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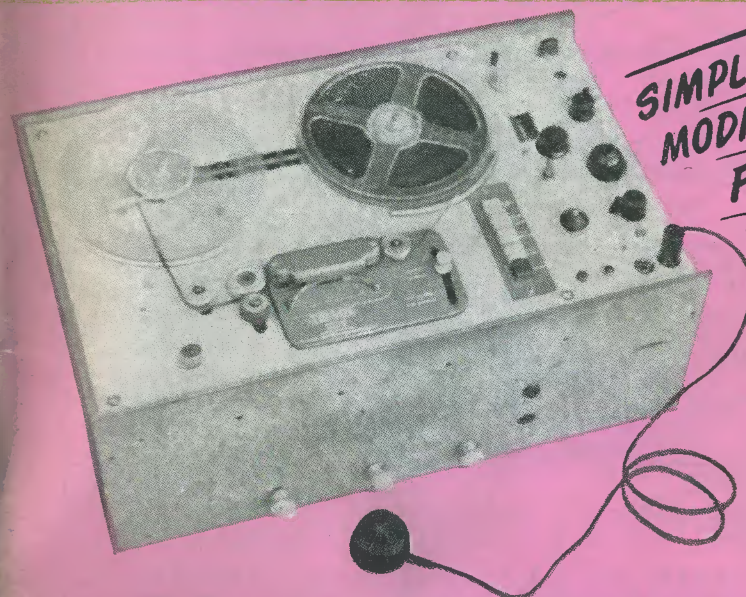
THE "LUDFORD" SINGLE-VALVE RADIOGRAM, Part 2

VOLUME 12
NUMBER 12
JULY
1959

The RADIO Constructor

RADIO · TELEVISION · AUDIO · ELECTRONICS

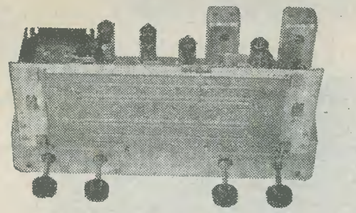


SIMPLE MODIFICATIONS FOR MOST TAPE RECORDERS

Fade Erase, Spot Erase, & Superimposing of Tape Recordings

Included in this issue
A TWO-TRANSISTOR ELECTRONIC TIMER
DESIGNING AN ELECTRONIC MIXER UNIT
A SIMPLE SIGNAL TRACER
RESISTOR CONDENSER COLOUR CODES
RECORDING LEVEL INDICATORS

DATA Publications 1/9



1959 RADIOGRAM CHASSIS

THREE WAVEBANDS — FIVE VALVES
S.W. 16 m.–50 m. — LATEST MULLARD
M.W. 200 m.–550 m. — MINIATURE SERIES
L.W. 800 m.–2,000 m.

12 month Guarantee. A.C. 200/250V, 4-way switch. Short-Medium-Long-Gram. A.V.C and negative feed-back. 4 2 watts. Chassis 13½" x 5½" x 2¼". Glass dial 12½" x 5¾" horizontal or vertical 10" x 4½". 2 pilot lamps. Four knobs, walnut or ivory, aligned and calibrated. Chassis isolated from mains. Immediate delivery.

BRAND NEW £9.10.0 Carr. 4/6

TERMS: Deposit £5.5.0 and 5 monthly payments of £1
MATCHED SPEAKERS: 8" 17/6. 10" 25/-. 12" 30/-

★ **GARRARD 4-SPEED SINGLE RECORD PLAYER 4SP** ★

£7.10. AUDIO PERFECTION — **POST FREE**

De luxe Cabinet with amplifier and 6½" speaker £6.15.0 or complete kit £14.

BUILD THIS REPRODUCER BARGAIN

SPECIAL SINGLE PLAYER KIT

COLLARO 4-speed Gram-Pick-up Unit	£4.10.0
Handsome portable case 17½" x 13½" x 7" with room to play 12" records	£2. 5.0
Ready built 3-watt amplifier with two valves and 7" elip. speaker, printed circuit	£3.12.6

or **£9.15.0** complete kit post free

I.F. TRANSFORMERS 7/6 pair
465 kc/s slug tuning miniature can 2½" x 1" x 1". High Q and good band width. By Pye Radio. Data sheet supplied.

Wearite M800 Midget I.F.S.	465 kc/s	12/6 pair
Wearite 550 Standard I.F.S.	465 kc/s	12/6 pair

New boxed VALVES 90-day Guarantee

1R5	8/6	6K8G	8/6	EA50	1/6	EZ80	8/6
1S5	8/6	6L6G	10/6	EABC80	10/6	E1148	1/6
1T4	8/6	6N7M	7/6	EB91	6/6	HABC80	12/6
2X2	2/6	6Q7G	10/6	EBC33	8/6	HVR2A	7/6
3S4	8/6	6SA7	10/6	EBC41	10/6	MU14	10/6
3V4	8/6	6SJ7M	10/6	EBF80	10/6	P61	6/6
5U4	8/6	6SN7	8/6	ECC84	12/6	PCC84	12/6
5Y3	8/6	6V6G	7/6	ECF80	11/6	PCF80	11/6
5Z4	10/6	6X4	7/6	ECH42	10/6	PCF82	11/6
6AM6	8/6	6X5	7/6	ECL80	12/6	PCL82	11/6
6B8	5/6	7S7	10/6	ECL82	12/6	PEN25	6/6
6BE6	7/6	12AT7	10/6	EF39	7/9	PL82	10/6
6BH6	10/6	12AU7	9/6	EF41	10/6	PY80	8/6
6BW6	10/6	12AX7	9/6	EF50	5/6	PY81	10/6
6D6	7/6	12BE6	9/6	EF50	8/6	PY82	8/6
6F6	7/6	12K7	8/6	Sylv.		SP61	5/6
6H6	3/6	12Q7	8/6	EF80	10/6	UBC41	10/6
6J5	6/6	35L6	9/6	EF92	5/6	UCH42	10/6
6J6	7/6	35Z4	9/6	EL32	5/6	UF41	10/6
6J7G	8/6	80	10/6	EL84	10/6	UL41	10/6
6K6GT	6/6	807	6/6	EY51	12/6	UY41	8/6
6K7G	5/6	954	1/6	EZ40	8/6	U22	10/6

STOP PRESS B.B.C. TV Pocket Transistor M.W. & L.W. Radio Kit 32/6. 'Phones 7/6. Deaf aid earpiece 12/6. Special lead and plug 2/6. Continental OC71 7/6.

Our written guarantee with every purchase

C.R.T. ISOLATION TRANSFORMERS
For Cathode Ray Tubes having heater cathode short circuit and for C.R. Tubes with falling emission, full instructions supplied. **Type A.** Low leakage windings. **Optional 25% and 50%** boost on secondary: 2V, or 4V, or 6.3V, or 10.3V, or 13.3V, with mains primaries, **12/6.** **Our Latest Superior Product. Mains Input Type A2. High quality low capacity 10-15pF. Optional boost 25%, 50%, 75%, 16/6** each **Type B.** Mains input. Low capacity. Multi output 2, 4, 6.3, 7.3, 10 and 13V. Boost 25% and 50%. This transformer is suitable for all TV tubes. **21/-** each.

RESISTORS. Preferred values. 20% 10 ohms to 10 meg, ¼W **4d.**, ½W **4d.**, 1W **6d.**, 1½W **8d.**, 2W **1/-**
HIGH STABILITY. ½W 1%, **2/-.** All preferred values 100Ω–10MΩ. Ditto 5% 100Ω–5MΩ **9d.** each

WIRE-WOUND RESISTORS 25 ohms–10,000 ohms: 5 watt 1/3; 10 watt 1/6; 15 watt 2/-
15,000 ohms–50,000 ohms, 5W, **1/9**; 10W, **2/3.**

WIRE-WOUND POTS Pre-set min. TV type. Knurled slotted knob. All values 25 ohms to 25k, **3/-** each, 30k, 50k, **4/-.** Ditto Carbon Track 30k to 2 Meg, **3/-.**

3W Lab. Colvern, etc. Standard size Pots, 2¼" Spindle, high grade. All values, 100 ohms to 50k, **6/6**; 100k, **7/6.**
W/W EXT. SPEAKER CONTROL 10Ω, **3/-.**

MAINS TRANSFORMERS—200/250 AC

STANDARD 250-0-250, 80mA, 6.3V tapped 4V 4A. Rectifier 6.3V 1A tapped 5V 2A and 4V 2A	22/6
Ditto 350-0-350	22/6
MINIATURE. 200V 20mA, 6.3V 1A	10/6
MIDGET. 220V 45mA, 6.3V 2A	15/6
SMALL. 220-0-220, 45mA, 6.3V 2A	17/6
STANDARD. 250-0-250, 65mA, 6.3V 3.5A	17/6
HEATER TRANS. 6.3V 1½A	7/6
Ditto tapped sec. 2, 4, 6.3V 1½A	8/6
Ditto, sec. 6.3V 3A	10/6
Mullard "510" 300,0-300, 120mA, 6.3V 4A c.t., 6.3V 2A tapped 5V	38/6

O/P TRANSFORMERS. Heavy duty 50mA, **4/6.** Multi-ratio push-pull, **7/6.** Miniature 3V4, etc. **4/6.** Small pentode, **4/6** Hygrade push-pull 7 watts, **15/6.** Heavy duty 10/20W 6k or 8k c.t., **30/-.**
L.F. CHOKES 15/10H 60/65mA, **5/-**; 10H, 85mA, **10/6**; 10H 150mA, **12/6**; 5H, 250mA, **16/6.**

CRYSTAL MIKE INSERT by Acos **6/6**
Precision engineered Size only ⅞" x 3/16"
ACOS CRYSTAL DESK MIKE, 35/-

ALADDIN FORMERS and cores. ¼" **8d.**, ⅜" **10d.** **0·3" FORMERS** 5937/8 and cans TV1/2. ⅝" sq. x 2½" and ⅜" sq. x 1¼", **2/-** complete with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6-1, **2/3.**
TYANA. Midget Soldering Iron. 40W, **16/9.**
REMPLOY INSTRUMENT IRON, 25W, **17/6.**
MAINS DROPPERS. 3" x 1½". Three adj. sliders, 0.3A, 750 ohms, **4/3**; 0.2A 1,000 ohms, **4/3.**
LINE CORD. 0.3A 60 ohms per foot, 0.2A 100 ohms per foot, 2-way, **6d.** per foot; 3-way, **7d.** per foot.
MIKE TRANSF. 50:1, **3/9**; 100:1, potted, **10/6.**
LOUDSPEAKERS. P.M. 3 ohm. 2½" and 5", **17/6**; 6" x 4" Rola, **18/-**; 4" Hi-Fi Tweeter, **25/-**; 8" Plessey, **19/6**; 6½" Goodmans, **18/6**; 10" R.A., **30/-**; 12" Plessey, **30/-**; 10" x 6" R.A., **27/6**; 12" Baker 15W 3 ohm or 15 ohm models, **105/-**; Stentorian HF1012 10", **99/6.**
CRYSTAL DIODES. G.E.C., **2/-**; GEX34, **4/-.**
40 CIRCUITS FOR GERMANIUM DIODES, 3/-.
H.R. HEADPHONES 4,000 ohms, brand new, **16/6** pr
SWITCH CLEANER FLUID, squirt spout, **4/3** tin.
TWIN GANG CONDENSERS. 365pF, miniature. 1⅜" x 1¼" x 1⅜", **10/-**; 0.0005 standard with trimmers, **9/-**; less trimmers, **8/-**; Midget, **7/6**; 50pF single **2/6.** Single 80pF, 100pF, 160pF, **7/-** each.
TUNING AND REACTION CONDENSERS. 100pF, 300pF, 500pF, **3/6** each, solid dielectric.

HIGH GAIN TV PRE-AMPLIFIERS
BAND I B.B.C.—*See page 852 June issue.*
Tuneable channels 1 to 5. Gain 18dB. ECC84 valve. Kit price **29/6** or **49/6** with power pack. Details **6d.**
BAND III I.T.A.
Tuneable channels 8 to 13. Gain 17 dB. ECC84 valve. Kit price **29/6** or **49/6** with power pack. Details **6d.**

Volume Controls
Midget size. Long spindles. Guaranteed 1 year. All values 5,000 ohms to 2 Meg.
No Switch 3/- — D.P Switch 4/9
Linear or Log Tracks

80Ω Coaxial Cable
Semi-air spaced Polythene insulated ¼" dia. stranded core. Ideal Band III **9d** yd.. Losses cut 50%
FRINGE QUALITY
Air-spaced Coaxial 1/6 yd.

Coaxial Plugs	1/-	**Lead Socket**	2/-
Panel Sockets	1/-	**Outlet Boxes**	4/6

Balanced Twin Feeder, per yd **6d.**, 80Ω or 300Ω
Twin Screened Balanced Feeder 1/6 yd, 80 ohms
Trimmers. Ceramic 30. 50, 70pF, **9d.**; 100pF, 150pF, **1/3**; 250pF, **1/6**; 600pF 750pF, **1/9**; Philips, **1/-** each
BLACK CRACKLE PAINT. Air drying, **3/-** tin.
P.V.C CONN. WIRE, 8 colours, single or stranded, **2d.** yd. Sleeving 1, 2mm, **2d.**, 2. 3mm, **3d.**, 6mm, **5d.** yd
NEON MAINS TESTER SCREWDRIVERS, 5/3
SOLDER RADIOGRADE, 3 yds **9d.**, ½lb **2/6.**

Aluminium Chassis. 18 s.w.g. Plain, undrilled, with 4 sides, riveted corners and lattice fixing holes. with 2½" sides. 7" x 4", **4/6**; 9" x 7", **5/9**; 11" x 7" **6/9**; 13" x 9", **8/6**; 14" x 11", **10/6**; 15" x 14", **12/6**; 18" x 16" x 3", **16/6.**

Miniature Contact Cooled Rectifiers. 250V 50mA, **7/6**; 250V 85mA, **9/6.** **Selenium Rect.** 300V 85mA, **7/6.**
Coils. Wearite "P" type, **3/-** each. Osmor Midget "Q" type, adj. dust core, from **4/-** each. All ranges
Teletron A.H.F. L. & Med. T.R.F. with reaction, **3/6.**
Ferrite Rod Aerials. M.W., **8/9**; M. & L., **12/6.**
T.R.F. Coils A/HF, **7/-** pair. **H.F. Chokes, 2/6.**
Speaker Fret. Gold cloth, 17" x 25", **5/-**; 25" x 35", **10/-.** **Tygan.** 4' 6" wide, **10/-** ft; 2' 3" wide, **5/-** ft. Samples, S.A.E.
Condensers. New stock, 0.001μF 7kV T.C.C., **5/6**; ditto 20kV, **9/6**; 100pF to 500pF Micas, **6d.**; Tubular 500V 0.001 to 0.01μF, **9d.**; 0.05, 0.1, **1/-**; 0.25, **1/6**; 0.1/350V, **9d.**; 0.5, **1/9**; 0.01/2,000V, **1/9**; 0.1/2,000V, **3/6.**
Ceramic Condensers. 500V 0.3pF to 0.01μF, **9d.**
Silver Mica. 10% 5pF to 500pF, **1/-**; 600pF to 3,000pF, **1/3**; close tolerance (plus or minus 1pF), 1.5pF to 47pF, **1/6**; ditto 1% 50pF to 815pF, **1/9**; 1,000pF to 5,000pF, **2/-**

NEW ELECTROLYTICS — FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350V	2/-	64/350V	5/6	8/500V	3/-
2/450V	2/3	100/25V	2/-	16/500V	4/-
4/450V	2/3	250/25V	2/6	32/350V	4/-
8/450V	2/3	500/12V	3/-	100/270V	5/6
8/500V	2/9	8+8/450V	4/6	2,500/3V	4/-
16/450V	3/6	8+8/500V	5/-	6,000/6V	5/-
16/500V	4/-	8+16/450V	5/-	32+32/350V	4/6
32/450V	5/6	8+16(500V	5/6	50+50/350V	7/-
25/25V	1/9	16+16/450V	5/6	64+120/275V	7/6
50/25V	2/-	32+32/350V	4/6	64+120/350V	11/6
50/50V	2/-	32+32/500V	7/6	100+200/275V	12/6

Full Wave Bridge Selenium Rectifiers. 2, 6 or 12V 1½A, **8/9**; 2A, **11/3**; 4A, **17/6.** Free charger circuit
Charger Transformers. Tapped input 200/250V for charging at 2, 6 or 12V 1½A, **15/6**; 2A, **17/6**; 4A, **22/6.**

LONG PLAY "GEVAERT GEVASONOR"
Plastic tape 50% extra 1,700ft 7" reel, **35/-**; 850ft 5" reel, **21/-.** Spare plastic reels **3/-** each.
SUPERIOR 1,200ft plastic tape, **24/-**, 7" plastic reel.
EMITAPE. 7" Long Play 1,800ft. **45/-.**
INSTANT bulk tape eraser, 200/250V a.c., **27/6.**

BRAND NEW AND BOXED
Model UA8
OUR PRICE
£6.19.6

STEREO MODELS
UA8 £9.19.6.
UA12 £11.17 6

★ **COLLARO** ★
HIGH-FIDELITY AUTOCHANGER
Latest Model Studio "O" pick-up
4 SPEEDS—10 RECORDS
BRAND NEW IN MAKER'S BOXES
OUR PRICE £7.19.6 post free

★ **GARRARD 4-SPEED RECORD CHANGERS RC121/D MK II MODELS** ★
With Plug-in Normal Head
AUDIO PERFECTION WIRED FOR STEREO
OUR PRICE £10.15.0 each Post Free
Plug in STEREO HEAD £2 extra

AUTOCHANGER ACCESSORIES

Suitable player cabinets (uncut boards)	49/6
Amplifier player cabinets with cut boards	63/-
2-valve amplifier and 6½" speaker for above	72/6
3-valve amplifier and 6½" speaker for above	95/-

Wired and tested ready for use

Wavechange Switches. 2 p. 2-way, 3 p. 2-way, short spindle, **2/6**; 5 p. 4-way 2 wafer, long spindle, **6/6**; 2 p. 6-way, 4 p. 2-way, 4 p. 3-way, long spindle, **3/6**; 3 p 4-way, 1 p. 2-way, long spindle, **3/6**; wavechange "MAKITS," 1 wafer, **8/6**· 2 wafer, **12/6**; 3 wafer, **16/-**; 4 wafer, **19/6**; 5 wafer, **23/-**; 6 wafer, **26/6.**
Toggle Switches, s.p. **2/-**; d.p., **3/6**; d.p.d.t., **4/-.**

JASON FM TUNER COIL SET, 26/-. H.F. coil, aerial coil, oscillator coil, two i.f. transformers 10.7 Mc/s, detector transformer and heater choke. Circuit and component book using four 6AM6, **2/6.** **Complete Jason FM Kit,** with valves and Jason Chassis with calibrated dial, **£6.15.0,** post free. **Mullard 3-3.** Quality amplifier ready built, with power socket for tuner, **£7.17.6.**

Valveholders. Pax. int. oct., **4d.** EA50, E150, **6d.** B12A, CRT **1/3.** Eng. and Amer. 4, 5, 6 and 7 pin, **1/-.** MOULDED Mazda and int. oct., **6d.**, B7G, B8A, B8G, B9A, **9d.** B7G with can, **1/6.** B9A with can, **1/9.** Ceramic, EF50, B7G, B9A int. oct. **1/-.** B7G with can, **1/9**; B9A with can, **2/9.**
TV Fault Finding, 5/-. Quality Amplifiers 4/6.
Radio Valve Guide. Books 1, 2 or 3 — 5/- each
TRANSISTORS. Ediswan Audio XB102, **10/-.** R F. 4 Mc/s, XA104 **18/-.** **Sub-miniature Electrolytics** (15V), 1μF, 2μF, 4μF, 5μF, 8μF, 25μF 50μF, **3/-.**

Teletron Transistor Pocket Radios
Designers Specified Kits
COMPANION PRINTED CIRCUIT THREE
Local station receiver kit, 4½" x 3" x 1½" **£4.19.6**
3 Ediswan or Mullard transistors, plans **6d.**

Transidyne Superhet Six 6" x 4" x 1¾"
T.C.C. Printed Circuit, internal Ferrite aerial, Rola loudspeaker push-pull output. All parts, cabinet, 6 Ediswan or Mullard transistors.
£11.19.6 Plans, etc., **9d.**
No surplus reject transistors supplied

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD WEST CROYDON
Catalogue 1/6 — *Telephone* **THO 1665**

Buses 133 or 68 pass door S.R. Stn. Selhurst
48 hour postal service 1/-, over £2 post free. C.O.D. 1/6 (Export welcome. Send remittance and extra postage)

SUMMER TIME IS AERIAL TIME

HEADPHONES. H.R. type, 4,000 ohms, very sensitive. Only **12/6** pair. P. & P. 1/6. C.L.R. (low res.) **8/6**, P. & P. 1/6.

RECORD CHANGERS. Latest B S.R. Monarch UA8 with manual and auto control, latest Ful-Fi Cartridge. List £9.15.0. OUR PRICE **£6.19.6**, carr. paid.

MULTI-WAY CABLE. ⅜" diam. 7 colour coded wires Ideal for mobile or inter-chassis connection. Any lengths cut, **1/3** per yard. P. & P. 1/6 min.

10-WAY CABLE (5 pairs). Screened and plastic covered. Any length cut, **2/-** per yard. P. & P. 1/6 min. **7-way** (unscreened), **1/3** yard.

DUAL RANGE VOLTMETERS. Dual range 0–5V and 0–100 M.C. 1,000Ω/V. Ranges easily extended. With test prods and leads. Complete in solid leather carrying case 6¼" x 5" x 2¼". A GIFT at **25/-**. Post free.

ABSORPTION WAVEMETERS. 3.00 to 35.00 Mc/s in 3 switched bands, marked on scale Complete with indicator bulb. A MUST for any ham shack. **Only 17/6**, post free.

Send for our new 56-page illustrated catalogue. P.O. or stamps, 1/6.

SPECIAL OFFER

ROTARY CONVERTERS

6V input, 250V, 125mA output. Only 5½" × 3" × 3" **17/6** each P. & P. 3/-.

12V MINIATURE ROTARIES

Only 4¼" x 2¼" overall. Output 360V, 30mA or 310V, 70mA. NEW LOW PRICE **12/6** each or **22/6** for 2. P. & P. 1/6.

100 KC/S CRYSTALS. American 3 pin based crystals. New condition. Worth £3.10.0. **Only 25/-**, post free.

R.F. CHOKES. 2.5mH, 120mA. Pie wound, **2/-** each. Three or more post free.

NATIONAL TYPE R-300μ. Type R-300μ pillar mounting choke, 1mH, 300mA, **3/-** each or **6** for **15/-**.

SHADED POLE MOTORS. For tape decks or gram. units. 3-hole fixing, twin coil, closed field type, 200/240V, 50 c/s, **15/-** each or **27/6** for 2. P. & P. 2/-.

RACK MOUNTING PANELS. 9" x 5¼", 7", 8¾", or 10½" black crackle finish, **5/9**, **6/6**, **7/6** respectively postage and packing 2/-.

AERIAL EQUIPMENT

COPPER WIRE. 14g. h.d.: 140' **17/-**; 70' **8/6**; 7/25 stranded: 140' **10/-**; 70' **5/-** plus 2/- P. & P.

RIBBED GLASS INSULATORS. 3" **1/6** each or 6 for **7/6**. P. & P. 1/6.

TWIN FEEDER. 300 ohm twin ribbon feeder, similar K25, **6d.** per yard. K358 Telcon (round) **1/6** per yard. Post on above feeder and cable 1/6 any length.

SUPER AERAXIAL CABLE 1/6 a yard. P & P. 1/6

CERAMIC FEEDER SPREADERS. Type F.S. 6" **9d.** each or 8/- doz. P. & P. 2/-.

CERAMIC "T" PIECES. Type AT for centre of dipoles **1/5** each or 3 for **4/-**. P. & P. 1/6.

MOSLEY TRI-BAND BEAMS

Orders for these will be handled in strict rotation.

T33, JR. 3 EL	**£25**
TA32 JR. 2 EL	**£18**
V3 JR. Vertical 3 Band ...	**£8**

PLACE YOUR ORDER EARLY

CHAS. H. YOUNG LTD (Dept. R)

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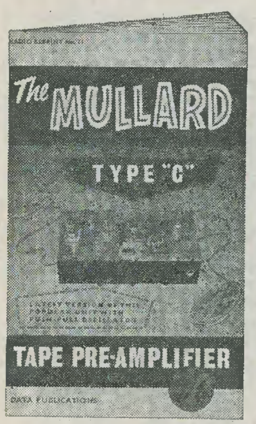


The LATEST in our Radio Reprint Series

THE MULLARD DESIGNED TYPE "C" TAPE PRE-AMPLIFIER

The subject matter of this addition to our Radio Reprints, (RR11) was originally described in a series of articles in *The Radio Constructor.* These articles, describing the construction of a high fidelity tape pre-amplifier proved to be very popular and are now reproduced with the latest modifications, in handy booklet form.

The prototypes of this amplifier were designed and built in the Mullard Applications Research Laboratory.

24 pages, plus laminated plastic board cover

Price 2/6 *Postage 4d.*

obtainable from your usual supplier or direct from the Publishers

DATA PUBLICATIONS LTD MAIDA VALE LONDON W9

BUILD YOUR FM TUNER

with an authentic Jason kit

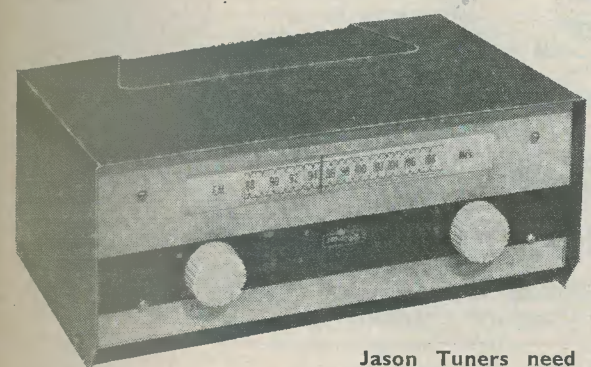
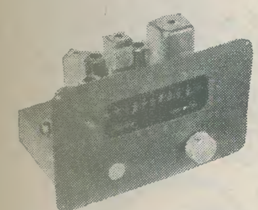


Illustration shows FM Fringe Tuner in standard Jason Kit Housing, which is also available for the standard FM Tuner. Below, standard tuner in chassis form.



Jason Tuners need very little introduction to "Radio Constructor" readers. From the time of the first standard FM Tuner design to today, when there is a wide range of Jason Kit designs to choose from, Jason Kits have led the way in good design, good performance, ease of construction and fair prices. The range now extends to Stereo Amplifiers and Electronic Test equipment. Details of Jason Kit designs gladly sent on request.

STANDARD TUNER in chassis form, less valves (*requires external source of power*)	**£5.5.0**
STANDARD TUNER in Jason standard Kit Case as illustrated, self-powered, less valves	**£7.3.0**
FRINGE TUNER self-powered, with case, less valves	**£8.5.0**

OTHER JASON TUNER KITS

ARGONAUT AM/FM chassis, less valves	£10.10.0
MERCURY switched FM chassis with 2 valves in front end	£9.0.0
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NOTICES

ARTICLES appearing in this magazine which describe kits are inserted only on condition that such kits, or special components thereof, are freely available at a trade discount to all retail advertisers.

OPINIONS expressed by contributors are not necessarily those of the Editor or proprietors.

THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should preferably be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but all relevant information should be included.

ALL MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

TRADE NEWS. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

TECHNICAL QUERIES should be submitted in writing. We regret that we are unable to answer queries, other than those arising from articles appearing in this magazine; nor can we advise on modifications to the equipment described in these articles.

ALL CORRESPONDENCE should be addressed to THE RADIO CONSTRUCTOR 57 Maida Vale London W9

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No. 104 A Two-Transistor Electronic Timer

suggested circuits

The circuits presented in this series have been designed by G. A. FRENCH, specially for the enthusiast who needs only the circuit and essential relevant data

ELECTRONIC TIMERS, DEVICES CAPABLE OF repeatedly carrying out a switching operation over a pre-selected period of time, are used to a large extent not only in industry but also in more domestic applications. The most obvious example of the latter occurs in photography. It is possible, for instance, to use an electronic timer for switching the lamp in an enlarger, thereby enabling successive prints to be given reliably controlled periods of exposure.

This month's "Suggested Circuit" describes an electronic timer which incorporates two transistors, and which is capable of functioning from a 12 volt supply. The timing periods available range from 0.6 seconds to 2 minutes and it is possible by the addition of further components to extend this range to greater periods of time, should this be desired. Despite the low supply voltage, the controlled external circuits are switched by a relay having robust contacts.

The Circuit

The circuit is illustrated in Fig. 1. In this diagram the circuitry around TR_2 and the relay is similar to that which occurred in a recent "Suggested Circuit" describing a light-operated switch.[1] This particular part of the previous "Suggested Circuit" is repeated here because it offers a high degree of operating efficiency and fits very well into a home-constructor unit. The design conditions under which TR_2 works were fully discussed in the earlier contribution, and the salient points are briefly summarised at the end of this article. It should be pointed out that the reader is strongly advised not to use a relay or a transistor in the TR_2 position other than those specified in Fig. 1.

An OC72 is specified also for the TR_1 stage but, in this case, the choice of transistor type is not very critical. This is due to the fact that the low dissipation required of TR_1 permits the use of almost any p.n.p. junction transistor in this position. The component values shown in the diagram apply to the OC72 only, and R_4 and R_5 may require experimental adjustment if any other transistor is fitted in the TR_1 stage.

We may now proceed to an explanation of circuit functioning. It would be best to commence this explanation for the case when Range Switch S_1 is in position "A" and when S_2 is in the "Reset" position. Under these conditions the base of transistor TR_1 is at the same potential as its emitter, the circuit between these two points being completed by R_4, R_2 and R_3. In consequence TR_1 draws little current through R_6, and a relatively heavy bias current passes through the base and emitter junction of TR_2. Due to this heavy bias current the collector of TR_2 draws an energising current through the coil of the relay. At the same time condenser C_2 becomes charged up, via S_2 and R_1, to the full supply voltage.

[1] "Suggested Circuits" No. 100. "A Transistorised Light-operated Switch," *Radio Constructor*, March 1959.

If S_2 is thrown to the "Trip" position, condenser C_2, in the charged condition, connects to the junction of R_4 and R_2. The negative potential on the top plate of C_2 causes a relatively large bias current to pass to the base of TR_1 via R_4. This bias current results in a large increase in the current drawn by TR_1 through R_6, with the consequence that the bias current available for TR_2 drops heavily. The collector current of TR_2 becomes reduced in consequence, causing the relay to de-energise and its contacts to switch the external controlled circuit.

As soon as S_2 was thrown to the "Trip" position C_2 commenced to discharge, the discharge current flowing through R_2 and R_3 in series, and through the base-emitter junction of TR_1 via R_4. As the potential across the plates of C_2 reduces, so also does the bias current to TR_1. At a potential of approximately 2 volts, the bias current to TR_1 drops sufficiently low to cause a marked decrease in collector current via R_6. TR_2 now commences to draw an increased bias current, whereupon its collector current increases in sympathy. The final result is that the relay becomes energised once more, and the controlled external circuit switched back to its original condition.

The timing period is now complete, and the relay will continue to stay in the energised position even when S_2 is returned to the "Reset" position. It is only when S_2 is, once more, thrown to the "Trip" position that the relay becomes de-energised and, again, switches the controlled external circuit.

The Timing Circuit

As will be gathered, the device is capable of switching an external circuit over a pre-selected period, this period being governed by the time taken for C_2 to discharge. In the circuit R_3 is made variable in order to enable a continuously variable control of the timing period to be made within the range selected by S_1.

When S_1 is thrown to position "B" condenser C_1 is connected across C_2. If both condensers have their nominal values, the total capacity in the timing circuit will then increase eleven times, with the consequence that the timing range offered on Range "B" has maximum and minimum values which are

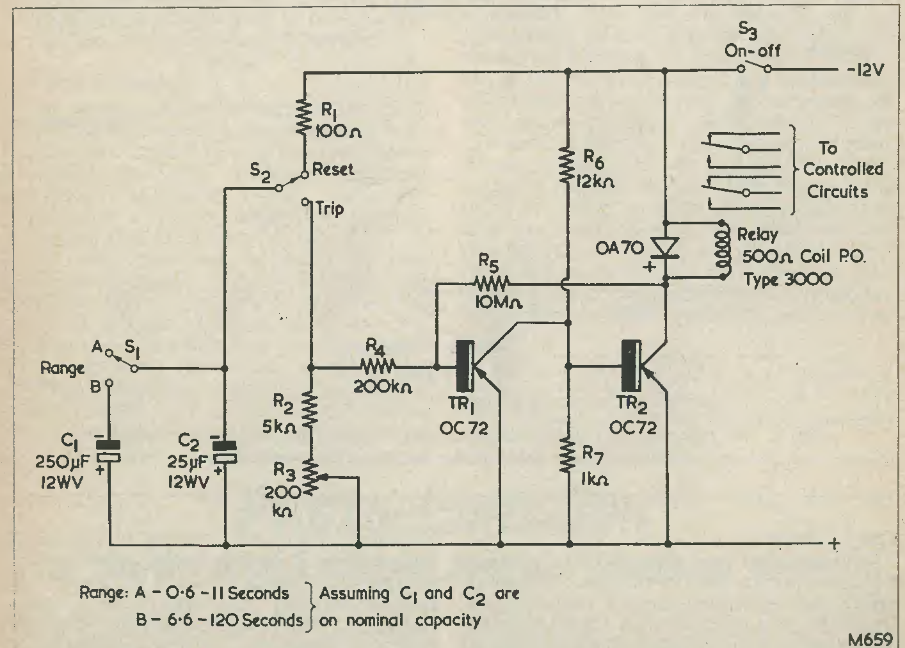


Fig. 1. The circuit of the two-transistor unit

eleven times the maximum and minimum values offered on Range "A." Timing periods longer than 120 seconds can be obtained by connecting further capacity across C_1 and C_2.

It will be noted that a 100Ω resistor, R_1, is connected in series with the negative supply line and the "Reset" contact of S_2. This resistor serves to limit the initial charging current to C_2, or to C_2 and C_1 in parallel, when S_2 is thrown to the "Reset" position. Without R_1 the initial charging current could be high enough to cause reduced switch contact life.

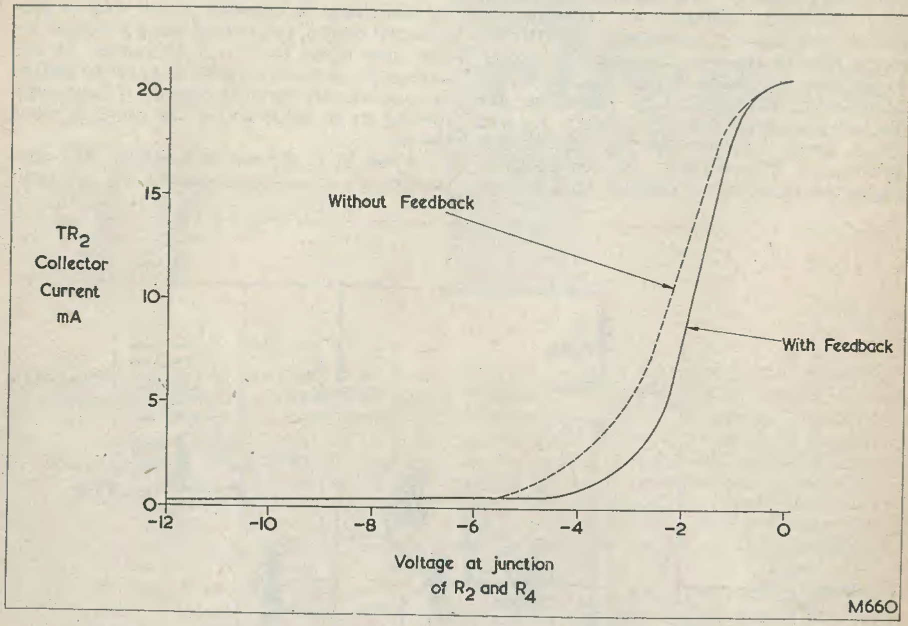


Fig. 2. Curves, obtained from the prototype, showing TR_2 collector current for differing potentials at the junction of R_2 and R_4

Relay Current

When an electronic timer employs a relay it is an important feature of circuit design to ensure that energising current increases (or decreases) at a quick rate as the end of the timing period is approached. If the energising current changes at a slow rate near the end of the timing period reliance has to be placed on the ability of the relay to repeatedly energise (or de-energise) at the same current in each successive timing period. This state of affairs cannot be guaranteed in practice due to the mechanical limitations of the relay, and timing periods are liable to be erratic in consequence.

In the timer described here care has been taken to ensure that relay energising current near the end of the timing cycle increases as dramatically as is possible commensurate with the limitations imposed by the requirements of circuit simplicity and economy of components. With this unit it is the use of two transistors in successive stages which enables a satisfactory energising current/time characteristic to be obtained. However, a further improvement on the characteristic given by the basic two-transistor circuit is possible with the use of positive feedback; and this is provided by the 10MΩ resistor, R_5, which couples the collector of TR_2 to the base of TR_1. It is not possible, unfortunately, to apply too much feedback or the circuit tends to oscillate. The value of 10MΩ specified for R_5 proved satisfactory in the prototype and should be similarly satisfactory in units made up by readers. If however, there is any tendency to oscillation (evidenced by relay chatter at the end of the timing period) the value of R_5 should be increased, or the resistor removed altogether. Such alterations should normally only be required if transistors other than the OC72 are used in the TR_1 position.

Fig. 2 shows a graph depicting current through the relay coil against voltage at the junction of R_2 and R_4. The solid curve depicts the characteristic given when R_5 is in circuit, whilst the dotted line represents the case when R_5 is absent. As is to be expected, R_5 only affects the curve near the end of the timing period. It will be seen that the provision of positive feedback does not have a very great effect on the characteristic. Nevertheless, a significant improvement does take place and makes it worth while incorporating the single extra resistor involved.

Setting Up

When the device has been completed it will be necessary for R_3 to be calibrated in units of time. Independent calibration will be needed on both ranges due to the difficulty of ensuring nominal values in C_1 and C_2. The calibration can be carried out by experimental runs checked against a watch or clock having a second hand.

If C_1 and C_2 are purchased new, or if they have not been used for a very long time, it might be advisable to have several preliminary runs to enable them to become fully formed before commencing calibration.

The Relay Circuit

The more important features of the OC72 relay switching circuit (summarised from "Suggested Circuits" No. 100) are as follows. References to OC72 working conditions apply here to TR_2 only.

Assuming a supply voltage of nominal value, collector dissipation in the OC72 is 40mW when the relay is energised. The maximum allowable collector dissipation of an OC72 without a cooling fin is 122mW at 30° C (86° F) and 87mW at 40° C (104° F). When coupled to a heat sink the corresponding dissipation figures are 150mW and 117mW respectively. Although the OC72 is worked within the maximum dissipation figures applicable for use without a cooling fin, it would be good practice to clamp it to a heat sink. This should have the minimum dimensions of 1½in square.

The OA70 connected across the relay coil prevents the formation of high reverse voltages which would otherwise appear if the energising current were suddenly reduced in value. It is essential to connect the OA70 with correct polarity, or damage to the OC72 may result.

The power supply voltage should be reasonably well-regulated, a desirable figure being better than ±2 volts on 12 volts.

The relay specified is a 500Ω Post Office type 3,000 unit, and the reader is very strongly recommended to employ a relay of this type. The relay specified will function satisfactorily with either one or two sets of contacts. More than two sets of contacts will cause energising current requirements to become excessive. On no account should a relay having a coil resistance less than 500Ω be used[2]

Although not entirely necessary, it is desirable to check OC72 current when the unit is completed. With S_2 in the "Reset" position the current flowing through the relay coil should lie between 17 and 23mA.[3] If it is found that collector current lies slightly outside these figures it may be decreased by making a small increase in the value of R_6, or increased by making a small decrease in value of this resistor. In the absence of a milliammeter capable of reading currents of the order of 20mA, a high resistance voltmeter may be connected across the relay coil, and the readings provided by this instrument converted to current figures. Thus, to take an example, a reading of 10 volts across the 500Ω relay coil would indicate a current flow of 20mA.

[2] A suitable relay, fitted with two sets of change-over contacts, is available from H. L. Smith & Co. Ltd., 287 Edgware Road, London, W.2.

[3] "Suggested Circuits" No. 100 quoted a maximum current of 22mA.

"Photo-Emission"

A NEW MULLARD-E.F.V.A. SCIENCE FILM

The Mullard Educational Service has announced the introduction of a new teaching film entitled *Photo-Emission.*

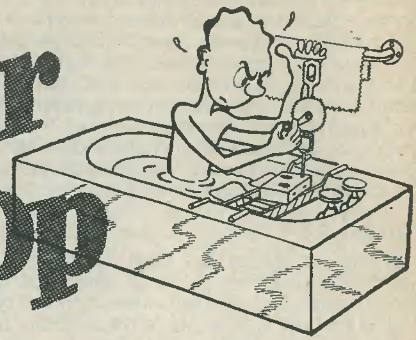
Produced in conjunction with the Educational Foundation for Visual Aids, *Photo-Emission* is the latest addition to the Advanced Science Series for sixth forms and technical colleges. It runs for 18 minutes, on 16mm. black-and-white sound film, and is backed-up by comprehensive teaching notes.

The film starts by describing the working and construction of a simple photo-emissive cell, and goes on to show some of the early experiments of Elster, Geitel and Millikan. The theory of photo-emission is concisely and simply explained, and the established laws of the effect are set out. The explanations are put over effectively by animated diagrams and easily-followed experiments.

A short survey of the many practical and laboratory applications of photo-emissive cells is given in the closing sequences.

Photo-Emission is available on hire from the Educational Foundation for Visual Aids, Film Library, Brooklands House, Weybridge, Surrey.

In your Workshop



This month Smithy the Serviceman passes on to his assistant Dick, some information on commonly-encountered component codes

"SMITHY," CALLED OUT DICK, "WHAT DO you know about e.s.p.?" One of Dick's more annoying habits consisted of suddenly asking questions which had no relation whatsoever to any subject immediately on hand.

"Dash it all, Dick," grumbled the Serviceman, tearing his thoughts away from the chassis he was troubleshooting, "not only do you fire questions at me out of the blue, but you also expect me to know what initials like e.s.p. stand for!"

"Well, last month you expected me to know what salmagundi meant," said Dick, defensively.

"That's different. Salmagundi is a *word*, not a set of initials. You know, I'm convinced that, ever since the last war ended, people have been wandering around adding to the world's stock of initials just so that they can keep ahead of ordinary people who haven't the time to remember what such disconnected things stand for. It's a conspiracy, that's what it is," Smithy was now firmly astride a favourite hobby-horse, "a conspiracy brought about by those persons who have set themselves up as *experts*" (no words can convey the contempt which Smithy injected into the word) "on some damn silly subject whose need was never even dreamed of before the war. Since they're "experts" they feel they have to doll up their language with a lot of incomprehensible terminology, whereupon the best they can do is to call everything by initials so that basic information is kept one step away from those who are not in the swim."

"Here, take it easy," said Dick, alarmed.

"I'm darned if I'm going to take it easy," replied Smithy. "There's *far* too much use of initials nowadays. What is the most annoying fact of all is that the most initial-happy types are those in Government departments who ought to know better. Not only do these Government geysers continually dream up new sets of initials, but they actually torture them into words on their own. Look at Grace, for instance."

"You look at her," said Dick, irreverently.

"Don't try to put me off. Grace is the initial letters for the new Post Office long-distance dialling system, and it stands for Group Routing and Charging Equipment. But who's to know that? And, what about Ernie? Do *you* know what Ernie stands for?"

"Almost anything, I would say," said Dick dispassionately, "considering how red his ears must be after I've looked down the list of winning Premium Bond numbers each month."

Smithy's assistant paused for a moment, whilst an inspired expression lit his face.

"You've given me an idea, Smithy," he remarked, a little excitedly. "Here, listen to this:-

If Ernie and Grace were to marry,
What a saving of labour we'd see.
We would dial our Premium Bond numbers,
And for winnings would press Button B!"

Despite himself, Smithy had to chuckle. Dick's ability to break into doggerel at odd moments always activated the Serviceman's sense of humour.

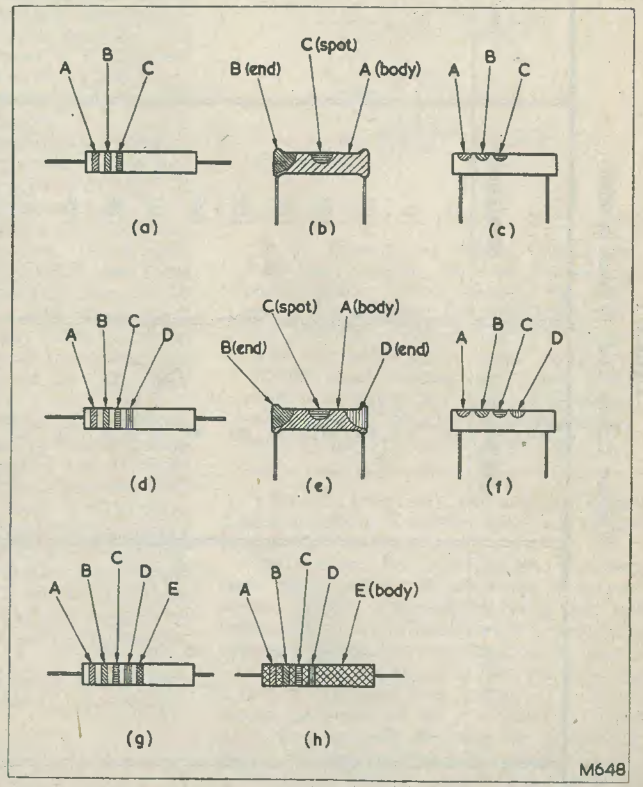
"Fair enough," he laughed, "and I must ask you to excuse my getting all worked up over the business of initials. Nevertheless, I still say that with all the initials which are knocking around these days, you need extra-sensory perception if you're going to understand your own language."

"Which," Dick explained, "is exactly what the initials e.s.p. stand for"

Extra-Sensory Perception

"Then why the deuce didn't you say so in the first place?," asked Smithy, heatedly. "If you'd done so I wouldn't have got myself all fussed up! Anyway, what has extra-sensory perception got to do with service engineers?"

Fig. 1. Various methods currently employed for colour coding resistors. See Table I. Resistors (a) (b), (d) and (e) use conventional three- or four-colour systems. Resistors (c) and (f), typical of those recently introduced for printed circuits, employ coloured dots. Resistors (g) and (h) are high-stability types, in which the fifth colour, salmon pink, appears as a fifth band or as a body colour. American coding systems follow British practice for resistors (a), (b), (d) and (e), with the exception that colour band A of types (a) and (d) is liable to appear at the extreme end of the body.



"I wish I'd never started this now," said Dick unhappily. "The only reason I raised the question of e.s.p. is that it seems that this is what engineers need if they're going to discover the values of components fitted to the sets they service. Here's a typical example of what I mean. I have just unearthed a potentiometer whose performance I suspect. Yet I can't check its resistance even, because it has no indication of value on it whatsoever. All I can see is a blurred stamp which looks something like REVLOGIOS. Could REVLOGIOS be the name of the maker?"

"It sounds Greek to me," commented Smithy. He wandered over to look at the offending component.

"Why, this one's quite easy," he remarked, after a moment's examination. "The blurred stamping has made you mistake the final character. The true legend should be REVLOG105; which makes the pot a reverse log component having a resistance of 1MΩ."

"Hey?"

"That's right. You still don't get it? O.K., we'll start from the beginning. As you know, the usual type of pot we handle is either linear or logarithmic. With a linear pot the resistance of the track increases directly as the rotation of the slider. With a log pot it is the *logarithm* of the track resistance which increases directly as the rotation of the slider. This assumes, by the way, that the control knob moves in a clockwise direction. Linear pots are used normally in such applications

TABLE I

Resistor Colour Code (Values in ohms)

Colour	A 1st Sig. Fig.	B 2nd Sig. Fig.	C Multiplier	D Tolerance	E
BLACK	0	0	1	—	—
BROWN	1	1	10	—	—
RED	2	2	10^2	—	—
ORANGE	3	3	10^3	—	—
YELLOW	4	4	10^4	—	—
GREEN	5	5	10^5	—	—
BLUE	6	6	10^6	—	—
VIOLET	7	7	10^7	—	—
GREY	8	8	10^8	—	—
WHITE	9	9	10^9	—	—
GOLD	—	—	0.1	±5%	—
SILVER	—	—	0.01	±10%	—
NO COLOUR	—	—	—	±20%	—
SALMON PINK	—	—	—	—	High Stability*

* The fifth colour, Salmon Pink (=High Stability), appears in the British R.I.C. code only.

Example 1.—A resistor coded Brown, Red, Green has a value of 1.2MΩ ±20%.

Example 2.—A resistor coded White, Brown, Gold, Silver, Salmon Pink, has a value of 9.1Ω ±10%, and is a high stability component.

as line and frame hold controls, brightness controls, and so on; whilst log pots appear as volume controls. Sometimes a designer dreams up a circuit, such as a tone control network, wherein smoothest operation is given by a reverse log track. In this case the logarithm of track resistance still increases directly as the rotation of the slider, but only when the control knob is turned in an anti-clockwise direction. The pot you have is one of those."

"O.K." said Dick. "That explains the REVLOG bit. How did you determine the 1MΩ figure?"

"Elementary," replied Smithy. "There were only three digits in the figure group, so it would be quite safe to assume these followed ordinary three-colour code practice. 105 would then mean 1 followed by 0, followed by five more 0's. That is to say, 1,000,000Ω, or 1MΩ. Incidentally, this three-figure code is quite often employed on pots."

"I suppose that's reasonable enough," conceded Dick, "but why couldn't they just stamp 1MΩ on the pot instead of 105? It wouldn't have taken up any more room."

"Agreed," replied Smithy, "but that fact only applies for certain values. If the resistance of the pot were, say, 300kΩ, then there would definitely be a saving in space if the appropriate code group, 304, were used. Speaking frankly, I can't say I like the three-figure code on the pots much more than you do. It is one of those things up with which we peasants have to put."

"I see," said Dick, reflectively. "You know, Smithy, if all the troubles I've had in finding out component values worked out as easily as that we've just looked into, things wouldn't be so bad. But there are plenty of other components whose values I have extreme difficulty in reading, simply because there are so many different coding practices in use. How would it be if I were to prepare a number of tables covering the codes most likely to be met by ourselves. They'd be jolly useful stuck up on the wall."

"I think that's an excellent idea," said Smithy, "and I would certainly take advantage of them myself."

Resistor Codes

"O.K." said Dick. "Let's start with something nice and easy, like resistors."

"Right," replied Smithy, briskly. "We'll commence with composition resistors."

"By composition resistors I presume you mean what are usually called *carbon* resistors?"

"That's correct. Their resistive material consists of a mixture of carbon particles and resins all bonded up together."

"A salmagundi, in fact."

"I wish I'd never taught you that word," said Smithy irritably. "Anyway, let's get back to the coding. Now a composition resistor may be coded with three colours, four colours, or five colours (Fig. 1). If it is coded with three colours, these may appear on the resistor as three bands, in which case you read them from left to right, as in my sketch. Alternatively, they may appear as a coloured body, a coloured end and a coloured spot, or band; in which case you read them in that order."

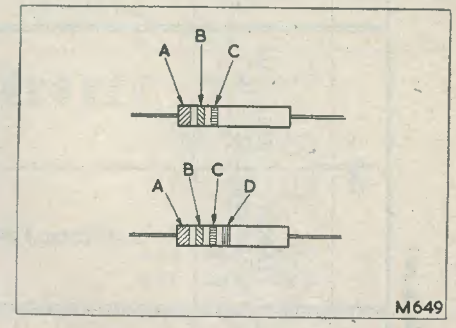


Fig. 2. Wire-wound resistors with axial leads may employ three-or four-colour codes similar to those shown in Fig. 1 (a) and (d), and having the same interpretation. However, colour band A will have twice the width of the other bands, to indicate a wire-wound component. This code is of American origin, whereupon colour band A is shown in the diagram as being at the extreme end of the body

"I thought that body, end and spot coding died out quite a few years ago," commented Dick.

"Perhaps so. But you may find it coming back again on some miniature resistors," replied Smithy, "the reason being that it is sometimes rather difficult to put a number of coloured bands on very small components. I had better warn you also that you may find a row of coloured dots, instead of coloured bands, on some of the new resistors which have been specially designed for printed circuits. I've shown these in my sketch as well."

"Resistors having four colours follow just the same coding rules as do resistors having three colours. The fourth colour is either silver or gold, and it tells you that the resistor has a tolerance of ±10% or ±5% respectively. Three colour resistors have tolerances of ±20%."

"In other words, the coding for ±20% is 'no colour'."

"That's right. The fourth colour may be added as a fourth band, or a fourth dot, to resistors employing bands or dots. If the resistor is of the body, end, spot variety, the

TABLE II
Six-Dot Condenser Code (Values in pF)

Colour	Dot 1: JAN or RTMA code	Dot 1: RMA code 1st Sig. Fig.	Dot 2: JAN or RTMA code, 1st Sig. Fig. RMA code, 2nd Sig. Fig.	Dot 3: JAN or RTMA code, 2nd Sig. Fig. RMA code, 3rd Sig. Fig.	Dot 6: All codes, multiplier	Dot 4: JAN or RTMA code	Dot 4: RMA code D.C. W.V.	Dot 5: Tolerance JAN or RTMA code	Dot 5: Tolerance RMA code
BLACK ..	Mica cdsr. JAN code	—	0	0	1	CLASS (RTMA) OR CHARACTERISTIC (JAN)	—	±20%	—
BROWN ..	—	1	1	1	10		100	—	±1%
RED ..	—	2	2	2	10^2		200	±2%	±2%
ORANGE ..	—	3	3	3	10^3		300	±3%	±3%
YELLOW ..	—	4	4	4	10^4		400	—	±4%
GREEN ..	—	5	5	5	—		500	±5%	±5%
BLUE ..	—	6	6	6	—		600	—	±6%
VIOLET ..	—	7	7	7	—		700	—	±7%
GREY ..	—	8	8	8	—		800	—	±8%
WHITE ..	Mica cdsr.* RTMA code	9*	9	9	—		900	—	±9%
GOLD ..	—	—	—	—	0.1		1000	—	—
SILVER ..	Paper cdsr. JAN code	—	—	—	0.01		2000	±10%	±10%
NO COLOUR	—	—	—	—	—		—	—	±20%

* A white dot 1 is more liable to indicate the RTMA code than figure 9 in the RMA code.

Example 1.—A condenser coded Silver, Yellow, Green, Violet, Red, Brown is read as follows: Silver indicates a paper condenser with JAN coding, whereupon Yellow, Green and Brown (dots 2, 3 and 6) give a value of 450pF. Dot 5 (Red) indicates a tolerance of 2%. Dot 4 (Violet) is ignored.

Example 2.—A condenser coded Brown, Grey, Violet, Yellow, Orange, Brown is read as follows: Brown indicates the RMA code, whereupon Brown, Grey, Violet and Brown (dots 1, 2, 3 and 6) give a value of 1,870pF. Dot 5 (Orange) indicates a tolerance of 3%. Dot 4 (Yellow) indicates a d.c. working voltage of 400.

fourth colour appears at the remaining end. You can't muddle the ends up because the fourth colour can only be silver or gold."

"The five colour code was introduced to cater for high stability resistors. The first four colours are read as before, and the added fifth colour is always salmon pink. This indicates a high stability component, and it appears as a fifth band, or as an overall body colour. Again, see my sketch."

"What's a high stability resistor?"

"One that maintains its value within very close tolerances in use, "replied Smithy. "Ordinary composition resistors tend to wander around a little in value under certain working conditions. You'll find high stab. resistors in test equipment mainly, although they turn up now and again in domestic time-base circuits.

"You will have seen that I have labelled the colours on all the resistors we have discussed with the letters A, B, C, D and E as applicable. These letters can now appear in a table which summarises the coding systems (Table 1).

"I think the principle of this table, and the coding it depicts, is clear enough. The first two figures in the code tell you the first two digits of the resistor value, whilst the third gives you the decimal multiplier. Thus, colours A, B and C for a 250kΩ resistor would be red, green and yellow respectively, the red and green giving you 2 and 5 for the first two digits, and the yellow telling you to add four 0's afterwards."

"What about the gold and silver multipliers?"

"Well, if the third colour were gold you would divide by ten," said Smithy. "Thus, red, green and gold would be 2 and 5 divided by 10; that is, 2.5Ω. If the colours were red, green and silver you'd divide the first two digits by 100, giving you 0.25Ω. Got it?"

Dick gave the Serviceman an affirmative nod of his head.

"Now," continued Smithy, "before concluding on resistors, I should mention that there is a colour code for wire-wound resistors with axial lead-out wires in addition to that for composition resistors. This code should appear on the resistor as either three or four coloured bands (Fig. 2), the first band being twice the width of the other bands to indicate that the component is wire-wound. The colours employed stand for exactly the same things as they do when applied to composition resistors, so our first table suffices for wire-wound resistors as well."

Condenser Coding

"What about condenser coding?" asked Dick.

"Ah," said Smithy, shaking his head dolefully, "this is where we begin to enter the jungle! So far as paper, electrolytic, and most types of mica condensers are concerned, things aren't too bad because the value, and in many cases the tolerance, is printed on the case. It is when we leave printing and go on to colour coding that things begin to get complicated. I'll start off with mica condensers.

"Now, the only colour codes you'll normally encounter with mica condensers are those used on American moulded types. Several codes are employed, and they all use coloured dots.

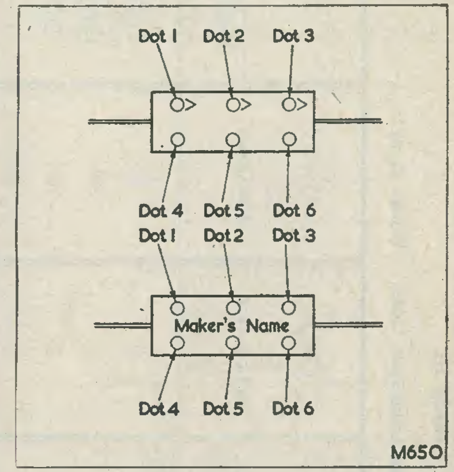


Fig. 3. Moulded mica or moulded paper condensers may employ the six-dot code shown here. See Table II. Usually the maker's name or arrows pointing to the right are moulded into the case so that dots may be read in correct order; but these aids are frequently omitted

"The first type to examine is the six-dot code. (Fig. 3). As you can see, the six dots in this code run in two rows of three, and you have to make certain that the condenser is right way up before you start reading off its value. There should normally be arrows pointing to the right to help you here, or the maker's name should be moulded into the case. If you have neither of these indications of dot order to help you—and I've seen quite a few condensers which haven't—then the only thing I can suggest is that you read the value going both ways, whereupon one answer should be ridiculous!"

"Ridiculous, he says," commented Dick, rudely.

"There's worse to come yet," grinned Smithy, unabashed. "There are at least three separate six-dot condenser codes."

TABLE III

R.I.C. Five-Dot Ceramic Condenser Code. (Values in pF)

Colour	End Colour (Indicates Temperature Coefficient; parts/million/°C.)	Dot 1	Dot 2	Dot 3	Dot 4	
		1st Sig. Fig.	2nd Sig. Fig.	Multiplier	Tolerance	
					10pF or less	More than 10pF
BLACK ..	NP0	0	0	1	±2pF	±20%
BROWN ..	N030	1	1	10	±0.1pF	±1%
RED ..	N080	2	2	10^2	±0.2pF*	±2%
ORANGE ..	N150	3	3	10^3	—	±2.5%
YELLOW ..	N220	4	4	10^4	—	—
GREEN ..	N330	5	5	—	±0.5pF	±5%
BLUE ..	N470	6	6	—	—	—
VIOLET ..	N750	7	7	—	—	—
GREY ..	P030	8	8	0.01	±0.25pF†	—
WHITE ..	P100	9	9	0.1	±1pF	±10%

* A tolerance of ±0.2pF for Red is not in the R.I.C. code, but is used by some manufacturers.

† Some manufacturers use Orange to indicate a tolerance of ±0.25pF.

Example 1.—A condenser coded Brown, Orange, Black, White, Green has a value of 3.0pF ±0.5pF and a temperature coefficient of N030.

Example 2.—A condenser coded Violet, Blue, Grey, Brown, Black has a value of 680pF ±20% and a temperature coefficient of N750.

"Come off it, Smithy," exclaimed Dick, "that statement just *can't* be true."

"Well, it is," said Smithy. "Fortunately, two of these codes are, as near as dammit, the same. These two similar codes are the ones most recently introduced, and I think we'd better deal with them first. One of the codes is known as the American R.T.M.A. Colour Marking, and the other as the JAN six-dot colour coding."

"Who's introducing initials now?"

"Sorry! R.T.M.A. stands for Radio and Television Manufacturers' Association, and a JAN specification is a Joint Army-Navy specification. Now, if the R.T.M.A. Colour Marking—which someone, believe it or not, has further abbreviated to R.C.M.—is employed, the first dot is always white. If JAN coding is employed the first dot is always black. These colours not only indicate the type of coding employed but also show that the condenser is mica, as opposed to paper or ceramic. After you've got safely over the hurdle of the first colour, it's pretty easy going. For both codes the second dot is the first digit of the capacity value, the third dot is the second digit in the value, and the *sixth* dot is the multiplier. So you read the second, third and sixth dot, in that order, just like the three colours of a resistor; the only major difference being that your value is now in picafarads instead of in ohms.

"So far so good. The next dot to consider is No. 5. This defines tolerance and is the same for both JAN and R.T.M.A. codes. The remaining dot is the fourth one. This qualifies methods of testing, classification and use, and it differs in the two systems. So far as you and I are concerned, it's best to forget about the fourth dot altogether, as its use is aimed mainly at the equipment designer. For servicing, or home construction work, the fourth dot may be quite safely ignored.

"Right! Now we come onto the third of our mica condenser six-dot codes. This is the old R.M.A. six-dot coding; and, before you interrupt, I'll tell you that R.M.A. stands for Radio Manufacturers's Association. The old R.M.A. six-dot code is quite different from the other two we've just considered. In this case, the first, second and third colours signify the first *three* digits in the capacity value. Note that this earlier code allows for three significant figures in the value instead of the two allowed for in the later codes. Once again the sixth dot gives us the multiplier, and once again dot No. 5 gives us the tolerance. Dot 4 is, however, different. This time it tells us the d.c. working voltage."

"Phew," commented Dick. "Bit complicated, ain't it?"

"It's not too bad, really," said the Serviceman. "The only bit I don't like about it is that, if the first dot is white, it *could* also signify the old R.M.A. coding with a first digit equal to 9. However, the chances of having a condenser value beginning with 9 are pretty remote."

"Up to now, I've been speaking about the three six-dot codes which apply to moulded mica condensers. In actual fact there is a fourth six-dot condenser code which should, I think, be included, if only for the sake of completeness." Dick groaned. "This fourth code applies to moulded *paper* condensers. If the first dot of a six-dot code is silver, this means that the condenser is a paper component and that it employs the same JAN coding for value, etc., as does the mica condenser with the black dot.

"I think we can now draw up a table quite

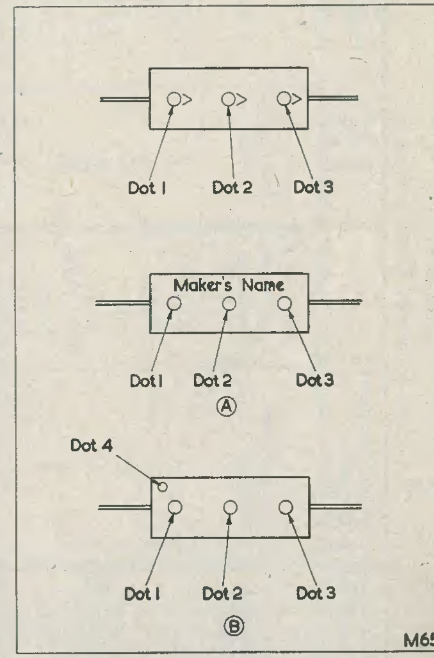


Fig. 4. Moulded mica condensers employing the three- or four-dot code. Again, the maker's name, or arrows pointing to the right, should be moulded into the case to indicate the correct order of reading. Dots 1, 2 and 3 are read in the same manner as colours A, B and C of Table I, values being given in pF. Dot 4 indicates tolerance, and it employs the R.M.A. coding shown in the Dot 5 column of Table II. All three- and four-dot condenser codes assume a voltage rating of 500. *All three-dot codes assume a tolerance of* ±20%

TABLE IV
Erie Condenser Letter Coding

Normal temperature coefficient and high negative temperature coefficient condensers.				
Tolerance Letter	Tolerance: 10pF or less	Tolerance: More than 10pF	Temperature Coefficient Letter	Temperature Coefficient
B	±0.1pF	—	A	P100
C	±0.25pF	—	B	P030
D	±0.5pF	—	C	NP0
F	±1pF	±1%	D	N030
G	±2pF	±2%	E	N047/N050
H	—	±2.5%	F	N080
J	±5%	±5%	G	N150
K	±10%	±10%	H	N220
M	±20%	±20%	J	N330
			K	N470
			L	N560
			M	N650
			N	N750
			P	N1500
			R	N2200
			S	N3300
			T	N4200
			U	N4700
			V	N5600

High permattivity condensers			
Tolerance Letter	Tolerance	Dielectric Letter	Dielectric Material
K	±10%	W	K0600–K1000
M	±20%	X	K1100–K2000
N	−20 +40%	Y	K2100–K4000
P	−20 +80%	Z	K4100–K8000
R	−0 +100% or G.M.V.*		
S	±25%		
T	−20 +100%		

* G.M.V.=Guaranteed Minimum Value.

Example 1.—A condenser coded 18 FG has a value of 18pF ±1% and a temperature coefficient of N150.

Example 2.—A condenser coded 1000 PY has a value of 1,000pF −20 +80% and employs dielectric of constant "K" between 2100 and 4000.

easily from the information we've just discussed. (Table II).

Three- and Four-Dot Codes

"The remaining American systems to deal with are the three- and four-dot systems. The three-dot system consists, quite simply, of three dots in a row (Fig. 4 (*a*), whereupon you read them from left to right. If the manufacturer was in a helpful mood when he made the condenser he will have provided arrows to guide our enquiring eyes, or he will have put his name on the front so that we can see the correct way to hold the condenser. You read the three colours in this code in just the same manner as you do the three colours of a resistor, and you get your answer in picafarads instead of in ohms. The four-dot system is an off-shoot of the three-dot system, and it consists of adding a fourth dot in the corner of the condenser (Fig. 4 (*b*). This fourth dot tells you the tolerance figure, and it follows the tolerance coding used in the six-dot R.M.A. code. An important point to remember is that, if the three- or four-dot code is used, the condenser has a working voltage of 500. Also, the three-dot system assumes a tolerance of ±20%, which is to be expected.

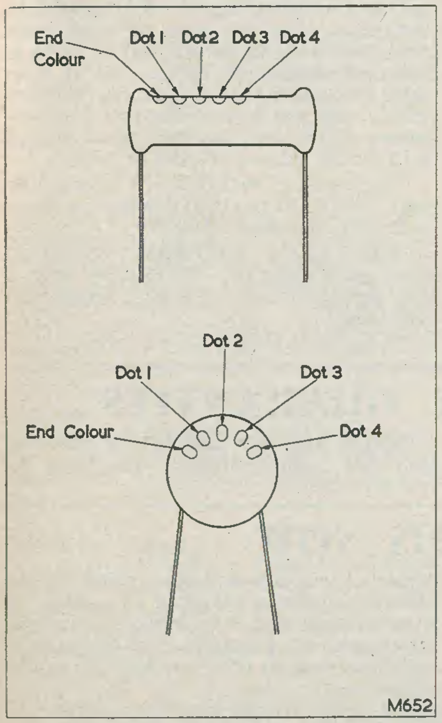


Fig. 5. Tubular and disc ceramic condensers employing the five-dot colour code. The British R.I.C. version of this code is given in Table III. (The British R.I.C. code is almost identical with the American R.M.A. five-dot ceramic colour code)

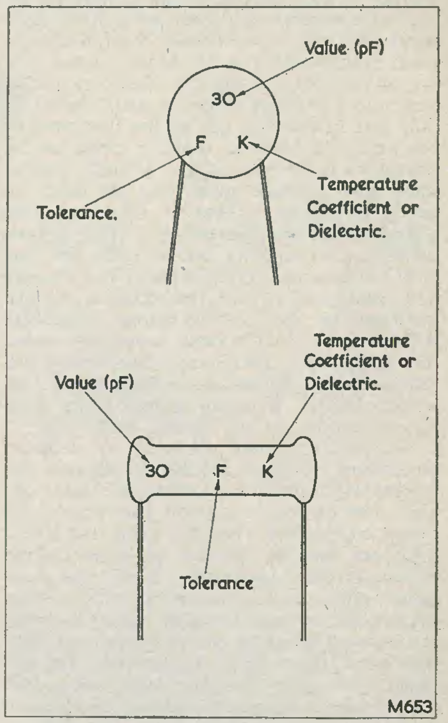


Fig. 6. Some Erie ceramic condensers employ a code in which the value is shown directly in pF, tolerance and temperature coefficient, or dielectric material, being indicated by two succeeding letters. See Table IV. The dielectric materials shown in Table IV against letters X, Y and Z are not of direct interest to the service engineer or home-constructor, apart from the fact that they indicate that the associated condenser is normally employed for decoupling purposes

Ceramic Condensers

"We next get on to ceramic condensers."

"Oh, goody," exclaimed Dick, sarcastically. "How many codes this time?"

"Well, there is one basic five-dot code used in this country," said Smithy, "this having been laid down by the British Radio Industry Council. I would say that this is the best code for us to consider here. The R.I.C. code is read from left to right. However, just to make things nice and confused-like, the first dot on the left is not given a number but is called the *end colour*. The remaining four dots after this end colour are then known as the first, second, third and fourth dots. Ideally, the coded condenser should be marked so that the end colour is well to one end on a tubular condenser, or is to the left hand side on a disc condenser when the leads point downwards (Fig. 5). Unfortunately, so far as tubular condensers are concerned, these are nowadays made so small that it is only just possible to get all the five colours on, and you have to make a guess as to which dot is the end colour. Usually, this is fairly easy as, once again, you are liable to get a ridiculous answer if you read the colours in the wrong direction. There are no difficulties in making out a table for the R.I.C. five-colour code (Table III). I should add, incidentally, that this code is almost identical to the corresponding American R.M.A. five-colour ceramic condenser code, the only major discrepancy concerning the temperature coefficient corresponding to white. In the American system white does not correspond to any specific coefficient.

"In practice, there are a lot of ceramic condensers sculling around in British receivers which don't employ the five-dot code. The most obvious exception you're liable to bump into occurs when the value and tolerance are printed, instead of being colour coded, on the condenser. Also, you may quite often find condensers which have printed values and tolerances, but whose ends are painted white or violet to indicate that they are P100 or N750 respectively. Or, yet again, you may find that the value and tolerance printing is *itself* done in white or violet to indicate one or other of these two temperature coefficients.

"Another code you may encounter employs letters (Fig. 6). This is a nice easy straightforward code, and you can easily make up a table for it (Table IV). As you can see, the code consists quite simply of the value followed by two letters."

Smithy paused for a moment and lit a cigarette.

"You know," said Dick, thoughtfully, "this coding business isn't all that shocking, once you get down to it."

"It isn't really," agreed Smithy. "What usually foxes people are the condenser codes where the first colour isn't the first digit of the value. I think I had better add, incidentally, that the five-colour ceramic condenser code doesn't normally cover such things as 1,000 and 2,000pF decoupling condensers. Usually, these have very high tolerances, of the order of -20 to $+80\%$, as well as somewhat astronomic temperature coefficients. For the class of work such condensers have to do this sort of thing is quite permissible, of course, but it does rather preclude the use of the code. Another point is that you'll very often find that condensers of this type have their values printed as 1K or 2K, instead of 1,000 or 2,000."

"Fair enough," said Dick. "I'll remember that. It looks as though I'd better get down to drawing up some tables."

"Right you are," said Smithy. "But you'd better get a move on. We've spent enough time gassing already, what with initials and everything."

"O.K.," said Dick. "I'll do it P.D.Q."

EXTENDED C.R.T. GUARANTEES

Suffolk Tubes Ltd., Midland Tubes Ltd., and Vidio Replacement Co., each well-known in the electrical trade as cathode ray tube rebuilders, have now extended the period of their full cover guarantee from seven to twelve months.

12 MONTHS NOW

Following the announcement that a major TV tube manufacturer was introducing a 12 months guarantee from 1st June, C.R.T. Ltd., the Golden Touch TV tube rebuilders are following suit.

From 1st June, therefore, all C.R.T. tubes registered will automatically qualify for the extended guarantee period of 12 months. It is emphasised that the complete conditions attaching to the guarantee must be complied with in all respects otherwise no claim can be entertained.

ARE YOU INTERESTED IN RTTY?

Further to our recent announcement regarding the formation of a Teletype Group, this is to be known as the British Amateur Teletype Group. At the moment, no subscriptions, etc., are required. All that is necessary is a genuine interest in RTTY. Further details can be had from: Dr. Arthur C. Gee, G2UK, "East Keal," Romany Road, Oulton Broad, Lowestoft, Suffolk.

UNDERSTANDING TELEVISION

PART 18

By **W. G. MORLEY**

The eighteenth in a series of articles which, starting from first principles, describes the basic theory and practice of television

In last month's issue we completed our discussion of the i.f. section of the television receiver by dealing with the sound i.f. amplifiers employed in television systems having frequency modulated sound. Most of the last article was, in consequence, concerned with intercarrier sound circuits, as are fitted almost universally in currently manufactured receivers intended for such systems.

In this month's article we shall carry on to the audio amplifier stages of the receiver; after which we shall commence to examine the video amplifier.

The A.F. Stages

It is not intended to discuss the a.f. stages of the television receiver at very great length, as the circuits employed are very similar to, if not identical with, those used in conventional sound radio receivers. Where discrepancies occur they are usually of a minor order, and are frequently dictated by the commercial requirements of economic design. Savings are normally effected in the number of components used in the a.f. stages as well as in the space the a.f. amplifier takes up. To take an example, it is quite common practice to provide no tone control in a television receiver, thereby saving the cost and space incurred by the inclusion of this control together with its circuit. Since the varying background noise levels given by reception of a.m. signals on broadcast bands should be largely absent on television channels (where it may be argued that a signal which is sufficiently strong to enable an entertainment-value picture to be resolved should also provide a sound channel having a relatively noise-free background, and where heterodyne whistle interference from transmitters in adjacent channels cannot occur) the deletion of the tone control is a reasonably acceptable economy. In some receivers a simple pre-set control of the higher audio frequencies is provided by a socket-board at the rear of the chassis. This socket-board is designed to accept a short-circuiting plug in two or more alternative positions, as shown in Fig. 102. Such an arrangement enables varying values of capacity to be connected between, say, the grid of one of the valves in the a.f. amplifier and chassis, thereby enabling differing degrees of attenuation of the higher audio frequencies to be achieved.

Another economy in the a.f. section is given by the use of elliptical or rectangular loudspeakers. Loudspeakers of this type can provide considerable savings of space inside the cabinet. Elliptical or rectangular loudspeakers are particularly useful when it is desired to project the sound forwards from the front of the receiver cabinet. In such instances the loudspeaker may be positioned directly alongside the cathode ray tube—the most popular position being below it—and cause proportionately very little increase in cabinet front area in consequence. It should not be inferred, incidentally, that an elliptical or rectangular speaker provides a quality of reproduction which is inferior to that given by a round speaker of similar cost.

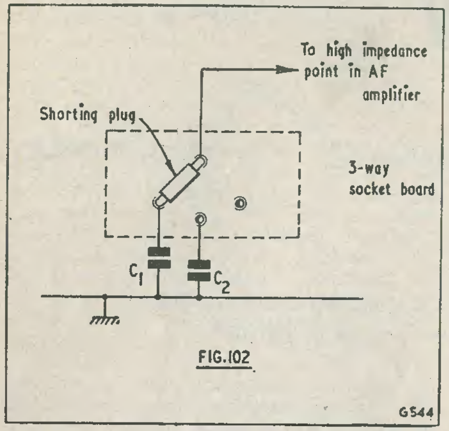


Fig. 102. A simple and economic pre-set tone control, as fitted to the a.f. amplifier circuits of some television receivers

As is to be expected, the more expensive television receivers tend to offer more comprehensive sound circuits than are provided in the cheaper models. In some countries, and particularly on the Continent, there is, however, a current tendency to provide rather ambitious sound circuits in even the cheaper receivers. This trend is probably the result of increasing experience of "hi-fi" sound reproduction on the part of the public (together with, perhaps, a certain gimmick-conscious sales approach).

In conventional television receivers the a.f. amplifier may employ one or two valves. Single valve amplifiers were common in earlier receivers, wherein detection was carried out at a relatively high level. The single a.f. valve in such receivers was, almost inevitably, an output pentode. Current receivers usually employ two valve a.f. amplifiers, these consisting of a triode followed by a pentode output valve. It is possible nowadays to manufacture two-stage a.f. amplifiers which take up very little volume due to the availability of such valves as the PCL82 and PCL83. These valves comprise a triode and an output pentode in one envelope and allow the two-stage a.f. amplifier, and its components, to occupy only slightly more space than would be required by a single output pentode.

A minor point of difference between the a.f. amplifiers employed in television receivers and those employed in sound receivers is that it is occasional practice for the output valve in the former to receive an h.t. supply which is decoupled from the main h.t. line. The decoupling condenser employed may have a value around 16 to 50μF, and the decoupling resistor a value of some 500 to 2,000 ohms. The main purpose of such decoupling is to prevent audio frequencies from appearing on the h.t. line, where they might interfere with the functioning of other parts of the receiver. Audio amplifier h.t. decoupling circuits are uncommon in modern receivers, since the latter employ h.t. smoothing condensers having large values, of the order of 100μF. Condensers having capacities as high as this are capable of adequately bypassing any audio frequency voltages which may be impressed on the h.t. line.

Sound Interference Limiter

There is, finally, a further discrepancy between television a.f. amplifiers and those employed in sound receivers, this being provided by the interference limiting circuits fitted to most television receivers which work on a.m. sound. The interference which is most liable to occur in television receivers having a.m. sound circuits is impulsive in character, and is given by car ignition systems and the like. This interference becomes particularly troublesome in television receivers due to the fact that it is especially prevalent at the frequencies employed for television reception.

The noise limiter circuit most commonly encountered is of the series diode type and it appears in the receiver circuit immediately after the sound detector. A typical example, with representative component values, is shown in Fig. 103. The noise limiter diode in this diagram is caused to pass current by reason of the two resistors, R_2 and R_3, connecting between chassis and the h.t. positive line, with the result that it allows the a.f. signal developed across the sound diode load, R_1, to be passed on to the subsequent a.f. amplifier. If an interference pulse is received this is rectified by the sound detector and is passed to the anode of the noise limiter diode in the form of a large amplitude negative-going pulse. This pulse then causes the diode anode to go negative. The cathode of the noise limiter diode also tends to go negative. However, it cannot do so as quickly as the anode due to the presence in the circuit of C_2, in parallel with R_3. C_2 and R_3 have values such that C_2 discharges into R_3 by only a small amount during the length of the interference pulse. As a result the diode is cut off during the length of the interfering pulse, and the consequent effect is that the audible effects of the pulse are very considerably reduced.

The Video Amplifier

The video amplifier employed in modern television receivers consists, in almost every instance, of a single valve stage following the video detector. It is the function of the video amplifier to amplify the video signal offered by the vision detector and to apply it to the modulating electrode of the cathode ray tube. In order that the video amplifier shall carry out its function with greatest efficiency, a number of points have to be taken into consideration.

The first of these concerns the polarity of the video signal passed to the amplifier. We shall consider, primarily, the case where positive modulation, as occurs in the British 405 line system, is employed. According to which way round the vision detector is connected, the signal available across its load resistor may appear either as that shown in Fig. 104 (*a*) or that shown in Fig. 105 (*a*). It will be noted that, in either case, synchronising pulse level corresponds to minimum voltage across the diode load,[1] the picture information then causing the voltage at the end of the load resistor remote from chassis to go either negative or positive according to the manner in which the vision detector is connected. It is desirable to connect the diode load resistor directly to the grid of the video amplifier valve, and this practice is normally followed in modern receivers.[2] Let us now proceed to examine how we may connect up the video amplifier valve so that it may deal with either of the two signals shown in Figs. 104 (*a*) and 105 (*a*).

For reasons of economic design there is no point in employing a video amplifier valve which is capable of handling signals excessively larger than would be available from the vision detector. In consequence, the anode current/grid voltage characteristic of a typical video amplifier valve would be equivalent to that shown in Fig. 104 (*b*), wherein we also see the signal of Fig. 104 (*a*).

We may see from Fig. 104 (*b*) that the total amplitude of the applied video signal is such that, at its furthermost negative point, an appreciable grid voltage is still in hand before cut-off occurs. Similarly, a comfortable margin is available between the furthermost positive part of the signal and zero grid voltage. In consequence, we may see that the valve is worked efficiently within its capabilities so far as grid voltage is concerned.

Fig. 105 (*b*) shows the state of affairs which exists when a detected signal of opposite polarity is applied to the video amplifier valve. Once more we have a comfortable margin of grid voltage in hand at the furthermost positive and negative parts of the signal.

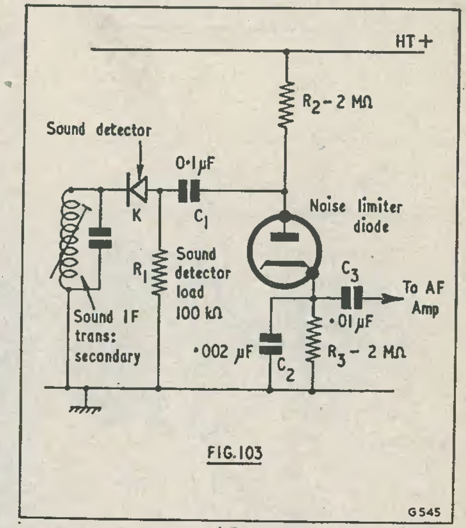


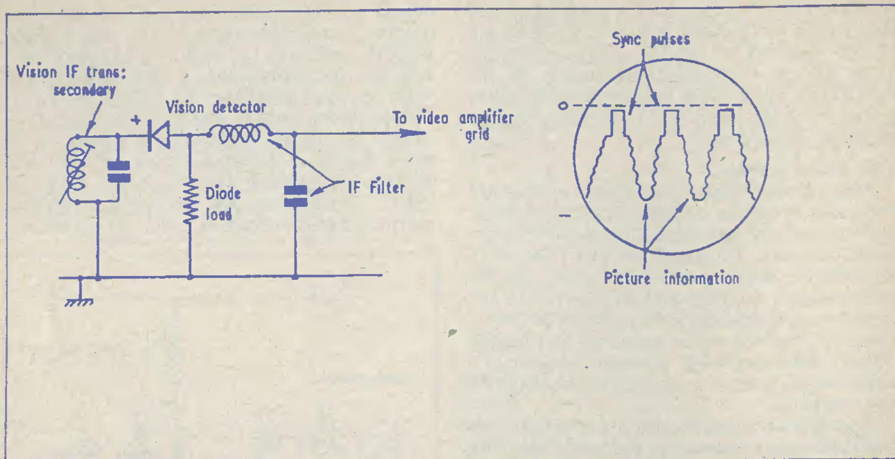
Fig. 103. A series diode sound interference limiter. The component values shown are representative of those found in practical receivers. (The "cathode" of the germanium diode is indicated by the letter "K").

If the video amplifier valve is to handle either of the two signals we are considering it must be provided with an appropriate bias voltage. In the case of Fig. 104 (*b*) the valve must be biased at point X in the diagram, since this corresponds to zero signal in the waveform. In practice the bias will be obtained by applying a positive voltage to the cathode of the valve, as shown in Fig. 104 (*c*). The voltage of the cathode bias should then be equal to the voltage between point X and zero grid volts in Fig. 104 (*b*); that is, x volts. The arrangement will now work in the following manner. During the period when the sync pulse is applied to the grid of the valve, this electrode will be negative of its cathode by x volts.[3] When

[1] Actually, this voltage is of the order of 3% of white level—See Fig. 15, "Understanding Television," part 3, March 1958 issue.

[2] The reason for the desirability of this direct connection will be dealt with when we come to consider d.c. and a.c. coupling circuits. (Connection to the video amplifier grid via a filter choke or chokes is equivalent to a direct connection.)

[3] Plus the very small signal at synchronising level referred to in footnote 1.



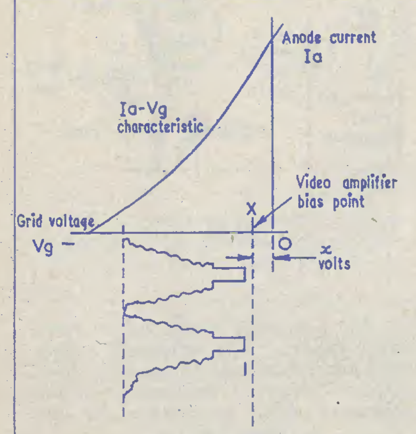
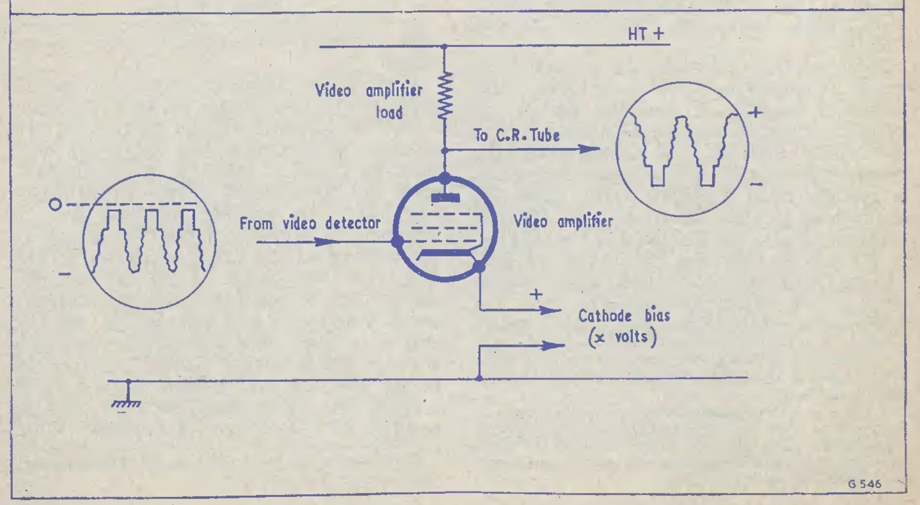
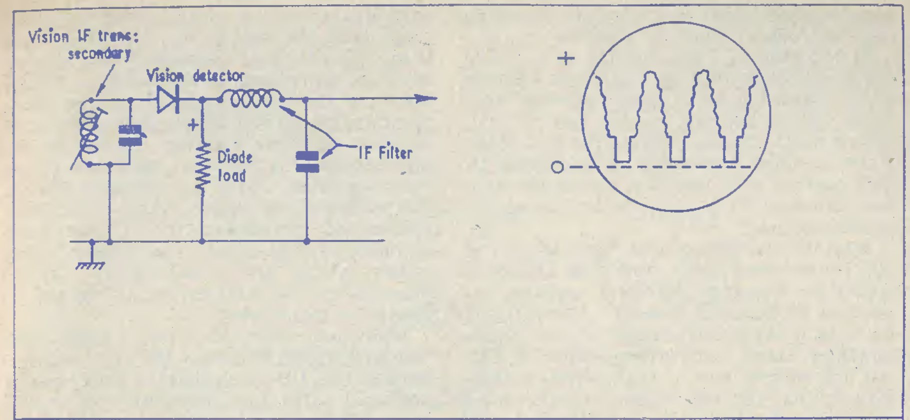


Fig. 104 (*a*) *If the vision detector in a positive modulation system is connected as shown here, the detected signal takes up the polarity illustrated. The choke and condenser which constitute the "i.f. filter" function merely as a low-pass filter, and are intended to remove any i.f. voltages which might otherwise be passed to the video amplifier grid.* (*b*) *Illustrating diagrammatically how the detected waveform of* (*a*) *may be applied to the anode current/grid voltage characteristic of the video amplifier valve.* (*c*) *How the video amplifier valve handles the detected waveform of* (*a*). *It should be noted that the input waveform is reversed in polarity at the anode*





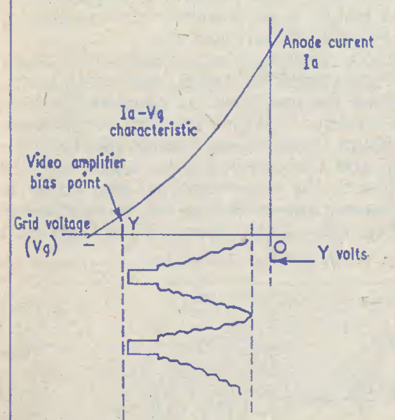
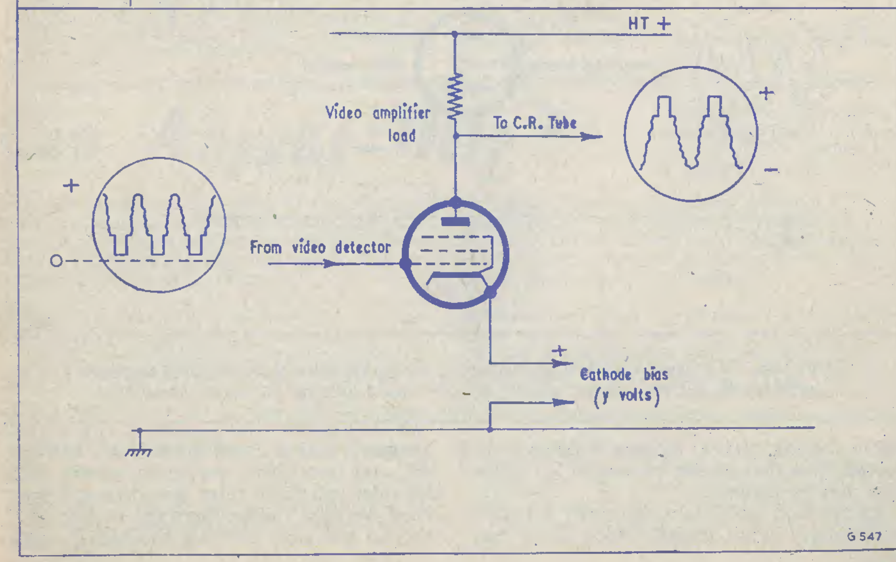


Fig. 105 (*a*) *If the diode of Fig.* 104 (*a*) *is reversed, the polarity of the detected signal reverses also.* (*b*) *The waveform of* (*a*) *applied to the anode current/grid voltage characteristic of the video amplifier valve.* (*c*) *This diagram, which should be compared with Fig.* 104 (*c*) *shows the signal of* (*a*) *applied to the video amplifier*



picture information is applied to the grid, this electrode will then go negative.

In the case of Figs. 105 (*b*) and (*c*) the required bias point is at Y, and the cathode of the valve has to be biased positive by y volts. What happens in this case is that, during synchronising periods, the grid of the video amplifier is negative of its cathode by very nearly y volts, and that picture information causes it to go positive by the appropriate amount.

Both the arrangements of Figs. 104 (*c*) and 105 (*c*) are practicable, and both are to be found in television receivers working on positive modulation systems. Disregarding any circuit requirements external to the video amplifier stage, the arrangement of Fig. 104 (*c*) suffers from a slight disadvantage. This is that the bias applied to the video amplifier valve has only a small value, with the result that, in the absence of a video signal, the valve tends to pass a proportionately high anode current. The arrangement of Fig. 105 (*c*), on the other hand, has the advantage that, in the absence of signal, the high bias voltage it employs causes the valve to pass only a low anode current. Absence of signal is liable to occur over quite an appreciable time during normal usage of a television receiver, and it may be argued that the life of a video amplifier valve connected up in the Fig. 105 (*c*) manner is liable to be longer than that of one connected up in the Fig. 104 (*c*) manner.

In practice, whilst it is obviously desirable to employ circuit design which gives best working conditions in the video amplifier stage itself, the manner in which this works is more liable to be dictated by the requirements of other parts of the receiver. In this instance the requirements of the sync separator circuit very largely govern the mode of video amplifier working. Normally, the sync separator is fed from the anode of the video amplifier, and it is possible to provide this section of the receiver with a particularly simple and inexpensive circuit if the video amplifier anode signal has synchronising pulses which are positive-going. It so happens that the arrangement of Fig. 105 (*c*) meets this requirement.

Following from the two points just reviewed, it may be seen that the arrangement of Fig. 105 (*c*) provides us with possibly increased video amplifier valve life, as well as satisfying sync separator requirements. As a result, most modern receivers employ the Fig. 105 (*c*) arrangement.

Before concluding on this particular aspect of video amplifier design we should also consider the case given in negative modulation systems. With negative modulation, minimum video signal corresponds to white level, and the detected video signal may be applied to the video amplifier grid either in the manner shown in Fig. 106, or that shown in Fig. 107. Once again we have our bias voltages x and y, as we did in Figs. 104 and 105, and once again we could assume that the video amplifier valve would have longer life if we used the arrangement of Fig. 107, wherein the valve receives the higher value

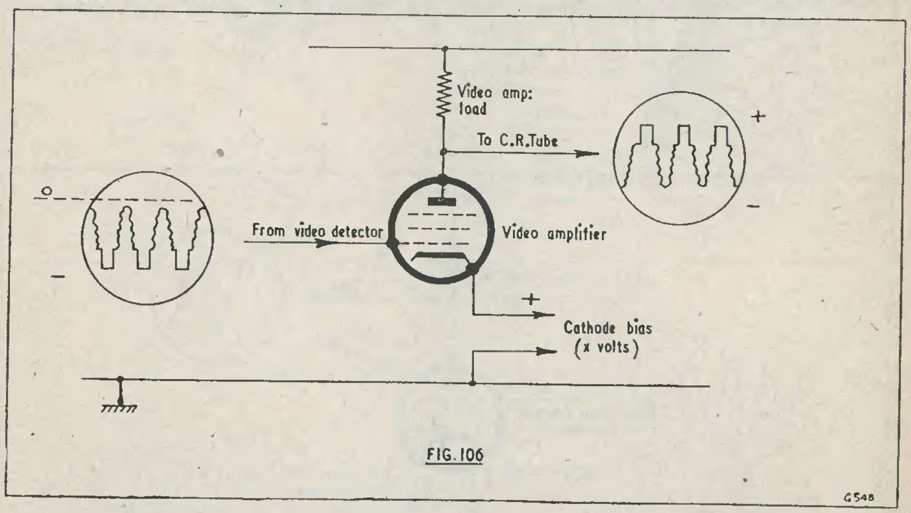


Fig. 106. In a negative modulation system, the signal passed to the video amplifier grid by the detector circuit of Fig. 104 (a) would take up the form shown here

of bias. Unfortunately, however, the nature of the signal causes the sync pulses given in the anode circuit of Fig. 107 to be negative-going, and this does not satisfy the needs of an inexpensive sync separator.

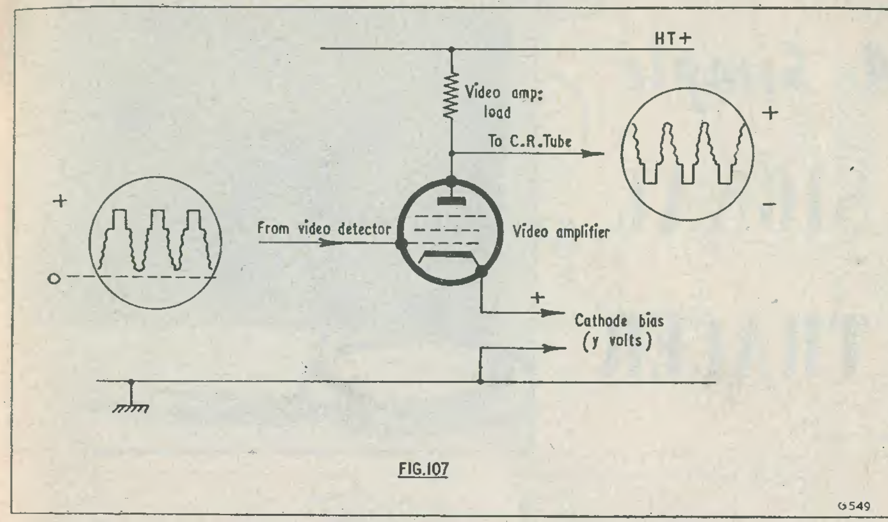


Fig. 107. The reverse instance to Fig. 106. In this diagram the video signal is obtained from a diode connected as shown in Fig. 105 (a)

There is, also, a further complicating issue, this being caused by the fact that, with negative modulation, it is possible to employ the sync pulses of the detected signal to provide a negative a.g.c. voltage for the vision i.f. amplifier.[4]

In Fig. 106 the sync pulses immediately after detection are negative-going, and become at once available for such an application. This point, combined with the fact that the sync pulses in the anode of Fig. 106 are positive-going, makes this arrangement that which is most frequently employed in receivers working in negative modulation systems; the incidental advantage of possibly increased valve life given by the Fig. 107 arrangement being outweighed.

[4] Vision a.g.c. systems will be dealt with in a future article in this series.

Next Month

In next month's article we shall continue to discuss the video amplifier.

Can Anyone Help?

Requests for information are inserted in this section free of charge, subject to space being available

DST.100 Mk. II.—J. L. Burd, 47 Corporation Avenue, Llanelly, S. Wales, is considering purchasing one of these receivers, and would like to hear from anyone running one, and to borrow a manual. All expenses refunded.

* * *

AR88D Receiver.—Any information on the AR88D receiver and CNY1 transmitter would be gratefully received by D. Byrne, G3KPO, Jersey House, Eye, Peterborough, Northants.

* * *

BX.454 and R.109.—C. P. Guy, 85 Dunstable Street, Ampthill, Beds., wishes to beg or borrow the circuit or any relevant data. Expenses gladly repaid.

* * *

No. 38 Mk. II Transreceiver.—M. Ritchie, 70 Ashley Road, Aberdeen, Angus, would like to obtain a service sheet.

The Radio Constructor, Show Number, 1953 Vol. 7, No. 2.—G. Watson, 20 Duchess Street Salford 7, Lancs., is anxious to obtain this copy which is out of print. Article concerned is a Simple 'Scope, by L. N. Sinfield.

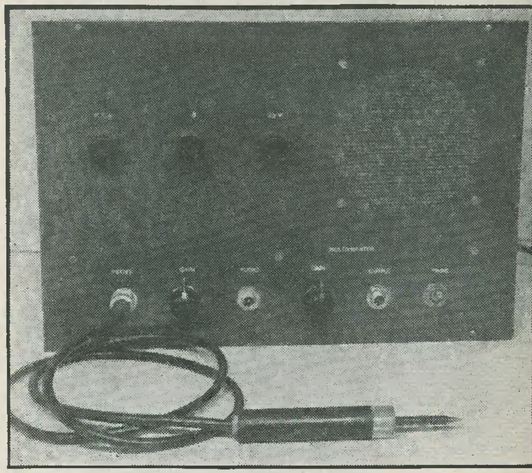
* * *

Indicator Unit Type 96 (voltages and connections) and Transformers types 352–71942 and 352–72452 (connections, voltages and amperages).—This information is needed by D Featherston, Alma House, Collingham, near Wetherby, Yorks.

* * *

R.1132A Receiver.—G. A. O'Dowling, 28 Kylemore Lane, Greenock, Renfrewshire, wishes to learn the value of each section of the tuning condenser, the i.f., and circuit modification for f.m. reception 80–110 Mc/s. Circuit diagram available. All letters answered.

A Simple SIGNAL TRACER



By J. W. BAGNALL

The instrument described in this article provides, in the writer's opinion, the most rapid and easy method of locating snags in even the most complex receivers. Employing a simple circuit, it is useful for trouble shooting in both radio receivers and P.A. amplifiers. It has no critical adjustments to get out of order and is easy to use, having only two variable controls.

A rather novel idea is that a multivibrator signal source is incorporated in the instrument. This may be fed either into the r.f. or the a.f. stages of the receiver under test. This obviates the use of a signal generator in areas of poor signal strengths, and also the device is self-contained for use outside the workshop.

Operation

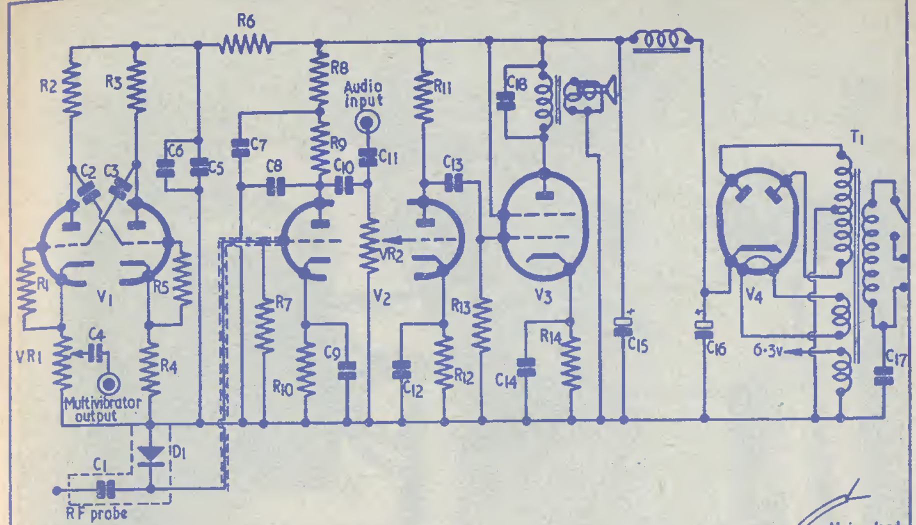
While most readers will be familiar with the use of a signal tracer, a brief description of its uses may not be out of place for the benefit of the uninitiated. Broadly speaking, signal tracing consists of following a signal through the receiver from the aerial input to loudspeaker, tapping off the signal from each stage in succession until the faulty stage is reached.

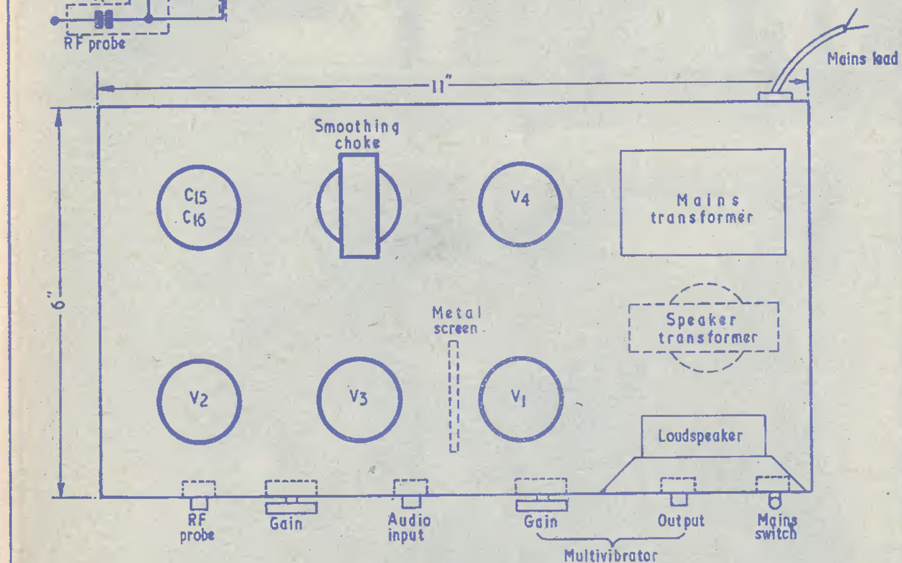
A signal is fed into the aerial terminal of the receiver; this can be obtained either from the multivibrator or the set can be tuned to a strong local station. The r.f. probe is then placed on the grid of the first stage, whether it be r.f. amplifier, mixer or detector. If the signal is heard loud and clear in the loudspeaker of the signal tracer, then the probe is placed on the anode.

This check carried out through the r.f. and i.f. stages may locate the faulty section. If, however, the trouble is in the a.f. stages, the i.f. probe is discarded and use is made of the a.f. lead. This consists of a length of shielded cable terminated in a crocodile clip for the earth connection and an insulated test prod. The gain control of the signal tracer will need reducing as the output stage is approached to prevent too loud a signal from the tracer loudspeaker.

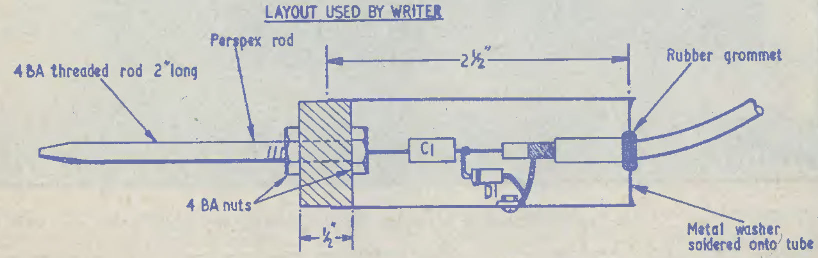
Circuit Description

When designing this instrument, it was decided to keep the circuit as simple as possible consistent with good results. Examination of the circuit diagram will show that this has been achieved in that only two valves are used in the signal tracer section,



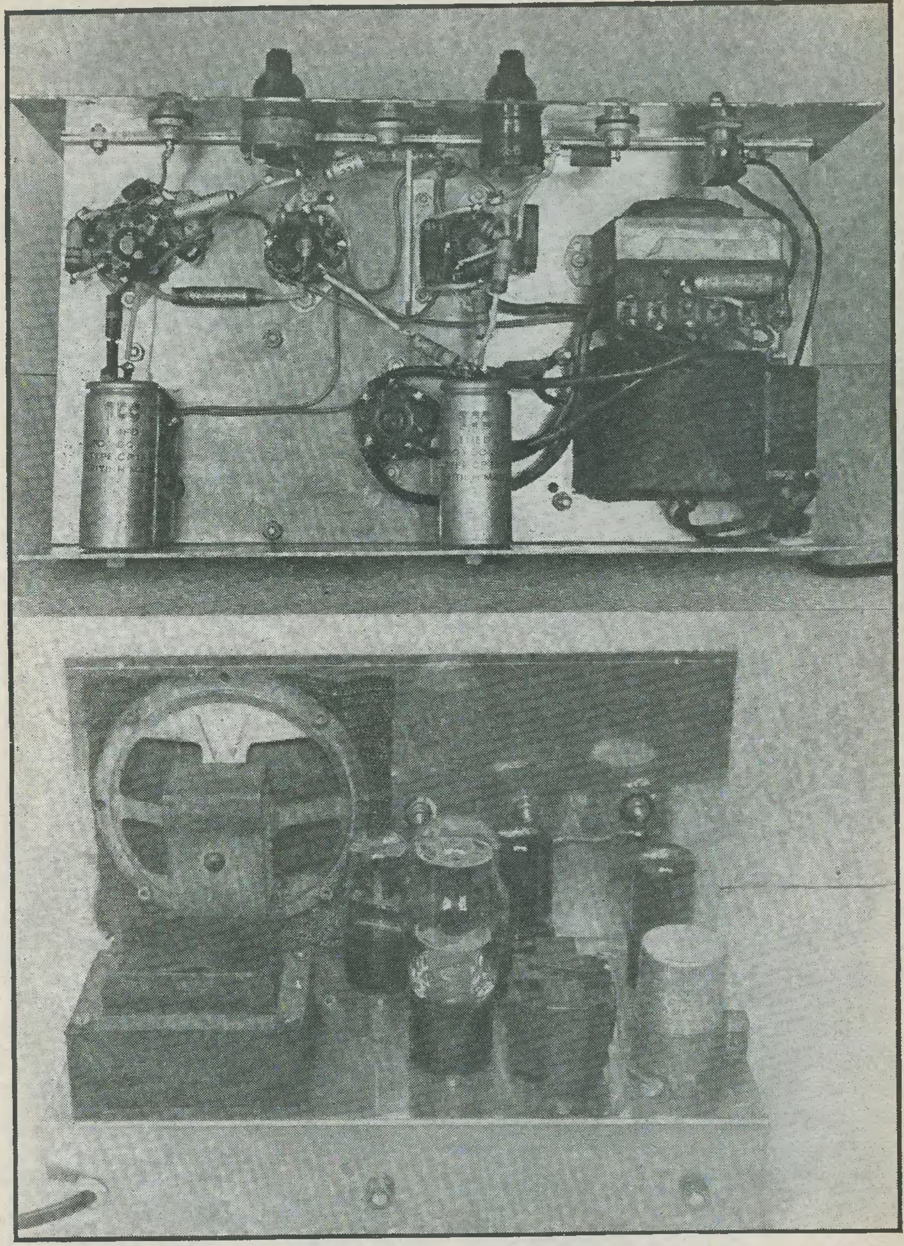


LAYOUT USED BY WRITER



R.F. PROBE ASSEMBLY

E664



Top and bottom views of the simple signal tracer

and yet these provide ample gain. In fact, with the addition of a tuning condenser and suitable coil, the unit is quite capable of being used as an emergency receiver.

The valves V_2 and V_3 form a simple cascade a.f. amplifier, the a.f. test signal

Components List

Resistors

R_1	1MΩ ¼W
R_2	47kΩ ½W
R_3	47kΩ ½W
R_4	1kΩ ½W
R_5	1MΩ ¼W
R_6	47kΩ ½W
R_7	100kΩ ¼W
R_8	47kΩ ¼W
R_9	22kΩ ¼W
R_{10}	3.3kΩ ¼W
R_{11}	100kΩ ½W
R_{12}	1kΩ ¼W
R_{13}	470kΩ ¼W
R_{14}	330Ω ½W
VR_1	1kΩ ½W potentiometer
VR_2	250kΩ volume control

Valves

V_1	6SN7
V_2	6SN7
V_3	6V6GT
V_4	5V4G
D_1	OA81 or similar

Capacitors

C_1	50pF mica
C_2	200pF mica
C_3	200pF mica
C_4	0.01μF 350V wkg
C_5	1μF 350V wkg
C_6	1,000pF mica
C_7	1μF 350V wkg
C_8	200pF mica
C_9	0.1μF 150V wkg
C_{10}	0.01μF 350V wkg
C_{11}	0.01μF 350V wkg
C_{12}	0.1μF 150V wkg
C_{13}	0.01μF 350V wkg
C_{14}	25μF 12V wkg
C_{15}	16μF 500V wkg
C_{16}	16μF 500V wkg
C_{17}	0.005μF mica
C_{18}	0.02μF 350V wkg

Transformer

T_1	250–0–250V at 60mA
	5V at 2A
	6.3V at 3A

being fed into the second half of V_2 to prevent overloading of the output stage. The gain control is common to both a.f. and r.f. signal inputs. The square wave generator V_1 produces a waveform with an a.f. fundamental while the harmonics extend well into the r.f. range. This enables the same signal to be used for audio work and also as an r.f. signal. The output is taken from a potentiometer placed in the cathode to ensure a reasonably low impedance source when coupling into the aerial coil.

The probe unit is simple in the extreme, consisting of a d.c. blocking condenser, crystal rectifier and the rectifier load, which is the grid leak of V_2. The rectifier charging condenser is formed by the capacity of the shielded cable connecting the probe to the signal tracer.

The power supply shown is quite ordinary except that three terminals are provided on the front panel to enable other equipment to be supplied.

Construction

The construction of the instrument should not present any problems, providing the original layout is followed in the positioning of the principle components. The main problem is to prevent pick-up of the multivibrator by the valve V_2. This is achieved by placing the two valves some distance apart. In addition, a small metal screen, some 2in high and 2in wide was placed below the chassis, and it will be found with these precautions that no trouble will be experienced in this direction.

The probe was made from a length of ½in thin wall brass tubing, a length of 4BA threaded rod and a small piece of Perspex rod. A study of the diagram will soon enable the reader to grasp its construction. The constructor of this item of test equipment will find that it more than pays for itself in time saved on many servicing jobs.

Brentford Evening Institute Radio Classes

Normally the enrolment for these classes is approximately two hundred students, many of whom prepare for the City and Guilds examination for Radio Amateurs or Radio 1.

The programme of work is as follows: Radio Amateurs' Class, 7 p.m.–9 p.m. Wednesday; Morse, 7 p.m.–9 p.m. Tuesday; Radio Servicing, 7 p.m.–9 p.m. Tuesdays and Thursdays. Enrolment, 14th–17th September, 1959. Classes begin 21st September, 1959, at 7 p.m. at Brentford Evening Institute, Clifden Road, Brentford.

Fade Erase, Spot Erase and Superimposing of Tape Recordings

Description and circuit details for simple modifications to suit most recorders

By Charles H. Gittus

A GOOD RECORDING CONTAINS NO SOUNDS other than the programme material, and with the excellent tapes available today recordings should have a really low noise level. However, when a recording has been made it is often desirable to erase an unwanted part at the end of a particular item—for instance, the applause after a musical item or an unwanted "pop" song from a series of songs. This is usually effected by switching to "record" with the gain control at zero, but this method, whilst effective, gives rise to rather unpleasant "clicks" or "plops" at the start and finish of the erasure.

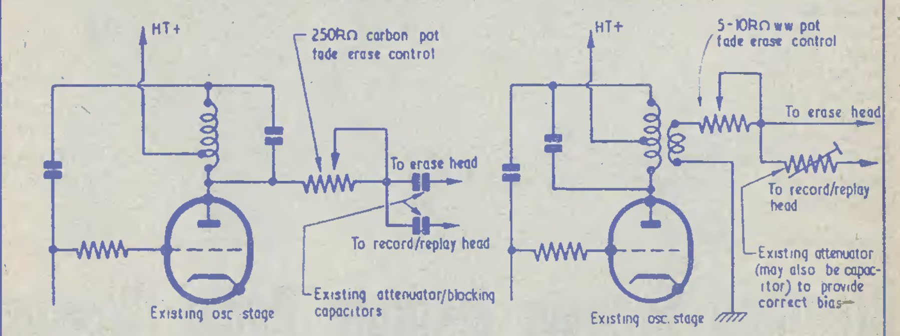


Fig. 1a
For TRUVOX & similar high-Z heads

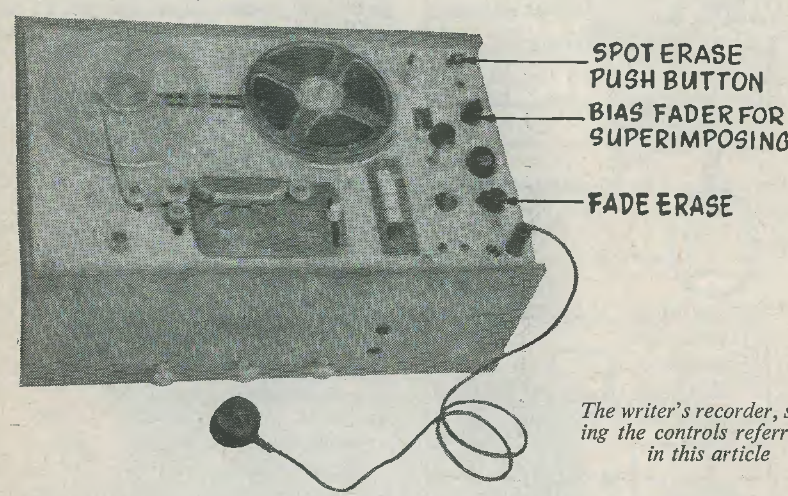
Fig. 1b
For low-Z heads

In this article details will be given whereby it is possible to "fade out" an existing recording and to come back smoothly when required to the remainder of the recorded programme. Details will also be given to permit "spot-erasing" and the superimposing of a new recording on an existing one. The circuit for superimposing will permit the smooth fade down of the original recording, superimposing, and a smooth fade back to full strength of the original recording. At any time during superimposing it is possible to smoothly erase the "background" as may be required. This is quite useful for "coupling" two items since the superimposed item, such as an announcement or comment, covers the smooth merging of the two items.

All the modifications can be easily carried out with practically any recorder at very low cost, and due to the increased versatility of the recorder the tape recordings will have a more professional sound.

The author's recording equipment consists of a Truvox Mk. III Tape deck, Mullard Type B amplifier and a simple push-pull (2 x EL41) power amplifier, but details for other recorders are given in the following notes. These units, together with a heavy duty power pack capable also of supplying a tuner unit or mixer, are housed in a simple box-like case—portability having been sacrificed in the interests of versatility—and whilst the recorder is transportable it is not portable in the sense that one would not wish, or indeed be able, to carry it far single-handed!

Whilst it is not essential to incorporate all the features listed it is recommended that this is done, since they are somewhat inter-dependent, but for those constructors who wish to build in one feature only, suitable notes will be given to enable this to be done.



The writer's recorder, showing the controls referred to in this article

Fade-Erase Control

This useful facility is obtained very easily at a cost of a few shillings. To effect a fade erase we require a means of varying the effect of the erase circuit from zero to maximum, smoothly. A simple way of doing this is to insert a variable resistor in the feed from the oscillator output to erase head. However, since the bias fed to the record head has some erasing effect on a recorded tape, it is desirable to include this in the fade-control circuit.

When using high impedance heads the resistor should be about 250kΩ carbon track (linear or log law) and it is connected between the oscillator output connection and the feed to the heads, as shown in Fig. 1*a*.

For those decks using low impedance heads a wire-wound variable resistor of 5kΩ should prove satisfactory and should be wired between the output connection of the oscillator transformer and the output to the heads as shown in Fig. 1*b*. It should be noted that any existing attenuators should not be removed or altered, otherwise the bias level will be changed with adverse effect on recordings. A wire-wound resistor is necessary with low impedance circuits due to the higher currents encountered. It may prove advantageous to arrange an "off" position at the end of the resistance track.

For the Collaro or Brenell deck it is recommended, since the record head is high impedance and the erase head low impedance, that the separate fade erase and superimposing controls be fitted, since this avoids the use of ganged components.

To check the effectiveness of the control, an unwanted recording should be run past the heads with the recorder switched to record and with the fade control fully in circuit. During this test the recording gain control must be at zero, and whilst the tape is passing the heads the fade erase control should be slowly operated so that the resistance is fully removed from the circuit—the movement should be smooth—and after a few seconds, smoothly returned to its original position, allowing the tape to run on for a few seconds.

Upon playback the original recording should be heard at normal level, fading away completely and then returning to full volume with no objectional clicks either before or after the fade.

If the signal is reduced in level with the resistance fully in circuit, then the resistance of the fade control is too low. On the other hand, too high a value of resistance will result in the fade taking place over a small range of movement, thus making a smooth fade rather difficult. In either of these cases the control should be replaced with an appropriately different value of resistance.

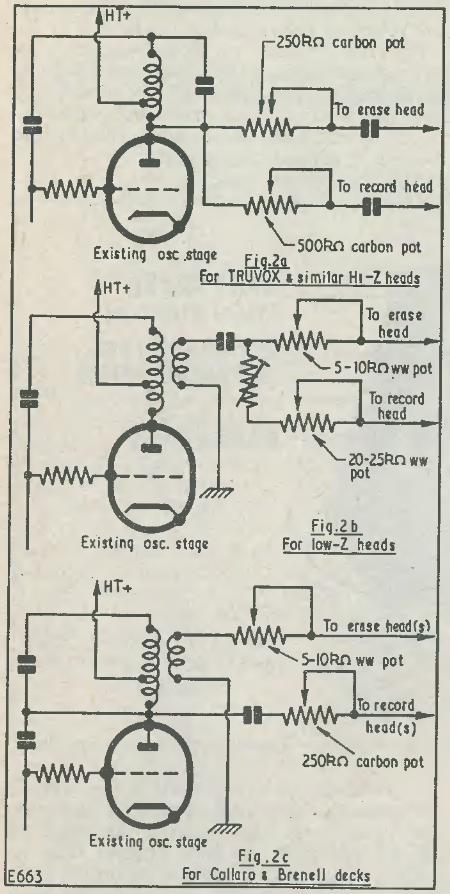


Fig.2a For TRUVOX & similar Hi-Z heads
Fig.2b For low-Z heads
Fig.2c For Collaro & Brenell decks

In a home-built recorder this control can be permanently mounted on the control panel, or perhaps the more simple way would be to insert a switched jack socket in the lead from the oscillator. The switch should short-circuit the jack when the plug is withdrawn, and for this arrangement the variable resistor would be mounted on a reasonably short—say 12in—piece of coaxial cable terminated in a suitable jack plug. This method is admirable for the commercially made recorders, since it only necessitates the fitting of one jack which takes up much less space than the variable control and knob. There is also another advantage when using this method, and this is that the fade erase control is in circuit only when it is actually required, and there is thus little danger of a programme being spoiled because the fader was in such a position that the erase head and bias were not fully effective at the time of recording.

With a panel mounted control this could be safeguarded by using a variable resistor with ganged on/off switch which would be utilised to switch on a warning light to indicate that the control is not set for a normal recording. Alternatively, the switch could be arranged to switch off the recording indicator lamp if one is fitted—a normal radio type volume control with on/off switch can usually be easily modified so that the switch will operate in reverse, i.e. to switch "off" when the control is turned clockwise and "on" when it is returned to the normal "off" position.

To effect a fade erase, the recorder is switched to "record," and with the gain control at zero and the erase control fully in circuit the tape transport is started. At the appropriate place—marked by a paper marker tab or similar "device"—turn the erase control smoothly to its minimum resistance position. Upon playback the erase will be smooth and will not be marred by a sudden change in level. With practice, and using markers, one can return the erase control to its maximum resistance position as required and can thus remove any unwanted parts of the recording smoothly and without clicks or plops.

Superimposing

Although several recorders are available with this feature, the circuit about to be described differs from the usual type in that the original recording is *faded* down prior to the superimposed item and can be smoothly brought up to normal level after the superimposing—again without any clicks or other extraneous noises.

Basically, in order to superimpose one recording on another, we simply have to render the erase head ineffective. On some recorders perhaps the erase head can be bypassed by the tape or a non-metallic insert can be used to prevent the tape contacting the head—but take care not to damage or strain the pressure pad when doing this. Another simple method is to switch the lead to the erase head, but if this is done the head must NEVER be switched off with the recorder switched to record. If this precaution is not observed the head may become magnetised due to the abrupt cessation of

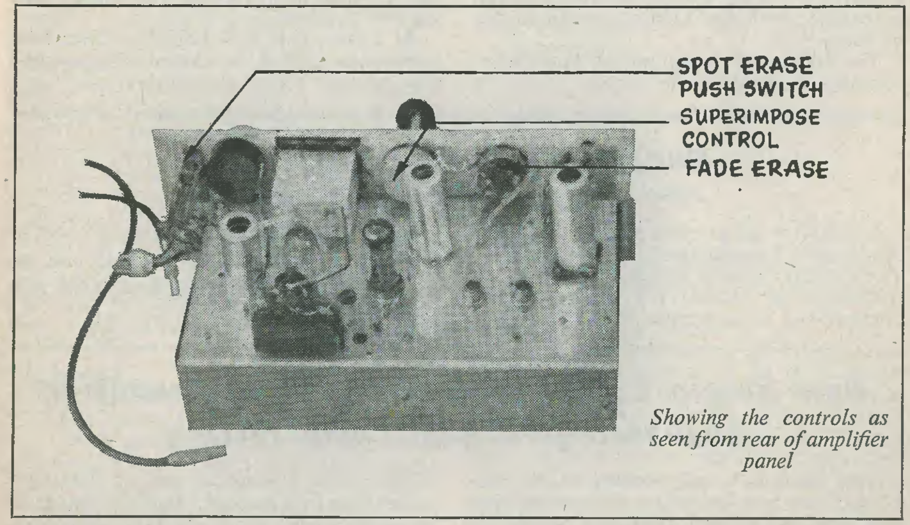
the oscillations, and in this state can cause damage to any recordings contacting it at any future time. However, the head will not become magnetised if it is made gradually ineffective—in fact it will be demagnetised by so doing, and since all heads tend to become magnetised with use, this will be a most useful aid in safeguarding valuable recordings.

The fade erase control already described is, with a slight modification, exactly what we require to effect a simple superimposing as it is a means of rendering the erase head ineffective in a gradual manner. The modification consists of restoring the record bias connection to the oscillator side of the fade erase control, thus ensuring that the erase current only is affected by this control. All we have to do then is switch to record, and with the fade erase control fully in circuit, i.e. erase head ineffective—we record in the normal way. However, since the erase circuit is not effective, the previous recording will not be erased—therefore the second recording will be superimposed on the first. This simple method, however, does result in an abrupt change in level at the beginning and end of the superimposing, and to avoid this we can modify any recorder at a cost of a few shillings, since all that is required is one variable resistor and knob and a few oddments of wire.

The variable resistor is wired between the record replay head and the source of bias—the connection to the head must, of course, be before the point at which the recording signal is fed into the circuit—and for high impedance heads it should have a resistance of 500kΩ. For low impedance heads a value of 20kΩ should prove suitable. The erase fade control should now be connected so that it is in the feed to the erase head only, as shown in Fig. 2*a* for high impedance and 2*b* for low impedance heads. With the Truvox deck a 500kΩ carbon pot has proved satisfactory, and a value of about 20kΩ for low impedance heads should be about right but can be checked as follows.

To check that the resistance of the control is sufficiently high the erase head must be rendered ineffective by turning the fade erase control fully in circuit. The bias control resistor (superimposing control) is now put fully in circuit and an unwanted recording is run through for, say, half a minute, with the controls at playback, then switching to record with the gain control at zero. Upon playback of this tape there should be no audible change in signal level, thus proving that insufficient bias is being fed to the head to cause any erasure. It should be noted that with this bias control at minimum resistance the bias level is exactly as it was prior to the fitting of this control. It is important that any pre-set bias control provided by the manufacturer of a commercial recorder must not be removed or altered.

The mounting of this extra control can be done in exactly the same way as the fade erase control, and a similar warning light



Showing the controls as seen from rear of amplifier panel

system could be used—the switch being in parallel with that on the fade erase control if a light is to be switched on, but in series if it is to be switched off in the case of an existing lamp being provided as record indicator.

To effect a "clickless" superimposing, set the fade erase and bias resistors fully in circuit, and with the gain control at zero, switch to record with a recorded tape on the machine. Start the tape transport and slowly rotate the bias fader until its resistance is fully shorted out—now advance the gain control to give the usual signal level using any desired source of signal—at the end of the superimposing, reduce the gain to zero and then smoothly turn back the bias fader so that its resistance is fully in circuit.

Upon playback the result will be the original programme at normal level, fading down below the level of the superimposed item and at the end of this returning smoothly to its original level.

The only fault with this method is that there is some loss of top response on the original recording where superimposing occurs, due to the erasing effect of the normal bias applied to the record head but, since the signal level is reduced, this lack of top is not too noticeable.

After fitting the above controls it quickly becomes apparent that for accurate location of fades it is necessary to monitor the tape as it passes the erase head. This can be arranged quite easily by fitting an auxiliary switch to energise the oscillator circuit. This is usually rendered inoperative on playback by switching off the h.t. to the oscillator valve, and in order to energise it when switched to playback we simply add a switch in parallel with the existing switch in the h.t. line.

The writer uses a small push-button switch currently available in the surplus stores for a few coppers. A small cover over this switch button is essential to ensure that it cannot be operated unintentionally and possibly ruin a valuable recording.

Using the switch it is now quite simple to "spot erase" a word or phase with fair accuracy and to fade erase with precision.

The procedure for spot erasure is to switch to playback and set the erase fader in the normal position, and as soon as one hears the part of the tape immediately preceding the unwanted word or phrase press the button for the requisite time—it should be noted that this permits precise commencement of the erase but the duration must be timed, since as soon as the erase head operates no signal remains on the tape to be reproduced by the replay head and amplifier.

To execute an accurate fade at the end of a piece of music or song, etc., set the recorder to playback and with the erase fade control fully in circuit listen to the programme until the point at which the fade should commence. Press the button while the erase fader is smoothly rotated and the effect will be heard instantly.

In conclusion it may be added that with practice these simple controls will prove most useful for various trick effects and for compiling feature tapes and the like. It also becomes quite simple to blend a musical item on to the end of a previous recording—in fact it makes mixing possible to some extent without a mixer!

At a later date it is hoped to describe a monitoring circuit to extend the versatile tape recorder's uses still further.

Northwood Evening Institute

Potter Street School, Northwood Hills, Middlesex

In addition to the courses for the Radio Amateurs' Examination, General Radio Theory, and Practical Radio, a new course of instruction in Morse is to be conducted, commencing in September 1959.

Enquiries and enrolments may be made at the Institute between 6.30 and 8.30 p.m. on Monday, Tuesday or Wednesday, 14th–16th September.

New Bulgin L.E.S. (BS.98/E.5) Panel-mounting Low-voltage Signal Lamp Fitting

This new item, all-moulded in thermoplastic, has push-on grip-washer fixing (put burr-side away from back of panel), for panels 18 s.w.g. to 3/16in thick, and is easily applied with a tubular push-tool. It has a Water-clear, Red, Amber, Green or Blue moulded transparent *snap-in* lens-cap, and takes L.E.S.-cap bulbs (available 2.5V–24/28V, watts 1.2 max. (for 16° C. ambient). The body and lens will work at up to 60° C—framework heating as well as lamp-heat to be taken into account. Bulbs are made by Hivac/Philips/Vitality, and in various voltages/currents, stocked according to demand/availability.

The new fitting has 3in wire leads for connection—these may be shortened, but do not solder connections (10 sec. max. dwell) closer than ¾in from fitting.

The LUDFORD

A SINGLE-VALVE LOCAL-STATION RADIOGRAM

Part 2

By J. WOOLLEN, B.Sc.

This series of articles describes the construction of a simple radiogram which is capable of good quality reproduction from local stations and from records. The circuitry is simple, and the cabinet work is lucidly explained so that no difficulty should be experienced even by a beginner

THE CABINET

Dimensions

In order to accommodate the Collaro Motor AC3/554 and the Elac Model 59T the overall dimensions are as follows:

Length 15¼in.
Width 13½in.
Height of Case 6½in } each including top or
Height of Lid 2¾in } bottom ¼in thick.

To allow ⅛in all the way round for cleaning up, the top of the lid and the bottom of the case are thus made 15½in x 13¾in. In the same way ¼in is added to the finished length, front and back of cabinet.

Cutting List

2 pieces each 15½in x 6¼in x ½in.
2 pieces each 15½in x 2½in x ½in.
(These are front and back of case and lid).
2 pieces 12½in x 6¼in x ½in (sides of case).
2 pieces 12½in x 2½in x ½in (sides of lid).
1 plywood top 15½in x 13¾in x ¼in.
1 plywood bottom 15½in x 13¾in x ¼in.

Tools Required

Tenon saw.
Coping saw.
Adjustable plane.
Hammer.
1in panel pins.
½in panel pins.
Punch (for panel pins).
Try-square.
Marking gauge.
File,
Drill.

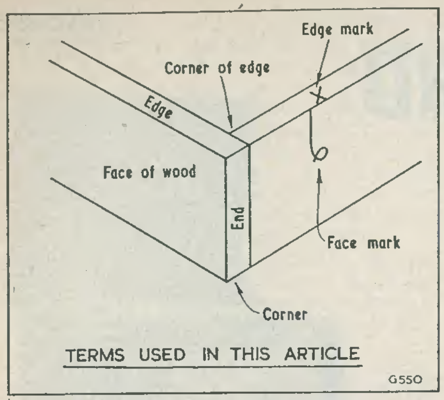
Materials

Veneer.
Alabastine filler.
2 half-crown tins Croid Aero Glue.
Long piece of wood for diagonal test.

Preparation of the Timber

The size of the cabinet is governed by the minimum size required for the gramophone motor board and the height of the elliptical speaker used. This calls for timber of length 15½in and of width 6¼in. The writer did not find it easy to obtain timber to finish 6¼in wide and, if necessary, ½-in plywood will be satisfactory.

Before embarking on marking out, should solid timber be used, it is important to prepare it to be of uniform thickness, free from "wind" (twist) and of the correct widths required. The writer had this done at a joiner's shop and the small cost was well worth the saving of time taken when doing the work by hand.



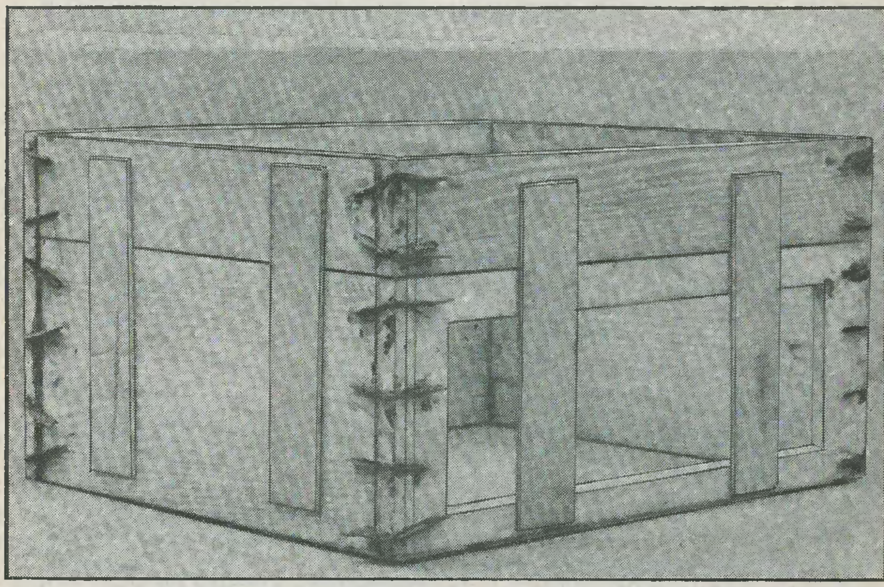
The timber should be made square, that is, the edge made to be at right-angles to the face. The pieces should be selected and marked so that the better face of each will be on the outside of the finished job.

Unfortunately, the butt joint, when used in this manner, is also the weakest of joints—and so it must be strengthened in other ways. When the bottom is glued and nailed to the cabinet its strength is considerably increased; but this is not sufficient, particularly at the top of the cabinet (not the lid) where the weight of the motor board might force the joints apart.

Accordingly tongues of veneer were used, in a manner described later, and as a result the cabinet is very strong indeed. In all cases where nails (more precisely, panel pins) are used, it is essential to punch the heads of the nails well home and finish with a filler. If this is not done, rust forming on the nail heads will cause unsightly stains on the covering material at a later stage.

Method of Construction

The cabinet calls for a case and a lid which will fit perfectly when hinged together. This is by no means a simple task, and some



The cabinet immediately after gluing. The veneer tongues, together with the glue squeezed out, are clearly seen

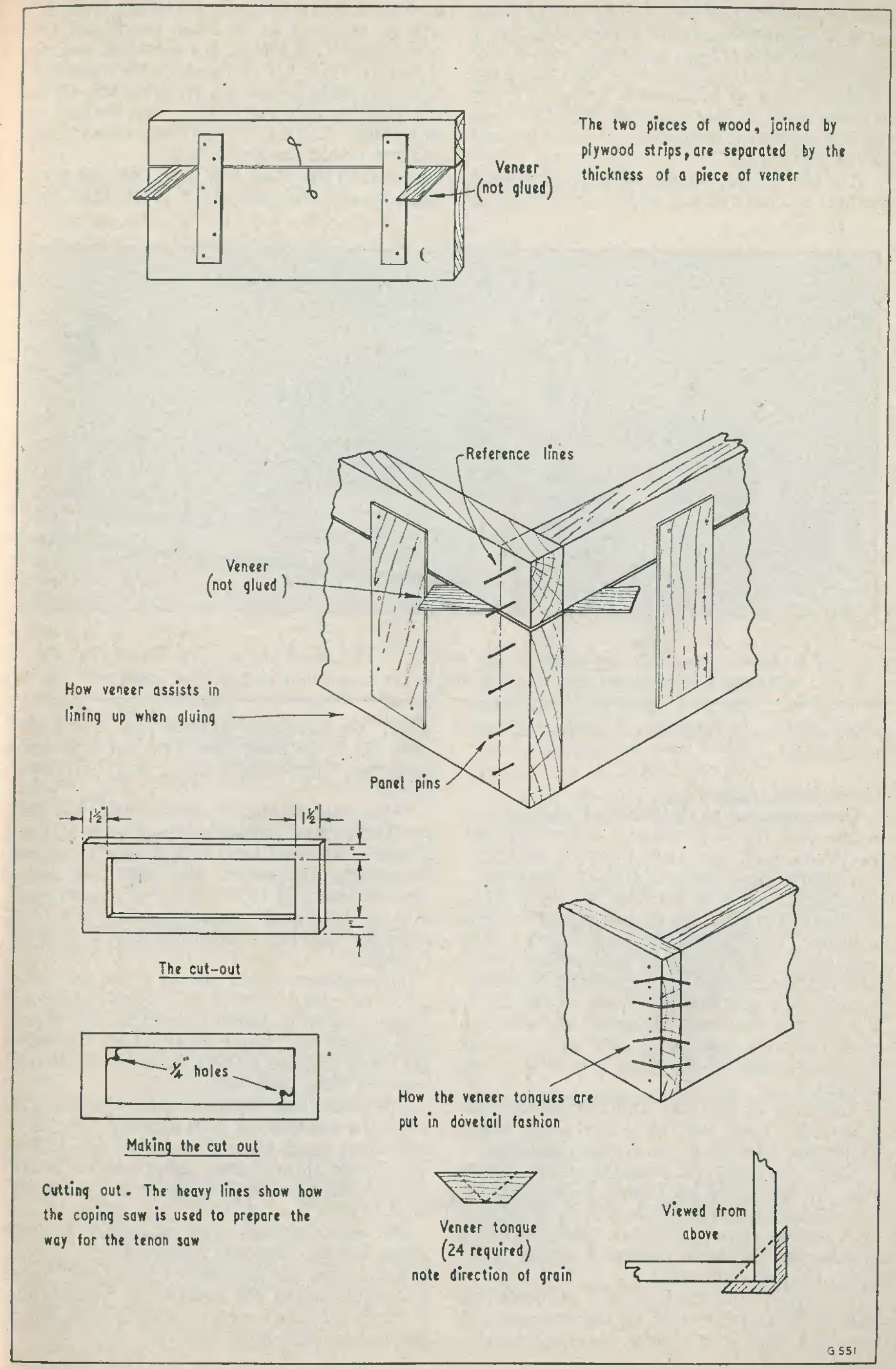
Form of Construction

In order that the construction of the cabinet could be undertaken by an inexperienced worker, the general form of the cabinet was made as simple as possible and in addition the simplest form of joint, the butt joint, glued and nailed, was employed.

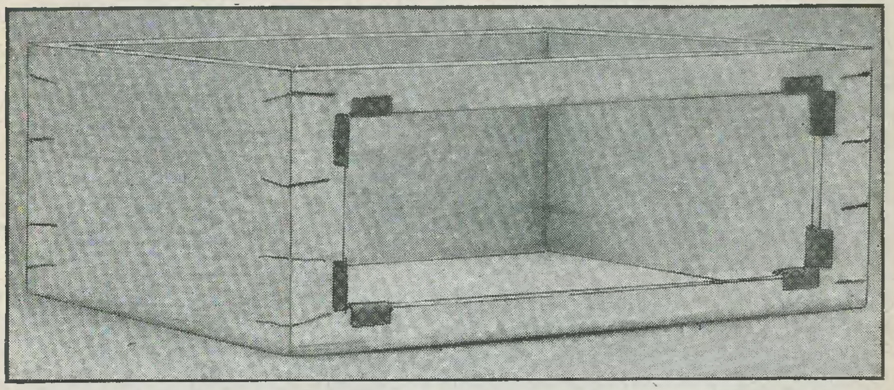
consideration of the possible methods is necessary.

1. To make the case and lid separately, working very accurately. This can be very difficult, particularly when it comes to fitting them together.

2. To make the case and lid as one and



then to saw apart. This appears to be a more attractive proposition, but it does in fact call for considerable skill in sawing in such a way that a good deal of planing is not necessary to cause them to fit together again. This is not the method for a novice, although it is not denied that it is possible to make a good job in this way.



The case cleaned up and ready to be covered. The small pieces of cloth at the corners of the cut-out will be explained in the concluding article next month

The writer accordingly evolved a special method of construction which he believes to be original and which gave a perfect fit with no trouble at all.

The Method Adopted

The advantage of this method adopted lies in the fact that all surfaces, where the lid meets the case, are planed before assembly and require no attention later. It is stressed, however, that it is because of the simple method of construction that extreme care and accuracy in measuring and sawing are necessary. The fact that the cabinet is to be covered with Rexine (or similar material) is no excuse for slovenly work as the cloth will assume the exact shape of the wooden construction just as surely as water takes up the exact shape of the glass into which it is poured.

The sides of the case and the lid are first prepared. They are all exactly the same length and all ends are thoroughly squared.

They are paired, i.e. one side case with one side lid, and they are marked accordingly. Each pair is nailed together with strips of thin plywood, as shown, the ends being perfectly aligned and the pieces separated by the thickness of a piece of veneer.

The front (the cut-out will be described elsewhere) and the back of the case and lid are dealt with in a similar manner. In this case the lengths are made ¼in longer than they will be required to be when construction is complete. This allows ⅛in at either end for "cleaning up." (If you feel confident enough you may reduce this ⅛in to 1/16in, but on no account should you try to work with no allowance at all. Even an experienced worker would never do that).

It is into the front and back that the panel pins are driven. Lines to mark the inner width are carefully squared all round the ends. It is on these lines that the assembly depends. They will be called the "reference lines."

When assembling the sides to the front and the back, speed and accuracy are required at the same time. If too much time is taken up in making the joints, the glue will have become too cold to be effective. Because of this the 1in panel pins used are driven into place for half their length, tips level with back surface.

The surfaces which are to make the joint are now glued. Strips of veneer, used as shown, assist in lining up before the panel pins are driven home. The ends of the sides are made to come into line with the reference lines on front and back.

The panel pins are now driven home, and when the constructor feels satisfied that all is well, their heads should be driven 1/16in below the surface of the timber, using a suitable nail punch (failing this, a large nail previously blunted).

The work should now be square in two ways, but the diagonal test remains.

Following this, a piece of hardboard may be nailed across the bottom to ensure that it keeps its position until the glue is hard, after which it is removed.

The Cutout

The piece used for the front must be of plywood. So much is cut away that solid timber would lack the necessary strength. The constructor may have other methods, but the writer will describe the one which he used.

After marking out, two ¼in holes are drilled as shown. These holes enable a coping saw to be used. Cuts are made with the coping saw as shown. Their purpose is to provide a start for a tenon saw which can be used to make a very straight cut over the long edges. The coping saw is again used at the corners where a vertical cut cannot be made with a tenon saw. A file and sandpaper are used to smooth the edges.

As previously stated, the nailed glued joint lacks sufficient strength.

This strength is added by making saw cuts, dovetail fashion, where shown in the corners. Veneer tongues are glued into the saw cuts.

The veneer should be of hardwood (beech was used). It should be matched with a suitable saw in such a way that it is a good fit in the saw cut.

A number of veneer tongues should have been cut in readiness. The size of each is such that it protrudes about ¼in all round when slid into the saw cut.

Each tongue should be covered with hot glue and introduced into the saw cut, then slid backwards and forwards once or twice to drive out all surplus glue. It should soon become too tight to move. It should now be left to harden.

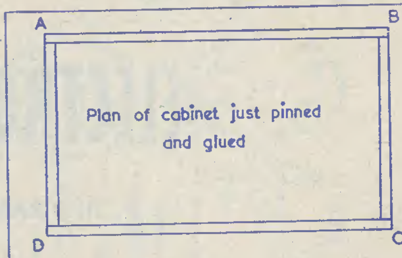
Two tongues should be used for each corner of the lid and four for each corner of the case. They add tremendous strength to the joint.

The work should be laid aside and no cleaning up attempted until the following day.

Cleaning Up

This is the stage which brings a feeling of satisfaction. It consists of removing surplus wood and glue from all joints until the true appearance of the structure emerges.

The work should be held in a vice and care taken not to use such force that the glued joints are strained.



THE DIAGONAL TEST FOR SQUARENESS

The diagonal A-C should be equal to diagonal B-D. When it has been made so, a piece of hardboard is nailed across to hold it in position until the glue is hard

G552

A good smoothing plane, sharp and adjustable, is essential. The writer's method is not approved by all. It consists of cleaning off surplus glue with the plane. This certainly dulls the plane edge, but when all glue has been removed the plane is given an extremely keen edge and set very fine before the final cleaning up is carried out.

In this work patience is necessary, so the constructor must curb the natural desire to hurry.

The top of the lid and the bottom of the case may now be glued and pinned into position. After they have been cleaned up the work may be sandpapered and is then ready to be covered. Do not forget to cut a small notch where the mains lead comes from the cabinet, otherwise it will not be possible to close the lid.

(*To be continued*)

The "Mayfair" Televisor

Direct TV Replacements, 138 Lewisham Way, New Cross, London, S.E.14, announce that they are now able to supply a turret tuner which is suitable for this televisor.

The price is £7 7s. (no charge for postage and packing), and the tuner covers one B.B.C. and one I.T.A. station. The particular channels required *must* be specified when ordering.

Designing an ELECTRONIC MIXER UNIT

By P. R. TRAVERS

VERY FEW TAPE RECORDERS, EVEN IN THE semi-professional category, provide means for mixing the inputs from several sources when recording. In recording effects for plays, or choral and orchestral concerts, and indeed in many other situations, the use of more than one input is often a great convenience and sometimes a necessity.

Some time ago I set out to design a three-channel electronic mixer unit, and encountered a number of problems which were sufficiently interesting to justify describing the lines along which development took place.

Before describing the evolution of the final unit, it is as well to state the requirements of any mixer:

(i) There must be no interaction between the various channels. That is to say that not only must there be no cross-talk, but also that altering the gain of one channel must have absolutely no effect on the level of the signal from any other channel in use at the time.

(ii) Hum and noise level must be extremely low as the unit will feed into an early stage of the recorder.

(iii) The frequency response of the unit must not be less than that of the recorder with which it is to be used.

(iv) It must be convenient and simple to use.

The basic mixer circuit is illustrated in Fig. 1; each input requires a separate valve to ensure complete isolation from all other channels. From this was derived the first mixer to be built, the circuit of which is given in Fig. 2. It will be seen that a common anode load has been used for the three triodes—its value being one-third of the value of the load recommended for each individual valve. Double triodes were used and the spare half of the second valve was connected as a cathode follower in the first instance, and the output from the mixer was fed into the high-gain input of the tape recorder. Power supplies were available from the tuner.

This unit worked well, but after only a short period of use the gain controls became very noisy. Other potentiometers were substituted but the same problem recurred after a time. Inquiry revealed that it is considered bad practice to mix at low level (for this reason amongst others) and that a stage of amplification should be used before any gain control is inserted. The logical development of the circuit is to provide one double triode for each channel, using the first half of the valve as a voltage amplifier, the second half in the mixer circuit and inserting the gain control between the two halves of the valve. A second unit was built using the circuit shown in Fig. 3. With two stages of amplification the output from the mixer overloaded the high-gain input of the recorder, and the low gain input was used. Since the unit was to be used in association with the recorder without long connecting leads, there was no need for a cathode follower output stage and it was omitted. This saved the use of another valve and gave better matching. This Mark II unit was very satisfactory, and it was only the desire to produce an even simpler unit that prompted further experiment.

Accepting the fact that there must be a stage of amplification before the gain controls, it follows that any simplification of the circuit must be in the mixer stage. Interaction between channels will be prevented if a resistance of large value is included in the output from each channel. This basic arrangement is shown in Fig. 4. A unit was built up using this circuit with a triode as voltage amplifier in each input circuit. As double triodes were used, the remaining half of the second valve was connected as a voltage amplifier to give sufficient gain to

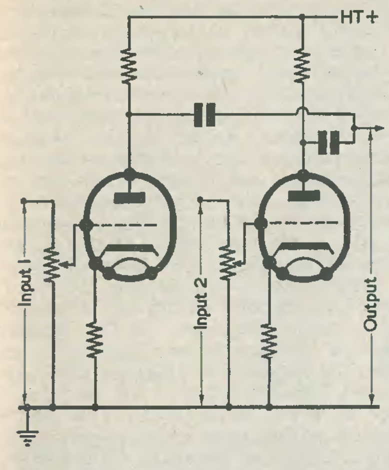


FIG.1

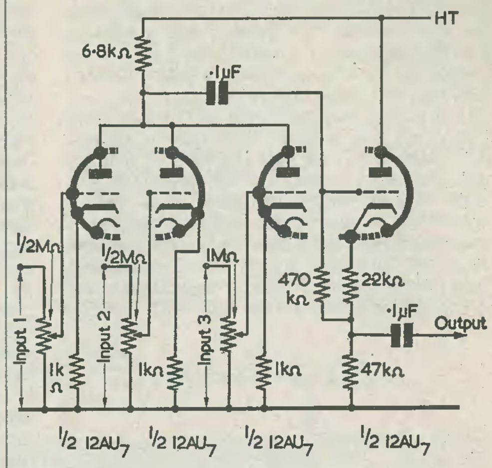


FIG.2

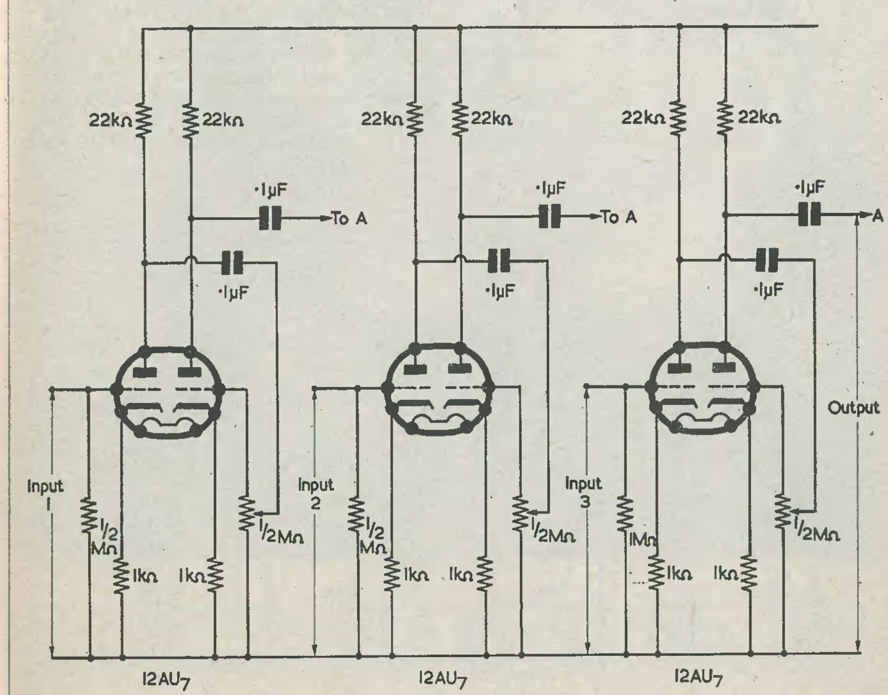


FIG.3

M657

load the low gain input of the recorder. A cathode follower could have been used, but the low-gain input gave better results with the short connecting leads used and this arrangement kept the signal level up in the connecting leads and jacks and helped to keep the hum and noise level down.

It is in the keeping down of the hum and noise level that considerable care is needed in construction. At first the idea of using a high frequency supply for the heaters of the mixer valves was considered, but before embarking on such a complicated scheme, a unit was built which drew its heater supplies from the auxiliary socket of the recorder. This heater supply is centre-tapped to earth at the mains transformer, and with closely-twisted leads no trouble was experienced with hum from this source. Naturally, a stout earthing bus-bar was used running from one input socket to the next. Adequate spacing of components and careful separation of the grid and anode components is extremely important. Little screening is needed, provided that the input leads are kept as short as possible. To this end the valves are mounted on small brackets between the input potentiometers and all grid leads are less than 1in long. The only screened lead is that which connects the output of each circuit to the grid of the final output triode. If this lead is left unscreened a lot of hum is picked up. High stability components are recommended throughout the circuit. A multiple lead connects the mixer to the auxiliary socket of the recorder and a screened lead carries the output jack. Only one earth lead is taken from the mixer to the recorder, in order to avoid earth loops. This lead is included in the power cable as this avoids using the braid of the signal cable carrying the h.t. return. The input jack can therefore be withdrawn from the recorder without breaking the earth return and so making the mixer chassis "live" with respect to the recorder. The braid of the coaxial signal lead is earthed only at the mixer end and is not connected to the jack at all. A suitable h.t. dropping resistor is included in the h.t. lead, its value depending on the available h.t. A decoupling capacitor is also required. The power requirements of the unit are 250V at 12 mA for the h.t. and 6.3V at 0.6A for the valve heaters.

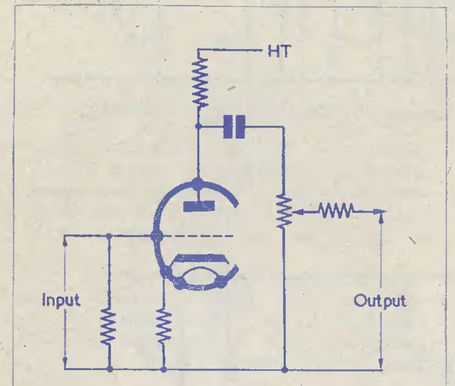


FIG.4A

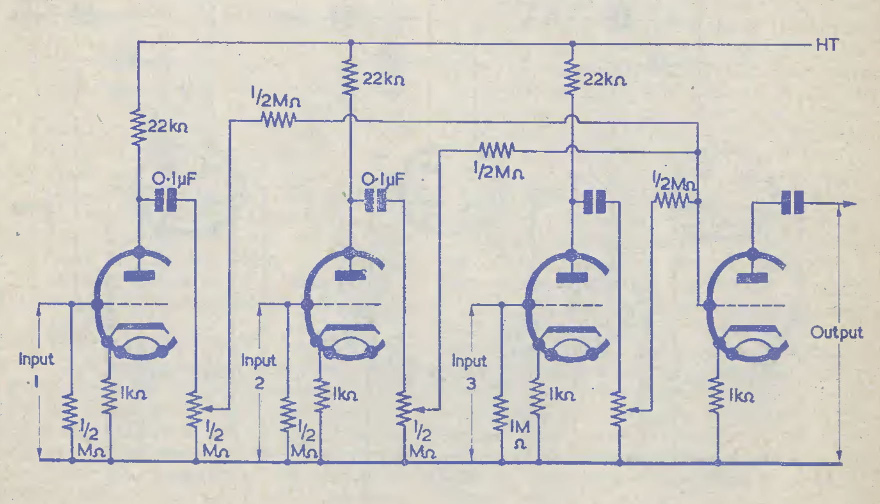


FIG.4B

M658

As the mixer unit is intended for use in close association with the recorder no signal level meter or output gain control is included, these being available in the recorder. Similarly, the monitor output socket on the recorder is used, headphones being plugged in so that the balance of the different channels may be judged during recording.

In use this final unit has proved to be most satisfactory, and easy to handle. Ribbon microphones with matching transformers are used with inputs one and two and a crystal microphone or pick-up may be used with channel three. No noise from the gain controls has been noted and the hum level is not increased when the unit is in use. When recording with a crystal microphone and long leads the recorder must be effectively earthed, otherwise the hum level rises appreciably. The use of large value coupling capacitors prevents any limitation of the frequency response and test tapes recorded with and without the mixer in circuit show identical frequency response using the same ribbon microphone in each case.

Having a mixer unit available has made the tape recorder much more versatile and has provided a very great deal of interest and amusement.

New West End Showrooms

Continued expansion in the Hi-Fi field and their latest venture, the production of test equipment in both kit and ready-built forms, has made it imperative for the Jason Motor and Electronic Co. to move their sales and development organisations to larger premises at 3–4 Gt. Chapel Street, Oxford Street, London, W.1. The new West End showrooms are now well established under the management of Mr. E. G. Bailey, who is well-known in Hi-Fi circles, and who is shown on the right in the above photograph. Observant readers will note that Mr. Bailey is handling a copy of this magazine—in fact, a stock of our publications is carried for the convenience of customers.

A Constructor Visits The

1959 INTERNATIONAL TRANSISTOR EXHIBITION

The international transistor exhibition, held recently at Earls Court, was the first international exhibition of its kind. Promoted by the Institute of Electrical Engineers, it marked 10 years of transistor progress. A transistor convention was also held during the same period as the exhibition, and was attended by such pioneers in the field as Professor J. Bardeen, Dr. W. Brattain and Dr. W. B. Shockley, who were jointly awarded the Nobel Prize for their invention of the transistor.

The transistor has certainly come a long way in 10 years. The first transistor was a point-contact germanium type: nowadays it is difficult to find a point-contact transistor amongst the manufacturers' lists, and interest is rapidly shifting from germanium to silicon. Silicon is much less temperature conscious than germanium, but is much more difficult to handle in production. The Raytheon stand featured a display showing subsequent stages in the miniaturisation of transistors to the smallest in the world—far smaller than a match head.

To call this a transistor exhibition was something of a misnomer; "semiconductor" would have been a better word, for the exhibition included diodes, metal rectifiers, thermistors and photo-sensitive semiconductor devices. There is a lot of activity in the semiconductor diode field, particularly where silicon power diodes are concerned. Silicon rectifiers with forward currents of 500mA, and peak inverse voltages up to 800V are listed by the majority of manufacturers. High voltage units with peak inverse voltages up to 10kV, capable of passing forward currents up to 100mA are included in the Ferranti range, and 50A rectifiers with peak inverse voltages up to 400V were shown by Transitron. Rectifier stacks are available capable of almost any combination of output voltage and current. Diodes whose capacitance varies with the applied voltage, having obvious applications in a.f.c. circuits, were also to be seen. A diode of particular interest was shown by Texas Instruments. This diode, of subminiature construction and made of gallium arsenide, has a maximum dissipation of 800mW and will operate at up to 325°C.

A new departure in semiconductors are the multilayer devices, with characteristics similar to gas-filled tubes. The Westinghouse Dynistor Switch is one example. Six types are available with breakdown voltages ranging from 20 to 200V. The voltage drop of these devices at 500mA is only 1 volt. Another multilayer device is the Westinghouse CS26 Trinsistor Switch which is comparable to a thyratron, having a mean current of 20A at a voltage drop of just over 1 volt.

Other items of interest included a wide range of photo-devices employing various semiconductor materials—cadmium sulphide, indium antimonide, lead telluride, etc. Each of these materials has a different spectral response, and between them they cover the complete spectrum from ultra-violet to infra-red. The cadmium sulphide cell is claimed to be 20,000 times as sensitive as some of the earlier photo-emissive cells. Some of the photo-diodes are extremely small. Sylvania were exhibiting a unit measuring only 1in x 1in which contained 100 photo-diodes.

But perhaps the applications of some of these semiconductors are of more interest to the home constructor. Not that constructional details of any of the units were available, but the mere mention of them will show what applications are possible, and may give the constructor ideas. Of course, there were the usual transistor portables, which are now almost commonplace. Two television sets were shown, one by Burndept Ltd., and the other by Texas Instruments. The only thermionic devices in these receivers were the cathode ray tubes and the e.h.t. rectifiers.

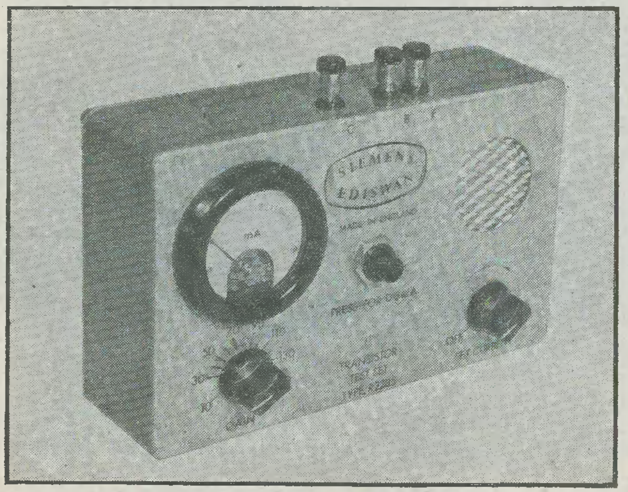
But the transistor instruments on show were even more interesting. Valve voltmeters using transistors are not new, of course, but in addition to these Dawe Instruments Ltd. were showing an audio oscillator with a frequency range of 20 c/s to 20 kc/s with an accuracy of 3%. There was also a frequency meter with a range of 10 c/s to 30 kc/s. One interesting application of this is the measurement of shaft speeds up to 100,000 r.p.m. This can be done by using a photo-transistor to convert the r.p.m. to electrical pulses. The same manufacturer was exhibiting a sound-level meter and a transistored strobopack. There were three oscilloscopes at the exhibition, made by B.T.H., Cossor, and Dawe. This is a new application for transistors and a cathode ray tube with a high sensitivity is required because of the low deflection voltages available from transistors.

Pye featured a 4-channel audio mixer unit, and also a motor-cycle transmitter-receiver which was a hybrid unit. Thickness gauges, millisecond and microsecond stop clocks, transistor-regulated power packs, binary counters, keyboard translators and tape mergers were among the more specialised applications. Of particular interest was a 4 watt 500 kc/s marine distress frequency transmitter using two Mullard OC24 r.f. power transistors.

Many exhibitors had interesting displays showing the various stages in the manufacture of transistors, and some of the techniques employed. There were also a number of stands which showed research work on semiconductor materials. Sylvania were featuring their "Mesa" transistor, a construction which facilitates both high frequency and high power operation. Large-scale models of transistors were shown on the Mullard stand. The Americans have had n-p-n transistors for a number of years, but until recently all the British and European types have been of the p-n-p structure. There is now an interest in n-p-n types for computers in this country.

This exhibition showed that semiconductors can do most of the things valves can do. There are, however, many economic problems to be overcome before they take over completely.

Trade Reviews



First Low-Priced Transistor Tester

Selling at a price of £11, with special terms to trade and industry, the transistor beta tester introduced by Siemens Edison Swan Ltd. is described as the first low-priced transistor tester on the market.

Its purpose is to provide quick, accurate, run-of-the-mill tests on all P.N.P. transistors, current gain and collector leakage being measured under common emitter conditions.

Current gain (10–150) is read directly off a calibrated dial in conjunction with an audible signal at a collector current of 0.5–4mA. Leakage current is measured on a meter at a fixed collector voltage of 9 volts. Accuracy is 5%.

The new beta tester is a battery-operated transistorised unit in a die-cast alloy case. The terminals are of the quick-release type.

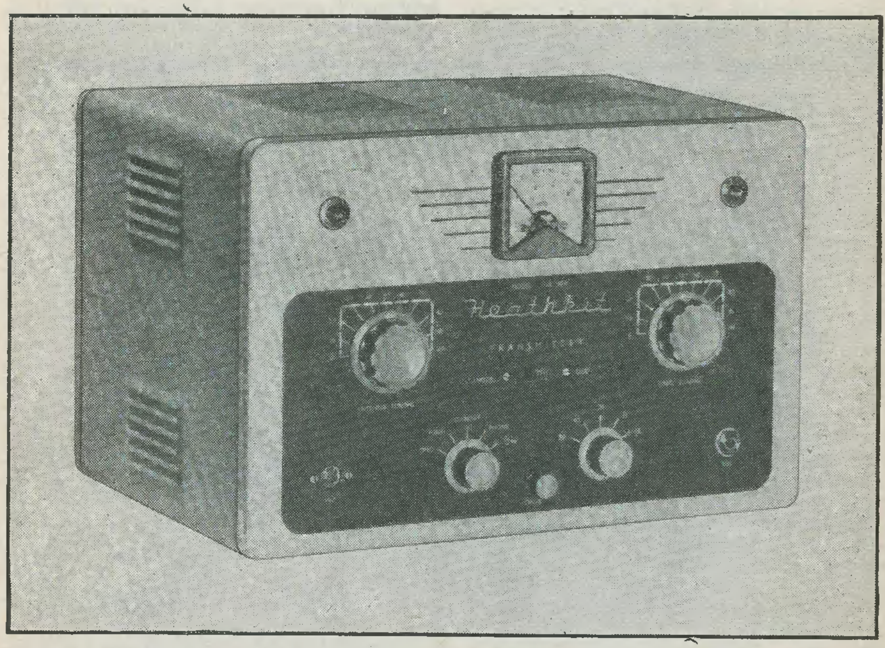
Measurements can be carried out by unskilled personnel in a few seconds. Full operating instructions are printed on the back cover of the tester.

The Heathkit Amateur TRANSMITTER

MODEL DX-40U

THROUGH THE COURTESY OF DAYSTROM LTD., Gloucester, we were recently given the opportunity of building up the kit for their Model DX-40U Amateur Transmitter. Daystrom Ltd. have—as most readers will have seen from their advertisements—introduced the Heathkit series of electronic equipment in kit form to this country, so instead of turning the advertisement pages of the American radio magazines with envy at these wonderful kits, the radio constructor in this connection. All components, metalwork and cabinet are of excellent quality and everything, even down to washers and soldering tags, is provided.

The transmitter worked excellently from completion, no snags requiring skilled experience for their unravelling being encountered. In spite of the limitations naturally imposed by xtal control, the three switched xtal positions enable one to get around the bands nicely and Dx QSOs have



country can now acquire them himself.

The kit comes beautifully packed, consequently there is little chance of damage in transit. A most comprehensive instruction book is provided which gives just about all the information one could wish for in building, testing and putting the transmitter on the air. Large circuit and pictorial diagrams of various stages of construction leave nothing in doubt. The stage-by-stage instructions are quite the most unique thing the writer has come across and enable one to use odd moments of spare time for taking construction a few stages further, without fear of missing out some component or

been made at the writer's QTH without difficulty.

Using limited spare time, completion from start to first QSO was two weeks in the writer's case. A colleague, however, built one in a weekend, starting on Friday night and having the first phone QSO at 6 p.m. on the Sunday!

From our experience with the kit, we can thoroughly recommend "Heathkits" to our readers, and this kit for the DX-40U in particular. The pleasure you will get in building it is equally as great as is the operation of the completed unit.

Technical Forum

Recording Level Indication

TAPE RECORDERS WERE AT ONE TIME SOLD very largely for professional use, but as they became more popular in this sphere, and the prices began to come down, they started to find their way into the entertainment market. Now the ever-increasing demand has enabled several firms to mass-produce recorders so that the price becomes yet more attractive, the cheaper equipment today costing about the same as a good class radio set. It is safe to forecast that this fall in price will continue for another year or so with the introduction of still cheaper tape decks, so that we may in the near future find a tape recorder alongside the record player in the home.

As usually occurs, an increasing demand for new equipment brings with it an increase in the demand for components, so that the home constructor can try his hand at making his own either with a view to economising, or to provide something which is tailor built to suit his particular requirements. Thus it is over the past few years that the home constructor has turned to the making of tape recorders, and one of the accessories which can be selected to suit individual tastes is the recording level indicator.

Part of the art of obtaining good quality sound reproduction from magnetic tape is to employ its magnetic properties to the full whilst avoiding any overloading. Should the recording be originally made at too low a level, the gain of the playback amplifier will have to be increased and consequently the signal-to-noise ratio will suffer. Conversely, if the recording is made at too high a level, that is with too much energy being fed to the recording head, then the tape will be driven into magnetic saturation. The result of this on playback will be that the amplitude of the louder sound passages will be limited in relation to the weaker passages, and arising directly from this limiting action there will be a substantial increase in audible distortion.

The recording level indicator is employed for the purpose of enabling the gain of the recording amplifier to be adjusted so that optimum use can be made of the magnetic tape without it being driven into saturation. Two forms of recording indicator are currently in use, a tuning indicator or a meter. The latter has found preference mainly on professional equipment such as may be employed in recording studios, because the meter scale is accurately calibrated and permits a close adjustment to be made of the sound level. The tuning indicator, however, is employed on all the entertainment type recorders such as are used in the home, its advantage being that it has a pleasing appearance and is at the same time capable of indicating the point beyond which overloading commences.

The Tuning Indicator

A tuning indicator with a new form of target display has recently been introduced by Mullards under the type No. EM84. This indicator is quite unlike either the EM34—where the display was at the end of the bulb—or the EM81—in which the target is curved and viewed through the side of the bulb. In the EM84 the display appears as two luminous patches on a strip of phosphor laid horizontally along two-thirds of the length of the bulb. This phosphor is similar to that used on the screens of green oscilloscope tubes, and is 33mm long and 4mm high. With zero input such as would occur under no-signal conditions, the luminescence appears only at the extreme ends of the phosphor; but as the signal is increased, these two areas of light increase in size until they meet in the centre. The edges of the phosphor and those of the luminescence are well defined, giving the display a most pleasing appearance. The EM84 is best mounted horizontally, and is viewed through a slot on the motor board or control panel depending upon its preferred location. It is an advantage to chamfer the edges of the slot outwards and mount the indicator as close behind it as possible, as this permits the greatest possible viewing angle to be obtained. One of the advantages of this type of indicator is that the phosphor is deposited on the inner wall of the bulb, bringing the display more forward than on the conventional indicator, and thereby increasing the angle at which it can be viewed.

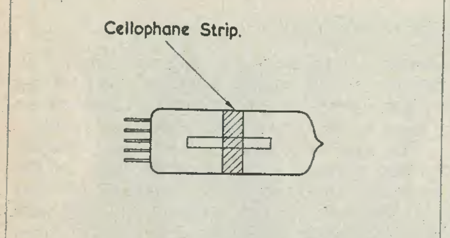


FIG.1
The EM.84 Indicator adapted as described in the text. M654

One of the disadvantages of using a tuning indicator in this application is that the petals gradually close until the target is fully illuminated, and this is taken as the point at which full modulation occurs. It is possible, however, when the indicator is adjusted to this condition that the louder sound passages may be in excess of the overload point, but as the petals are fully closed this will not be immediately observed. The display on the EM84 is, in fact, capable of quite accurate calibration, and although this is hardly necessary it is possible to make the overload point some little distance away from the centre of the phosphor so that it will be readily observed should this point be exceeded. An attractive manner of marking the overload point is to stick a band of coloured cellophane around the bulb of the indicator so that it exactly covers the centre of the phosphor strip (see Fig. 1), then as the signal level is raised the luminescence will advance from the remote sides of the phosphor and the optimum recording level will be indicated when it reaches the edge of the cellophone. Any overloading will be immediately observed as the luminescence will advance under the cellophane where it will be apparent because of its change in colour.

The method of connecting the EM84 into the circuit is as shown in Fig. 2. The majority of tape recorders employ high impedance heads, which enables the indicator to be fed from the same point in the amplifier as the head itself. The signal is first fed on to a germanium diode which functions as a half-wave rectifier and supplies a negative d.c. voltage to the control grid of the tuning indicator. A resistance/capacity smoothing filter has been included in the grid circuit to prevent the very short term fluctuations in the signal level from producing a blurred display on the indicator.

The sensitivity of the circuit is such that a resistor can be added between it and the amplifier, and this further has the advantage that it reduces the damping on the amplifier. The sensitivity of the display may be adjusted by means of R_1. The method usually adopted for checking the sensitivity of the indicating device is described later.

The Meter

Small 0–1 milliammeters are most satisfactory for use in level indicator circuits. As there is normally insufficient power available from the amplifier to permit the meter to be fed directly from a half-wave rectifier an additional valve has to be employed. This is usually made of the double section type so

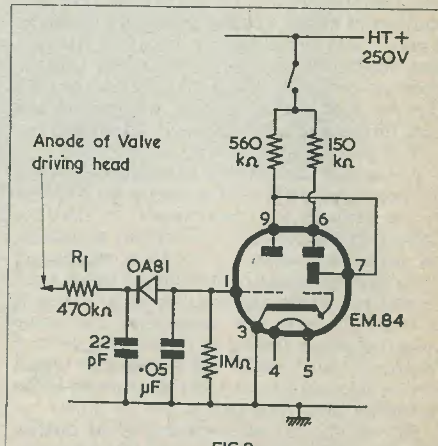


FIG.2
Circuit for EM.84 Level Indicator M655

that one half may be employed as a rectifier and the other half as a cathode follower with the meter connected in the cathode circuit. Here, again, a long time constant R-C combination is included in the anode circuit of the diode to iron out any short term deviations in the signal level. Adjustment of the sensitivity is made by means of a variable resistor which is connected in shunt with the

meter. The value of this resistor will be dependent upon that of the meter and should be made approximately equal to twice the meter resistance. A complete circuit for the meter indicator is shown in Fig. 3.

Adjusting Procedure

Both the circuits described require an input signal voltage of approximately 15V to indicate the point of maximum level; this is the voltage which should appear at the anode of the valve driving a high impedance recording head via a suitable parallel-T network. To check that the indicator is accurately adjusted it is necessary to measure the current flowing in the recording head. Full modulation of the tape will occur when the recording current is 200 microamps; it is normal to make this test when feeding a 1 kc/s sine wave into the amplifier. Having set the gain of the amplifier to give this required recording head current, the sensitivity of the level indicator should be adjusted by the means already described to give full indication. Should a suitable current meter not be available for this measurement it is permissible to connect a non-inductive 50 ohm resistor in series with the head and measure the voltage appearing across it. In this case the required 200 microamps will be indicated by a voltage of 5 millivolts.

Conclusion

In this short article we have considered the two most popular methods of indicating the recording level in tape equipments, but there is a third level indicator which comes to mind and which may appeal to many constructors who happen to have a small oscilloscope tube available. A 1in oscilloscope tube makes a particularly attractive though expensive level indicator and at the same time it can be useful in providing a quick check of the amplifier response. This latter may be achieved by recording a square wave on the

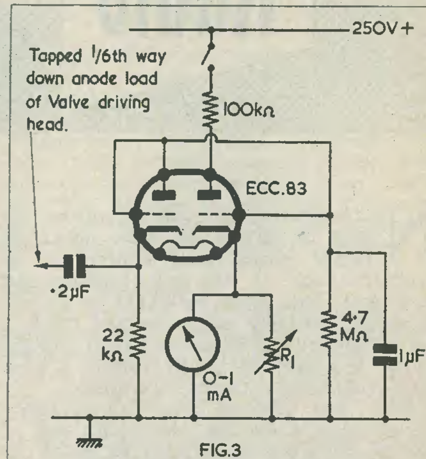


FIG.3
Circuit of Meter Level Indicator. M656

tape and then playing it back in the normal way. The tube will indicate the waveform fed to the recording head when connected as a level indicator, and may be switched to the output stage of the replay amplifier to display the resultant wave.

Amateur Radio Mobile Society

MALDON MOBILE RALLY

5th JULY 1959

The first rally of the recently-formed Amateur Radio Mobile Society will take place on Sunday, 5th July, at Maldon, in Essex.

A section of the Municipal car park will be reserved for those attending the rally, and the parking fee is 1s. 6d. for cars and 1s. for motorcycles. Programmes—price 3d.—will be available on arrival and will be numbered for a prize draw. The proceeds of the programme sales will be donated to charity. Talk-in stations will be operating from approx. 10 a.m. as follows: G2BCX/P, 1980 kc/s; G3KVF/P, 3700 kc/s—both located at the rally site—and G3HTC/P located at Danbury Common and operating in the 2-metre band on one or more of the following frequencies which will be used as necessary to avoid interference with stations taking part in the 2-metre field day: 144.12, 144.5, 144.8, 145.0, 145.4 and 145.5 Mc/s.

The rally will be formally opened at noon. The programme of events will commence at 2 p.m. and will include an inspection, with a prize for the mobile installation most nearly meeting the requirements of Article 17 of the A.R.M.S. Articles of Constitution. This relates to the safety of the installation. No discrimination will be made between commercial and home-built equipment.

The rally will be visited during the afternoon by His Worship the Mayor of Maldon.

Amenities at the rally include boating, bathing and beach, children's fun fair, etc. A raffle for attractive prizes of both radio and domestic interest will be held.

It is suggested that visitors to the rally should provide themselves with a picnic lunch, although there are a number of tea kiosks, small cafes and restaurants in the vicinity.

Radio miscellany

No doubt when we are bedridden we tend to take a lot more notice of details which pass unobserved at normal times. I am still bedfast—and perhaps a little more observant as a consequence. Reading magazines and things I never ordinarily see which have been brought to the sick-room by kindly visitors, I have discovered some extraordinary things.

One item, gleaned from a gardening periodical, was that we were in for one of Mr. Buchan's cold spells from the 9th to the 14th May. I have no tender garden plants to worry about, but I carefully watched the sky, the thermometer and the daily forecast. I cannot imagine any people in the world more weather conscious than we British. Our climate's surprises are never-ending at any period of the year. How many times annually do we find ourselves saying "Proper Indian summer, what!" or "Call this flaming June?"—more likely the latter, of course.

We radio old-timers have more than the average morbid British interest in the weather. Our climate seems to either consist of lengthy droughts which invariably occur when everything in the garden is growing fast and in need of rain. These are accompanied by the order, "The use of hoses is forbidden." Or else we get a week or so of more or less continuous rain. Whichever it is, it is invariably the opposite of what you personally want at that particular period.

In the early days of wireless it was more or less universally accepted that the weather had a much greater influence on radiation conditions than we now know to be the case. It wasn't as simple as all that just because low-power medium-wave stations in hot, dry countries were less effective than those in temporate climates, but generally a damp atmosphere was thought to be very much better for good listening conditions. Fogs were supposed to be an excellent thing. Did they not blanket the signals to the earth's surface instead of letting them rush off into space?

Foggy winter nights found all the enthusiasts knob-twiddling for the more distant B.B.C. stations, and it was no uncommon thing for the keen types to go out and drench their earthing points with buckets of water just to improve things a little more. Indeed, some of this tradition persists today. No amateur dreams of omitting the Wx (weather conditions) space from his QSL card, and every short-wave listener's report card blithely follows suit. The stronger our claims to Old Timership the more deeply tinged we are with weather consciousness, and so from the comfort of my sick bed I switched on for the Wx forecast on the morning of the 9th. Apparently the meteorologists had also been swotting up on Mr. Buchan and were in complete agreement with his conclusions. In fact, what with their talk about deep depressions, etc., they made it sound a lot worse. This was in spite of brilliant early sunshine. Anybody but a half-wit could clearly infer that to venture out of doors without umbrella, mackintosh and top-boots would have been just asking for it.

As the day progressed the sun grew hotter and hotter, and high-temperature records up and down the country fell like ninepins. Were the Met. men abashed? Not on your Nellie. They cheerfully came up with the same sort of forecast for the 10th—except they threw in a little thunder for luck. It also turned out to be a beautiful summery day with temperatures reaching the 80's in places. So it went on for the next day or two. The forecasts getting gloomier and gloomier and the weather getting hotter and hotter. One responsible daily who run a detailed forecast was apparently so disgusted that they sent a reporter to the Met. Office. The reply left me wondering how in these days of radio communication the reports could be so slow in coming in. Perhaps the Met. men haven't made so many advances since Mr. Buchan's days of over a hundred years ago.

I see that his next cold spell is due on the 29th June to 4th July. Watch out!

Number Please

W.A.H. of West Kensington writes sharply censuring those manufacturers who mark the type numbers on the glass envelopes of their valves with a "thin coating of weak white-wash." After being handled a couple of times the type letters and numbers simply disappear.

This column raised this problem in the early days after the war. At that time there were an enormous number of "bottles" taken from ex-W.D. apparatus on which the type markings were indecipherable. It was then facetiously suggested that a long exhalation of Old Solders' Breath (suitably charged with the right sort of refreshment) might revive the marking sufficiently well to become readable. There was also a suggestion that refrigeration treatment might help, but this apparently is no quick method. The valve is left until both it and the inside of the "fridge" need defrosting when, with luck, something of the type markings might be faintly visible.

Since those far-off days when I last aired this problem many bright lads with real brains have entered our ranks. Can any of them suggest a new, sure-fire method?

Quality Quest

In the last few months our Old Timer correspondents have been strangely quiet; but oddly enough, my paragraph on loudspeakers, and the money one can spend on

Centre Tap talks about items of general interest

them if so inclined, brings another Old Timer into action. J.T. of Wolverhampton reminds me that spending a lot of money on speakers is no new thing. It goes right back to the early days. He himself wonders on which he has spent the most money, speakers or valves, and that includes the early valves which were mighty expensive items.

J.T. is, of course, quite right. Enthusiasts spent small fortunes on their early speakers despite the fact they were nothing more than earpieces with straight tin trumpets mounted on them.

Then came larger earpieces, which only gave louder distortion, followed by the even more expensive horn-shaped trumpets. The more elaborate of these had the flared end finished with small wooden panels neatly joined to follow the contour of the horn. Their shape was supposed to be based on that of the human throat, thus ensuring perfect "naturalness" of speech! It must be admitted that after getting used to a particular model it was usually possible to understand nearly 50% of what was being said. For a short time there was an effort to christen them "table-talkers," but this died out and no one has since thought of a better name than loud-speaker," despite its clumsy inappropriateness. I suspect the table-talker touch was an Americanism but in the early 'twenties there were no talkies and the general population still spoke in English. Even crooners used English words with near-British pronunciation!

The first real improvement in reproduction as far as amateurs were concerned was the pleated paper diaphragm type. This was held in wooden milliners' hoops with a blob of sealing wax in the middle. A Brown's "A" type (reed) earpiece mounted at the back actuated the diaphragm via a piece of stiff wire fixed between the reed and the sealing wax. The result was very much more pleasing than anything we had previously heard.

Another Misnomer

This more or less naturally led to the development of the balanced armature unit, which was built to handle a good deal more current than the Brown's earpiece. About this time "power valves" were introduced—an unfortunate name if ever there was one. Purchasers imagined that if they fitted one in the final stage of their existing sets they would get lot-more-powerful signals. They usually got a lesser signal and invariably ran their h.t. batteries down twice as quickly. The name "power," of course, was meant to imply that they would *handle* greater power—not give more power from a weak input. That was left for the pentode which had still to come. Because of the "power" valves which desperately overloaded the poor Brown's earpieces with their d.c. drain, burn-outs occurred within weeks and it was left to the balanced armature to save the situation. A well-advertised, and good, type was the Blue Spot; and amateurs spent much time and ingenuity in devising means of "floating" Kraft paper cones in rings of light flexible materials. Coupled with improved microphones we began to hear the lower frequencies for the first time. Not very low, of course, but a bit deeper than we ever heard before. This whetted the appetite of every keen amateur to such an extent that any means of accentuating the bass was exploited. Housewives who had already learned to tolerate in the drawing room breadboard constructed sets with ebonite panels, batteries and numerous knobs, suddenly found they also had to put up with six-foot plywood baffle boards stuck across the corner. Others built frames on which they stretched "doped" linen handkerchief diaphragms. Only the largest and finest linen handkerchiefs were used, of course, far more expensive hankies than one would ever dream of buying to wipe one's nose on.

So in those days, as now, no expense was spared by the enthusiast for an extra note in the lower register. There was also an impressive-looking, and impressively named, balanced armature speaker called the "Wufa," marketed soon after the Blue Spot, which meant further expense for the keen types. The first moving-coil speakers cost very nearly the earth, and I well remember how desperately I adjusted my finances to acquire mine. It had a six-volt field, mains transformer and 1.5A metal rectifier. Anyway, it wasn't a complete waste of money for when it became old-fashioned I used the metal rectifier in a battery charger where it still does yeoman service.

All Party Support

Enforced idleness gave me opportunity to bother with all sorts of things we busy hobbyists rarely allow to trouble us. I even got round to reading Parliamentary Debates. Before the Budget this column dropped a hint or two to the Chancellor about reducing the Purchase Tax on gramophone records—which he more or less ignored. He did, of course, make a small concession (about 2s. on an L.P.) and when later the debate on the Finance Bill came up there was widespread all-party criticism at this alleged niggardliness.

Sir Hamilton Kerr (Con., Cambridge) expressed his disappointment that in so generous a Budget he had not been kinder to the gramo-phile and drew attention to the anomaly that the words of the great classic writers could be bought P.T. free in printed form, but if recorded by a great artist liability for tax was incurred. Lady Tweedsmuir (Con., Aberdeen S.) endorsed this, and urged removal of records into another tax category. Dame Irene Ward (Con., Tynemouth) suggested it was a tax on the development of good taste in the arts.

In criticising the tax on records Dr. Stross (Soc., Stoke-on-Trent) pointed out that there was no tax on looking at great masterpieces on canvas, but to have them on a record one had to pay tax. Mr. J. Price (Soc., Westhoughton) thought it questionable that there was any merit in freeing "pop" records from tax. He personally would double the tax on them, a view endorsed by Dr. Dugdale (Soc., West Bromwich). He said "I have two children, and there are some pop singers on whose records I would like a tax of 500 or even 1,000 per cent.", and Dr. King (Soc., Itchen) practically called the Chancellor a Philistine. Had he not made a more generous cut in the tax on beer than he had on Beethoven?

Anyway, all this argument made no difference. All we can do now is to wait until the next Budget.

I Wonder

Why do I.T.V. advertisers of foodstuffs imagine that viewers find it attractive to watch ill-mannered children behave so badly in front of the camera. Apparently the modern child sits at the table badly, although they sometimes eat on the floor, hair unbrushed, cramming excessive quantities of the plugged product into their mouths. By grinning, stomach-rubbing and making grunting noises one is supposed to imagine the child has passed through a period of ecstatic enjoyment. As a kid, I should have been sharply punished for a tenth of this ill-mannered display, but then we were fed on real foods which required the use of a knife, a fork, and a certain decorum in their use.

It seems that the latest fashion, as copied from New York's leading slums, is to shovel spoonful after spoonful of crunchie-wunchie, popsi-wopsi into the mouth and wipe the surplus off with the back of the hand. This induces the right mood for eye-rolling, and satisfaction-grunting, while at the same time it does away with the need of real food for breakfast.

Book Reviews

HIGH QUALITY SOUND REPRODUCTION. By James Moir, M.I.E.E. 591 pages, 340 diagrams and illustrations. Published by Chapman & Hall Ltd., 37 Essex Street, London, W.C.2. Price 70s.

Anyone who has had anything to do with hi-fi, either as a knowledgeable amateur, professional engineer, or enthusiastic listener, will recognise in this book the comprehensive treatment of the subject in its many aspects that only an experienced engineer could present so well. James Moir is no new boy at the game; he is certainly adequately qualified in all respects to write such a book, and the result of his labours undoubtedly does him great credit. He claims, and rightly so, to know more than a little about the subjects he deals with in so masterly a fashion throughout the book—the quiet confidence of the real expert is so apparent all the way through. On the other hand, his Preface implies that in some matters the treatment might not go so deeply into some subjects: this may be so in a few chapters, but such components as output transformers, for example, are a specialised subject and only part of the general appreciation of the high-fidelity reproducing art. The chapter on output transformers, and the one dealing with power amplifiers, strike one as being a little too brief, especially when they are compared with the much longer chapters dealing in detail with loudspeakers, room acoustics, and the mechanism of human hearing.

Be that as it may, one cannot escape from the conviction that the author deals with some of the lesser-known aspects of hi-fi reproduction at far greater length than most others care to do. The reason for this is not hard to find; it is simply that the author's knowledge is unique. His discussions and explanations make this abundantly clear—they also reveal that he is no mean exponent in imparting his knowledge to others.

Those who want to learn from the written word are catered for fully in this book. Practically all of it is text which makes enjoyable, informative reading, mathematical treatments being conspicuous by their almost total absence. Charts and graphs seem to have been used to clarify and co-relate matters which so often are clouded over with pages of almost incomprehensible mathematics. To the top-flight designer mathematics are the real tools of his calling, and he, no doubt, is adequately catered for in other works, but to the reader who is less knowledgeable this book will appeal because it tells its story in a language he can understand. Where mathematics are necessary to illustrate or justify statements in the text, they appear in appendices to each chapter. There are also short, but useful, references to further reading at the end of each chapter.

The price of this book is not, perhaps, within the limits that some people can afford. Nevertheless, it is not an expensive book, taking into account the quality of its production, the considerable amount of material it contains, the enormous task performed in preparing it, and the fact that it must surely take its place among notable reference books of lasting usefulness.

DIRECT COUPLED AMPLIFIER CONSTRUCTION. By James S. Kendall. 18 pages, 15 diagrams and illustrations. Published by K. & M. Printing and Publishing Co., 18 Melville Road, Birmingham 16. Price 2s. 6d.

This little handbook gives useful hints and tips on making simple hi-fi amplifiers, and constructional details for two amplifiers using the direct-coupled circuit technique. The first of these amplifiers does not seem to have a specified power output rating, though from a study of the circuit it seems this could be of the order of 2–3 watts. The circuit itself is delightfully simple, using a triode-pentode in the audio section and a full-wave ectifier. In the audio circuit only four resistors, two capacitors and an output transformer are needed.

The second amplifier is a little more ambitious, using three valves in the audio circuit, plus a full-wave rectifier. A tone control is included, but apart from this there is still economy of components due to the direct-coupled driver and output stages. A power output of 10 watts is claimed, though it is considered this is rather in the nature of wishful thinking when the output stage is single-ended, using an EL84 p.a. stage. At least, this is the type specified in the parts list, though it is noticed in the text that reference is made to an EL34 which could, of course, deliver the stated output of 10 watts.

Other items dealt with in the booklet are an inexpensive tape deck and a control unit for use with it. It is regrettable that the presentation and editing could have been better, for this shortcoming tends to reduce the value of what is already a fairly high-priced publication having regard to the amount of material contained in it.

BASIC ELECTRICITY FOR COMMUNICATIONS (2nd Edition). By William H. Timbie, revised by Francis J. Ricker. 538 pages, 450 diagrams and illustrations. Published by John Wiley & Sons Inc., New York. Obtainable in England from Chapman & Hall Ltd., 37 Essex Street, London, W.C.2. Price 50s.

Students of electronics must of necessity have a sound knowledge of basic electrical theory if they are to understand properly the many facets of the wider applications. It is no use trying to work out, for example, the resonant frequency of a complex reactive network unless one knows how to manipulate some of the mathematics associated with a.c. theory, inductive and capacitive reactances, and in some cases, certain network theorems. In this book is to be found excellent training for such operations.

There are sixteen chapters. Some of these deal with simple concepts and basic principles such as fundamentals, Ohm's Law, power and energy, conductors and insulators, batteries, and the measurement of resistance. Others delve more deeply into such matters as the application of Ohm's Law to problems, Kirchoff's Laws, and Thevénin's Theorem, alternating currents, inductance, capacitance, resonant circuits, magnets and magnetic circuits. One chapter on applying Thevénin's Theorem to alternating current circuits is particularly useful. Several worked examples show how relatively complicated networks can be reduced to simpler terms by means of the equivalent circuit device expounded by this Theorem.

The book abounds with examples which show the logical steps in solving a wide variety of problems. Throughout each chapter this principle of teaching by example is most noticeable. It is rather a pity to find that although each chapter concludes its various sections with a selection of problems for the student to solve for himself, no answers to them are given so that he can verify the accuracy of his solutions.

One would have thought that a book which extends so far into the realms of alternating current circuits would have made more use of the j-operator for solving many problems, and that an opportunity has been missed to show the usefulness of this device. As it is, the j-operator finds mention only in one of the appendices, and though the explanation is sufficient for a receptive mind, more use of it in the previous chapters might well have made it easier for many to understand. Many examples are given of the graphical method of solving vectorial quantities; they could have been followed by the j-operator method to clarify the use of this mathematical tool.

This book is very clearly printed on good quality paper and has an attractive, durable binding. The drawings and diagrams are also clear and simple; quite obviously no effort has been spared in producing such a large number of them. For its quality and usefulness this book is good value for money, and certainly will not disgrace even the best of bookshelves.

W. E. THOMPSON

★ VALVES NEW TESTED AND GUARANTEED

1R5	7/6	6X4	7/6	DK91	7/6	EF92	5/6
1S5	7/6	6X5G	6/–	DK92	9/–	EL41	10/–
1T4	6/–	12AH8	9/6	DK96	9/–	EL84	9/–
3S4	7/6	12AT7	7/6	DL92	7/6	EL91	7/6
3V4	8/–	12AU7	7/6	DL94	8/–	EY51	10/6
5U4G	6/–	12AX7	9/–	DL96	9/–	E135	8/–
5Z4G	9/–	12K8GT	13/6	EB91	5/6	EZ40	8/–
6AM6	6/9	12K7GT	8/6	EBC41	8/–	EZ80	8/–
6AL5	5/6	12Q7GT	7/–	EBF80	9/6	EZ81	8/6
6AT6	7/6	25A6G	10/6	ECC81	7/6	PCF82	11/–
6BA6	8/6	25L6GT	7/6	ECC82	7/6	PL81	13/6
6BE6	7/6	35Z5GT	8/6	ECC83	7/6	PL82	10/6
6BR7	10/6	35L6GT	9/6	ECC84	8/6	PY81	8/–
6BW6	8/6	53KU	11/6	ECF82	11/–	PCC84	9/–
6J5G	5/6	807	6/9	ECH81	10/6	PCF80	9/6
6J7GT	8/6	5763	10/6	ECH42	10/–	U76	8/6
6K7G	2/6	DAF91	7/6	ECL80	12/6	UBC41	10/–
6K8G	7/6	DAF96	9/–	EF36	7/6	UCH42	9/–
6Q7GT	8/6	DF91	7/6	EF39	5/6	UV41	10/–
6SL7GT	8/–	DG96	9/–	EF41	9/–	UL41	9/6
6SN7GT	8/6	DH76	8/6	EF80	8/–	UY41	8/–
6V6G	7/6	DH77	7/6	EF91	6/9	W76	8/6

Matched Pairs. EL84, **23/–**; 6V6G, **17/–**; 6BW6, **18/–**; KT33C, **19/6**; KT66, **27/6**; 807 **14/6** pair

1R5, 1S5, 1T4, 3S4, 3V4, DAF91, DF91, DK91, DK92, DL92, DL94, any four, **27/6** per set

P.P. Op. Transformers. MR 3-15 ohms for EL84, 6V6, 6BW6, etc., **18/6**; Op. Pen. 50mA, **5/6**; 30mA, **4/6**

Volume Controls. All values, long spindle. L/S **3/–**, s.p. **4/–**, d.p. **4/9**, ext. spkr. control **3/–**

W.W. Pots. Pre-set **3/–**; 3W long spindle **5/6**, s.p. **6/6**

P.M. Speakers. 3 ohm. 5" **16/6**, 6½" **17/6**, 8" **21/–**, 10" **25/–**, 12" **30/–**, Bakers 12" 15 ohm 15W, **90/–**

Coaxial Cable. 75 ohm ¼" stranded, **8d.** yd; semi-air spaced, **9d.** yd; screen cable single and twin, **9d.** yd

Coaxial Plugs 1/– each; **Sockets 1/–** each

★ **C.R.T. Isolation Transformers** with nil, 25% and 50% boost, low capacity a.c. mains 200/250V for 2V 4V, 6.3V and 13V tubes. All **10/6** each

Valveholders. 4, 5, 7 pin English and U.S.A. B7G, B9A, I0, M0, B8G, **9d.** each; B7G, B9A with screening can, **1/6**; B12A, **1/3**. Aladdin formers ¼" with core, **8d.** each

Scotch Boy Recording Tape, 1,200ft reels, **27/–**

Jack Plugs, miniature standard, **3/–**; **Sockets 3/–**

2-Gang Condensers, 0.0005μF small size, **7/6**

I.F. Transformers, 465 kc/s, small size, **7/6** pair

Capacitors, small mica, 5% 1pF to 100pF, **8d.**; 120pF to 1,000pF, **9d.**; 1,000V wkg. .01, .0015, .0025, .004, .005μF, **1/–** each

Crystal Diodes, G.E.C., **1/6** each

Headphones, lightweight, 4,000 ohm, **16/6** pair

Ceramic Capacitors, close tol' 500V for V.H.F., **9d.**

Paper Capacitors, tubular, 0.01μF 1,000V, **1/–**; 0.1 to 0.5μF 500V, **10d.**

Paper Blocks, 4μF, 1,000 wkg., **3/6**

Rectifiers, contact cooled, 250V 50mA, **7/6**; 85mA, **9/6**

Reaction Condensers, .0001, .0003, .0005μF, **4/6** each

Heater Trans. 200/240V, 6.3V, 1.5A, **7/6**

Resistors, ¼ and ½W, insulated, **4d.** and **6d.**; 1W, **8d.** 6W W.W., **1/–**; 10W, **2/–**

Electrolytics. Wire ends. 25/25V, **1/6**; 50/50V, **2/–**; 12/50V, **9d.**; 8/450V, **2/–**; 16/450V, **2/9**; 16/500V, **3/6**; 32/450V, **4/–**; 8+8/450V, **4/6**; 8+16/450V, **4/6**; can types: 16/450V, **3/6**; 16+16/500V, **6/–**; 32/500V, **6/6**; 32/450V, **6/6**; 20+20/450V, **4/6**; 64+120/275V, **7/6**

Wavechange Switches, midget: 1p 12W, 2p 6W, 3p 4W, 4p 3W, 4p 2W, long spindles, **4/6**

Toggle Switches. QMB, s.p.s.t., **2/–**; s.p.d.t., **3/3**; d.p.s.t., **3/6**; d.p.d.t., **4/–**

Chokes, 80mA, 15H, **8/6**; 100mA 10H, **10/6**; 150mA 10H, **14/6**

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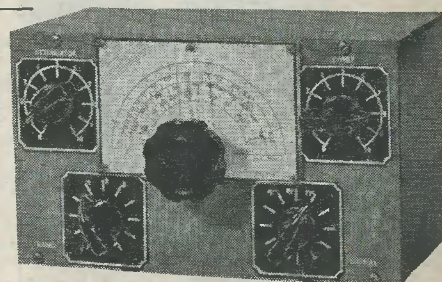

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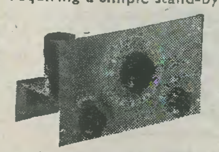

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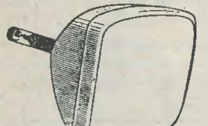

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continued on page 951

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continued from page 949

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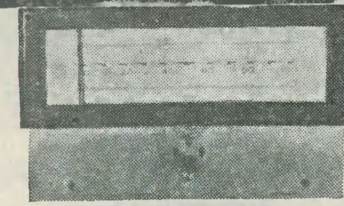

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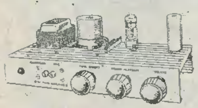

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