followed the article thus far will have realised, this should, of course, read "peak to peak value." Consequently, for sine waves the result given by the oscilloscope must be divided by 2.828 if the R.M.S value is needed, as is usually the case.

I would take this opportunity of apologising to your readers for this unfortunate slip, and trust they will regard it as evidence that writers are human. —S. C. MURISON (Surbiton).

"Beginner's Guide to Radio"

SIR,—I have followed the series under the above title from its commencement and have constructed my first radio receiver as a result of my learnings. Now my son, age 13, is also becoming interested but, unfortunately, I have mislaid some of the original issues.

Can you tell me whether the series will be published in book form?—B. WHEELER (Norwich).

[*The series will be prepared in book form as soon as the articles come to an end.—Editor.*]

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6H6	3/6	—	6SK7	6/9	—	ECC31	—	7/0
6J5GT	5/0	—	6V6GT	8/6	—	EF80	—	10/6
6J7	—	7/0	6V6G	—	6/9	KTZ41	5/9	—
6K6GT	7/0	—	9D6	—	7/9	RK34	2/3	1/9
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Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS, Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

No. of Blueprint

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PRACTICAL WIRELESS, Nov., 1954.

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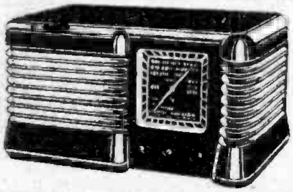

Used metal rectifier, 230 v. 50mA., **3/6** ; gan ; with trimmers, **6/6** ; M. & L. T.R.F. coils, **5/-** ; 3 Govt. valves, 3 v/h and circuit, **4/8** ; heater trans., **6/-** ; volume control with switch, **3/6** ; wave-change switch, **2/-** ; 32 x 32 mfd., **4/-** ; bias condenser, **1/-** ; resistor kit, **2/-** ; condenser kit, **4/-**.

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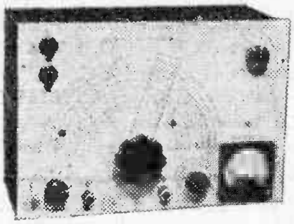

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32 x 32 mfd., 350 wkg. and 25 mfd., 25 wkg.	6/6
25 mfd., 25 wkg.	11d.
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16 mfd., 500 wkg. wire ends	3/3
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100 mfd., 350 wkg.	4/-
100+200 mfd., 350 wkg.	9/6
16+16 mfd., 350 wkg.	3/3
Ex Govt. 8 mfd. 500 v. wkg., size 3¾ x 1¾, 2 for	2/6
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65 mfd., 220 wkg.	1/6
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60+100 mfd., 280 wkg.	8/6
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Miniature wire ends moulded 100 pf., 500 pf., and .001 ea	7d.

CONSTRUCTOR'S PARCEL comprising chassis 12½ x 8 x 2in., cad. plated 18 gauge, v/h., IF and trans. cut-outs, backplate, 2 supporting brackets, 3 waveband scale, new wavelength station names. Size of scale 11½ x 4½in., drive spindle, drum, 2 pulleys, pointer, 2 bulb holders, 5 paxolin international octal valve holders, 4 knobs, and pair of 465 IFs, **16/6**. P. & P. 1/9.

AS ABOVE, but complete with 16+16 mfd. 350 wkg. and semi-shrouded drop thro' 250-0-250 60 m.a., 6 v. 3 amp. Pri. 200-250, and twin-gang, **31/6**. P. & P. 3/-.

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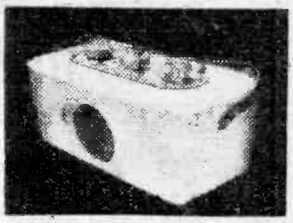
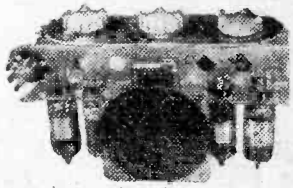
PATTERN GENERATOR 40-70 Mc/s. direct calibration, checks frame and line time base, frequency and linearity, vision channel alignment, sound channel and sound rejection circuits, and vision channel band width. Silver plated coils, black crackle finished case, 10 x 6¾ x 4½in. and white front panel. A.C. mains 200/250 volts. This instrument will align any TV. receiver. Cash price, **£3.19.6** or £1.9.0 deposit and 3 monthly payments of £1. Post and packing 4/- extra.

TV. CONVERTER for the new commercial stations, complete with 2 valves. Frequency :—can be set to any channel within the 186-196 Mc/s. band. I.F. :—will work into any existing TV. receiver, designed to work between 42-68 Mc/s. Sensitivity 10 Mu/v. with any normal TV. set. Input :—arranged for 300 ohm feeder, 80 ohm feeder can be used with slight reduction in R.F. gain. Circuit EF80 as local oscillator, ECC81 as R.F. amplifier and mixer. The gain of the first stage, grounded grid R.F. amplifier, 10db. Requires power supply of 200 v. D.C. at 25 mA., 6.3 v. A.C. at 0.6 amp. Input filter ensuring complete freedom from unwanted signals. 2 simple adjustments only. **£2.10.0** Post and packing 2/6.



PERSONAL PORTABLE CABINET in cream-coloured plastic, size 7 x 4½ x 3in. Complete 4-valve chassis. Scale and 3 knobs. Takes miniature 90 v. and 7½ v. batteries. **10/-**. P. & P. 2/-.

3in. P.M. SPEAKER to fit above, **10/-**. Miniature output transformer, **5/-**. Miniature wave-change switch, **2/-**. Miniature 1-pole 4-way used as Volume and Off, **2/-**. 4 B7G valveholders, **2/4**. Midget twin gang ¾in. dia., ¾in. long and pair medium and long-wave T.R.F. coils ¾in. long x ¾in. wide : complete with 4-valve all-dry mains and battery circuit, **9/6**. Condenser Kit, comprising 11 miniature condensers, **3/6**. Resistor Kit, comprising 15 miniature resistors, **4/6**. 25 x 25 mfd., **1/6**. P. & P. 2/6. Valves to suit above **10/-** ea. Point to Point Wiring Diagram 1/-.



View of chassis as it would look when assembled with valves inserted.

Extension speaker cabinet, in contrasting walnut veneers, size 15 x 10½in. Will take 6½ or 8in. speaker, **17/6**. P. & P. 2/-.

Volume Controls. Long spindle less switch, 50 K., 500 K., 1 meg. **2/6** each. P. & P. 3d. each.

Volume Controls. Long spindle and switch, ¼, ½, 1 and 2 meg., **4/-** each ; 10 K. and 50 K., **3/6** each. ½ and 1 meg., long spindle, double pole switch, miniature **5/-**.

Standard Wave-change Switches, 4-pole 3-way, **1/9** ; 5-pole 3-way, **1/9**. Miniature 2-pole 4-way 4-pole 3-way, **2/6**.

Valveholders, Paxolin octal, **4d.** Moulded octal, **7d.** EF50, **7d.** Moulded B7G, **7d.** Loctal amphenol, **7d.** Loctal pax., **4d.** Mazda Amph., **7d.** Mazda pax., **4d.** B8A, B9A amphenol, **7d.** B7G with screening can, **1/6**. Duodecal paxolin, **9d.**

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Midget .00037 dust cover and trimmers, **8/6**.

P.M. SPEAKERS

	with trans.	less trans.
3½in.		16/-
5in.	19/-	15/-
6½in.	19/-	15/-
8in.	21/-	17/6
10in.		22/6

Post and packing on each of the above, 1/6 extra.

RADIOGRAM CHASSIS.—5 valve A.C./D.C. 3-way band superhet, 195/255 volts 19-49, 200-550 and 1,000-2,000 metres, flywheel tuning frequency, 470 K/cs iron-cored coils and IFs. Size of chassis, 13 x 6½ x 2½. Complete with valves and 8in. P.M. speaker, p. & p., 5/-, **£8/17/6**.

Terms of business : Cash with order. Dispatch of goods within three days from receipt of order. Where post and packing charge is not stated, please add 1/6 up to 10/-, 2/- up to £1, and 2/6 up to £2. All enquiries S.A.E. Lists 5d. each.

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