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NATIONAL HRO ALIGNMENT DATA

VOLUME 13
NUMBER 5
DECEMBER
1959

The RADIO Constructor

RADIO · TELEVISION · AUDIO · ELECTRONICS

Described by James Sinclair

Included in this issue

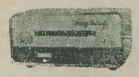
VERY SENSITIVE D.C. NULL INDICATOR
"TRANSITONE" SIMPLE ELECTRONIC ORGAN
COOPER-SMITH STEREO CONTROL UNIT
COMPREHENSIVE TRANSISTOR CHECKER
CAR RADIO 2-WATT TRANSISTOR AMPLIFIER
GOOD QUALITY AUDIO AMPLIFIER

DATA Publications 1/9

Heathkit
DAYSTROM

Here are our NEW kits designed to the same high technical standard

HI-FI FM TUNER



This model is available as two units which, for your convenience, are sold separately. They comprise a Tuner Unit, Model FMT-4U (**£3.2.0** including Purchase Tax) with I.F. output of 10.7 mc/s and an Amplifier Unit complete with attractively styled cabinet, power supply and valves, Model FMA-4U (**10.10.6**) making a total cost for the equipment of **£13.12.6.**

AMATEUR TRANSMITTER Model DX-100U

This is the most popular Amateur transmitter in the world and requires no introduction to "Hams" the world over. Covers all bands from 160–10 metres. Self-contained, including power supply, Modulator and V.F.O. **£78.10.0**

ELECTRONIC SWITCH Model S-3U
(Oscilloscope Trace Doubler)

This extremely useful low-priced device will extend the application of your single-beam oscilloscope by enabling it to give simultaneous traces of two separate and independent signals. **£9.18.6**

DIRECT READING CAPACITANCE METER

Model CM-1U. Full-scale ranges of 100 micro-microfarad, 1,000 micro-microfarad, 0.01 microfarad and 0.1 microfarad. Easily built in a few hours. **£14.10.0**

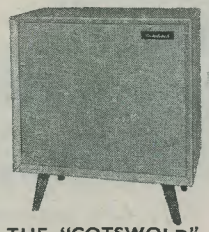
TRANSCRIPTION RECORD PLAYER, Model RP-1U

This new RP594 Collaro Transcription Unit has a Ronette Stereo Pick-up, giving excellent results on stereo or mono (33, 45 or 78 r.p.m.) discs. Complete with furniture-grade wooden plinth. **£12.10.0**

THE "GLOUCESTER". It will house Tape Deck and/or Record Player—as well as FM Tuner and Stereo Amplifier, and storage space is provided for records, tapes and power amplifiers. Furthermore, to meet the needs of those with whom room-space is an overriding consideration, provision is made in the cabinet ends for matched Hi-Fi Stereo Speaker Systems.

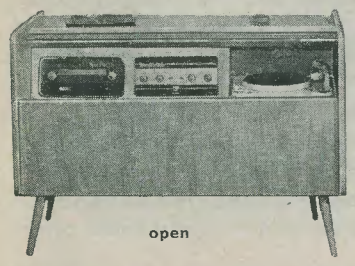
Mk. 1. Tape Deck or Record Player. **£15.18.6**

Mk. 2. Tape Deck and Record Player. **£17.8.6**



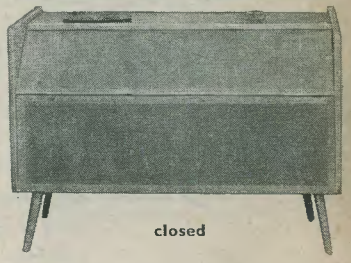
THE "COTSWOLD"

THE "COTSWOLD". This is an acoustically designed enclosure 26" x 23" x 15⅛" housing a 12" bass speaker with 2" speech coil, elliptical middle speaker together with a pressure unit to cover the full frequency range of 32–20,000 c/s. Capable of doing justice to the finest programme source, its polar distribution makes it ideal for really Hi-Fi Stereo. Delivered complete with speakers, cross-over unit, level control, Tygan grille cloth, etc. All parts pre-cut and drilled for ease of assembly and left "in the white" for finish to personal taste. **£19.18.6**



open

THE "GLOUCESTER"



closed

DAYSTROM LTD DEPT. RC12 GLOUCESTER ENGLAND

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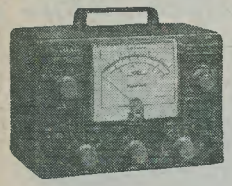
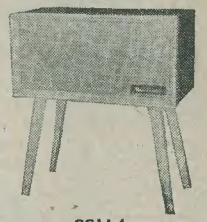
Easily-built instruments of excellent quality at much lower cost



AG-9U

AUDIO GENERATOR: AG-9U. 10 volts, 10 c/s to 100 kc/s pure sine-wave. Switch-selected frequencies/attenuation. **£19.3.0**

HI-FI SPEAKER SYSTEM: SSU-1. Ideal twin speaker/ducted-reflex cabinet for stereo/mono. in average room (left "in the white"). Legs **£1.7.0** extra. **£10.5.6**



SSU-1

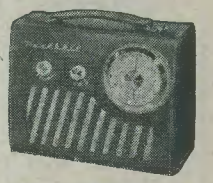
HI-FI STEREO 6 WATT AMPLIFIER: S-33. Low priced but high quality; less than 0.3% distn at 2½ watts per channel. **£11.8.0**

TRANSISTOR PORTABLE: UXR-1. In elegant solid hide case, with golden relief. Six transistors, dual-wave, fine reproduction, very easy to build. **£15.18.6**

USP-1

HI-FI STEREO BOOSTER: USP-1. Input of 2 to 20mV gives output adjustable from 20mV to 2V. Negligible distn. Also suitable as a high gain monaural amplifier. **£5.19.6**

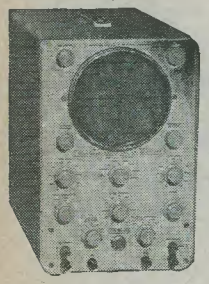
HI-FI STEREO 16 WATT AMPLIFIER: S-88. Superb reproduction for the man who wants the best in Hi-Fi. Only 0.1% distortion at 6 W/chnl. Many special features. **£25.5.6**



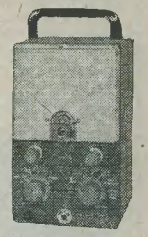
UXR-1

5" OSCILLOSCOPE: O-12U. "Y" sensitivity 10mV/cm., 3 c/s to over 5 Mc/s. Rise time, 0.08 μsecs or less. Sweep, 10 c/s to 500 kc/s. Electronically stabilised. **£34.15.0**

VALVE VOLTMETER: V-7A. The World's largest-selling VVM. Measures Volts to 1500 (DC & RMS) and 4,000 pk. to pk.; Resistance 0.1Ω to 1,000MΩ D.C. Sensitivity: 7,333,333 ohms per volt. **£13.0.0**



O-12U



V-7A

(Following models not illustrated)

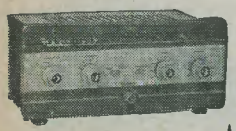
CAPACITANCE/RESISTANCE BRIDGE C-3U. Measures capacity, 10pF to 1,000μF. Resistance, 100Ω to 5MΩ; Pwr. F'ctr. **£7.19.6**

"HAM" TRANSMITTER: DX-40U. 75 W. CW; 60 W. pk. c/c phone; 40 W. into Aerial. **£29.10.0**

VARIABLE FREQUENCY OSCILLATOR: VF-1U. 10V output; covers 10 to 160 metres. **£10.12.0**

AUDIO WATTMETER: AW-1U. Up to 25 W. continuous, 50 W. intermittent. **£13.18.6**

AUDIO VALVE-MILLIVOLTMETER: AV-3U. 1mV to 300V A.C. 10 c/s to 400 kc/s. **£13.18.6**



S-33

S-88

COMPLETE MATCHED STERO OUTFIT

comprising record player, amplifier and twin speaker systems. **£42.10.0**

All prices include free delivery in U.K. Deferred terms available on orders above £10.

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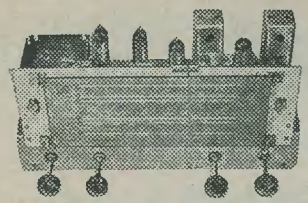
BRITISH HEATHKIT CATALOGUE .....

FULL DETAILS OF MODEL(S) .....

DAYSTROM LTD DEPT. RC12 GLOUCESTER . ENGLAND

A member of the Daystrom Group, manufacturers of the WORLD'S LARGEST-SELLING ELECTRONIC KITS



1959 RADIOGRAM CHASSIS

THREE WAVEBANDS — FIVE VALVES
S.W. 16 m.–50 m. — LATEST MULLARD
M W. 200 m.–550 m. — ECH81, EF89, EBC81,
L.W. 800 m.–2,000 m. — EL84, EZ80

12 month Guarantee. A.C. 200/250V, 4-way switch. Short-Medium-Long-Gram. A.V.C. and negative feedback. 4.2 watts. Chassis 13½" x 5½" x 2½". Glass dial, horizontal or vertical, size 10" x 4½". 2 pilot lamps. Four knobs, walnut or ivory, aligned and calibrated. Chassis isolated from mains. Leaflet S.A.E.

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/–
New 6V AM/FM model. £18.19.6.

LATEST "E.M.I." 4 SPEED SINGLE RECORD PLAYER

Acos 73 Hi-Fi Stereo and Normal Xtal Pick-up for 7", 10" and 12" records — Silent Motor, Heavy Turntable

Special offer **£6.19.6** post 3/6

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" ellip 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
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New boxed VALVES 90-day Guarantee

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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

B.B.C. Pocket Transistor. M.W. & L.W. Radio Kit 32/6. 'Phones 7/6. Ardente deaf aid earpiece with special lead and plug 15/-.

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, 10 watt, 15 watt — **1/3, 1/6, 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 ½W Carbon Track 30kto 2 Meg, **3/–**.

3W Lab. Colvern, etc. Standard size Pots, 2½" 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. 250V 45mA, 6.3V 2A — **15/6**
SMALL. 250-0-250V 100mA, 6.3V 3.5A — **19/6**
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" Osram "912" 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, **14/–**.

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Precision engineered. Size only ⅞" x ¾"
ACOS CRYSTAL HAND or DESK MIKE, 35/–

ALADDIN FORMERS and cores. ¼" **8d.**, ⅜" **10d.** **0.3" FORMERS** 5937 or 8 and cans TV1 or 2. ⅜" sq. x 2½" or ¾" sq. x 1¾", **2/–** with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6-1, **2/3.**
TYANA. Midget Soldering Iron. 230V 40W, **16/9.**
REMPLOY INSTRUMENT IRON, 230V 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 TRANS. 50:1, **3/9**; 100:1, potted, **10/6.**
LOUDSPEAKERS. P.M. 3 ohm. 5", Rola **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", **95/-.**
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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.
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SHORT WAVE Single 75pF, 100pF, 160pF, **7/–** each.
TUNING AND REACTION CONDENSERS. 100pF, 300pF, 500pF, **3/6** each, solid dielectric.

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Buses 133 or 68 pass door S.R. Stn. Selhurst.

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48 hour postal service 1/–, over £2 post free. C.O.D. 1/6 (Export welcome. Send remittance and extra postage)

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.—Same prices
Tuneable channels 8 to 13. Gain 17 dB ECC84 valve.

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

Post 1d. per yard
Semi-air spaced Polythene Ideal Band III **6d** yd.
Losses cut 50%
FRINGE QUALITY
Air spaced Coaxial **1/-** 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, 3 mm, **3d.**, 6 mm, **5d.** yd.
NEON MAINS TESTER SCREWDRIVERS, 5/-.
SOLDER RADIOGRADE, 4d. yard ½lb **2/6.**

Aluminium Chassis. 18 s.w.g. Plain, undrilled, 4 sides, riveted corners, lattice fixing holes, 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 D.W.R. 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. 0.001μF 7kV T.C.C., **5/6**; ditto 20kV, **9/6**; 0.1μF 7kV, **9/6**; 100pF to 500pF Micas, **6d.**; Tubular 500V 0.001 to 0.05, **9d.**; 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 — TUBULAR

1/350V	2/–	64/350V	5/6
2/450V	2/3	100/25V	2/–
4/450V	2/3	250/25V	2/6
8/450V	2/3	500/12V	3/–
8/500V	2/9	8+8/450V	4/6
16/450V	3/6	8+8/500V	5/–
16/500V	4/–	8+16/450V	5/–
32/450V	5/6	8+16/500V	5/6
25/25V	1/9	16+16/450V	5/6
50/25V	2/–	32+32/350V	4/6
50/50V	2/–	32+32/500V	7/6

FAMOUS MAKES CAN TYPES

8/500V	3/–
16/500V	4/–
32/350V	4/–
100/270V	5/6
2,500/3V	4/–
6,000/6V	5/–
32+32/350V	4/6
50+50/350V	7/–
64+120/275V	7/6
64+120/350V	11/6
100+200/275V	12/6

Full Wave Bridge Selenium Rectifiers. 2, 6 or 12V 1¼A, **8/9**; 2A, **11/3**; 4A, **17/6.** Free charger circuit.
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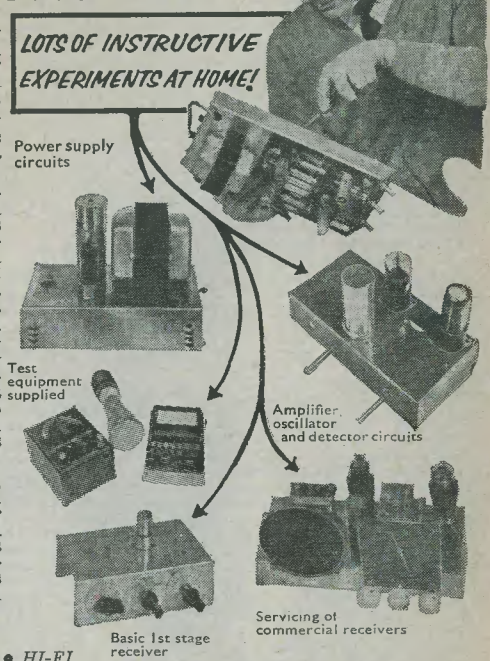

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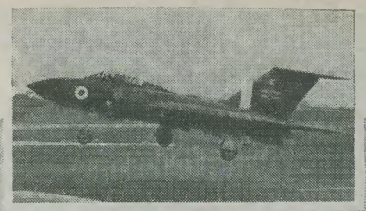

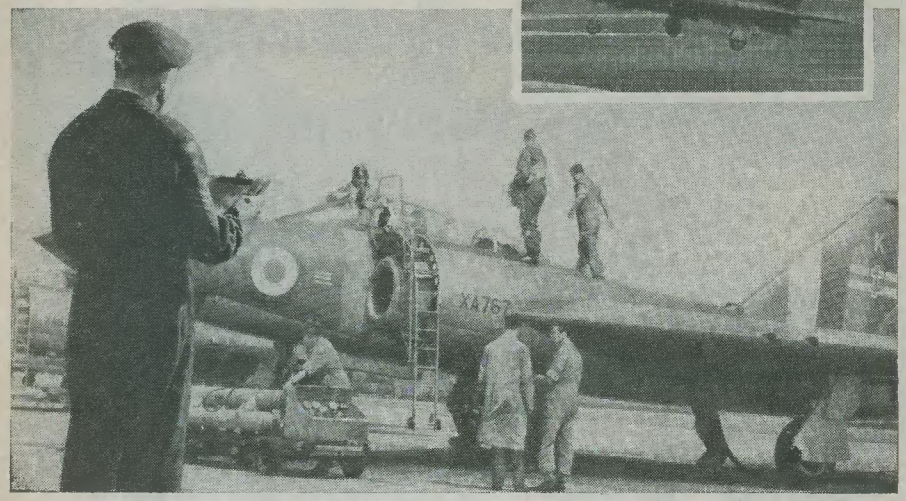

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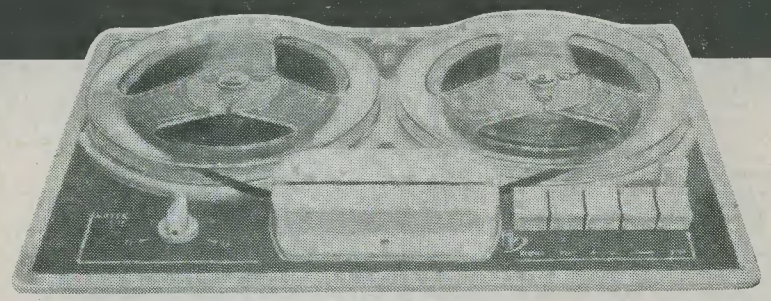

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TWO VERY INTERESTING ARTICLES HAVE recently come to the writer's notice. The first of these[1] describes a light-operated relay unit which possesses some unusual design features. The unit, which was installed at an Industrial Fair in Wellington, New Zealand, causes a buzzer to sound whenever the trigger of a rifle, fitted with an internal light bulb and pointing directly at the centre of a target, is pulled. The trigger operates a shutter in the barrel of the rifle, thereby illuminating a photocell immediately behind the target centre. The most interesting design feature of this device is that the photocell is connected to a fairly conventional a.f. amplifier and that this amplifier handles the *pulse* resulting from the sudden illumination of the photocell. The amplified pulse energises a relay with a "hold-on" contact in the output anode circuit and this relay, in its turn, causes the buzzer to sound. The device does not respond to slow-changing variations in ambient illumination and no special shielding of the photocell against incident light is required.

The second article[2] describes the new TF.868B Universal Impedance Bridge manufactured by Marconi Instruments Ltd. Part of this second article deals with the balance indicator employed for the resistance-measuring bridge circuits. The bridge is energised by direct current and the voltage between its two balance arms is converted to a.c. by a mechanical vibrator, or chopper, which runs at 80–120 c/s. The a.c. from the chopper is then amplified by an a.f. amplifier, the output of which is detected and fed to an indicating meter. Care is taken to ensure that hum and high frequency components do not reach the detector. The device is capable of considerable sensitivity, and can give useful indications with only a few millivolts d.c. from the bridge.

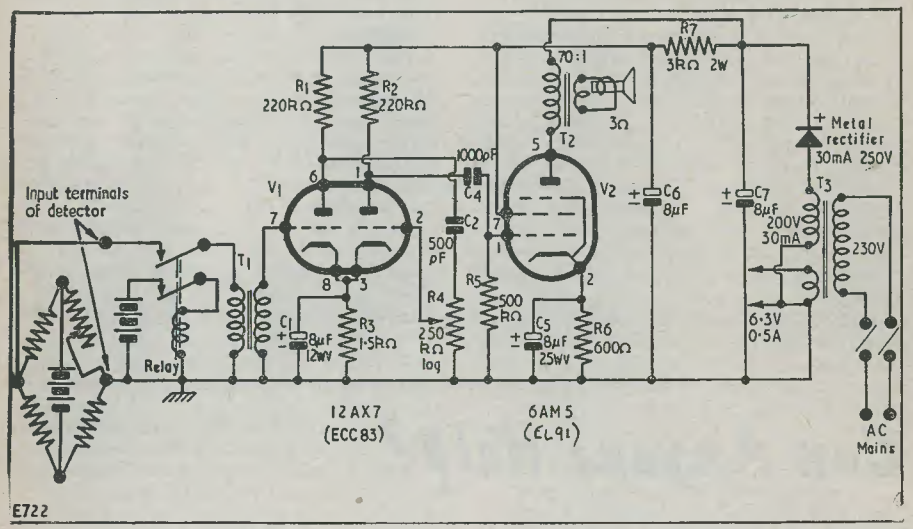
Both these designs have the feature that effective amplification of a direct voltage is achieved by a.c. amplifier techniques. In the first case it is a pulse which is handled and, in the second, it is a square-wave a.c. which is handled.

The writer felt that it would be interesting to see whether the principles employed in the two devices could be combined together in a form suitable for home-constructor use; and this month's circuit provides the result he arrived at.

The circuit discussed in this article is intended to operate as a very sensitive d.c. null detector. The direct voltage applied to the detector input terminals is chopped by mechanical means at a frequency of some 5 to 20 c/s. The resultant square wave is then applied to an amplifier which, by differentiation, causes each cycle to be converted to one positive-going and one negative-going spike. The spikes are then passed to a loudspeaker which reproduces them as a series of closely-spaced "clicks," indication of null being given by minimum volume from the speaker. A loudspeaker method of null indication has been chosen here because of its cheapness and also because it takes advantage of the ear's ability to distinguish between the distinctive noise given by the spikes and any background noise, such as hum, which may be present.

1 "A Special-Purpose Light-Operated Relay," *Radio and Electrical Review* (New Zealand), May, 1959.

2 "The Marconi TF.868B," by E. C. Crawford, *Marconi Instrumentation*, September, 1959. *Marconi Instrumentation* is published by Marconi Instruments Ltd., St. Albans, Herts.



The Circuit

The ciruit of the detector accompanies this article, and it may be seen that the input voltage (obtained for purposes of illustration here from a Wheatstone bridge) is applied to a contact set on a relay. A second contact set on the relay is connected between its coil and a battery in such a manner that the relay energises and de-energises continuously in the manner of an electric bell or buzzer. Thus, the first contact set causes the input voltage to be interrupted at the frequency at which the relay operates, this interrupted voltage being passed to the primary of an a.f. transformer, T_1. The secondary of T_1 couples to an a.f. amplifier and, thence, to the speaker.

The circuit of the amplifier is similar to one used very successfully by the writer some years ago,[3] and which is capable of offering a very high level of gain. Especially of interest in the amplifier circuit, so far as its present application is concerned, are the low-value coupling condensers C_2 and C_4. The original purpose of these condensers was that of reducing hum and low-frequency response, but they now serve the additional function of differentiating the square wave applied to T_1. In consequence each cycle applied to T_1 appears on the grid of V_2 in the form of two successive spikes of opposite polarity, each being capable of causing a "click" to be heard from the speaker. The amplitude of the spikes is limited at the grid of V_2, incidentally, by the fact that an excessive positive-going spike causes grid current to flow and that an excessive negative-going spike takes the grid beyond cut-off.

If, when the device is connected up and operating, a d.c. voltage is applied to the input terminals, a succession of closely spaced "clicks" should be heard from the loudspeaker. As the d.c. diminishes in value so, also, does the volume of the "clicks." When the d.c. voltage is zero there should be no "clicks" from the speaker.

Practical Points

There are a number of practical points to clear up. The first of these concerns the relay. No specific type is recommended here as the constructor may wish to take advan-

3 Suggested Circuits No. 71, "A Very High Gain Low-Cost Amplifier," *The Radio Constructor*, October, 1956.

tage of whatever components he may have on hand. The relay is shown in the diagram as being operated from a battery but the latter may, of course, be replaced by a suitable mains power unit. It would be undesirable to attempt to operate the relay from the amplifier h.t. supply unless heavy decoupling was used to prevent coil switching impulses from appearing on the h.t. line. If it is found difficult to make the relay operate at the requisite frequency and with adequate movement of the armature, it should be electrically "slugged" by connecting a resistor across its coil. The value of this resistor will have to be found by experiment, but it will be commensurate with coil resistance.

Transformer T_1 needs to be a high-impedance a.f. type having a ratio lying between 1:1 and 1:5. An "inter-valve" transformer would be ideal here.

The amplifier proper needs little comment, as its operation is simple and straightforward. A 6AM5 is not essential for the V_2 position, as any output pentode with similar power capability will cope in this position. Alternative output valves may, however, make greater demands upon the simple power supply arrangements shown in the circuit. It will be noted that the decoupling circuits are extremely rudimentary. This was a feature of the original amplifier and is possible because of the reduced low frequency response.

The greatest precaution which needs to be taken in the circuit is the avoidance of hum pick-up in the circuit around T_1. Because of this it may be necessary to screen the lead from the primary of the transformer to the upper contact set of the relay and, also, the lead from this contact set to the bridge itself. Care should also be taken to prevent hum injection due to inductive coupling between T_1 and T_3. If these two components are kept well spaced from each other this coupling should cause no trouble. Care needs to be taken, also, to prevent pick-up of the noise generated in the energising circuit of the relay. This trouble, if it appears, should be cleared by fitting screening between the two contact sets and by earthing the metal work of the relay to chassis.

A gain control is provided by R_4. This should be brought out to the front panel, whereupon it can be employed as a sensitivity control.

Sensitivity

The sensitivity of the indicator should be very high. A spike of one volt amplitude on the primary of T_2—which should cause a clearly audible "click" from the speaker—corresponds to an input voltage (assuming no losses, and a 1:1 ratio in T_1) of 0.0063mV only. It is doubtful if such a high sensitivity can be achieved in practice due to losses, especially in T_1, and also because some rounding-off of the spikes will occur in the amplifier, thereby reducing their audible effect. Nevertheless, it should be possible to achieve a sensitivity of at least several millivolts quite readily.

Can Anyone Help?

Requests for data are inserted free of charge. Enquirers undertake to answer all correspondence and defray all expenses

CR100 Modifications, etc.—D. Bowers, 24 Home Park Road, Saltash, Cornwall, a disabled S.W.L., would like any amateur or enthusiast to loan or sell him any modifications or improvements to the CR100 receiver. Also wanted are copies of *QST*, *CQ*, *Radio Handbook*, by Editors and Engineers, since 1953, cheap if possible.

* * *

Monitor Type 61.—D. M. Macphee, 22 Birch Avenue, Upton, Wirrall, Cheshire, would be extremely grateful if any reader could supply him with circuit diagram and modification details to convert the above unit into an oscilloscope suitable for t.v. servicing.

* * *

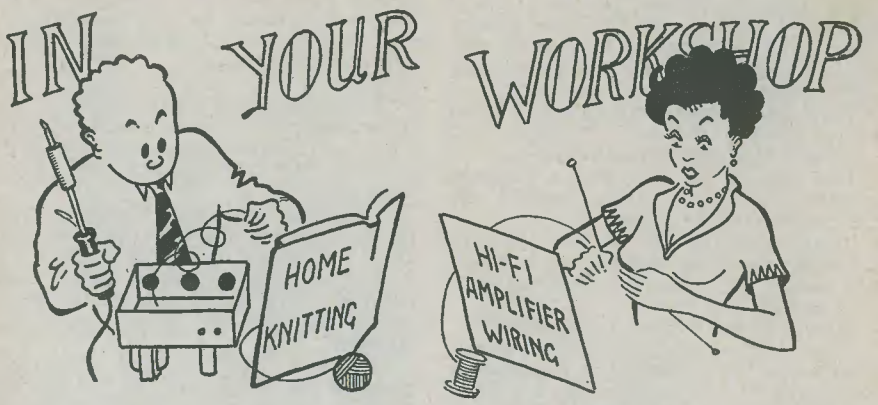
A.M. Crystal Filter Unit type 53 and 1172 Receiver.—H. L. Braham, 25 Chiltern Road, Newbury Park, Ilford, Essex, is trying to find some information on the two items of equipment above. Can any reader help?

* * *

MCR1 Receiver.—K. F. Gosling, "Melville Cottage," Park View Road, Woldingham, Surrey, would like to receive a circuit diagram and any other information on this receiver. All expenses met.

* * *

BC221 Frequency Meter.—G. A. Bould, 27 Horsford Street, Weymouth, Dorset, would like any information on adding an LF modulator, valve or transistor, to this unit. In particular, has any reader used with the BC221 the Transistor Audio Signal Generator described in the August 1959 issue of *The Radio Constructor*?



This month Smithy the Serviceman discusses with his able assistant, Dick, the vagaries of frame output stages, and introduces him to the ever-present problem of tolerances

THERE IS A TENDENCY, STRONGLY CONdemned by the literary critics, for the Modern Novel to become more and more Symbolic in character. Whatever the literary critics might have had to say about the state of affairs existing in the Workshop one early winter's morning, there is little doubt that many Modern Novelists might have readily employed it to illustrate a direct connection between Symbol and Emotion.

In front of Smithy was a television receiver displaying a circle of immaculate roundness and symmetry; and Smithy was chirpily happy in consequence. In front of Smithy's assistant, Dick, was a second television receiver. This exhibited a circle which was round only over its lower 270 degrees, the uppermost section being elongated to at least twice its normal height. And, because of this, Dick was fretful and miserable.

A Modern Novelist who was really on the ball would have taken this situation firmly in hand by defining Smithy's perfectly round circle as being representative of self-sufficient and cheerful maturity; and by equating Dick's egg-shape in terms of youth still controlled, subconsciously, by the ovum. Or something of that order, anyway; and certainly to the extent of a good few hundred words.

Dick, whose idea of the Modern Novel encompassed only the works of Hank Jansen and who would say that Symbols were what the local Salvation Army used when they had the full band out, was not a person to remain depressed for very long—even when confronted by the ovate. Turning away from his receiver he suddenly cheered up rapidly, and inflated his lungs.

"Smithy," he yelled out, "please give me a hand, will you?"

Frame Output Fussiness

"What's up?" said the Serviceman.

"It's this darned t.v. set," replied Dick, bitterly. "It's got a bad attack of vertical non-linearity and I've spent ages trying to clear it. Right now, I'm stumped for ideas."

The Serviceman did not move from his chair or, even, turn his face away from his own work.

"Are you getting sufficient height?" he said, over his shoulder.

"Stacks."

"And have you checked the condensers, particularly the paper ones, in the frame output stage for leakiness?"

"Every one, and they're all as sound as a bell."

"Are you absolutely sure? A 10MΩ leak in a condenser in the frame output stage, especially if it's in the feedback circuits, can sometimes cause havoc, you know."

"I've checked them thoroughly," replied Dick confidently, "and they're all perfect."

"Resistors O.K. and on value?"

"Whereabouts?"

"Again, in the output stage."

Dick hesitated.

"They should be now," he remarked at length. "I had one that had gone high in value, but I've swapped it for a brand new one. I must admit, though, that the new one didn't improve the linearity very much."

The Serviceman grunted, and left his bench to look at Dick's chassis.

"Where is the one you took out?"

Dick showed the Serviceman a half-watt component. Smithy then examined the replacement on the chassis.

"Well," he remarked, "the very first thing I can see is that you've taken out a 1.2MΩ 5% resistor and replaced it with a 1.2MΩ 20% resistor."

"Is that liable to cause much trouble?"

"It *might* do. Manufacturers don't usually fit expensive 5% resistors if they can get away with cheaper low-tolerance units. See if you can find another 1.2MΩ resistor of the right tolerance."

Dick hunted around and soon found a component of the right type. Under Smithy's watchful eye he carefully removed the component he had already fitted, and soldered in the new one.

"Right," said Smithy, as Dick switched on, "let's see how this one behaves."

As soon as the set warmed up and Test Card "C" appeared, Dick tackled the linearity controls. To his considerable surprise he found that he was able to achieve frame linearity which was perfectly acceptable.

"Well, I'm dashed," he remarked. "So it *was* that resistor after all."

"So it was," repeated Smithy a little drily, "and I hope this brings home the lesson that close-tolerance components should always be replaced by components of similar tolerance."

"You must admit," said Dick, on the defensive, "that you didn't sound too certain, yourself, that the new 5% resistor would clear the bad linearity."

"I wasn't," confessed Smithy. "Firstly, because frame output stages are notoriously fussy on component values so far as linearity is concerned and some other equally abstruse fault might have been in existence; and, secondly, because the value of the 20% resistor might have fallen within the 5% tolerance in any case!"

Dick considered these two points for a moment.

"Why," he asked, "do you say that frame output stages are temperamental with regard to linearity?"

"Because of the job they have to do," replied the Serviceman promptly. "They have to ensure that a sawtooth waveform having a very low frequency is fed into the deflection yoke at quite a high power and with low distortion. Also, the feeding has to be done via an iron-cored transformer whose mutual inductance, between primary and secondary, is liable to change quite considerably during the cycle."

"Hey?"

"I'm quite serious," said Smithy. "The permeability of the iron core decreases as the output valve draws more current through the primary, and this reduces the mutual inductance."

"I still can't see why all this should make the frame output stage so touchy," remarked Dick. "A square wave is probably just as hard, if not harder, to amplify than is a sawtooth, and yet a square wave can be handled almost distortion-free by any good hi-fi amplifier."

"That's a different thing altogether," protested the Serviceman. "A hi-fi amplifier employs output valves having plenty of power in reserve, and it uses a pretty massive output tranny. Also, it's designed to have considerably more gain than is really needed, so that plenty of negative feedback can be applied. If you started putting hi-fi circuitry into the frame section of a t.v. set its price would go up by another twenty to thirty quid.

"What you have to do in the frame output stage instead is to keep costs to a sensible level by using an output valve which has just enough beef for the job and an output tranny which is just big enough to cope. It's true that you use n.f.b. circuits in a frame output stage but, since you haven't got much gain in hand, these circuits are not able to exert a high level of control. All they can do is 'trim up' the linearity."

"Fair enough," said Dick, ruminatively. "I must say that it all sounds very reasonable. What you've told me explains also why all your questions just now were concerned with the frame output stage."

"That's right," confirmed Smithy. "If you get bad frame linearity and the frame oscillator seems to be giving plenty of whack, always suspect the frame output stage."

"What about the frame output valve?"

"That's a good suspect. If the frame output valve is getting weary of life you usually get trouble around the bottom of the picture because that corresponds to maximum anode current through the primary. A tired bottle will have trouble drawing sufficient current."

"Do you have to select valves to get best results from the frame output stage?"

"Not normally. Frame output valves seem to be much of a muchness provided they can pass the requisite current. You may quite probably find, however, that different valves need slightly different linearity control settings."

A Question of Tolerance

"Okey dokey," said Dick. "Now what about your second point? That of tolerance? You said that I might have fitted a resistor which fell within 5% tolerance even if it was marked 20%."

"So I did," said Smithy, "and such a thing could quite easily occur. However, in your case it so happened that the component you fitted was well outside the 5% tolerance range, and it was that which caused you all your trouble. And I must say again," Smithy added, "that you should always try to replace a low tolerance component in a fussy circuit with one of the same tolerance. I might add that, if you haven't got the low tolerance type available, you should measure those you *have* got in order to find one that falls into the required range of values."

"Well, I suppose you're right," conceded Dick, "and I admit that I dropped a clanger in this particular instance. Nevertheless, I think that most people, nowadays, have got into the habit of fitting replacement components of any old tolerance. They seem to get away with it."

"Well, I certainly wouldn't agree with sweeping generalisations such as that," said Smithy, "because I don't think you're correct. I feel we have a more personal problem here—your own inability to visualise how wide a 20% tolerance is. Let me give you an example."

Smithy unearthed a piece of paper and proceeded to sketch out a circuit.

"Now here," he remarked, "we have a simple a.f. phase-splitter of the type you encounter very frequently in ordinary amplifier work. (Fig. 1.) There is a resistor between h.t. plus and the triode anode, and another between chassis and the triode cathode. The function of the phase-splitter is to pass equal voltages of opposite phase to the push-pull output stage which follows. O.K. so far?"

"Surely."

"Right. Now let's give these two resistors a value and a tolerance. The value could quite comfortably be 100kΩ, and for the purpose of my argument, we'll make the tolerance 20%. Still O.K.?"

"Yep."

"Fine. Now, at any given instant of time, the same current flows through both these resistors; so that we may say that the a.f. voltage appearing across each will be directly proportional to its resistance. Any questions?"

"Nope."

Dick was beginning to look a little bored.

"Fair enough," said the Serviceman. "If we were unlucky, it could quite easily happen that the upper resistance was on bottom tolerance, making it 80kΩ, and that the lower resistance was on top tolerance, making it 120kΩ. With the consequence that the ratio between the a.f. voltages developed across the two resistors will be 80:120. When you cancel things down this is the same as 1:1.5. Still with me?"

"Definitely," said Dick, his boredom vanished.

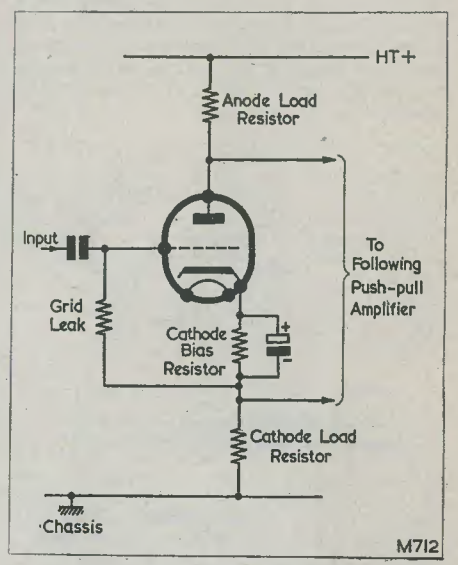


Fig. 1. A typical phase-splitter. If the anode and cathode load resistors have equal values the a.f. volts built up across them should be equal in amplitude

"And the *final* result," said Smithy, grandiosely, "is that by the use of the 20% resistors in the phase-splitter circuit you have achieved a state of affairs where the voltage passed to the output stages by the lower resistor is no less than 50% higher than that passed by the upper resistor."

"Golly," said Dick, impressed, "I hadn't realised that the error could blow up to as high a proportion as that."

"Well, it does do so," chuckled the Serviceman. "In this instance the error is the result of two tolerances working in opposite directions, with the result that you get an effect which is twice as bad."

"That's funny," said Dick, puzzled. "If it were twice as bad, the difference between the two voltages would have been 40 and not 50%."

Mechanical Tolerances

"The question of tolerances," said Smithy carrying on hurriedly, "is usually far more troublesome when mechanical dimensions are being looked into. I think, now that I'm getting you tolerance-minded, we ought to look into a simple design problem where mechanical tolerances assume considerable importance." Smithy scribbled away on his piece of paper. "For instance, how would you dimension the two parts I've drawn here if they were to be mass-produced? One part is a bush, and the other is a spindle which passes through it and must be free to rotate in it. (Fig. 2 (*a*).) These two pieces could easily be the part of a cord drive tuning mechanism on to which the tuning knob fits."

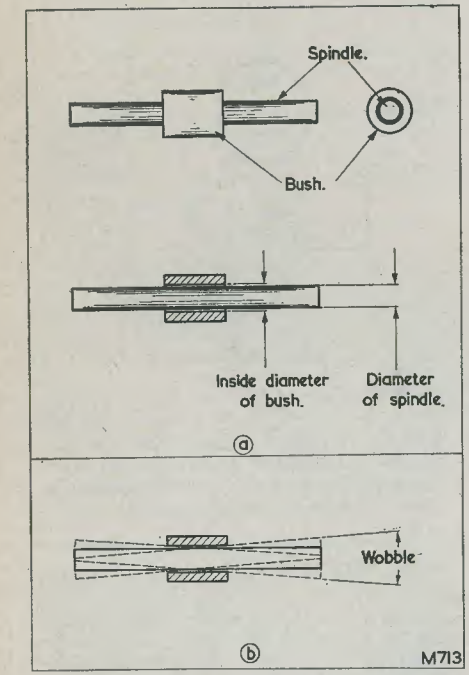


Fig. 2 (a) A typical bush and spindle assembly. The lower diagram shows a section through the centre of the assembly. (b) The amount of spindle wobble is proportional to the clearance between spindle diameter and bush inside diameter

"How d'you mean, dimension them?"

"Their diameters."

"Oh," said Dick, thoughtfully. "Well, I suppose that if the spindle is going to have a knob put on it I might as well give it a diameter of quarter of an inch."

"And the inside diameter of the bush?"

"Well, slightly above quarter of an inch." Smithy chuckled.

"It's not as easy as all that," he said. "A spindle and bush assembly of this nature is a notoriously difficult thing to handle. If the spindle is too tight in the bush it won't turn. If it's too loose you get a wobble effect. Like this. (Fig. 2 (*b*).) I know, incidentally, that the length of the bush will affect wobble but we'll ignore that for the time being."

Smithy stopped for a moment, as he lit a cigarette.

"To get you started," he resumed, "I'll say that the sort of tolerance you find in practice on parts of this nature is something like this. The spindle could have a diameter of 0.250 inch—that's your quarter-inch—with a tolerance, say, of plus or minus 0.0015 inch. This gives you a minimum of 0.2485 inch and a maximum dimension of 0.2515 inch. It should be possible to hold the inside diameter of the bush to the same tolerance or, even, significantly better. Let's say we can make it plus or minus 0.001 inch. Now, the clearance we need between bush and spindle to enable the latter to turn nicely and freely is, rough check, 0.001 inch again. So what do you think we should make the inside diameter of the bush?"

"Well," said Dick thoughtfully, "the spindle is 0.2515 inch on top tolerance. We need 0.001 inch clearance, so we should make the bush inside diameter 0.2525 inch."

"But I've just said," interjected Smithy, "that the tolerance on the bush inside diameter is plus or minus 0.001 inch. Your 0.2525 bush on bottom tolerance will be 0.2515 inch, whereupon it will seize up solid if you put a top tolerance spindle into it."

"Ah," said Dick quickly. "But how often will that happen?"

Smithy's eyes turned despairingly to the ceiling.

"If you've a good designer it should *never* happen. What you have to do is to make the bush inside diameter 0.2535 inch. Then, when it is on bottom tolerance it will still be 0.001 inch up on a top tolerance spindle."

"That's all very well," said Dick, scribbling figures on Smithy's paper, "but what happens if you're the other way round? A spindle on bottom tolerance will be 0.2485 inch and a bush on top tolerance will be 0.2545 inch. There's all of 0.006 inch clearance there. Won't that give you a lot of wobble?"

"Ah," said Smithy, satisfied, "now you're beginning to get the right idea! If you're designing a bush and spindle assembly such as that we're discussing here, you have to take two limiting factors into consideration. The first, and most important, limiting factor is that there must always be 0.001 inch clearance between the two diameters if the spindle is not going to be tight. After that you have to find your second limiting factor —how far can you go the other way before wobble becomes unacceptable. If the wobble given by 0.006 inch clearance is just as bad as we can go, then the tolerances we have just quoted will work very nicely. Alternatively, it may happen that a clearance of as much as 0.01 inch between diameters is acceptable, whereupon we could ease the tolerance figures we spoke of just now."

"You know," confessed Dick. "This is opening up an entirely new world to me. I've never even *thought* of mechanical tolerances before now. I just accepted the fact that most things fit! But, *must* we have tolerances? Why can't people make things *exact?*"

"Because it's impossible," said Smithy. "There must inevitably be tolerances somewhere. If you look at any engineering manufacturing drawing you will see tolerances on all its dimensions."

"Yes," persisted Dick, "but suppose I asked you to make something which was exactly one inch long. Couldn't you make it *exactly* one inch long, as measured by, say, a micrometer?"

"Even were I to attempt the job," said Smithy, "I would ask for tolerances, if only to take up errors in reading the micrometer! In any case the manufacturer of the micrometer would never guarantee that it was measuring *exactly* one inch. He would say it was measuring one inch plus or minus the tolerance he allowed in its manufacture."

"I give up," said Dick, disgustedly. "At any rate, I can definitely forget this tolerance business during my normal servicing work, if nowhere else. I do at least know that if I read 100 volts with my testmeter it *is* 100 volts."

"You don't, you know. The testmeter calibration accuracy is only guaranteed within a certain percentage of full scale deflection!"

"Oh, come off it, Smithy," protested Dick, "if what you say is true then there's *nothing* exactly correct in electronics at all. Everything is an approximation."

"Everything we measure is an approximation," said Smithy, correcting him. "And it is a salutary exercise of the mind to realise that it *is* an approximation."

"Some of the dimensional tolerances we were talking about just now were pretty small, weren't they?" questioned Dick, returning to the previous subject. "I mean such things as 0.001 and 0.0015 inch. 0.0015 inch is only one and a half thousandths of an inch, isn't it?"

"That's right," said Smithy, cheerfully, "but you quite often have to chase the odd half a 'thou' in things of this nature. You wouldn't normally require such tight tolerances if you were, say, dealing with the positioning of holes on a chassis. Something like plus or minus 10 or 20 'thou' would cope here."

Juggling Figures

Dick seemed satisfied with this and Smithy left him to carry on with his work.

After some minutes, however, Dick called out again.

"I *knew* there was something fishy in those figures of yours."

"What figures?" said Smith defensively.

"The figures you quoted when you did that explanation with the phase-splitter. You said that one voltage was 50% higher than the other."

"So it is," said Smithy, trying to suppress a grin.

"But," said Dick, aggressively, "if you take it the other way round, you could also say that one voltage was 33⅓% *lower* than the other. Which is a lot less than your 50% figure!"

Smithy laughed.

"I wondered how long it would be before you twigged it," he chuckled. "I'm afraid I couldn't resist using the higher figure to put my point over. Still, there's no harm done, I hope."

But Dick was lost in a further puzzle.

"I seem to have stumbled on something new here," he remarked thoughtfully. "Now, if I had to specify that the two voltages were within a certain percentage of each other I could get quite different results if I based the percentage on the higher instead of the lower voltage." He scribbled away furiously. "Now let's assume x % difference on either voltage and work out . . ."

His voice died away to an intermittent mutter as he struggled with his figures. The grinning Serviceman left him to it, realising after a glance at the clock that it was very nearly time for elevenses. Dick's mind would soon be diverted from his problem by the soothing action of a cup of tea.

The tea being, of course, Symbolic of Refreshment and Spiritual Restoration.

UNDERSTANDING TELEVISION

PART 23

By W. G. MORLEY

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

IN LAST MONTH'S ARTICLE WE COMMENCED an examination of the deflection circuits of the television receiver. We saw that the line and frame deflection sections usually consist of sawtooth generators, output valves and output transformers which couple directly into the appropriate deflection coils. We then discussed a capacitive "sawtooth-forming circuit" and showed the relationship between sawtooth linearity and amplitude and the component values employed in the circuit.

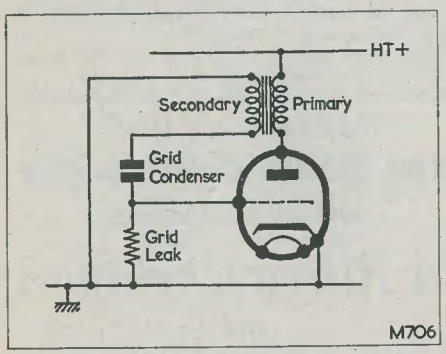


Fig. 124. The basic circuit of the blocking oscillator

Deflection Oscillators

In order that the "sawtooth-forming circuit" of Fig. 123 (*a*)[1] may be employed in a practical manner it is necessary that the condenser be made to charge and discharge at regular intervals by means of an oscillator, the frequency of the latter being easily controllable. In television receiver design two basic types of oscillator are employed to carry out this function. One basic type is known as a *blocking oscillator*, and the other as a *multivibrator*. We shall consider the blocking oscillator first.

The Blocking Oscillator

A typical blocking oscillator is illustrated in Fig. 124. In this diagram we have a triode valve in whose anode circuit is connected the primary winding of a transformer. The secondary winding of the transformer connects to the grid of the triode via a grid condenser and grid leak.

In order to describe the functioning of the blocking oscillator, it is useful to commence at a point in its oscillatory cycle when the anode commences to draw current through the primary winding. The inductance of the primary winding opposes the flow of current, with the result that this does not rise to a maximum value instantaneously. Instead it increases at a rate governed by the inductance.

[1] Accompanying last month's article.

The increasing current in the primary winding causes an expanding magnetic field to be produced in the transformer, the lines of force of which pass through the secondary winding and induce a voltage therein. The secondary winding is connected to grid and cathode such that this induced voltage causes a positive potential (with respect to chassis) to be applied to the grid via the grid condenser. Since the grid and cathode of the triode form an effective diode, the grid goes only slightly positive of the cathode, and the secondary voltage causes the grid condenser to become charged, its left-hand plate being positive. At the same time, the fact that the valve grid is slightly positive of its cathode ensures that the only hindrance to flow of maximum possible anode current is presented by the inductance of the primary winding.

After a period, the current flowing in the primary of the transformer ceases to increase, either because the valve has become saturated or because the transformer has become saturated.[2] In consequence the magnetic field becomes stationary and the induced voltage across the secondary winding commences to drop. The drop in secondary voltage results in the grid going negative, with a consequent reduction in anode current. This reduction, in its turn, causes the field in the transformer to contract, thereby inducing a voltage in the secondary having opposite polarity to that resulting from the expanding field. The grid, in consequence, rapidly goes further negative. The valve, by this time, is biased far beyond cut-off and anode current is nil.

During the time when anode current was increasing and before saturation occurred, the grid condenser was charged by the secondary such that its left-hand plate was positive. The condenser still holds this charge (or most of it) and it now causes a negative potential, well beyond cut-off, to be applied to the grid of the triode. The grid condenser cannot retain its charge, however, because the grid leak, in series with the secondary winding, is connected across it; and it discharges slowly. After a period, the charge on the condenser falls below cut-off value, with the result that the valve is able to draw anode current once again. Flow of anode current causes an expanding magnetic field in the transformer to be produced by the primary winding, whereupon the voltage induced in the secondary causes the grid to go positive once more and another cycle commences.

In order to understand the operation of the blocking oscillator more fully, it will be helpful to look at the voltage waveforms which appear on grid and anode of the triode. The grid waveform is shown in Fig. 125 (*a*). Before point A of this waveform we have the case where the grid condenser is slowly discharging into the grid leak, thereby causing the grid to become progressively less negative. At point A, the grid voltage becomes equal to the cut-off voltage for the valve, and anode current commences to flow. Due to the voltage induced in the transformer secondary the grid goes positive very rapidly, and it stays positive until point B is reached. At point B saturation occurs, and it is after this point that the violent negative swing of grid voltage, to point C, occurs. After point C there is a small positive excursion to point D, caused by the secondary voltage returning to zero, and this is followed by the slow decrease in negative voltage which results from the grid condenser discharging into the grid leak. At point E we reach cut-off potential once more and another cycle starts.

The corresponding anode voltage waveform is shown in Fig. 125 (*b*). (The letters in this diagram correspond to those in Fig. 125 (*a*).) As we approach point A we have the case where the grid is biased beyond cut-off and the anode draws no current. In consequence anode potential is the same as that of the h.t. supply. At point A we obtain the sudden increase in anode current initiated by the grid voltage falling below cut-off, this increase causing the anode voltage to decrease until it reaches a minimum at point B. After point B we get the rapid negative excursion of grid voltage. The anode at once ceases to draw current and, due to the collapse of the field in the transformer, its voltage actually goes positive of that on the h.t. rail to point C. The anode returns to h.t. positive potential at point D, and remains at this potential until the next cycle commences at point E. It is important to note that the anode only draws current between point A and a point situated shortly after point B. The anode current waveform is illustrated in Fig. 125 (*c*).

It is desirable, when blocking oscillators are employed in television receivers, to make the periods when anode current flows short, and the periods when the grid is beyond cut-off, or is "blocked,"[3] long. The length of time during which the anode draws current is dependent mainly upon the design of the blocking oscillator transformer, together with the characteristics of the valve. The length of the cut-off period, on the other hand, is mainly dependent upon the values of the grid condenser and grid leak.

In a television receiver it is necessary for us to couple the blocking oscillator to a

[2] A valve is saturated when it passes the maximum current which the cathode is capable of emitting. Saturation in a transformer can only occur when it is iron-cored (as are all conventional television blocking oscillation transformers) and it happens when the iron core is capable of no further magnetisation.

[3] Hence the term blocking oscillator.

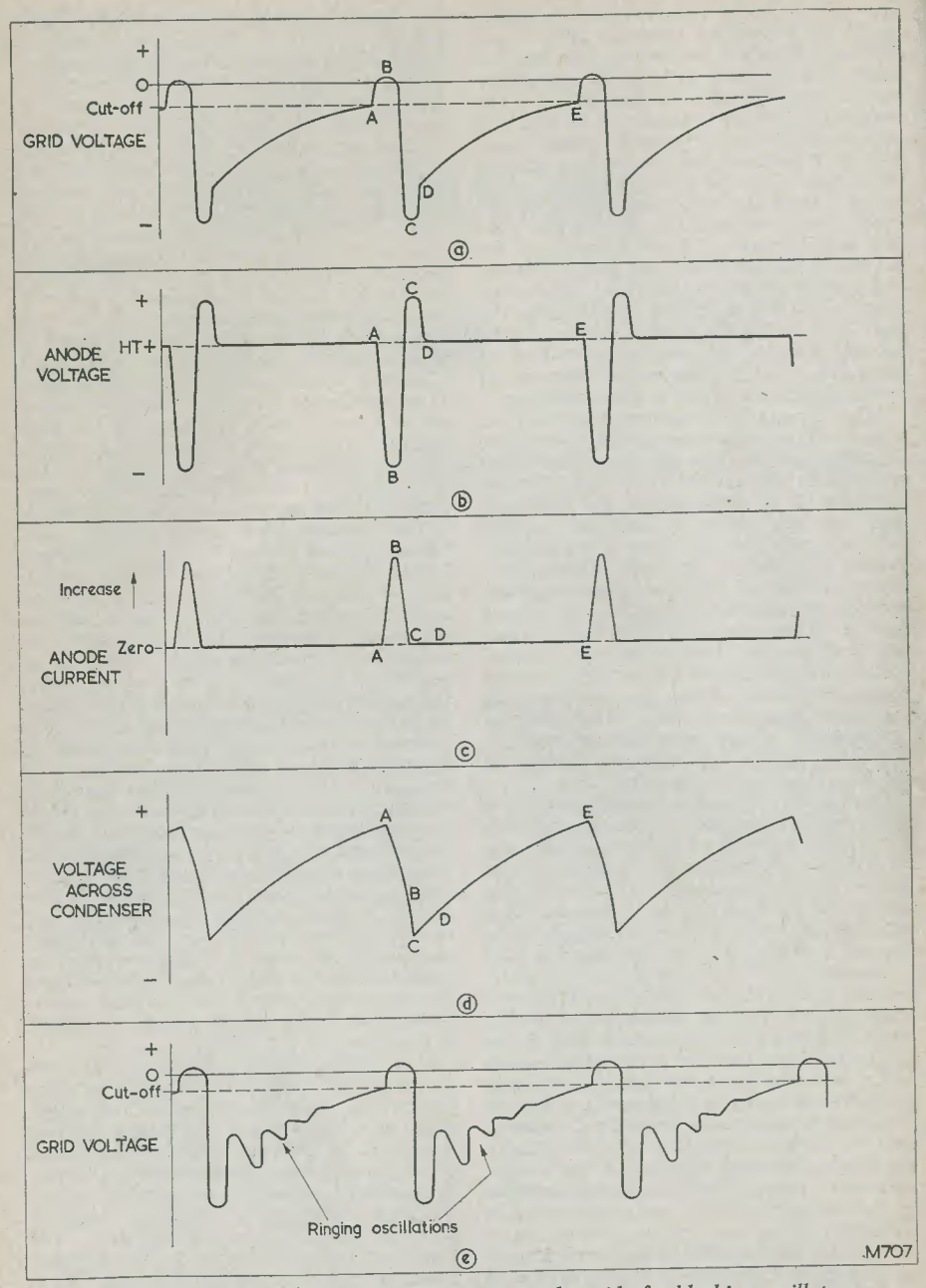


Fig. 125 (a) The voltage waveform appearing at the grid of a blocking oscillator. (b) The voltage waveform at the anode. (c) The anode current waveform. (d) The sawtooth waveform given by either circuit of Fig. 126. (e) If ringing occurs in the blocking oscillator transformer, the grid voltage waveform could look like this.

"sawtooth-forming circuit" such as that we examined in Fig. 123 (*a*). A simple method of doing this is illustrated in Fig. 126 (*a*). In this diagram we introduce a second triode whose grid is directly connected to the grid of the blocking oscillator triode. A resistor couples the anode of this second triode to the h.t. positive rail, and a condenser connects between the anode and chassis. The valve then functions as did the switch and series resistor of Fig. 123 (*a*). It is assumed that the second triode has a cut-off voltage equal to, or less than, that of the oscillator triode.

more and the second triode becomes non-conductive, allowing the condenser to commence charging up slowly again. The result, as seen in Fig. 125 (*d*), is a sawtooth waveform.

It is possible to dispense with the second triode by using the circuit device illustrated in Fig. 126 (*b*). In this diagram the condenser connected between the anode of the second valve and chassis now appears between the h.t. positive end of the blocking oscillator primary and chassis. Also, a resistor is interposed between this point and the h.t.

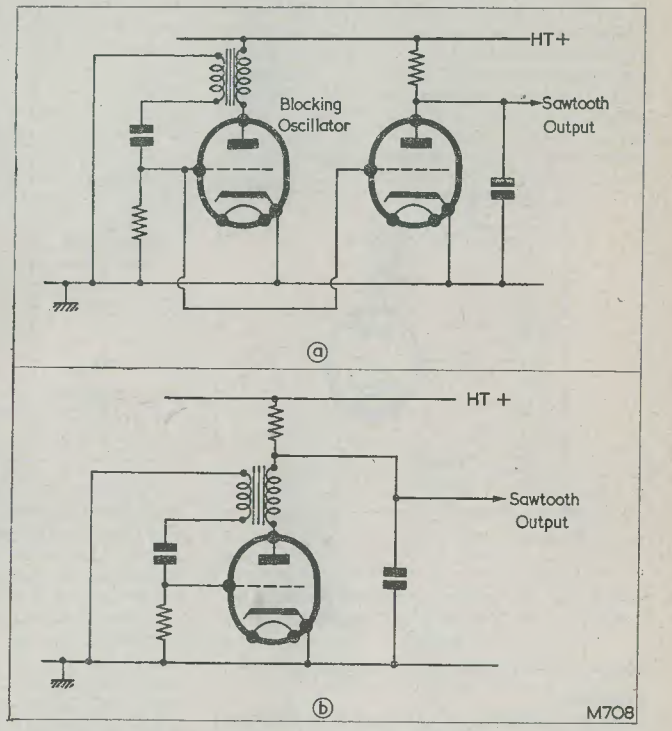


Fig. 126 (a) Connecting the grid of the blocking oscillator valve to the grid of another triode enables a sawtooth waveform to be formed at the anode of the latter. The condenser between chassis and the anode of the second valve discharges rapidly when the valve is conductive and charges slowly, via the resistor coupling it to the h.t. positive rail, when the valve is non-conductive. (b) In this circuit the blocking oscillator valve also causes the formation of the sawtooth waveform

The anode waveform of the second triode is shown in Fig. 125 (*d*). (Again, the lettered points correspond to those in the previous waveforms). Before point A, the second triode is cut off, with the result that the condenser between its anode and chassis is able to charge up, slowly, via the resistor coupling its upper plate to the h.t. positive rail. After point A the grid of the blocking oscillator valve goes rapidly positive, and so, also, does the grid of the second triode. This valve then conducts heavily, causing a rapid discharge in the condenser. At point C the grids of both valves are beyond cut-off once more and the second triode becomes non-conductive, allowing the condenser to commence charging up slowly again. The result, as seen in Fig. 125 (*d*), is a sawtooth waveform.

It is possible to dispense with the second triode by using the circuit device illustrated in Fig. 126 (*b*). In this diagram the condenser connected between the anode of the second valve and chassis now appears between the h.t. positive end of the blocking oscillator primary and chassis. Also, a resistor is interposed between this point and the h.t. positive rail. The action of this circuit is similar to that of Fig. 126 (*a*). When the blocking oscillator valve draws current, the condenser discharges quickly; when the oscillator valve is cut off, the condenser charges slowly via the series resistor. Once more, a sawtooth waveform results.

Ringing and Squegging

Due to the fact that the blocking oscillator transformer is an inductive component possessing stray capacities, there is a tendency for it to ring after the shock-excitation caused during the period when the anode draws

current.[4] If ringing is severe, it may cause the grid voltage waveform of the blocking oscillator valve to take up the appearance illustrated in Fig. 125 (*e*). The ringing effect is not a very desirable design feature, but it will not upset the operation of the oscillator provided that the ringing cycles are not so large as to cause the grid voltage to fall below cut-off before its proper time. Should this happen, the next cycle will be initiated too soon, and the operation of the blocking oscillator will become erratic.

The ringing effect just described should not be confused with *squegging*. A squegging oscillator functions in rather the same manner as does a blocking oscillator, but the transformer in this circuit is such that markedly more than one oscillation takes place before the grid becomes blocked. Squegging oscillators are not employed in television deflection circuits.

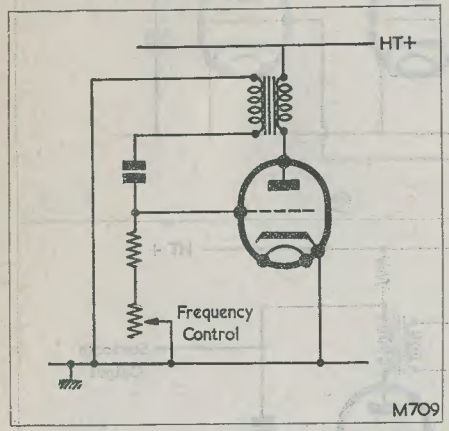


Fig. 127. A variable grid leak provides a control over the blocking oscillator frequency

Frequency

An examination of the sawtooth produced by the blocking oscillator and a "sawtooth-forming circuit" shows that the short discharge section (flyback) occurs during the period when the oscillator valve passes anode current, and that the long charge section (scan) corresponds to the period when the valve is cut off. We have noted, also, that the period when the valve passes anode current is dependent upon the design of the blocking oscillator transformer together with the characteristics of the valve, and that the length of the cut-off period is dependent upon the values of the grid leak and condenser. In a practical blocking oscillator intended for use in a television receiver the transformer is always designed in such a manner that, with its valve, the flyback period it controls is always shorter than the blanking period after the leading edge of the sync pulse passed on by the sync separator. At the same time, control of frequency is achieved by varying the period of time taken up by the cut-off period. Thus, whatever the frequency, the length of the flyback period, *within* each cycle, remains fixed.

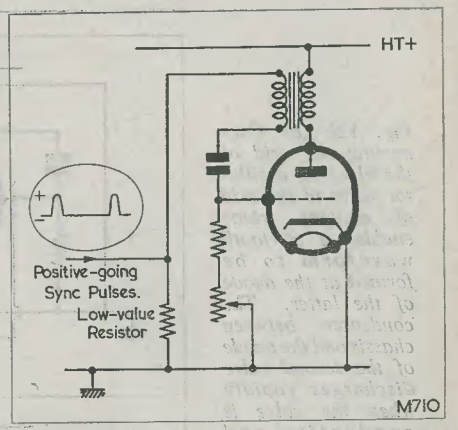


Fig. 128. Injecting positive-going sync pulses into the blocking oscillator

A typical method of controlling blocking oscillator frequency is shown in Fig. 127. In this diagram the grid leak consists of a fixed resistor in series with a variable resistor. Adjusting the variable resistor varies the time taken for the grid condenser to discharge to cut-off potential and, therefore, controls the frequency of the oscillator. The relative values of the two resistors determine the range of frequency control which may be achieved. If the variable resistor has a low value compared with the fixed resistor the range of control is low, and vice versa. An alternative, and much less convenient, method of control could consist of making the grid *condenser* variable.

Synchronising

In order to keep the deflection circuits of the television receiver in step with those at the transmitter it is necessary for the former to be synchronised. Synchonising pulses appear at the end of each line and frame and these are separated from the signal and passed, in suitable form, to the receiver deflection circuits by the sync separator stage.

A simple method of synchronising the blocking oscillator of Fig. 127 would consist of injecting positive-going sync pulses into its grid circuit. Fig. 128 shows how the circuit may be modified in order to allow such sync pulses to be injected. In Fig. 128 a low-value resistor is connected in series with the transformer secondary. The positive-going sync pulses are applied to the junction of this resistor and the secondary winding.

Fig. 129 (*a*) illustrates the grid waveform of the oscillator and shows how the pulses cause the oscillator to be synchronised. In this diagram each sync pulse arrives at a point just before the grid condenser discharges to cut-off voltage, and it causes the grid to go positive. The grid rises above cut-off level, causes anode current to flow, and thereby initiates the flyback part of the cycle. The same occurs in the following cycle, the sync pulse once more forcing the oscillator to go through the flyback part of the cycle before it would otherwise do so.

[4] The question of ringing was discussed in "Understanding Television," part 15 (March 1959 issue) when the i.f. amplifier was being dealt with.

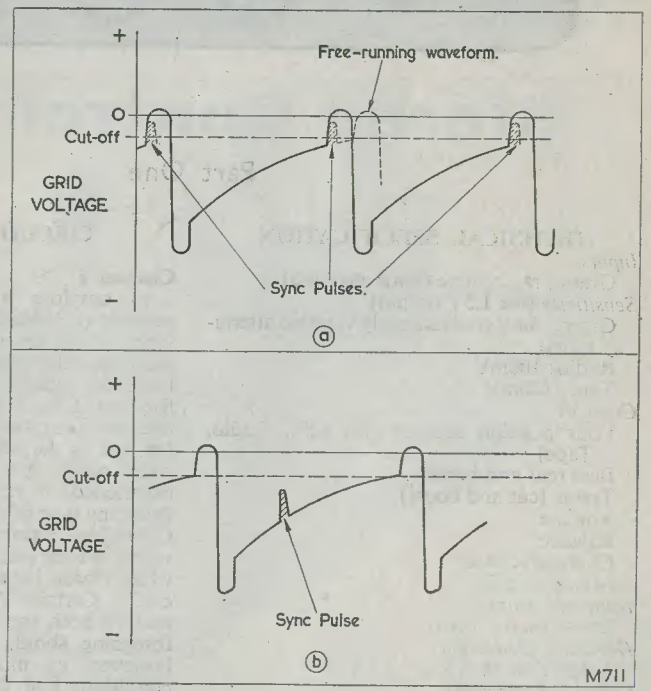


Fig. 129 (a) How the sync pulse forces the grid above cut-off potential, thereby initiating the flyback part of the cycle. (b) If the sync pulse is too small, or if it arrives too early, it cannot initiate the flyback period

Thus, the frequency of the blocking oscillator is held at the frequency of the sync pulses, and flyback, in each cycle, commences immediately after the appearance of the sync pulse leading edge.

It will be noted that, for synchronisation to occur, the blocking oscillator must operate at a frequency lower than that at which the sync pulses appear. If it ran at a higher frequency the flyback period would have commenced before the sync pulse arrived and the latter would have no effect.

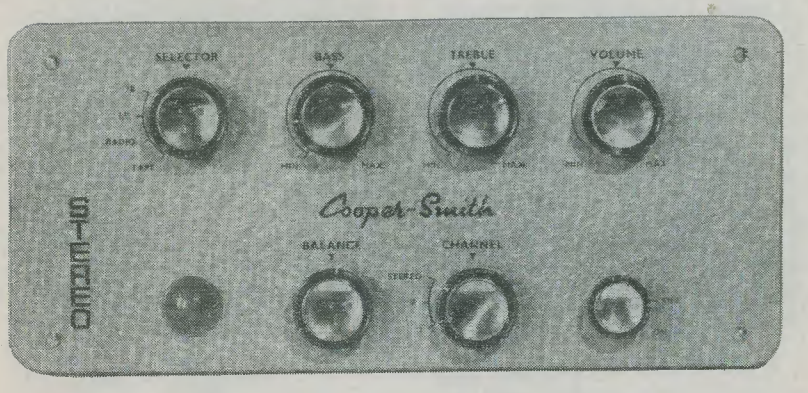
The oscillator will also fall out of synchronisation if the sync pulse could not force the grid above cut-off potential. Such a state of affairs would occur if the sync pulse were too small and/or if it appeared too early after the previous flyback period. A typical instance is shown in Fig. 129 (*b*). In this diagram the sync pulse arrives at a time when the grid condenser has a large negative charge. The sync pulse cannot carry the grid above cut-off potential, and so it has no effect.

We may now see that our blocking oscillator circuit may only be kept in synchronism if its natural running frequency is kept within two extremes. The highest frequency at which it may run is one which is just slightly lower than that of the pulses themselves, and the lowest frequency at which it may run is that which just allows the sync pulses to force the grid above cut-off potential.

In Fig. 127 we introduced a variable resistor which controlled the frequency of the blocking oscillator. Since this resistor, by changing the frequency, also enables the oscillator to be brought in and out of

Continued on page 373

The Cooper-Smith



Stereo 'Control' Unit

Part One

TECHNICAL SPECIFICATION

Inputs
Gram., radio, tape (both channels)
Sensitivity (for 1.5V output)
Gram.: 3mV (continuously variable attenuators)
Radio: 100mV
Tape: 100mV
Controls
Four position selector (78, L.P., Radio, Tape)
Bass (cut and boost)
Treble (cut and boost)
Volume
Balance
Channel selector
Mains on-off
Hum and Noise
Better than −60dB
Harmonic Distortion
Better than 0.15%
Power Requirements
6.3V at 1.3A
150–200V at 8–10mA
Dimensions (approx.)
Length 10½in
Height 4½in
Depth 3½in
Panel 10⅞in x 4⅞in
Weight
3½lb. approx.

CIRCUIT DESCRIPTION

Channel 1

V_1 employs a low noise, high slope pentode (EF86/6267) with negative feedback from anode to grid. On the two gram. positions the negative feedback becomes frequency selective, providing equalisation for both L.P. and 78 r.p.m. records. Only one curve for each speed has been provided for, but as the tone controls used are of the wide range type, no trouble should be experienced in obtaining satisfactory results from any type of disc. E.M.I. discs (H.M.V., Columbia, Parlophone) are normally played with the tone controls in the "flat" position, while Decca benefit from a degree of "top cut." Certain American discs, however, require both top cut and bass boost. The foregoing should not be taken as gospel, however, as much depends on listening conditions and the type of speakers used. The correct settings are those which sound best to you! The correction networks are formed by C_1, C_2, C_3, C_4 and C_5 and R_1, R_2 and R_5. On radio and tape the negative feedback is used purely for attenuation and the stage is "flat." The gram. input is fed via a potentiometer VR_1; this enables the control unit to handle practically any kind of pick-up.

The output of V_1 is fed via a fixed potentiometer P_1/P_2 to the grid of V_2(a). This uses one half of a double triode (12AT7) and is a simple voltage amplifier providing a comparatively low impedance source for the Baxendall tone control circuit (see "Low Cost High Quality Amplifiers," by P. J. Baxendall, B.SC.(ENG.) page 16). This is one of the best tone control circuits ever designed and is eminently suitable for stereo application as it uses linear potentiometers, these being more suitable for ganging. Furthermore, the circuit is of the negative feedback type and introduces a minimum amount of distortion. The small capacitor C_{14} across the treble control has been included to improve stability at maximum treble boost. This in no way impairs the action of the control.

V_2(b) provides negative feedback for the tone control, and the output of this is fed to the main amplifier via the volume control and channel selector switch. The latter enables either channel 1 or 2 to be selected individually and fed to both main amplifiers in parallel, or on "Stereo" to be connected each to its own amplifier and speaker.

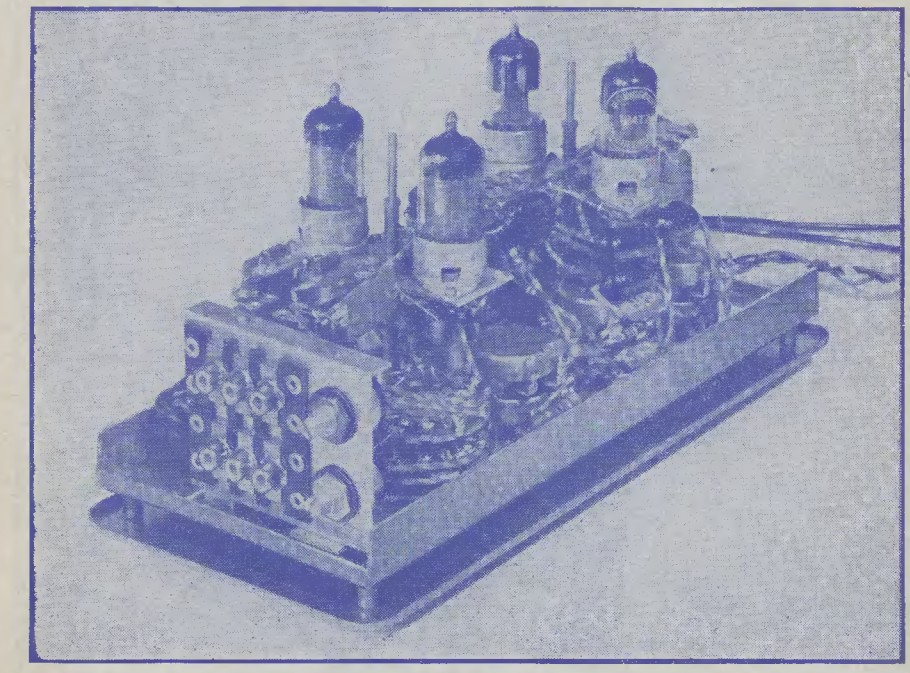
Channel 2

is identical except for the "Balance" control VR_2. The latter component is necessary to enable the optimum stereo effect to be obtained, as the correct positioning of the stereo "image" depends on the relative sound intensity of each channel one with the other.

With equal input signals the gain of Channel 2 may be adjusted so as to be above or below that of Channel 1, the gain of which is fixed by potentiometer P_1/P_2. When VR_2 is set at about two-thirds of maximum rotation the sound from the two loudspeakers should be approximately equal and the "image" in its correct place. If this is not so, it may be made to move to right or left by corresponding rotations of VR_2.

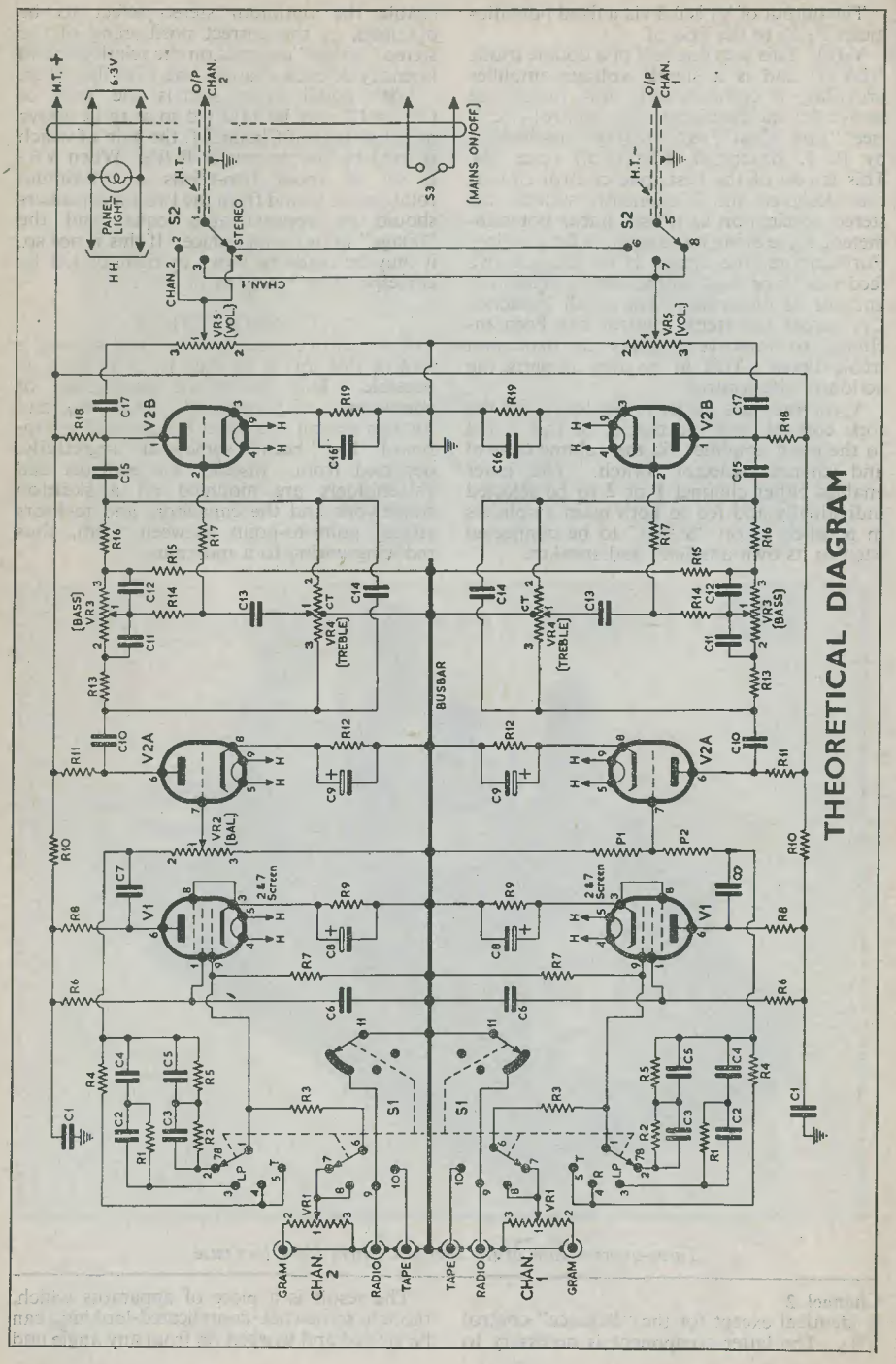
CONSTRUCTION

The main consideration when designing a unit of this sort is to keep leads as short as possible. This makes the positioning of components of paramount importance, and for this reason the usual chassis and groupboard has been, somewhat regretfully, departed from. Instead, the controls and valveholders are mounted on a skeleton framework and the capacitors and resistors strung point-to-point between them, thus reducing wiring to a minimum.



Three-quarter view of the Stereo Control Unit, less case

The result is a piece of apparatus which, though somewhat complicated-looking, can be viewed and worked on from any angle and



is not at all difficult to construct if the following stage-by-stage instructions are faithfully carried out.

The framework consists of a control carrier, an input panel and two tagstrips, the rear one of which carries the valveholders. As much of the wiring as possible is done before these are assembled (Figs. 1 to 4) then they are bolted together as shown in Fig. 5 and the wiring completed in three more stages (Figs. 6, 7 and 8). For the sake of clarity only the components used in each stage are shown in the drawings. These give the actual position of each and should be copied exactly, leads being kept short.

These drawings should be used in conjunction with the point-to-point wiring instructions, which should be carried out in the order given and carefully checked (if possible by someone else) before proceeding with the next stage. All connecting points are numbered on the drawings and the theoretical diagram and are referred to in the text in conjunction with the following abbreviations:

TS—Tagstrip

V_1, V_2—Valveholders

VR_1, VR_2, etc.—Variable resistors (potentiometers)

S_1, S_2, S_3—Switches

For example, V_1 (1)—C_6—TS (8) indicates that C_6 capacitor is to be fitted between pin 1 of valve 1 and tag No. 8 on the tagstrip. (C is, of course, capacitor (condenser) and R resistor.) As both channels are identical (except in the case of the balance control and the channel selector) the same numbers are given to components, etc., in each. Wiring instructions are given for one channel only.

The Cooper-Smith Stereo Control Unit

Components List

arranged for easy reference to the theoretical diagram above

Resistors

R_1	560kΩ ½W high stability, matched, 1 pair each	C_8	50μF 12V electrolytic, 1 pair
R_2	15MΩ ½W matched, 1 pair each	C_9	50μF 12V electrolytic, 1 pair
R_3	47kΩ ½W 1 pair each	C_{10}	0.1μF 250V paper, 1 pair
R_4	22kΩ ½W 1 pair each	C_{11}	5,000pF ceramic, matched, 1 pair
R_5	68kΩ ½W high stability, matched, 1 pair each	C_{12}	5,000pF ceramic, matched, 1 pair
R_6	1MΩ ½W high stability, 1 pair each	C_{13}	68pF 5% mica, 1 pair
R_7	120kΩ ½W high stability, 1 pair each	C_{14}	50pF 5% mica, 1 pair
R_8	220kΩ ½W high stability, matched, 1 pair each	C_{15}	0.1μF 250V paper, 1 pair
R_9	2.2kΩ ½W 1 pair each	C_{16}	50μF 12V electrolytic, 1 pair
R_{10}	68kΩ ½W 1 pair each	C_{17}	0.1μF 250V paper, 1 pair
R_{11}	68kΩ ½W matched, 1 pair each		
R_{12}	820Ω ½W 1 pair each	*Potentiometers*	
R_{13}	100kΩ ½W matched, 1 pair each	VR_1	100kΩ preset, 1 pair
R_{14}	220kΩ ½W matched, 1 pair each	VR_2	500kΩ log., 1 only
R_{15}	150kΩ ½W matched, 1 pair each	VR_3	1MΩ linear dual, 1 pair
R_{16}	330kΩ ½W, 1 pair each	VR_4	500kΩ linear dual, centre tapped, 1 only
R_{17}	1.2kΩ ½W, 1 pair each	VR_5	250kΩ log. dual, 1 only
R_{18}	68kΩ ½W matched, 1 pair each		
R_{19}	820Ω ¼W, 1 pair each	*Valves*	
P_1	390kΩ ½W, 1 only	V_1	EF86/6267, 1 pair
P_2	180kΩ ½W, 1 only	V_2	12AT7, 1 pair
		Switches	
Capacitors		S_1	4-pole 4-way input selector, 1 only
C_1	8μF 350V electrolytic, 1 pair	S_2	2-pole 3-way channel selector, 1 only
C_2	150pF 5% mica, 1 pair	S_3	Mains on-off, 1 only
C_3	680pF 5% mica, 1 pair		Control carrier, tagstrips, input panel, 1 set
C_4	560pF 5% mica, 1 pair		Socket strip, 3-way, 1 pair
C_5	82pF 5% mica, 1 pair		Input plugs, 1 pair
C_6	0.25μF 150V paper, 1 pair		Panel light holder, 1 only
C_7	0.1μF 250V paper, 1 pair		Control panel, 1 only
			Knobs, 1 set
			Case, 1 only

Much care and experience has gone into the design of this unit and the writing of these instructions; and, faulty components being very rare, when built it should work. Many hours are spent trying to find the reason for the failure of home-constructed apparatus to do so, and in ninety-nine cases out of a hundred it will be one or more of the following:

1. Wrong connection. (Check and re-check *as you go along*).
2. Connection omitted. (Tick off each as made.)
3. Wrong component. (Make sure you have identified each correctly.)
4. Short-circuit. (Use sleeving where necessary. Watch for solder getting in the wrong places. See that components touch only at connections.)

To those with little experience in soldering *as applied to electronic apparatus* these hints will be of much value and will save them (and probably us!) a lot of trouble.

The first essential is a small but efficient soldering iron such as the Solon 625, Remploy MH/4, Adcola or Litesold 930, all of which are 25 watts, or a solder gun such as the Primax 60 watt. A pair of thin-pointed pliers is also necessary for bending wires into position, and we recommend the small shears type of cutters for snipping off the ends. Use only resin-cored solder of the type specially made for this kind of work, such as Ersin Multicore 18 s.w.g. containing 60% tin and 40% lead. DO NOT USE A LIQUID FLUX. We have seen amateur-constructed apparatus so badly corroded owing to its use that most of the components have had to be scrapped.

The requirements of a good electrical joint are these:

1. The parts to be soldered *must* be clean. The wire, tags, etc., should be quite bright in appearance when received; if they are at all dull or the solder does not "take" immediately, scrape clean with a sharp blade.
2. Endeavour to join the parts together so that they will remain in position until soldered (e.g. bend wire round soldering tags and squeeze with pointed pliers).
3. Bring the point of the clean, properly tinned bit to the work and allow a second or two for the heat to flow into it.
4. Apply solder, allowing just sufficient to melt on to the work. Wait until this flows round the joint and remove bit. (Don't keep it on long enough to damage the component.)
5. Watch for solder to "freeze" before allowing any movement between joint.

If the solder takes the form of a blob it is not a good joint and should be cleaned off and done again; it should *flow* round the work. A crystal-like appearance indicates that the parts have moved at the moment of cooling, and a lumpy appearance that insufficient heat has been applied. Reheat. Use gravity to get solder to run where you want it, but see that it doesn't run where you don't. Too much solder may result in a short-circuit, especially between valveholder tags. Take a second or two to check each joint; it may be very difficult to locate and rectify one after the unit has been completed. Remember, even experts slip up sometimes!

Now to commence.

Stage One

Select the rear tagstrip (the one with the valveholders on) and the associated components, and referring to Fig. 1, place this the correct way round with the valveholder tags uppermost. The tag numbers may be scratched on the strip for easy reference. The valveholder tags number clockwise starting from the blank position. Wire up as follows and in this order (both channels):

V_1 (2)—spigot—V_1 (7)
V_1 (3)—V_1 (8)
V_2 (4)—V_2 (5)
TS (3) (either tag)—earth tag on valve bracket
TS (5)—V_2 (1)
TS (9)—V_1 (6)
TS (10)—V_1 (2 or 7)
TS (6)—TS (11)
TS (7)—R_{17} (brown/red/red)—V_2 (2)
TS (8)—C_6 (0.25μF)—V_1 (1)
V_1 (9)—R_7 (120kΩ)—V_1 (2 or 7)
Solder 3-4in wire to V_2 (3 & 8) and V_1 (8) and RH V_2 (7)
Using the twisted flex:
TS (1) (both)—V_2 (both) (4 & 9)—V_1 (both) (4 & 5)

Now take the front tagstrip, solder tags uppermost, and referring to Fig. 2, wire up as follows (both channels):

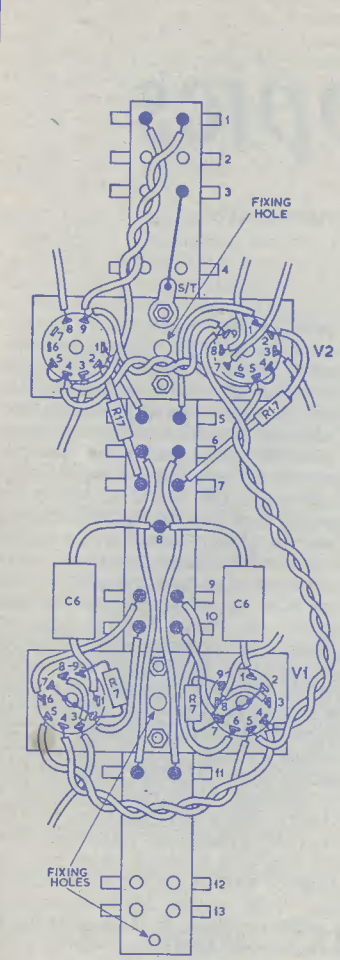
TS (15)—TS (19)
TS (18)—R_{10} (blue/grey/orange)—TS (19)
TS (14) (one wire only)—TS (18) (solder tags together)

Next take the input panel and fit the two VR_1 (100kΩ) as in Fig. 3. Use one nut each side of panel and adjust so that the thread projects no more than necessary to secure.

VR_1 (2) (both) to Gram. input sockets
VR_1 (3)—VR_1 (3)—all earth tags on input sockets, leaving about 5in loose wire from bottom RH tag
Solder 3-4in wire to both Radio and Tape sockets

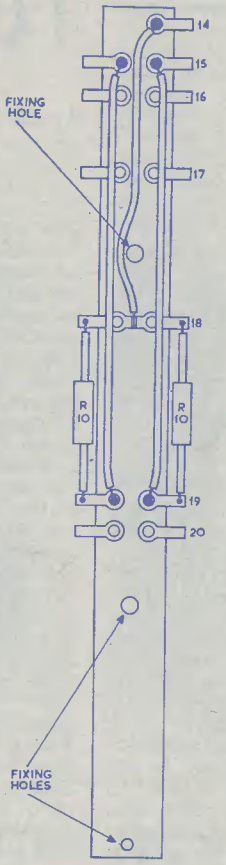
Lastly, take Selector Switch (S_1) and refer to Fig. 4. Viewed from rear with nuts horizontal and blank position at 8.30 o'clock, number tags 1 to 11 starting at 3.30 o'clock. Wire up as follows (both wafers):

S_1 (1)—R_3 (yellow/mauve/orange)—S_1 (6)



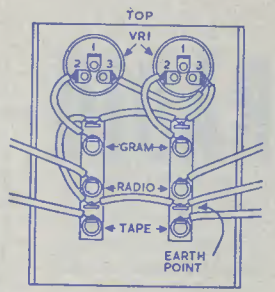
REAR TAG STRIP

Fig. 1



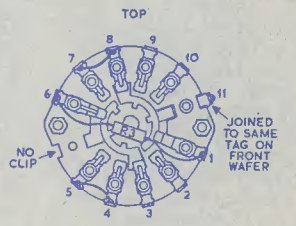
FRONT TAG STRIP

Fig. 2



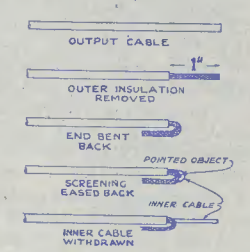
INPUT PANEL

Fig. 3



S1 WIRING
(BACK VIEW)
(REAR WAFER IDENTICAL)

Fig. 4



PREPARING OUTPUT CABLES

Fig. 9

STAGE ONE

Join 4 to 5 and 7 to 8
Join 11 on rear wafer to 11 on front wafer

Now prepare for Stage Two by building up the framework as shown in Fig. 5. This is shown without the components already fitted for the sake of clarity. Take care not to break tagstrips by over-tightening or bending.

To be continued

RADIO Topics

By Commentator

First QSOs

YOUR COMMENTATOR HAS NEVER CEASED to wonder what motivates those operators of amateur radio C.W. transmitters who churn out CQs by the string, often never stopping even to insert their call signs. The phenomenon is still as prevalent as ever, and no amount of publicity against this futile practice seems to stop it. But at last an explanation of its cause has appeared in print, an explanation which in the writer's opinion seems quite feasible.

Dealing with this problem in his editorial in the October issue of "CQ", Wayne Green, W2NSD, makes the suggestion that the root cause of this age-old vice is Fear! He writes: "I'm sure that everyone of you can remember the petrification of your first unaided QSO. This fear is so strong that many novices have never conquered it and have let their licences lapse rather than go on the air. Most of us get over our fears gradually, easing the early pangs by stereotyped contacts which require practically no thinking, and allow us to proceed through the trauma as painlessly as possible." Well, that certainly is one explanation and it's the best we've heard to date. Pity they don't try a few QSOs with a friend who can give them an understanding hearing, instead of putting half the amateur fraternity into a state of frenzied frustration, waiting for the call sign which never comes!

In the same issue of "CQ" there appears an account of a most ingenious legal defence put up by an "automobile mobiler" who was caught in a speed cop's radar trap. Producing evidence that his transmitter was "on-the-air" at the time of the check, he maintained that it caused interference with the radar equipment, producing an inaccurate speed reading. He succeeded in his defence. This seems to be one more good reason for "going mobile"! Will it, we wonder, lead to the production of yet more gadgetry, this time one which will turn the Tx on every time the speedometer reads over 30 m.p.h. in a built-up area?

RTTY—First Contacts

At the time of writing (late October) news has reached us of the first RTTY QSOs in the British Isles. G3CQE in Norwich and G2UK in Lowestoft have been having regular skeds and G3CQE has already worked the States. This is certainly good going; in fact the whole project of getting amateur radio teletype started in this country, which was the reason for forming the British Amateur Radio Teletype Group, seems to have been pushed ahead with such speed and enthusiasm that its organisers deserve the success, which on the face of it, appears to have come their way so easily. In actual fact, an immense amount of work has been put into the project and much opposition from many, who should have been the first to encourage such enterprise, has had to be overcome. It is strange how frequently progress is held up by "The Establishment"—those who by reason of their position and influence could help so much to further progressive ideas. It happened with Single Side Band and with the Radio Amateur Emergency Network. Both these were similarly frowned upon by "The Establishment" and in each case it was left to a keen little group of enthusiasts to conceive and nurture the growing child. Both SSB and the RAEN now enjoy every possible encouragement from all sides. They are "the thing" in amateur radio circles today. We wish the BARTG every success in their efforts to take the spirit of enterprise in amateur radio yet another stage further.

Friendly

Commercially, a magazine's success is judged from its monthly circulation; and, taking a broad view, presumably if tens of thousands of people buy it it must be giving them what they want, and the editorial staff are assured that their policy is correct. Sometimes, however, rather more personal evidence of having satisfied the customer comes in, in the form of letters to the Editor appraising his activities. Where this journal is concerned, a frequent remark from such correspondents is to the effect that "your magazine has such a friendly spirit about it". This perhaps is one of the reasons for its success. Formality is an outdated mode; nowadays a more personal relationship is sought between all sections of the community, and if a magazine manages to convey this outlook through such an impersonal medium as the printed page, those who direct its policy must be congratulated on their up-to-date outlook.

Valve Type Numbers

Talking of letters from readers, one picks up some good hints from some of these from time to time. I must thank Mr. J. Hockley for one suggestion which he says is not foolproof but may occasionally help in that very irritating situation where one finds that valve type numbers have become worn off the glass envelope. Try smearing a minute amount of grease—there is usually enough natural grease on the hand for this—on to the glass and then rub it off until there is just a faint rainbow of light reflected when looking across the glass. The remains of the numbers can occasionally be seen as a duller area in the brighter reflection. Ring the place round with a chinagraph pencil and recheck, marking the number prominently on the Bakelite base subsequently.

Electrified Air

Has the thought ever occurred to you that, besides the temperature, the humidity, the dustiness or clearness of the atmosphere in which we live, its electric state may affect our comfort and perhaps even our health? It appears that scientists have given this matter considerable attention ever since Benjamin Franklin demonstrated the fact that the atmosphere was at times electrified. In 1780, the Abbé Bertholan published a book on the therapeutic properties of atmospheric electricity. In later years the evil traditions associated with such natural phenomenon as the Fohn and Sirocco winds were ascribed to their electrical characteristics. But only recently has it been possible to put these theories to practical tests.

From the Naval Medical Research Unit, University of California, comes a communication based on a considerable amount of research work done by Drs. Albert P. Krenger and Richard F. Smith. It appears that ions, that is the particles of atmospheric gases having positive or negative charges, are continually formed in the atmosphere by such causes as radiation, electric discharges and frictional electricity produced by rainfall and sand blown in the wind. They have shown that these ions do affect living tissues, particularly those of the throat, nose and lungs. Negative ions have a favourable influence on these tissues; positive ions an unfavourable one. They predict that, at some future date, atmospheric electricity control may become an essential part of air-conditioning plants. They even suggest that some respiratory diseases, e.g. asthma, may possibly be treated by adjusting the atmospheric electricity.

The B.R.C.

The British Recording Club has reached an agreement with the British Tape Recording Society whereby the latter has been absorbed, so that the B.R.C. now becomes the largest organisation of its kind in the world. It has representation in thirty-six countries, and publishes a journal—*The Amateur Tape Recording Magazine*. It is reckoned that there are now 400,000 tape recording users in Great Britain alone.

British Audio Exhibit for New York

A composite exhibit of British audio equipment is being arranged for the British Exhibition in New York in June 1960. This is being organised by the Audio Manufacturers' Group of B.R.E.M.A., which was formed early this year, and the possibility of developing other overseas markets by concerted Group action is under consideration.

Apart from export promotion, other Group activities cover technical standards and codes of practice designed to benefit the industry, the trade and the general public, and to avoid confusion caused by the vague term "high fidelity" and its exploitation. A statistical service has also been started.

The Group reminds companies not at present members that any British company engaged in the audio industry in the widest sense is welcome to apply for membership of the Group, which is already representative of a wide section of the industry ranging from very small manufacturers to some of the much larger companies. The management body is elected by members of the Group and is autonomous in respect of all matters concerning audio equipment in the official schedule.

The present chairman is Major J. F. E. Clarke; the vice-chairman Mr. D. A. Lyons, and the secretary Mr. S. E. Allchurch, O.B.E., 49 Russell Square, London, W.C.1.

A GOOD QUALITY AUDIO AMPLIFIER

By A. J. Sercombe

THE AMPLIFIER TO BE DESCRIBED WAS built around an EF86 and an EL84 used in conjunction with an f.m. tuner. The results were found to be very pleasing and rather better than that generally obtained with commercial a.m./f.m. receivers. There is, of course, no reason why a gram input should not be used with suitable matching arrangements.

The circuit is quite straightforward. An alternative method to earthing one side of the heaters would be to use a potential divider arrangement across the heaters and earth the centre-tap. In either case a separate heater winding should be used for the rectifier.

It may be found convenient to omit C_4, and if the bass cut is too severe C_6 should be lowered, the final value being found by trial.

There is little to say about the circuit except that RV_1 and C_1 were incorporated in the f.m. tuner in the prototype; but they could be fitted to the main chassis if desired, or if a gram input were to be used. The circuit diagram shows a coax lead between tuner and amplifier. This lead should be not more than 12in in length.

If the tuner has not got its own power supply, power can be taken from the amplifier at the points as follows:

HT+—T (on circuit diagram).
HT−—Chassis.
Heaters—Parallel with amplifier heaters.

Good quality components should be used as much as possible for trouble-free operation. All resistors are ½W except R_8 which is 6W and R_7 which is 4W, and all are ±10%. The capacitors were of the mold seal type in the prototype, but almost any type would be suitable. The mains transformer secondaries used should be 250-0-250 volts 6.3V at 0.3A and 6.3V at 0.5A.

The output transformer should be of generous proportions as this is a very critical component of any audio amplifier, and it should match the R_a of an EL84 which is 4.5kΩ.

A layout drawing is given, but it must be pointed out that it has NOT been scaled as many types of mains and output transformers may be used which are suitable and available to constructors. It would be unwise to use a chassis smaller than 6in x 8in as shown in the components list.

Voltage measurements are given to help the constructor in case faults should occur.

Operation

It should be noted that the tone and on/off controls are on the amplifier chassis and the volume control on the f.m. tuner chassis, but if the latter control has been fitted to the amplifier the procedure is the same. Switch on, but do not rotate the tone control. Allow 60 seconds for warm-up, inject a signal, or connect a gram or f.m., etc., input.

See that volume varies as the volume control is varied, and rotate the tone control and note that bass response increases with increased rotation; if not, reverse the connections on the potentiometer.

COMPONENTS LISTS

Capacitors

C_1	0.01μF 400V
C_2	0.01μF 400V
C_3	8μF 350V
C_4	100pF ceramic
C_5	0.02μF 350V
C_6	0.005μF 400V
C_7	50μF 12V d.c. wkg.
C_8	~~50+~~ 50μF 350V
C_9	~~50+~~ 50μF 350V
C_{10}	0.01μF 400V
C_{11}	0.01μF 400V

Resistors

RV_1	1MΩ 10% ¼W
RV_2	500kΩ 10% ¼W
R_1	1MΩ 10% ¼W
R_2	~~1kΩ 10% 1W~~ 56kΩ
R_3	220kΩ 10% ¼W
R_4	1.2kΩ 10% ¼W
R_5	470kΩ 10% ¼W
R_6	10kΩ 10% ¼W
R_7	180Ω 10% 4W
R_8	~~180Ω 10% 6W~~ 1kΩ 4W

Miscellaneous

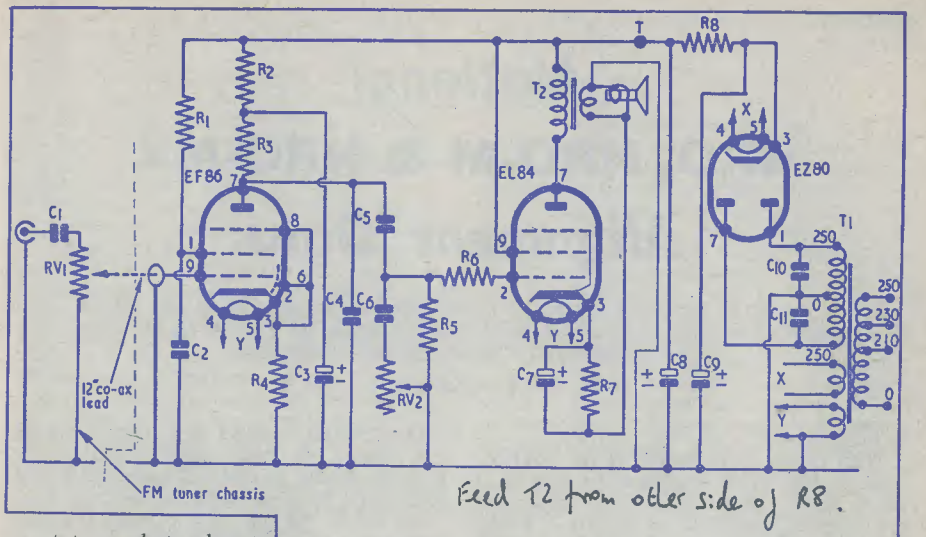
Chassis 6in x 8in, see text
T_1 Mains transformer 250–0–250V, 6.3V at 0.5A, Rectifier heater winding to suit.
T_2 O/P Transformer Sec. to suit L/S Primary 6,000Ω
10in L/S
1 EF86
1 EL84
1 EZ80 or suitable to T_1

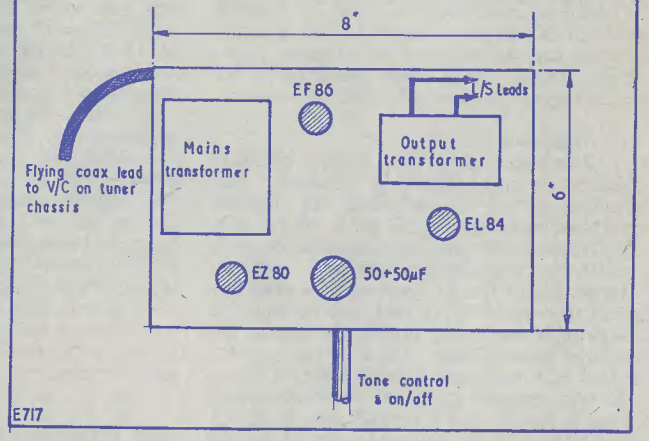
Voltage Table

EF86	V_1 Anode 2 volts approx.
	Grid 2, ½ volt approx.
	Cathode 0.2 approx.
EL84	V_2 Anode 105 volts approx.
	Grid 2, 120 volts approx.
	Cathode 3½ volts approx.

EZ80—V_3 Anodes 250 volts approx.
Cathode 125 volts approx.
Junction of R_8 and C_8 120 volts approx.

Fit 120Ω 1W in each anode lead of EZ80.





See Feb. 1960 p496 for important modifications. SBS. DEC. '96

RIGIDEX — THE POLYETHYLENE PLUS

The impact now being made on modern industry by the introduction of Rigidex high density polyethylene is well demonstrated in a new publication issued by British Resin Products Ltd., Devonshire House, Piccadilly, London, W.1 (telephone Hyde Park 0151). Entitled "Rigidex—the Polyethylene Plus", the booklet outlines the increasing use of Rigidex in many different industries and walks of life and shows how the superior properties of this new rigid polyethylene are making more things possible in plastics.

National
HRO, HRO-M & HRO-MX
Alignment Data

In answer to numerous enquiries for such information, we give in this article alignment data for the ex-WD HRO receivers which are so popular, and also include the circuit diagram with component values

I.F.=456 kc/s.

Crystal Filter

With crystal filter switch in off position, receiver bandwidth is approx. 3 kc/s at 2 times down. Switching crystal filter into circuit gives bandwidth of approx. 2.5 kc/s in broad position and about 200 c/s in sharp position of selectivity control. The phasing control can be adjusted to suppress interfering signal frequencies differing from desired signal frequency by 300 c/s or more.

I.F. Alignment

1. The alignment of the I.F. may be easily checked in the following manner. The receiver should be adjusted for normal operation with no antenna, a.v.c. off, r.f. gain at 9, crystal filter on, phasing control at 5, selectivity maximum and the c.w. osc. on. The setting of the a.f. gain control does not affect the measurement and may be adjusted to provide sufficient output to make the required observations. The c.w. osc. control should be turned until a point is found where the predominant pitch of the background noise is lowest and a crystal ring is heard. This setting of the c.w. osc. control should occur near 9 on the scale and the exact setting should be noted.

The crystal filter should then be disconnected from the circuit by turning the phasing control to 0 on the scale and the selectivity control adjusted for maximum background noise. The c.w. osc. control should again be adjusted for lowest predominant pitch of background noise and this new setting noted.

If the i.f. amplifier is properly aligned, the setting of the c.w. osc. control should be the same for both tests mentioned above.

2. When it is found necessary to align the i.f. amplifier, the following procedure should be used.

(*a*) Adjust receiver as explained above, with crystal filter connected into circuit and set for maximum selectivity.

(*b*) Connect antenna and tune in steady c.w. signal, or inject unmodulated signal from generator, so that it is tuned exactly on the crystal peak response frequency.

(*c*) Adjust the c.w. osc. to provide a beat note well within the audio range.

(*d*) Adjust i.f. amplifier trimmers, numbers 10, 11, 12, 13 and 14 for maximum response. Avoid second detector or audio overload by reducing the signal input as necessary.

(*e*) Check the alignment as outlined in 1 to ensure that alignment is correct.

3. After the i.f. amplifier has been aligned, the tuning of the c.w. osc should be checked. This may be readily accomplished by repeating the test of 1 with the crystal filter disconnected and the selectivity control adjusted for maximum background noise. If the setting of the c.w. osc. control does not occur at or near 9, with this test, turn the c.w. osc. control to 9 and adjust trimmer No. 15 or 16, or both, for the lowest pitch of background noise.

High Frequency Oscillator Alignment

B–1. The need for re-alignment of the high frequency oscillator is indicated when the frequency calibration of the receiver dial is in error by more than ±3% at the high frequency end of the band in question.

B–2. If the error is more than ±3%, it should be corrected in the following manner:

(*a*) Adjust the receiver for normal operation as follows: r.f. gain at 9, c.w. osc. off, a.v.c. off, crystal filter off, (phasing control at 0), selectivity control at the position of maximum background noise, and the a.f. gain set to provide a suitable signal level.

(*b*) Adjust an accurately calibrated test oscillator, frequency meter or signal generator to provide a signal which should be tuned in near 490 on the receiver dial according to the general coverage calibration chart for the coil set in use.

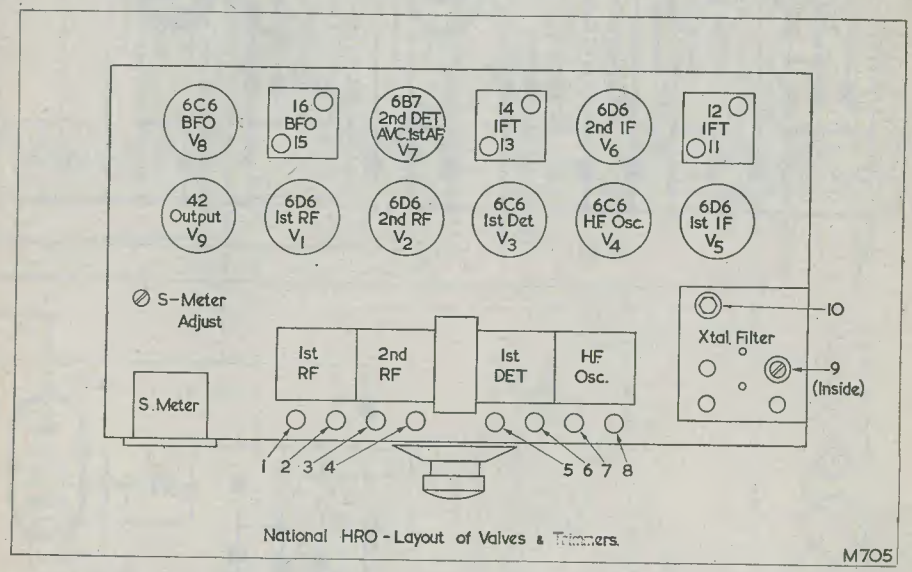
(*c*) Tune the receiver to the test signal and compare the dial reading with the calibration chart.

(*d*) When the dial reading is too low, more circuit capacity is required and is supplied by adjustment of trimmer No. 8. When the receiver dial reading is too high, less circuit capacity is required and is supplied by adjustment of the same trimmer.

B–3. It is particularly important that the high frequency oscillator circuits operate at a higher frequency than that of the r.f. amplifier circuits. This can be checked by tuning in the test signal as an image which is normally 912 kc/s lower on the receiver dial. The image signal should be considerably weaker if the r.f. amplifier is correctly aligned, and a stronger test signal may be required before the image can be found. If the image signal appears at a higher dial setting rather than a lower setting, the h.f. osc. circuit is incorrectly adjusted and the capacity of trimmer No. 8 must be decreased until the real signal and image signal appear at the proper points on the dial.

Tracking of the H.F. Osc. and R.F. Amplifier Circuits

D–1. Tracking of the h.f. osc. and r.f. amplifier circuits may be readily checked by observing the background noise while tuning throughout the range of the coil set in use. The background noise should not vary greatly as the dial is turned toward the low frequency end of the tuning range. The actual tracking of each stage near the low frequency limit of the range may be checked by pressing the outside rotor plates of the main tuning section toward or away from the stator, but not far enough to short the condenser or to permanently bend the rotor plates. Any change in capacity should decrease the background noise, indicating decreased sensitivity, if the stage is properly tracking. Coil sets which may require precise adjustment of circuit elements are provided with adjustable series padders in the high frequency oscillation portion of the coil



National HRO - Layout of Valves & Trimmers. M705

R.F. Amplifier Alignment

C–1. The term "r.f. amplifier alignment," as used in this section, includes alignment of both r.f. amplifier and mixer circuits.

C–2. The r.f. amplifier may be aligned as follows:

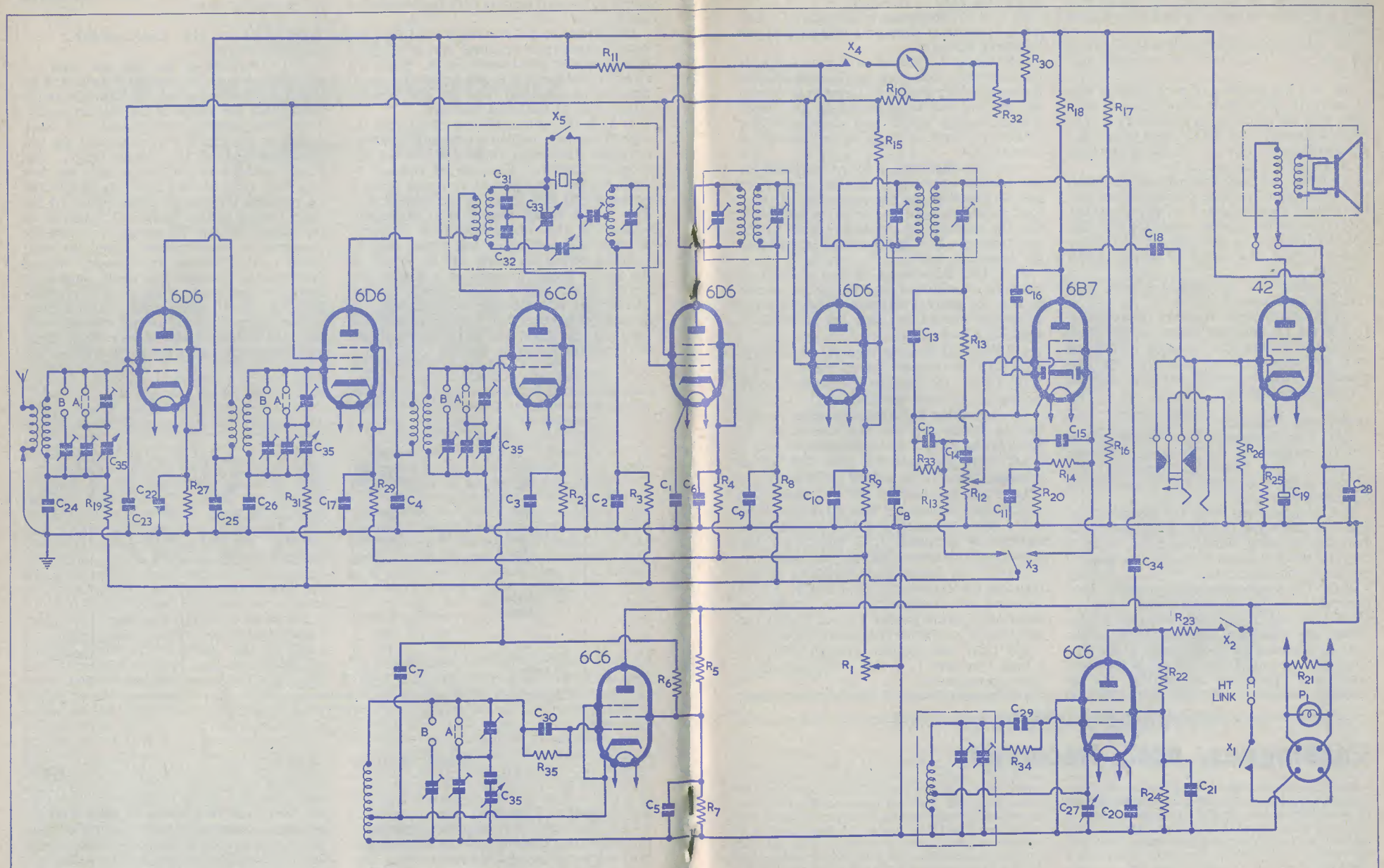
(*a*) Adjust the receiver as explained in (*a*) of para. B–2. No antenna is needed.

(*b*) Turn the receiver dial to 490.

(*c*) Adjust trimmers 2, 4 and 6 for maximum background noise, which is the setting for maximum gain.

set, which can be adjusted to track with the average adjustment of the r.f. amplifier coils. This series padder is mounted inside the coil and is adjustable from the rear by means of a screwdriver. It should be remembered that the series padders found in the coils of the coil sets type A, B, C and D are Bandspread series padders and should not be adjusted except during bandspread alignment.

D–2. After calibration and alignment at



Circuit of the National HRO, HRO-M & HRO-MX Receivers.

M704

Presented for readers' convenience as an addition to the HRO alignment article. For component values see page 363

the high frequency end of the coil set have been adjusted as explained in paragraphs B–2 and C–2, the tracking may be adjusted as follows:

(*a*) With the receiver adjusted as in part (*c*) of para. C–2, turn the receiver dial to 20.

(*b*) Test the tracking of each stage in turn by bending the outside rotor plate of each section of the main tuning gang and note any maladjustment. Do NOT bend any rotor plate to the extent that it will not spring back to its original position.

(*c*) Adjust the high freq. osc. series padder to its optimum tracking position when step (*b*) (above) gives indication of poor tracking.

(*d*) Turn the receiver dial to 490 and adjust trimmer 8 to give the proper calibration with the new value of series padder capacity.

(*e*) Repeat (*a*), (*b*) and (*c*) until best tracking is obtained.

(*f*) Note any slight tracking errors occurring in the r.f. amplifier stages so that if the same error occurs in a majority of the coil sets, the outside rotor plate may be permanently bent to provide the best tracking for the stage involved.

Bandspread Alignment

E–1. The bandspread feature may or may not be included in the particular coil sets supplied. The following alignment data applies only to coil sets which include the bandspread feature.

E–2. Adjustments made for general coverage will affect the bandspread adjustments, but the separate bandspread adjustments may be made without changing the general coverage coil alignment.

E–3. The four screws used to change from general coverage to bandspread must be shifted to the right-hand terminal blocks before any alignment adjustments are made.

E–4. The need for re-alignment of the high freq. osc. section of any coil set is indicated when the frequency calibration of the receiver dial is in error by more than 30 divisions (plus or minus) at the high frequency end of the band in question.

E–5. If the frequency calibration of a coil set is in error, it should be corrected in the following manner:

(*a*) Repeat the procedure of para B–2 with the exceptions that a test oscillator frequency is chosen which should be tuned in at 450 on the receiver dial as indicated by the bandspread tuning chart, and correction for calibration error is made by adjustment of trimmer 7.

E–6. The alignment of the r.f. amplifier for bandspread operation is similar to that for general coverage, so the procedure of para. C–2 should be repeated with the exception that the receiver dial should be turned to 450 and trimmers 1, 3 and 5 should be adjusted for maximum noise.

E–7. The adjustment of and method of checking bandspread tracking is not similar to that for general coverage. The following procedure should be used for bandspread tracking adjustments:

(*a*) With the receiver adjusted as in para. E–6, turn the receiver dial to 50.

(*b*) Check the receiver calibration at 50 against an accurate test oscillator.

(*c*) Adjust the high freq. osc. series padder located inside the h.f. osc. coil shield to provide the correct dial calibration.

(*d*) Turn the dial to 450 and adjust trimmer 7 to give the proper calibration.

(*e*) Turn the dial to 50 and check the calibration. Repeat (*c*) and (*d*) if necessary.

(*f*) With the receiver dial at 50 check the settings of trimmers 1, 3 and 5 for the position of maximum background noise.

(*g*) If it is found that increasing or decreasing the capacity of trimmers 1, 3 or 5 increases the background noise, adjust the associated series padder located inside the coil shields to provide the desired capacity.

(*h*) Turn the receiver dial to 450 and adjust trimmers 1, 3 and 5 for maximum background noise.

(*i*) Repeat (*f*) and (*h*), also (*g*), if necessary.

Catalogues, etc., Received

Designing for Diecasting—this is the title of a very well produced 32-page booklet now being issued, free of charge to readers, by Fry's Diecastings Ltd., of Merton Works, Prince George's Road, Merton Abbey, London, S.W.19. The booklet contains many line illustrations, in two colours, showing the desirable and undesirable methods of producing and planning diecasts.

1960 *Component Catalogue*—Home Radio Ltd., 187 London Road, Mitcham, Surrey, now have in stock their latest catalogue. This current production is attractively produced and printed in clear easy-to-read type. This square-backed production, of 128 pages, printed on fine quality Cotine paper, lists just about everything that one could possibly think of apertaining to radio retailing. Nothing is listed in this catalogue unless Home Radio Ltd. have the item in sufficient stock to last a considerable period and available to purchasers by return. Containing over 4,000 differing items and more than 400 illustrations —including full details of the Eddystone range of receivers and components—this well-produced production is priced at 2s. plus 9d. postage. What we particularly liked about this catalogue: complete index at the front, useful formulae at the rear, and the "How to reach Home Radio" feature on the rear cover.

COMPONENTS LIST

for National HRO, HRO-M & HRO-MX Receivers

see circuit on pages 360–361

Resistors

R_1	10,000Ω variable
R_2	5,000Ω ½ watt
R_3	500,000Ω ½ watt
R_4	300Ω ½ watt
R_5	50,000Ω ½ watt
R_6	100,000Ω ½ watt
R_7	100,000Ω ½ watt
R_8	500,000Ω ½ watt
R_9	1,000–5,000Ω ½ watt
R_{10}	15,000Ω 2 watt
R_{11}	250–2,500Ω ½ watt
R_{12}	500,000Ω variable
R_{13}	500,000Ω ½ watt
R_{14}	250,000Ω ½ watt
R_{15}	30,000Ω 2 watt
R_{16}	20,000Ω ½ watt
R_{17}	100,000Ω 2 watt
R_{18}	100,000Ω 2 watt
R_{19}	500,000Ω ½ watt
R_{20}	800Ω ½ watt
R_{21}	60Ω centre tapped
R_{22}	250,000Ω ½ watt
R_{23}	100,000Ω ½ watt
R_{24}	100,000Ω ½ watt
R_{25}	500Ω 2 watt
R_{26}	500,000Ω ½ watt
R_{27}	300Ω ½ watt
R_{28}	500,000Ω ½ watt
R_{29}	300Ω ½ watt
R_{30}	0–2,000Ω ½ watt
R_{31}	500,000Ω ½ watt
R_{32}	1,000Ω variable
R_{33}	500,000Ω ½ watt
R_{34}	50,000Ω ½ watt
R_{35}	20,000Ω ½ watt

Capacitors

C_1	0.1μF
C_2	0.01μF
C_3	0.1μF
C_4	0.1μF
C_5	0.1μF
C_6	0.1μF
C_7	0.01μF
C_8	0.25μF
C_9	0.01 μF
C_{10}	0.1 μF
C_{11}	10μF electrolytic
C_{12}	100pF mica
C_{13}	250pF
C_{14}	0.1μF
C_{15}	0.01μF
C_{16}	500pF mica
C_{17}	0.1μF
C_{18}	0.1μF
C_{19}	10μF electrolytic
C_{20}	0.1μF
C_{21}	0.1μF
C_{22}	0.1μF
C_{23}	0.1μF
C_{24}	0.01μF
C_{25}	0.1μF
C_{26}	0.01μF
C_{27}	30pF variable
C_{28}	0.01μF
C_{29}	0.001μF mica
C_{30}	100pF mica
C_{31}	100pF mica
C_{32}	100pF mica
C_{33}	50pF variable
C_{34}	2pF
C_{35}	250pF 4-gang variable

Miscellaneous

X_1	H.T. (stand-by) switch
X_2	C.W. Oscillator switch
X_3	A.V.C. on-off switch
X_4	S-meter push-switch
X_5	Crystal filter switch
P_1	Lamp 6.5V 0.3 amp.

NEW LABGEAR PRODUCTS

Labgear Limited has recently introduced new aerial accessories. First and by far the most important is the exclusive Labgear 3-station Diplexer Model CN.911. In many parts of the country, stations are so sited that it is now possible for viewers to receive one B.B.C. and two I.T.V. programmes, and the use of this Diplexer, the only one of its kind on the market, makes it possible to receive these programmes on one feeder lead. It is housed in a round watertight case which has a special bracket for fitting either to the chimney lashings or the facia board, saving therefore, the cost of an extra down lead, and alternatively the inconvenience of changing plugs at the receiver end, or using a switching device with its attendant losses. Channels must be specified when ordering. This very important unit retails at only 30s.

Another new unit is the Picture Equaliser Model PE.31. In areas where the I.T.V. signal is stronger than the B.B.C. this unit avoids the necessity of adjusting sensitivity and contrast controls when changing programmes, as it automatically reduces the Band III signal to the level of the Band I signal. It is an adaptation of the already familiar model PE.13 which is for areas where the B.B.C. signal is stronger than the I.T.V. No installation problems are involved as these models merely plug in between the feeder lead and the receiver and both retail at 10s. 6d.

A PERSONAL PORTABLE RECEIVER

described by James Sinclair

THE R.C.S. PRODUCTS (RADIO) LTD. personal portable receiver, about to be described, has proved to be extremely popular with the home constructor. It is essentially simple in design, effective in operation and reasonably inexpensive initially. From the front cover illustration it will be noted that the receiver is compact and, contained within a bronze hammer finished metal case, is attractive in appearance.

The receiver as such may be first constructed as a one-valve circuit, which makes the project of some appeal to the young beginner in radio work. Consequent upon this, the successful construction of the first stage may be followed by the addition of an added audio stage. Relatively simple to assemble and construct, and bearing in mind the low cost involved, this receiver should prove popular with those of the older radio enthusiasts who have a Christmas gift problem on their hands!

Circuit (1-Valve)

This is shown in Fig. 1, from which it will be seen that the circuit is built around the 954 acorn type valve, the anode and suppressor grid of which are not used. The screen grid is used here as the anode, the valve therefore functioning as a triode. The circuit as a whole is simple and basic, thus keeping the cost low and making the construction simple. The condenser C_R is used for reaction, whilst C_T is used for tuning purposes. The aerial, composed of three sections of aluminium rod, each being some 10½in in length, is fed directly to the grid winding, C_1 and R_1 being the grid condenser and leak respectively. The h.t. positive supply is taken, via the headphones, to the "anode."

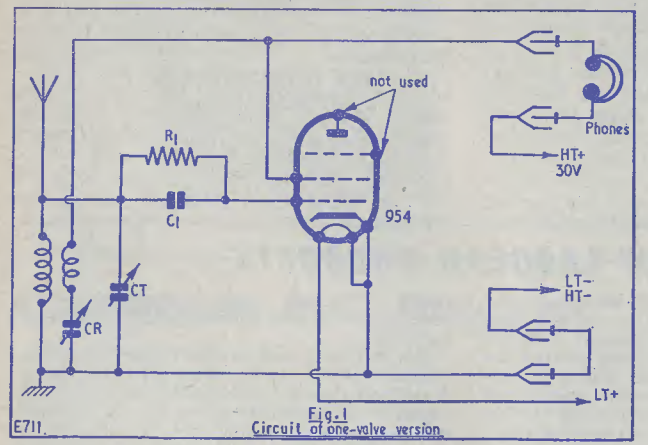


Fig.1 Circuit of one-valve version

Assembly Instructions

Secure into position, as shown in Fig. 2, the condenser C_R and the tuning condenser C_T, making sure that the aluminium washers supplied with these two components are fitted to the fixing bushes before placing them into the case apertures. Place the phone socket (paxolin strip) into position as shown, ensuring that the two sockets coloured *red* and *yellow* are nearest to the condenser C_R. Fix the strip into position by means of the screws and nuts provided, not overlooking the inclusion of the earthed soldering tag shown.

Fasten the aerial input terminal in position on the top of the case so that the solder tag is inside and nearest to the rear. (See Fig. 2.) Secure the coil in such a manner that the *red* locating spot is nearest the open rear of the case. Check that all fixing screws and condenser bush nuts are fixed tightly against the metal casing.

This completes the assembly of the case.

Wiring of the One-Valve Receiver

Note: All wiring must be insulated with the sleeving supplied.

Step No. 1.—Connect one end of a length of wire to the aerial input solder tag and from there to the *blue* tag of C_T. From the latter tag solder a further length to the *blue* tag of the coil. Do not forget the insulated sleeving.

Step No. 2.—Solder one end of a length of bare 22 s.w.g. wire to the solder tag coloured *white* on the phone strip and also to the earthed solder tag mounted with this strip.

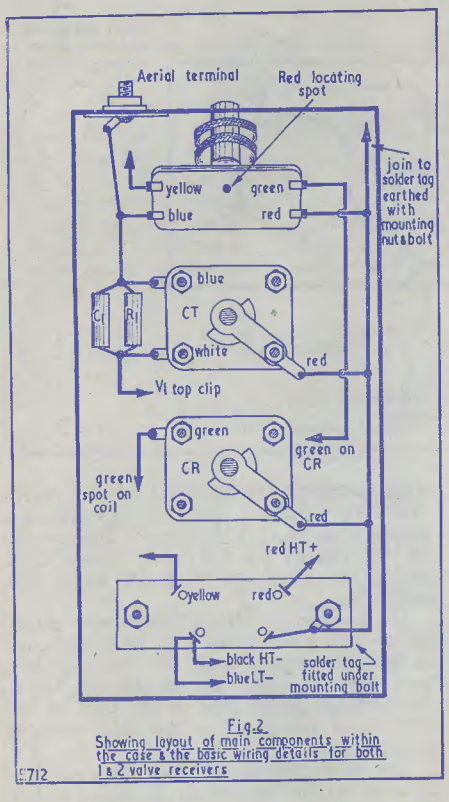


Fig.2 Showing layout of main components within the case & the basic wiring details for both 1 & 2 valve receivers

Continue from there, leaving all of this wire bare, and solder, at a suitable point along this wire, to the *red* tag of C_R. From this latter point leave sufficient wire to finally solder to an earthed tag which will be mounted later.

Step No. 3.—With a suitable length of wire, join together *yellow* on the coil to *yellow* on the phone strip.

Step No. 4.—Connect together *green* tag of the coil to the *green* tag on the condenser C_R.

Showing arrangement of batteries within the case

Step No. 5.—Detach C_1 and R_1 from the marked card on which they are mounted and, suitably shortened, solder one end of each to the *blue* tag of C_T, the other end of each of these components now being connected to the *white* tag of C_T.

Step No. 6.—Solder one end of a 4in length of wire to the *white* tag of C_T, suitably cover with systoflex and connect to the other end the small metal spring clip which is

eventually to be secured to the valve top connection at a later stage.

Step No. 7.—Cut approximately 9in of *black* wire and 4in of *black* wire and solder one end of each to the *green* tag of the phone strip.

Step No. 8.—Cut approximately 4in of *red* wire and connect one end to the *red* tag of the phone strip. Leave the other end free for the time being.

We must now commence to wire the sub-panel on which are mounted the valve or valves as the case may be—the valveholders already being in position as received. (See Fig. 3.)

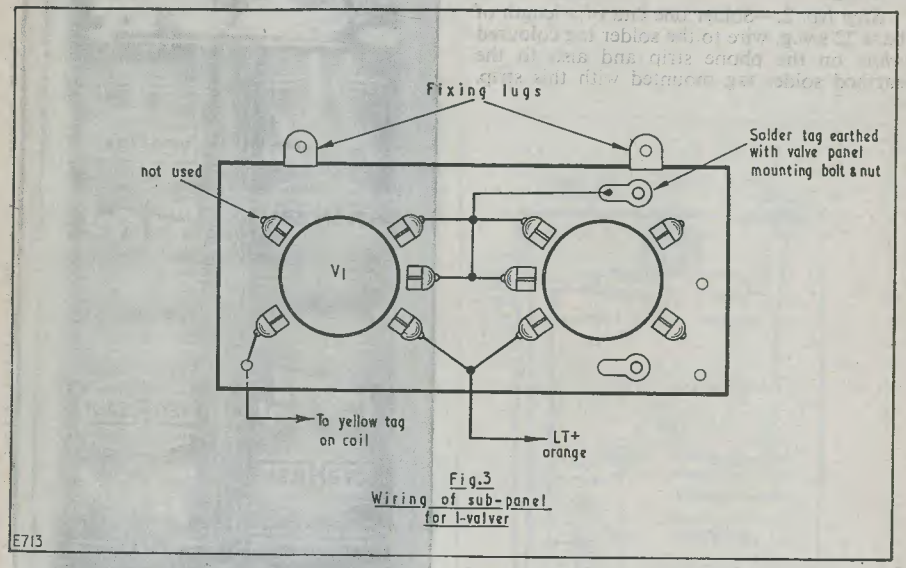


Fig.3
Wiring of sub-panel for 1-valver

Step No. 9.—Solder together the *red* tag of V_1 to the *red* tag of V_2. To this latter point, solder a short length of bare wire to connect with the *white* tags of both V_1 and V_2. Secure the sub-panel to the case by means of the screws and nuts, ensuring that an earthed tag is fitted under that screw on the right-hand side looking at the receiver from the rear. To this solder tag connect the end of the bare wire left from Step No. 2. Note here that although the *red* tags of both V_1 and V_2 are in physical contact as received, they *must* be soldered together as outlined above.

Step No. 10.—From the *blue* tag of V_1 connect one end of a length of wire, the other end of which is now soldered to the *blue* tag of V_2. Also solder to one of these *blue* tags one end of a 4in length of *orange* flex as shown in Fig. 3.

Step No. 11.—Solder one end of a length of *red* flex to the *yellow* tag of V_1, the other end of which is now connected to the *yellow* tag of the coil. From this latter tag solder a further length of *red* flex to the *yellow* tag of the phone strip.

The valve may now be inserted into the valveholder. Care must be taken to support the sub-panel at the same time, handling the valve itself gently as it is somewhat fragile. The elongated *red* end of the valve should be placed into the circular aperture in the centre of the valveholder and the valve pins then clipped into their respective seatings. The spring clip connection to the top pin of the valve should now be placed into position, this latter connection being left from Step No. 6. The wire which is connected to this clip should now be tucked into the cut-out slot on the edge of the sub-panel. There is no connection, of course, to the *red*, or bottom, valve pin.

The aluminium battery tray is now placed in the case with the *red* and *black* terminals at the sub-panel end of the case, allowing both the *red* and *black* lengths of flex to protrude on either side of the tray, at the bottom of the case, so that they may be connected to the h.t. battery.

The short length of *black* flex which is soldered to the *blue* tag on the phone strip is now brought up under the tray and connected to the *black* terminal on the tray soldering strip. The *orange* flex from the *blue* tag of V_1 is now soldered to the *red* tag of the tray. Next, connect the h.t. battery by soldering the *red* flex to the h.t.+ brass battery tag and the *black* flex to the h.t.− brass tag of the battery.

The h.t. battery should now be inserted at the bottom of the case, together with a small piece of cardboard at either end in order to prevent the battery contacts touching the metal casing. Next, fit the cardboard strips supplied in the case, one on either side, and then position the four U2 type batteries as shown in the photograph. The spring clip attached to the paxolin board should now be fitted underneath the four batteries in order to firmly press these batteries against the terminals at the top of the tray.

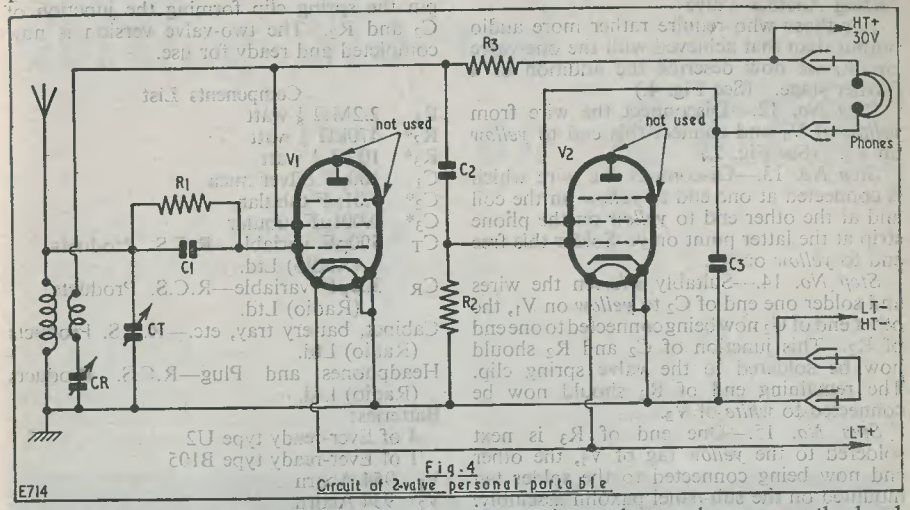


Fig.4
Circuit of 2-valve personal portable

Lastly, connect the phones to the phone plug. The insertion of this plug automatically causes both the l.t. and h.t. currents to flow, and these should therefore be removed when the set is not in use, i.e. remove the headphones. The headphone leads themselves are connected to the two wide spaced pins, the remaining two pins being shorted, i.e. connected together with a short length of bare wire. Having connected the phones to the plug, place the latter into the socket on the front panel, when the valve should "light-up". Screw the aerial rods to the

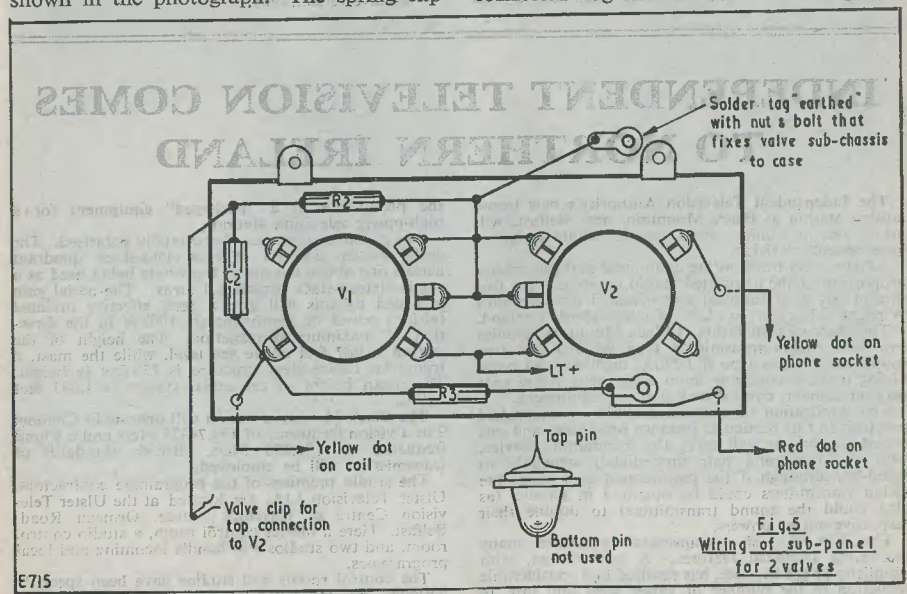


Fig.5
Wiring of sub-panel for 2 valves

aerial input fixture, and the set should now be in working order. For increased gain, advance the reaction control clockwise.

Adding Another Valve

For those who require rather more audio output than that achieved with the one-valve circuit, we now describe the addition of a further stage. (See Fig. 4.)

Step No. 12.—Disconnect the wire from *yellow* of V_1 and connect this end to *yellow* on V_2. (See Fig. 5.)

Step No. 13.—Disconnect the wire which is connected at one end to *yellow* on the coil and at the other end to *yellow* on the phone strip at the latter point only. Solder this free end to *yellow* on V_1.

Step No. 14.—Suitably shorten the wires and solder one end of C_2 to *yellow* on V_1, the other end of C_2 now being connected to one end of R_2. This junction of C_2 and R_2 should now be soldered to the valve spring clip. The remaining end of R_2 should now be connected to *white* of V_2.

Step No. 15.—One end of R_3 is next soldered to the *yellow* tag of V_1, the other end now being connected to the solder tag mounted on the sub-panel paxolin assembly. Also to this latter tag solder one end of a 7in length of wire. Pass this wire through the adjacent hole in the paxolin and connect at the other end to *red* on the phone strip.

Step No. 16.—Solder one end of C_3 to *yellow* on the phone strip and the other end to the *red* tag of the condenser C_R.

Place the second valve into position, as previously described, and secure to the top pin the spring clip forming the junction of C_2 and R_2. The two-valve version is now completed and ready for use.

Components List

R_1 2.2MΩ $\frac{1}{8}$ watt
R_2* 470kΩ $\frac{1}{4}$ watt
R_3* 10kΩ $\frac{1}{4}$ watt
C_1 100pF Silver mica
C_2* 0.01μF tubular
C_3* 0.001μF tubular
C_T 500pF variable—R.C.S. Products (Radio) Ltd.
C_R 300pF variable—R.C.S. Products (Radio) Ltd.
Cabinet, battery tray, etc.—R.C.S. Products (Radio) Ltd.
Headphones and Plug—R.C.S. Products (Radio) Ltd.
Batteries:
4 of Ever-ready type U2
1 of Ever-ready type B105
V_1 954 Acorn
V_2* 954 Acorn
Valveholders/Sub-panel — R.C.S. Products (Radio) Ltd.
Aerial input socket, phone strip, aerial rods, etc.—R.C.S. Products (Radio) Ltd.

* 2-valve version only.

INDEPENDENT TELEVISION COMES TO NORTHERN IRELAND

The Independent Television Authority's new transmitting station at Black Mountain, near Belfast, will bring over a million more people within range of independent television.

All the main transmitting equipment and the greater proportion of the associated studio equipment for this station has been supplied and installed by Marconi's Wireless Telegraph Co., Ltd. of Chelmsford, England.

The Marconi installation at Black Mountain includes two 4kW vision transmitters type BD.366 and two sound transmitters type BD.270A, together with combining units, programme input equipment, flying spot caption scanner, control desk and test equipment.

The duplication of transmitters follows established practice; in this particular instance one vision and one sound transmitter will carry the programme service, with the remaining pair immediately available as stand-by, although if the requirement ever arose the vision transmitters could be operated in parallel (as also could the sound transmitters) to double their respective output powers.

The BD.366 vision transmitter embodies many interesting technical features. A new design, with simplicity as the keynote, has resulted in a considerable reduction in the number of valves used and this, in turn, has made possible an extremely clean, straightforward layout and the incorporation of a simple yet thoroughly efficient cooling system which needs no sub-floor ducting. The transmitter represents the nearest approach yet made by any manufacturer to the production of a "packaged" equipment for a high-power television station.

The radiated signals are horizontally polarised. The aerial system consists of two eight-stack quadrant aerials one above the other, the whole being used as a single sixteen-stack directional array. The aerial gain provided by this will give a peak effective radiated (vision) power of approximately 100kW in the direction of maximum propagation. The height of the station is 987 feet above sea level, while the mast, a triangular lattice steel structure, is 750 feet in height. The mean height of the aerial system is 1,687 feet A.S.L.

The Black Mountain station will operate in Channel 9 at a vision frequency of 194.74325 Mc/s and a sound frequency of 191.230 Mc/s. British standards of transmission will be employed.

The studio premises of the programme contractors, Ulster Television Ltd., are located at the Ulster Television Centre at Havelock House, Ormeau Road, Belfast. Here a master control room, a studio control room, and two studios will handle incoming and local programmes.

The control rooms and studios have been specially designed by Marconi's in conjunction with Ulster Television Ltd.'s technical advisers. The larger studio is equipped with two Marconi Broadcast Vidicon cameras while the other, which is an announcers' studio, has a smaller Marconi Vidicon camera. Telecine equipment is installed in an adjacent room.

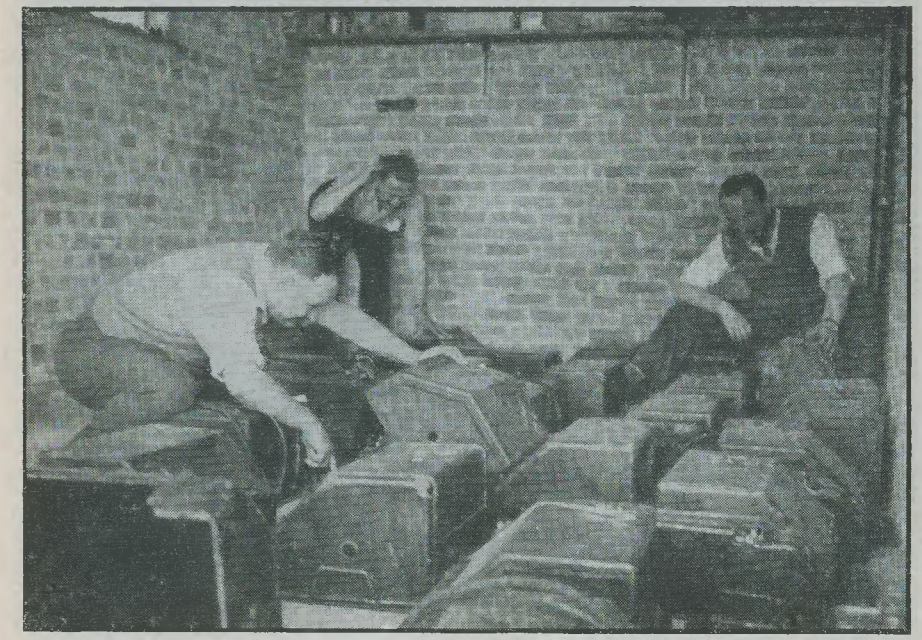
Getting Started on RTTY

by Arthur C. Gee, G2UK
Hon. Sec., British Amateur Radio Teletype Group

Part 2

ANY THOUGHT OF STARTING AMATEUR RTTY in this country had to be put right out of mind until a source of teleprinters could be found. Whilst the electronic gear can be easily built by the enthusiastic amateur, no amount of enthusiasm could conjure up a ready supply of the "machinery" side of the matter, nor did it seem able to persuade those concerns who were in a position to supply second-hand teleprinters to part with them at a price which would appeal to the average radio amateur.

And then, quite out of the blue, through a series of events which at first seemed most unlikely to go in the direction one wished, the opportunity came to the writer of acquiring a reasonable number of ex-G.P.O. machines of the type known as Creed Type 3's. Now, as was indicated in the first article

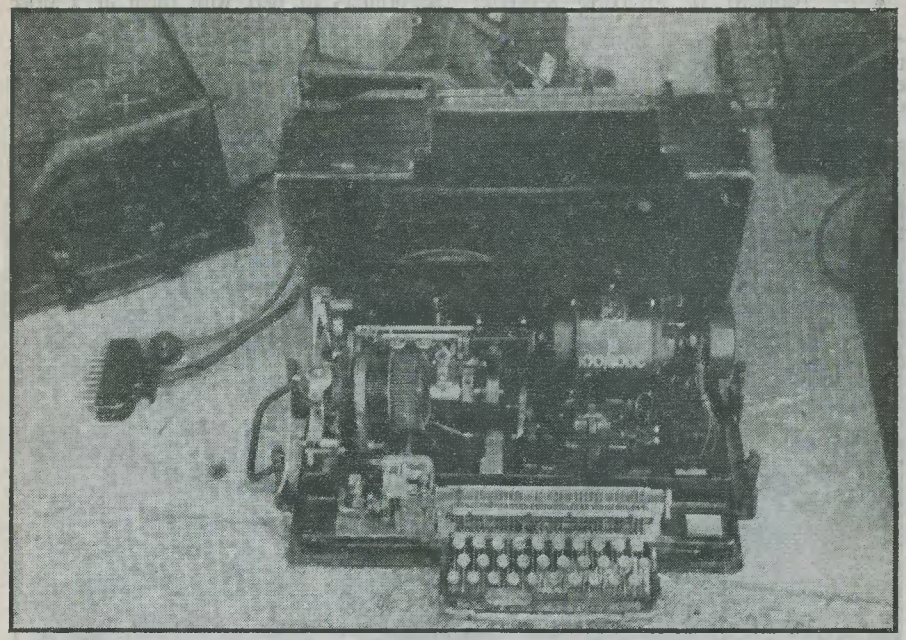


Teleprinters galore! Members of the B.A.R.T.G. examine the first of the Type 3 teleprinters which the Group has managed to acquire

in this series, there are two standards in common use in the field of teleprinter communication, the English or Creed System and the American system. Quite frankly, if one had had the choice, one would have preferred to have acquired American teleprinters rather than English ones, because most of the amateur RTTY going on at present is taking place in America, Canada and one or two other countries, all of whom have acquired their machines from civil or Services U.S.A. sources. As amateur RTTY operators will want to work into these countries, it would have been better to have adopted the American standard and kept just the one standard as far as amateur radio was concerned. However, American machines are rarely offered for sale in this country, and when they are, the price asked is far above the Creed system, not the American, so that their signals are intelligible on our machines.

This point has been laboured somewhat in order to warn those who may acquire teleprinters through sources other than the B.A.R.T.G. to be sure they work on the Creed system. There are to be had, at times, various ex-U.S.A. Services teleprinters. These will not work into the British net, without modification.

Generally speaking, there are two types of teleprinter. The older type, of which the Type 3 is an example, type on to a long paper tape. This will be familiar to most readers as the type used for those telegrams in which the message was printed on to gummed paper tape which was subsequently stuck on to message forms. The newer



Ex-G.P.O. Creed Type 3 Teleprinter. Typing head, with paper tape transport mechanism is to the left. The governor is to the right of the motor

that which an amateur can afford. With such an offer as came the B.A.R.T. Group's way, the obvious course was to take it, get a British—and perhaps European—net going, and sort out the difficulties of working American-equipped stations later.

As it happens, this decision has proved a wise one from another point of view, viz., that many of the European Shortwave Commercial Stations, whose signals have proved so useful in lining up one's gear, use models type directly on to message forms or paper rolls about 8in. wide in the form of a "page." These are designated "page printers."

Whilst the tape printer produces yards of paper tape on which the message is recorded and obviously hasn't the advantages in this direction which the page printer has, it has a number of advantages over the page printer, particularly in relation to simplicity of operation, which is a valuable feature for

those acquiring their first experience of this mode of communication.

So much for the generalities. Let's turn to some details of the Type 3 machine.

As can be seen from the photos, it is quite a compact unit, being 20½in long, 14½in back-to-front and, with its cover on, 10in high. It weighs about 60lb, which is not too bad for one-man handling. Of those acquired by the B.A.R.T.G., some had 100–110V d.c. motors; others 150–170V d.c. motors, and the remainder 200–220V d.c. motors.

The motor is maintained at a constant speed of 2,520 r.p.m. by a centrifugal governor mounted on the end of the motor shaft. As has already been explained, these teleprinters work on the "start-stop" system and the speed of one machine does not, therefore, have to be accurately timed to that of another, as is the case with the synchronone systems. Even so, the permissible speed difference between machines must not be too great and a tolerance of not more than 0.5% is usually aimed at. The amount of speed error permissible before errors show up depends on circuit characteristics and so on, but generally speaking a difference in speed between two machines of 2% or more will produce gross errors in printing between the two machines.

The speed of the teleprinter can be checked in a number of ways. One can, of course, check the motor speed with a speedometer in the normal way, if one has access to this type of instrument. A revolution counter can be similarly used. The manuals on these machines usually give a table of the various shaft speeds. In practice, rapid checking is carried out by using a stroboscope. This is a most ingenious little gadget consisting of a metal reed fixed to the bottom of a brass tube, up which it extends. At the top of the tube, the reed is attached to a metal weight. When this is made to vibrate, by pulling quickly to one side and releasing, it does so at a rate depending on the length of the reed. As it does so, it covers and uncovers a narrow aperture through which one can watch a white line marked on one of the gear wheels of the teleprinter. Various stroboscopes are available, each with different speed characteristics. Examination of the Type 3 machine will reveal a gear wheel with a well marked white line or segment on it. If this is viewed through the appropriate stroboscope, with the machine running at its correct speed, the line or segment will appear stationary. If the line appears to be rotating clockwise, the motor is running too fast; if anti-clockwise, too slow. In the case of the Type 3 teleprinter, the wheel carrying the white mark should rotate at 630 r.p.m. and the stroboscope required to check it is the No. 1.

Adjustment of the motor speed is done by adjusting the governor. Its cover is removed, the clamp screws holding the base plate are loosened, and the governor spring adjusting screw is turned in a clockwise direction to increase the motor speed or an anti-clockwise direction to slow the motor. One complete turn of the governor adjusting screw should alter the motor speed—not the gear wheel speed—by about 30 r.p.m.

Direct current supplies for the motor can be obtained in a variety of ways. For those who wish to buy a suitable unit, the Type 43 is the thing to look for, if you have a motor of the 100–110V range. These are rather large units, massively built, of the metal rectifier type. They can be obtained very cheaply from various firms who deal in surplus of this type. However, as most of these motors do not take much current —from ½–¾ amp—most members of the B.A.R.T.G. appear to have devised their own d.c. supplies from receiver type transformers and metal rectifiers which they already had on hand. Similarly with the 150 and 200V motors, for which at the time of writing the author has found no reasonably priced surplus unit.

It is not possible in the limited space available for this feature to deal with the mechanics of the teleprinter. For those who are interested, the various service manuals on this topic should be consulted.

The primary purpose of these articles is to show how to "join the equipment together and get it going," although in subsequent articles we shall deal with the construction of a receiving FSK converter, or "terminal unit" as it is called, and with FSK conversions for amateur transmitters.

Next month we shall deal with various matters relating to the circuitry of the machines and show how to wire them up so that they can be made to "self-print," a procedure which will indicate quite well whether or not your machine is suffering from any gross faults.

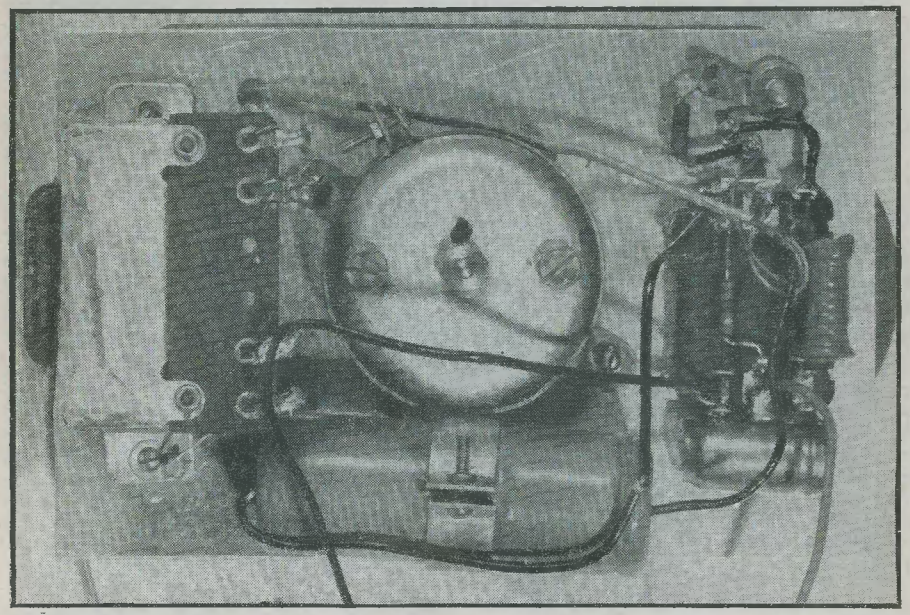
RADIO SHOW 1960

The National Radio and Television Exhibition is to be held at Earls Court, London, from 24th August to 3rd September with a preview for overseas and other specially invited visitors on 23rd August.

This will be the 27th National Radio Show.

Car Radio | 2-Watt Transistor Amplifier

THERE MUST BE MANY READERS OF THIS magazine who own a car radio and require just that little extra "punch" so often required when located in a notoriously poor reception area, or whose existing installations do not deliver sufficient audio output. Also, for those fortunate enough to have a trailer caravan, where usually more output is required, this amplifier should prove to be "just the job".



Layout of the car radio amplifier chassis

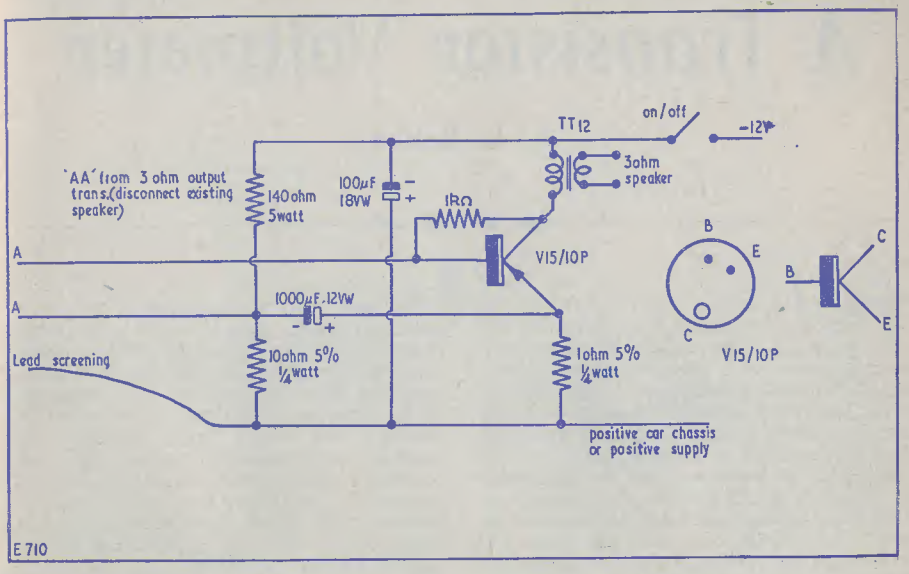
The circuit is shown in Fig. 1 and is self-explanatory, being the normal a.f. amplifier design met with power transistors. To connect the amplifier into circuit, disconnect the speaker voice coil from the existing output transformer of the receiver and connect to the output transformer TT12 of the amplifier. The output transformer of the receiver should now be connected to the input of the amplifier via a twin screened lead. The screening of this lead should only be connected at the amplifier end to positive, the other end being left free.

The collector of the Newmarket V15/10P power output transistor is the 0BA nut—in effect the transistor casing. This must be bolted directly to the amplifier metal chassis in order to dissipate heat and obviate thermal runaway. This being so, the chassis of the amplifier must *NOT* come into contact with the car chassis; indeed should this occur, a blown transistor and/or a flat car battery will result!

Connection to the car chassis in order to obtain a positive supply should be obtained by a lead soldered to the appropriate end of the 1Ω resistor inserted in the emitter supply. The negative supply should be obtained either direct from the car battery or a suitable nearby source and via the switch shown.

nected directly to the transistor base. The total current consumption of this amplifier is some 300mA.

The great advantage of this amplifier is that



Components List

Transistor, Newmarket V15/10P
1,000μF condenser 12V wkg.
100μF condenser 18V wkg.
Metal chassis—Henry's Radio Ltd.
7in x 4in high flux 3Ω speaker
Single pole On/Off switch
TT12 O/P transformer—Henry's Radio Ltd.

Resistors:
1kΩ, 56Ω, ¼ watt
10Ω 5%, ¼ watt
140Ω 5 watt
1Ω 5% ¼ watt

Tagboard, clips, etc.—Henry's Radio Ltd.

The output power obtained from this amplifier is some 2 watts maximum, and volume control is effected by using the existing control on the receiver. Should the output obtained prove to be an overload on the amplifier input, a 56Ω resistor should be inserted in series with the input lead connected with a suitably modified portable radio, the amplifier may be left within the car on such occasions when the portable is required for use elsewhere. The much greater audio output obtained, with no extra current drain on the portable batteries, is an advantage also not to be overlooked.

UNDERSTANDING TELEVISION

Continued from page 347

synchronism it is described as the oscillator "hold," or "lock," control.

In Fig. 128 the sync pulse is applied to the grid with the aid of a low-value resistor in series with the secondary of the transformer. There are other ways in which a positive-going pulse may be applied. A typical instance is given when the pulse is applied direct to the grid via a condenser (which should have a capacity markedly lower than that of the grid condenser). A *negative*-going pulse may also be used to synchronise the oscillator. In this case it would be applied to the anode, whereupon the necessary positive-going pulse at the grid would be obtained via the transformer.

Next Month

In next month's article we shall carry on to discuss the multivibrator.

A Transistor Voltmeter

By L. Baker

THE TRANSISTOR VOLTMETER TO BE described measures from 1 volt to 800 volts d.c. The use of a transistor in a circuit similar to a valve voltmeter enables the instrument to operate at a high value of input resistance which will give results which are comparable to that of the valve voltmeter. Voltages as small as 0.5 of a volt or less are easily read on the meter, and the instrument is especially useful for the measurement of very small voltages such as, for instance, the a.v.c. line voltage of a radio receiver. The number of components is kept to a minimum, the 100μA meter M_1 being the most expensive part.

The instrument can be built into a small case; in the original instrument this measured 5¾in x 4⅜in. However, since the only deciding factor as regards the size of the finished instrument is the meter itself, it could be made smaller if so desired, the actual size being left to the intending constructor to suit whatever meter parts he has on hand.

The actual ranges covered by the instrument are:

Range 1. 0 to 1 volt full-scale
Range 2. 0 to 10 volts full-scale
Range 3. 0 to 100 volts full-scale
Range 4. 0 to 200 volts full-scale
Range 5. 0 to 400 volts full-scale
Range 6. 0 to 600 volts full-scale
Range 7. 0 to 800 volts full-scale

Within the scope of these ranges will be found all d.c. volts encountered in radio receivers, amplifiers, and such like equipment. Both the penlite 1.5 volt dry batteries are housed in the case of the instrument itself. The penlite type is especially suitable for this instrument on account of its small size. The switch $S_{3A/B}$ is ganged with R_9, and serves the purpose of switching off both batteries when the instrument is not in use. It is recommended that both R_{10} (sensitivity) and R_9 (zero set) are of the wire-wound type. These give better stability and wear than carbon types.

The switch $S_{1A/B}$ is included as a polarity reversing switch. This is useful in the event of connecting the instrument the wrong way round to the voltage to be measured, in which event the meter will attempt to move in the wrong direction. This can be corrected by throwing the switch $S_{1A/B}$ to the other position, whereupon the meter will read correctly. On the front panel this switch is engraved + ground in one position and − ground in the other. With this system it is possible to tell the polarity of the test voltage without tracing the test leads, etc.

The only precision components are the voltage dividers $R_{1, 2, 3, 4, 5, 6, 7}$. It is recommended in the interest of accuracy that these be of the 1% type. TR_1 is a Mullard OC71 junction transistor; the use of this Mullard type is advised. However, it is likely that the red spot surplus type of transistor will work equally well in this position. It is probable that some adjustment will have to be made to R_8 in this case. R_8, in any event, is critical and may need some adjustment up or down even with the OC71. The nominal value of 47kΩ is given in the parts list as this was found to be the best value in the prototype instrument.

Construction

All parts are mounted behind the front panel, which in the prototype was of Formica. The actual size of the panel is, of course, dependent on the type of case the intending constructor has in mind. The Formica is drilled to suit the mounting bushings of R_9, R_{10}, $S_{1A/B}$, S_2 and $S_{3A/B}$. A hole is cut centrally in the panel to take the flush-fitting 2in microammeter. Holes should also be drilled in the Formica panel for the input socket strip. The clips for holding the batteries $B_{1, 2}$ are made from brass strip and are held on the front panel by means of 8BA screws and nuts. Connection to these batteries is made by soldering the appropriate leads directly to each cell electrode, and care should be taken to see that they are wired properly as shown in the circuit diagram. It is most important that these batteries are properly connected to avoid damage to the meter and transistor.

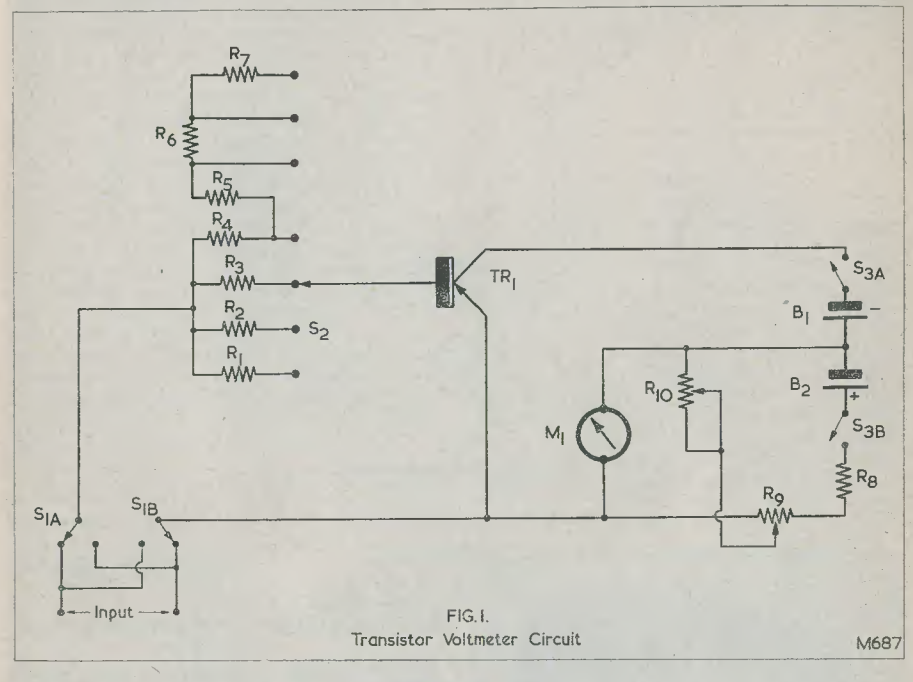


FIG. 1.
Transistor Voltmeter Circuit
M687

Components List

Resistors
R_1 150kΩ ½W 1%
R_2 1.5MΩ ½W 1%
R_3 15MΩ ½W 1%
R_4 30MΩ ½W 1%
R_5 30MΩ ½W 1%
R_6 30MΩ ½W 1%
R_7 30MΩ ½W 1%
R_8 47kΩ ½W, see text
R_9 50kΩ w.w. potentiometer
R_{10} 10kΩ w.w. potentiometer

Transistor
TR_1 Mullard OC71, see text

Meter
M_1 100μA f.s.d.

Switches
$S_{1\ a-b}$ Double-pole, double-throw
S_2 Single-pole, seven or more-way
$S_{3\ a-b}$ Double-pole, single throw

Batteries
B_1, B_2 Ever Ready Penlite

Miscellaneous
Input sockets, cabinet, screws, nuts, wire, Formica panel, sleeving, etc.

When all components have been mounted, wiring can be commenced, leaving the wiring-in of the transistor TR_1 until last to avoid damage to this part. The resistors R_1 to R_7 are mounted on the 11-tag strip as shown. Care should be taken when soldering these parts not to apply the hot soldering iron to the leads for long periods; this will avoid their values altering. The wire used should be a good quality plastic insulated type, and the thin coloured type is advisable. Having installed all parts (less TR_1) and soldered all joints with a good clean soldering iron, TR_1 can be mounted on the tagstrip. Small pieces of sleeving are slipped over the leads of TR_1 leaving enough room to grip the bare lead with small pliers when soldering to conduct away the heat and so avoid damage to the transistor. The batteries should be left out until the actual testing of the completed instrument.

Having installed TR_1, it is now advisable to check and double check the wiring for

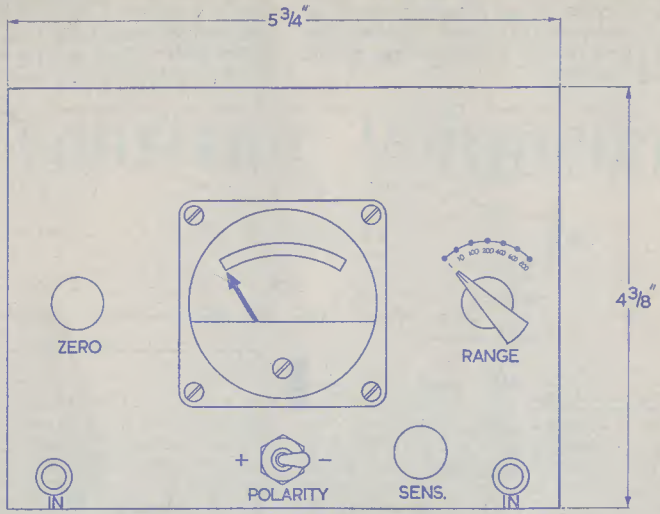


FIG.2.
Transistor Voltmeter-Front.

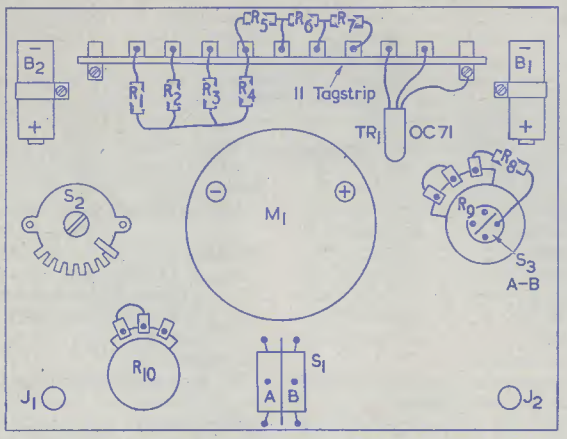


FIG.3.
Transistor Voltmeter – Rear of Front Panel.
M688

possible errors before connecting the batteries. If all is in order, the batteries can be installed with the instrument switched off.

For the initial testing, a known *accurate* voltmeter is required plus a source of several voltages such as a radio high tension battery. The resistors R_9 and R_{10} should be roughly set in the following manner. R_9 should be set so that all the resistance element is in circuit. R_{10} should be set approximately halfway through its travel. Test leads should be connected to the instrument and this switched on. The meter may now be made to read zero volts (with the input leads shorted) by rotating R_9 in the appropriate direction. R_{10} can be adjusted by rotating it so that as much of its resistance as possible is left in circuit consistent with steady zero on the meter with the test leads still shorted. Once R_{10} (sensitivity control) is set it will not be necessary to move it except occasionally. With a small single dry cell, and using the separate temporary circuit shown, set up one volt exactly as indicated by the known accurate voltmeter. This voltage may now be applied to the transistor voltmeter on range 1. The meter should now move to full scale indicating one volt. Range 2 may be tested using a grid-bias battery, and 4.5 volts and 9 volts checked on this range. The 100 volt range may be checked at several points by means of the h.t. battery, always comparing the readings on the transistor instrument to the known accurate instrument. For the other ranges use can be made of voltages encountered in, for instance, a domestic radio receiver. Check first of all with the known accurate instrument then compare with the transistor instrument, when all the higher ranges of volts should be within, say, 3 or 4 volts.

The instrument may be housed in a small case made especially for the meter. The writer used one made from 5-ply wood stained and polished, and especially made to suit the $5\frac{3}{4}$in x $4\frac{3}{8}$in Formica panel. Formica is obtainable at most hardware stores, and most places have scrap pieces of various colours which can be bought for a few pence. This material has a hard shiny surface which will resist damage and for appearance alone is worth including in the instrument. Other materials such as paxolin are also suitable.

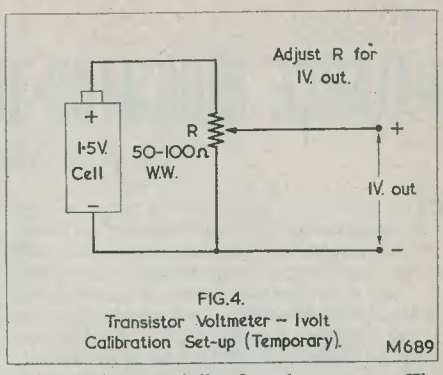
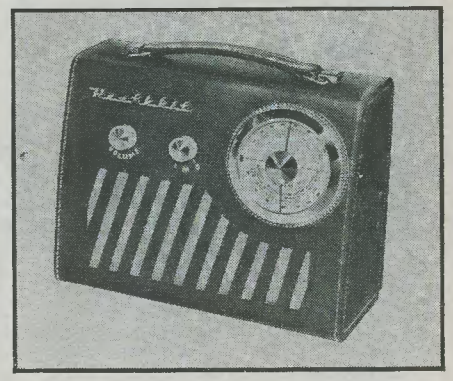


FIG.4.
Transistor Voltmeter – 1volt
Calibration Set-up (Temporary).
M689

Trade Review

The Heathkit Transistorised Portable Receiver, Model UXR.1



One of the most popular of the Heathkit range must surely be the personal receiver UXR.1. This is a six-transistor superhet receiver, using a printed circuit, and housed in a really good quality leather case; the whole, when completed, presenting an appearance of quality and elegance.

The writer recently had the opportunity of building up one of these kits and has used the receiver extensively since. In spite of it being his first experience of transistor circuits and incidentally of printed circuit construction, the unit worked straight away on completion and a minimum of lining-up was required. No special instruments were required for this process, alignment being carried out without the aid of a signal generator as outlined in the instruction manual for those not possessing such equipment. Everything worked out as detailed, and the receiver was working perfectly a few minutes after the final constructional step was completed. It has given faultless service since.

The layout of the printed circuit is sufficiently open to give easy construction, and every component fits nicely into its allotted place. As with all Heathkit equipment, each step has been carefully worked out so that an ideal sequence of construction is followed. Beginners need have no fear that the construction of what, at first, appears to be a somewhat complicated receiver will be beyond their capabilities. Provided they can make a soldered joint cleanly and quickly, the "step-by-step" procedure will keep them on the straight and narrow path to success. This kit is an excellent one which we can thoroughly recommend, and is one which will give the constructor a personal receiver of which he can be really proud.

BALANCE INDICATOR FOR STEREO AMPLIFIERS

By D. J. LINSEY, A.M.I.P.R.E.

TO OBTAIN THE BEST RESULTS FROM ANY equipment, whether it be mechanical or electrical, it is essential that each part of that equipment should function correctly.

In a stereophonic system the two volume levels should be equal. This can be done by fitting a balance control which varies the gain of each channel. Unfortunately, if the balance control cannot be adjusted from the listening position it is impossible to get the two levels equal.

To overcome this some means of level indication is required, and the diagram shows a circuit of such an indicator. Two out-of-phase and equal-in-amplitude signals are applied to the inputs of the amplifier, the two speakers being strapped together. (This is done so that the two out-of-phase signals are applied to each of the speakers simultaneously —two out-of-phase signals equal in amplitude give little or no output.) The balance control is adjusted for minimum signal, the speakers are next unstrapped, and the equipment is then set up.

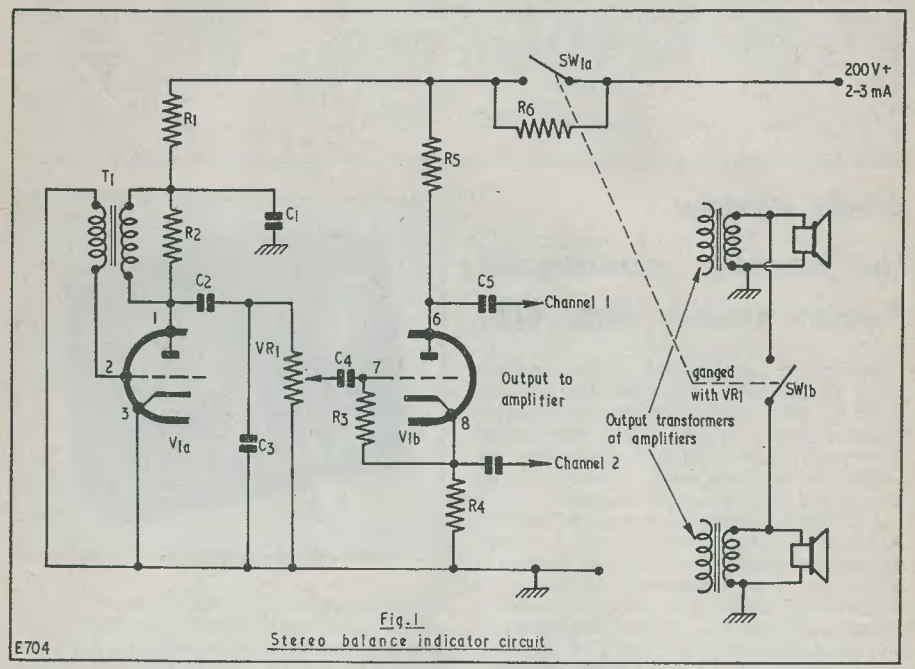


Fig.1
Stereo balance indicator circuit

Components List

Resistors—all ¼W

R_1	100kΩ
R_2	10kΩ
R_3	10MΩ
R_4	100kΩ ±2%
R_5	100kΩ ±2%
R_6	1MΩ

Transformer

T_1	Radiospares FB5

Capacitors

C_1	0.1μF
C_2	0.002μF
C_3	0.001μF
C_4	0.002μF
C_5	0.002μF
C_6	0.002μF

Valve

V_{1a-b}	ECC82 or equivalent

Operation

The circuit consists of a twin triode (ECC82). The first triode operates as a simple transformer-coupled oscillator, working at a frequency of approximately 600 c/s, the output being fed via VR_1 output control to a concertina phase-splitter. The two out-of-phase outputs are fed into the pick-up terminals of the stereo amplifier.

The volume control is fitted to vary the output to the amplifier, thus allowing the unit to be used for high or low settings of the amplifier volume control. It should be noted that the indicator can be used for either single-ended or push-pull amplifiers since the balancing is done by the output from the speakers.

Component values are not at all critical except those of R_4 and R_5, which should be matched to within 2% to give the equal outputs required.

The double-pole switch is ganged to the volume control, SW_{1a} being shunted by R_6 (1 MΩ) thus allowing a low anode current to flow during non-operation, which extends the life of the valve. $SW1_b$ is connected across the speakers as shown.

A VERTICAL TRAPPED DIPOLE ANTENNA

By ARTHUR C. GEE, G2UK

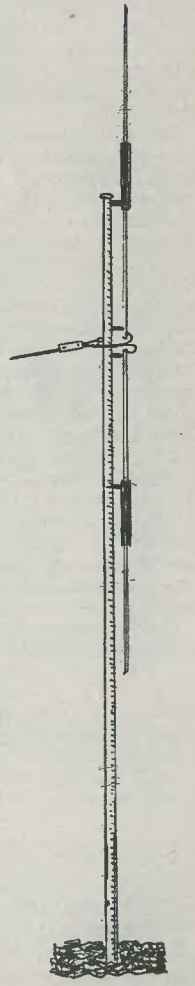
THE SEARCH FOR THE "PERFECT AERIAL" WILL NO DOUBT continue for as long as radio amateurs exist. The aerial to be described fulfils the author's requirements more satisfactorily than any other which he has so far used. Briefly, his requirements were: for use on 14–21–28 Mc/s primarily, freedom from unwanted directional effects, good Dx characteristics, ease of erection and an ability to stand heavy weather, rapidity of band-changing facilities and a compact, neat appearance.

The type of aerial which meets most of these requirements is, of course, the vertical dipole. However, these are too long to be readily put up by the amateur with the usual facilities. The ground plane is the next best thing, but the radials present a problem in space requirements and erection.

Turning over the advertisement pages of one of the radio periodicals, Mosley's range of aerials caught my interest. Could one use two "top-half" elements of their multiband ground plane antennas, mounted end to end up the side of a thirty foot wooden pole, feed the arrangement at the centre with twin feeder or coax, thus getting a rigid, stormproof, all-round-the-compass, low angle of radiation, compact antenna? There seemed no reason why it should not work. So Mr. O. J. Russell, G3BHJ, Mosley's British manager, was consulted and he agreed that the idea was a most interesting one, particularly as on first principles it would seem that it should work well and also because such an arrangement should appeal to the many amateurs whose space limitations are severe and whose "neighbour-reaction" is not favourable to elaborate aerial systems. He carried out some initial tests, which appeared to confirm that the idea was feasible and that approximately 80 ohm twin feeder seemed to produce the best compromise match. The necessary components were delivered to G2UK's QTH and the aerial erected as indicated in the accompanying illustration.

Results have passed all expectations. The centre of the aerial is approximately 22 feet above ground. It has been tested out with a home-built 60 watts transmitter and with an LG.300, both with pi-couplers coupled straight into the twin feeder so that switching from band to band is instantaneous. Excellent Dx contacts have been consistently maintained.

Mosley's have now decided to market this antenna as one of their standard lines. It has been designated Type TA31 Jr., and is available at £10. Their address is 15 Reepham Road, Norwich, Norfolk.



The TRANSITONE

A simple transistorised electronic organ

By J. G. Ransome

THIS LITTLE ELECTRONIC ORGAN IS VERY simple to construct and should meet the demands of the one-finger pianists who want to "go electric." Alternatively, it would make an ideal birthday or Christmas gift for a child. The inclusive cost of the electronic side of the instrument need not be more than 30s. even if every component is purchased new. The organ consists of two parts, the note generator and the output stage. The output stage is very simple and needs no explanation.

The note generator is shown in its basic form in Figure 1. The "old hands" will, of course, recognise it as our old friend, the multivibrator, but for the less experienced a word or two of explanation will not be out of place. Two waveforms are available from this type of oscillator, and these are depicted in Figure 1. The operation of the circuit is as follows: consider initially that TR_1 is fully conducting and TR_2 is cut-off (i.e., not conducting). When TR_1 is fully conducting it offers practically zero impedance and so almost all of the battery voltage appears across the collector load resistor R_1. C_1 then begins to charge and, as it does so, the base of TR_2 is driven negative until TR_2 conducts; C_2 then discharges, biasing off the base of TR_1 and cutting it off; but as TR_2 conducts C_2 charges through R_2 and slowly drives the base of TR_1 negative until it conducts, C_2 then discharging and cutting off TR_2. The cycle of operations then repeats itself producing a continuous oscillation.

The frequency of operation is given by the following expression:

$$f=\frac{1}{0.7\,C_1\,R_1+0.7\,C_2\,R_2}$$

where the capacitance is in farads and resistance is in ohms.

If we make $C_1=C_2$, we may simplify the expression to:

$$f=\frac{1}{0.7\,C\,(R_1+R_2)}$$

Using the above formula, we may now proceed to the final circuit. The complete circuit for the electronic organ is shown in Fig. 2.

As will be seen the oscillator section does not depart very far from the basic circuit outlined in Fig. 1, save that the timing resistor associated with C_1 now consists of two parts R_1 and R_x. R_1 is fixed and has a fairly low value and is used to prevent damage to TR_2 should any trouble occur on the keyboard. R_2 has a fixed value and a value of about 27kΩ is chosen for the final design. The oscillator may be keyed by switching in various pre-set variable resistors in series with R_1 to "h.t."

The output stage consisting of TR_3 is fairly conventional and any audio output transistor may be used. T_1 will have to be matched to the transistor used.

R_5 is an h.t. compensation resistor. Since the frequency of the oscillator is dependent upon the h.t. applied, the frequency of the oscillator will tend to drift as the h.t. battery ages—R_5 is incorporated to compensate for this drift. It is set to maximum resistance with a new battery and then is gradually reduced in value as the battery ages and the organ goes out of tune.

The value of R_x may be calculated from the above formula and the final value found by experiment.

For instance;

taking $C_1=C_2=0.1\mu F$ or 1×10^{-7} farad and $R_2=27k\Omega$

then for a note of middle C (f=256 c/s) R_x will be

$$f=\frac{1}{0.7C\,(R_1+R_x)} \text{ or } R_1+R_x=\frac{1}{0.7Cf}$$

$$\therefore Rx=\frac{1}{0.7Cf}-R_1 \text{ ohms}$$

$$\text{or } Rx=\frac{1}{0.7\times1\times10^{-7}\times256}-27{,}000$$

$$\simeq 33k\Omega$$

or for a note two octaves above (i.e., f=1,024 c/s)

taking $C_1=C_2=0.05\mu F$ or 5×10^{-8} farad

$R_1=27k\Omega$

$$Rx=\frac{1}{0.7Cf}-R_1 \text{ ohms}$$

$$\text{or } Rx=\frac{1}{0.7\times5\times10^{-8}\times1{,}024}-27{,}000\Omega$$

$$\simeq 1k\Omega$$

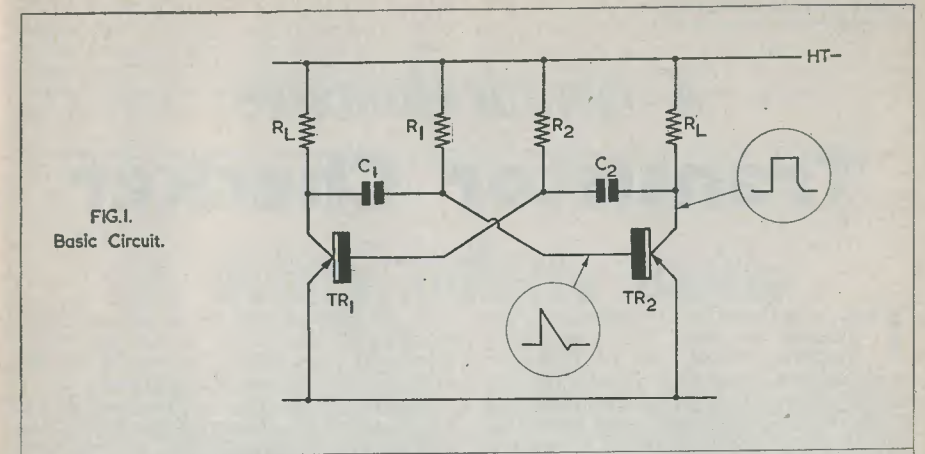


FIG.1. Basic Circuit.

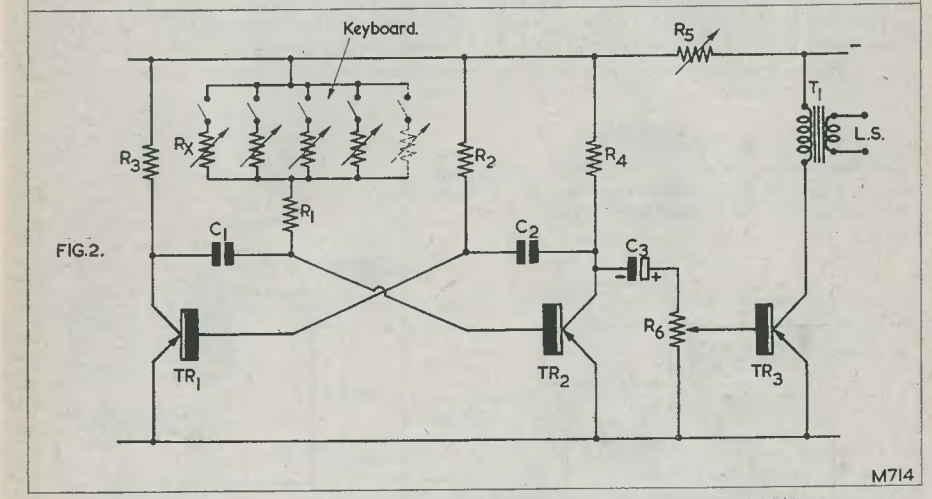


FIG.2.

Components List

Resistors

R_1	500Ω
R_2	27kΩ
R_3	1kΩ
R_4	1kΩ
R_5	10kΩ variable
R_6	1MΩ variable

Capacitors

C_1	See text
C_2	See text
C_3	2μF 6V wkg. electrolytic

Miscellaneous

TR_1 and TR_2—any audio transistor (Red Spot, etc.)
TR_3 Output transistor
T_1 Transformer to match
R_x Variable resistors, quantity according to number of notes to be produced.

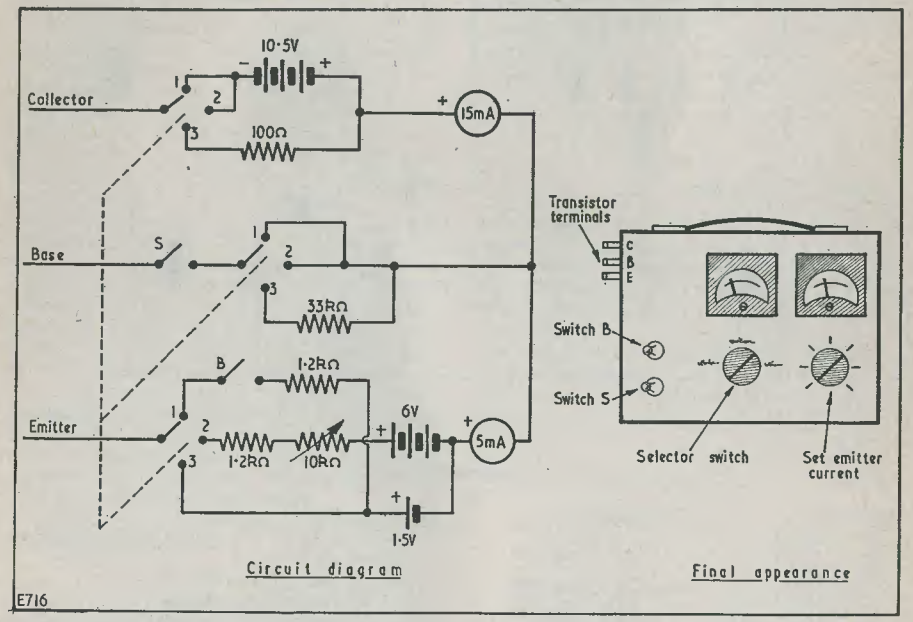
All other values may be calculated as above. The value calculated will not be exact because the calculation depends on the value of R_1 and if a 20% resistor is used in this position the value of R_x will only be approximate; but it is sufficiently accurate for our purposes.

The layout is in no way critical and any form may be adopted. The mechanical side is left to the reader but the original unit was constructed inside a small toy piano, the keys being used to make off a series of contacts to bring in the various note producing resistors.

A Comprehensive Transistor Checker

By J. Anderson

THIS INSTRUMENT WAS DESIGNED WITH economy in mind, but economy in transistors rather than of parts, for admittedly it is rather more complex than the majority of testers. It provides rough checks, characteristic measurements, and gain readings, as well as collector current values, and is suitable for the majority of both point-contact and junction transistors.



The selection of these facilities is, as will be seen, provided by a three-bank rotary switch.

When this is in position 1, a transistor may be checked by the fact that when switch "B" is open the current will be less than 1mA for a point-contact transistor, and less than 20μA for most junction types. If transistor action is occurring when "B" is closed, then for a point-contact transistor the current will rise by from 2 to 4mA, whilst for a junction type the increase will be in the region of 1.5mA. (It should be noted that some transistors may require only 4.5V in the collector line and not 10V as shown).

In position 2, the modification of the circuit allows the emitter current to be controlled and measured, and a group of characteristics to be plotted (I_c:V_c for various values of I_e). During this test switch "S" is, of course, closed.

When the rotary switch is in position 3, then, with switch "S" open, the meter will read I'_{co} which should be in the region of 150μA or $\frac{1}{30}$ full scale. On closing "S" the meter will read current gain or α, which will be found by multiplying the reading by 10 —that is, an f.s.d. of 150 units.

The unit is very safe to use, as with wrong connections (if made) the current will be limited, for the most part, by the resistances in the collector and base lines. The author constructed his instrument in a plastic box (easily obtained under the pseudonym of a "lunch box") 6in x 8in x 2½in, with three spring terminals as well as a transistor holder on one end, and a small handle on top. Current drain is so low that the batteries were wired in, but the experimenter may wish to substitute wander plug sockets for the 4.5/10.5 collector battery; the voltage of this battery can be checked at switch position 1, terminals B and C.

A Utility Infinite Baffle

By. A. H. Strange

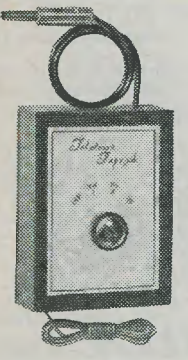
The small speaker enclosure is becoming increasingly popular, for which there is good reason, since the sound produced is pleasing; also, its size conforms with modern homes, and therefore generally meets with the approval of the lady of the house. However, it will be admitted that its compactness is dictated by necessity and economy, and that the large enclosure remains superior and the true infinite baffle unsurpassed.

Bearing this in mind, I suggest that many have almost a ready-made infinite baffle in the shape of a fireplace which perhaps is no longer used for heating as a more modern method is now employed. If this be so, a speaker could be mounted on a substantial baffle board large enough to fit tightly into the opening of the fireplace, with felt glued to the four edges to ensure an airtight enclosure. An infinite baffle has now been produced, which when finished by covering the whole board with speaker fabric is very much cheaper and less likely to cause dissention than cutting the legendary hole in the wall.

It may be argued that a resonance could be set up by the air column of the chimney; if this was so, the frequency would be below cut-off of the speaker due to the column length, and it would be damped by the porous nature of the bricks and soot.

Trade Review

TELETRON "TAPEJAK"



The Teletron "Tapejak", illustrated herewith, is a transistorised a.m. tuner unit powered by a 9V battery (Ever Ready PP4). It is the first transistorised radio tuner specially designed for use with tape recorders, and simply connects to the latter by inserting the jack plug into the microphone socket, the aerial lead then being uncoiled. The signal pick-up from this aerial energises a high-Q ferrite-cored input coil coupled to an r.f. transistor. The resultant amplified signal output from this stage is matched to a crystal diode by means of a tuned r.f. transformer, the rectified signal then being conducted, via a screened cable, to the terminating jack plug.

Internal pre-set condensers permit the unit to be adjusted for the reception of any two Medium wave local programmes, plus the permanent reception of the 1500 metre Long wave programme.

The standard type of jack plug, as illustrated, is fitted to all units, but alternatives can be fitted on request.

The Teletron "Takejak," which permits the recording of radio programmes directly on to tape, is modestly priced at £5 9s. 0d., tax paid, less battery. A high-gain version of the Tapejak, with an additional built-in pre-amplifier, is also available at £6 13s. 9d., tax paid, less battery. Both types are, of course, completely built and tested before despatch. The "Tapejak" is available direct from the manufacturers—The Teletron Co. Ltd., 112B Station Road, London, E.4, or from most radio retailers advertising in this magazine. Trade enquiries should be directed to Sam Mozer Ltd., 288 Hedge Lane, London, N.13. *Telephone:* PALmers Green 1748.

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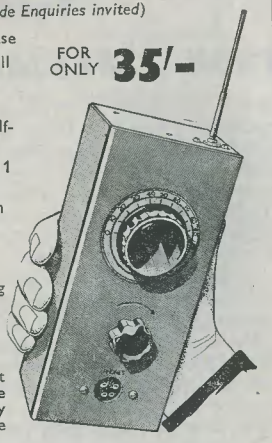

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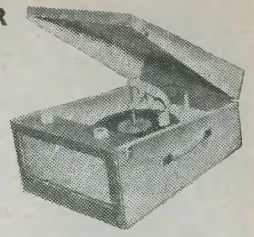

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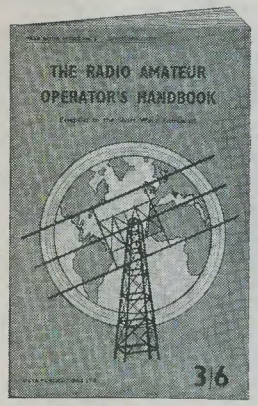

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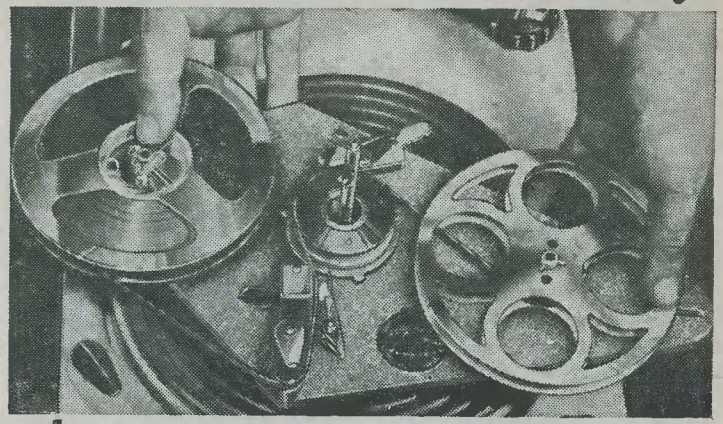

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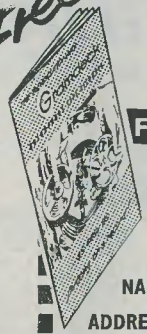

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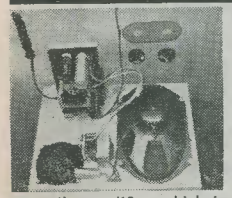

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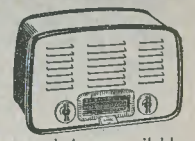

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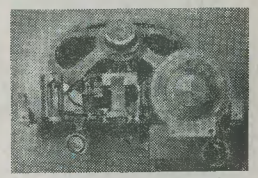

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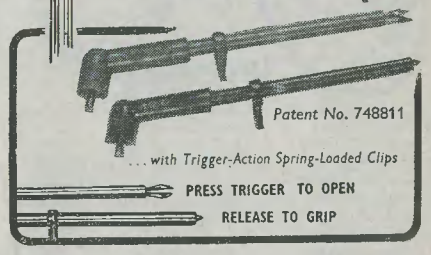

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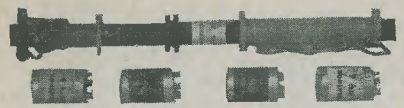

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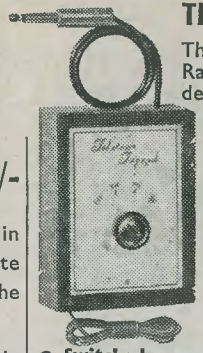

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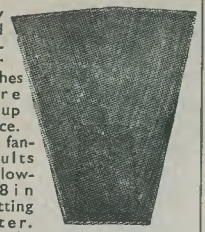

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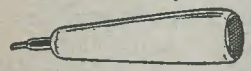
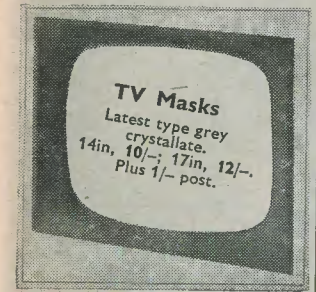


Model 39/1 this is ideal for tape or general amplifiers, complete with screened lead **39**/6, plus 1/– post.



R1155 for Spares

These are less valves but otherwise reasonably complete—ideal for spares—prices **£2** to **£4** depending on condition. Carriage 7/6.

Transistor Set Parcel

Cabinet as illustrated—with handle and motifs—2 gang tuning condenser—printed circuit—tuning scale—full circuit diagram showing other necessary parts—separate value £3—will all be sent for **29**/6 plus 2/6 post and insurance.

For the Record Enthusiast

New four speed playing deck by E.M.I. has the following features: Velocity operated auto trip; Pick-up on switch, cannot be damaged; Remarkably low rumble achieved by single ball thrust and magnetic screen on motor; Anti-microphony mounting. The ideal unit to renovate old equipment or to build into new. Size 11¾" wide, 1¼" deep, 2½" high, depth 2½". Mains model with stereo cartridge **£7,17.6.** Or with monaural cartridge, **£6.18.6,** post and insurance 3/6.

H.P. terms on request

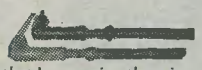
Components Would Cost More

Car Battery Charger—ready-made high output battery charger in stove-enamelled sheet steel louvred case. New, complete and ready to work, rated at 12V 4 amps. and variable rate selector for trickle charging, also a meter to show charging rate. Suitable for 230/250 A.C. mains. Special snip price of **55**/–, plus 3/6 post and ins.

Six Useful Articles

Our 1960 catalogue now ready gives constructional hints and circuits for the following items: Moisture-operated switch; Simple but clever signal tracer; Versatile power pack costing only 10/–; Instantaneous heater for workshop or den; Six transistor pocket superhet; Simple bed warmer; Photo-flood controller. *Send for this catalogue today*—price **2**/6 refundable from purchases.

Avo Prodclips



The advantage of these test prods is that by pressing the trigger at the side they become crocodile clips and can be left in circuit. This is a great time saver when servicing. Price **15**/– pair.

Thermostats

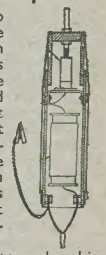
1½ amp	**3**/6
2 amp Q.M.B.	**5**/6
5 amp	**8**/6
15 amp	**15**/–
15 amp—wall mounting...	**27**/6

Note all are skeleton type similar to illustration except the wall mounting type which is encased in metal box with scale and pointer.

Yaxley Switches

1 pole 3 way, **1**/6; 1 pole 5 way, **2**/–; 1 pole 11 way, **2**/6; 2 pole 2 way ceramic, **2**/6; 2 pole 4 way, **2**/–; 2 pole 6 way, **2**/6; 2 pole 8 way, **3**/6; 2 pole 11 way, **3**/6; 2 pole 12 way, **4**/6; 3 pole 3 way, **1**/6; 3 pole 6 way, **3**/6; 4 pole 4 way, **3**/–; 6 position shorting, **2**/–; 6 pole 3 way, **2**/6; 6 pole 3 way ceramic, **3**/6; 8 pole 2 way, **2**/–; 9 pole 3 way, **2**/6; 12 pole 2 way, **2**/–.

Radio Stethoscope



This can be slipped into the pocket rather like a fountain pen. With it in most districts a receiver can be checked from the grid of the first valve right through to the output without a signal generator, the stethoscope will operate in both L.F. and R.F. circuits without alteration. It it a complete fault-finder.

All the necessary parts to make this tracer, **9**/6, post 1/–.

Band III Converters

Suitable Wales, London, Midlands, North, Scotland etc. All the parts including 2 EF80 valves, coils, fine tuner, contrast control, condensers and resistors. (Metal case available as an extra.) Price only **19**/6, plus 2/6 post and insurance. Data free with parts or available separately, **1**/6.

Please send two more kits, the one you sent last week is performing magnificently. We receive this sort of letter every day of the week, so if you have hesitated because you thought our kits too cheap you need hesitate no longer.

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42/46 Windmill Hill
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Croydon
Telephone CROydon 6558
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29 Stroud Green Road
Finsbury Park N4
Telephone ARChway 1049
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OZ4	5/–	12SN7GT	10/–	EF42	11/–
IC5	10/–	12SL7GT	10/–	EF89	8/6
IR5	7/–	DAF91	7/–	EF91	5/–
IS4	7/–	DAF96	9/–	EF92	5/–
IS5	6/6	DF91	7/–	EL42	10/–
IT4	6/–	DF96	9/–	EY51	10/–
3A5	9/–	DK91	7/–	EY86	10/–
3Q5	9/–	DL91	7/–	EZ40	7/6
3S4	7/–	DK96	9/–	EZ80	7/–
3V4	7/6	DL92	7/–	EZ81	7/–
5U4	6/–	DL94	7/6	MU14	7/6
5Y3GT	6/–	DL96	9/–	PCC84	9/–
6AL5	5/–	EB91	5/–	PCF80	9/–
6AM6	5/–	EBC41	9/6	PCL82	12/–
6C4	5/–	EBF80	9/6	PY80	7/6
6SL7	6/–	EBF89	9/6	PY81	8/6
6SN7	6/–	ECC81	8/–	PY82	7/6
6V6G	7/–	ECC82	7/6	UAF42	9/–
6V6GT	6/6	ECC91	5/–	UB41	10/–
6X4	6/–	ECF80	12/–	UBC41	9/–
6X5GT	5/–	ECL80	10/–	UCH42	10/–
7Y4	7/–	EF36	5/–	UF89	10/–
12AT7	8/–	EF39	5/–	UL41	8/–
12AU7	7/6	EF40	11/6	UL84	9/–
				UY41	7/6

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R.C.A. TYPE 165-A (110 to 250V A.C. Input)

D.C. ELECTRONIC VOLTMETER
6-Ranges. 3–10–30–100–300 and 1,000 volts. Input res: 11-meg. constant on all ranges. Sensitivity: 3,666,666 ohms per volt on 3V scale.

A.C. VOLTMETER
5-Ranges. 0–10–30–100–300–1,000 volts. Sensitivity: 1,000 ohms per volt.

ELECTRONIC OHMMETER
6-Ranges, from 0.1 ohms to 1,000 megohms.
Movement. 200 microamperes. D.C. accuracy ±2%.

Complete with Instruction Book and Test Prods.
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CAR RADIO 2-watt Amplifier

(See page 372 this issue)

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FOR USE WITH ANY BATTERY PORTABLE WITH 15-OHM OR 3-OHM OUTPUT TRANSFORMER.

Complete set of parts ... ... **65**/– P. & P. 2/6
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Short range key transmitter crystal controlled 8.4 to 8.6 Mc/s. Overall size 3" x 2" x ¾". All components including case, crystal and H.F. transistor, **22/6**, p.p 1/–. (Less key)

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Transistor Oscillator, ideal for audio circuit checking or RF modulator. Size 2¼" x 1⅜" x 1". All components **25**/–. P.P.1/–.

(See "R.C." Aug. 59)

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★ Size 4½" x 3" x 1¼"
★ Voice Modulated ★ Low Consumption
★ Ideal for short range communication

ALL PARTS 57/6 P. & P. 1/6
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(See "R.C." Jan. 1960)

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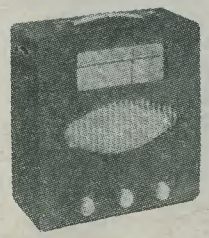
ALL WAVE PORTABLE RADIO



★ 5 valve superhet. ★ Built-in frame aerial. ★ Size 10" x 10" x 4" deep. ★ All Marconi valves. ★ Med., long and short waveband *OR* med. and two short wavebands. ★ Gram. sockets (for crystal or magnetic pick-ups). ★ 7" x 4" elliptical speaker. ★ 200-250 V a.c./d.c. ★ Slow motion tuning. ★ Ideal for a radiogram.

ONLY £7.12.6 P.P. 7/6
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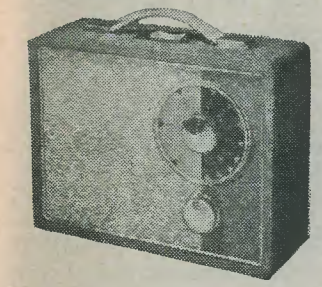
ANNOUNCING: Entirely New Design in Transistor Portable Radios! The "CONTINENTAL — 6" Combined Portable / Car Radio. M & LW Superhet.

Superseding the popular "Transistor—8"
For Style, Quality Performance and Value for Money



★ Plessey Printed Circuit
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★ 5" High Fidelity Speaker
★ 400mW Push-Pull Output
★ Internal Ferrite Aerial
★ Slow Motion Tuning
★ Step-by-Step Instructions

Total Cost of all Components
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including Cabinet, Car & AVC Components
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All parts available separately. Size 9½" x 7¼" x 3¼". Weight 4½ lb.

This superb receiver has been designed to produce maximum sensitivity, selectivity, ample volume and tonal quality on both Medium and Long waves. Its performance, style and quality have combined to make the "Continental-6" a top flight portable in the 20 guinea class.

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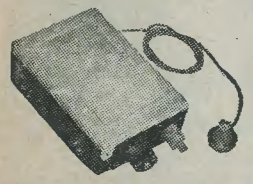

(As described in R.C., Sept. '59)

★ 5-stage Reflex Circuit
★ No Aerial or Earth
★ Min. Volume Control
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★ Medium Wave Tuning
★ Size 4½" x 3" x 1¼"
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★ Very sensitive
★ No aerial or earth
★ Complete layout
★ Over 6 months on one battery
★ 4½" x 3" x 1¼"
★ Weight only 4 ozs
★ Personal phone

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★ Medium Wave
★ 3-Stage Reflex
★ Internal Aerial
★ Smallest yet
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THE SMALLEST WORKING RECEIVER WITH BUILT-IN FERRITE AERIAL EVER OFFERED
All parts sold separately — *Diagram and List Free*

250 mW "ADDON" STAGE

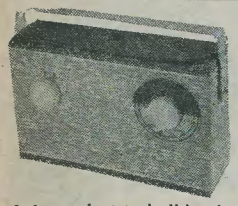
2-Transistor Power Amplifier for use with Major—2 or 3 or similar units to give 250mW. Push-pull from 3". Speaker.

★ 2—XB104 transistors
★ 3" Elac Speaker
★ Size 5¾" x 3½" x 1½"

All components complete 59/6 P.P. 1/6

FREE LIST AND DIAGRAM

"SUPER-SIX" Transistor Portable Superhet



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★ 6 Mullard Transistors
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★ Sensitive and Selective
★ Ferrite Rod Aerial
★ 3" 150Ω Speaker
★ Full Assembly Instructions
★ Size 7" x 2" x 1¾"

Total cost of all components (including washable rexine cabinet
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High sensitivity and selectivity combine to give excellent reception on both medium and long waves, this set is recommended by us as being one of the easiest-to-build printed circuit transistor sets ever offered.

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FOR SALE. Eddystone 358X receiver, coverage 40–31,000 Kc/s with 10 plug-in coil units, with power pack, 8in speaker, in good condition, £12 10s. o.n.o. Berec "Skyscraper" battery receiver, covers 28, 21, 14, 7 & 3.5 Mc/s amateur bands, plus 190–550 metres, magic eye plus 7 valves, wonderful job, £7. Meter, centre zero, scaled 0–20 either side, FSD 2.5mA, 70 ohm resistance, 10s. Another meter, centre zero, unscaled, made by Elliott, 10s. Jason "Argonaut" chassis with escutcheon and drive plus i.f.t's and valves. Has been used, £2 10s. Bunch of relays, various, one mounted on mains switch, another 3 relays in one unit mounted on 13-way miniature Jones plug and socket, German made, beautiful job, the lot, £2. Power pack MON8356 for P38 set, 230 mains input with input/output meter, £2. Any morning or Weds. evenings.—A. Melhuish, 31 Shepherds Bush Green, London, W.12.

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FOR SALE. Condensers, resistors, transformers, switches, etc. All new, s.a.e. for lists.—448 East Prescot Road, Liverpool.

HAMBANDER. 7 valve receiver with matching speaker, also Radiovision pre-selector, both in excellent condition.—Box No. E220.

AMATEUR. Selling unwanted components in genuine 6s. bargain parcels. At least two useful valves, pots, resistors, condensers, etc. Money back if not satisfied. Three parcels 15s.—Smith, 29 Pickford Road, Bexleyheath, Kent.

AMATEUR. Selling up has for disposal Taylor signal generator model 65B, s/b ex-Government scope, Primax solder gun. £15 the lot, buyer must collect (London Area).—Box No. E221

FOR SALE. Goodman Axiom 300, new. Nearest offer £8 15s.—Lawrence, 1 Gladstone Terrace, Raunds, Northants.

COLLARO MKIV. Complete recorder and R/P amps portable case etc., as new. £24.—*Telephone* GRA 2862 (London).

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AR88D. Communication receiver complete with S-meter, also Elizabethan transmitter in matching cabinet, £40 the pair. S.a.e. for particulars.—Bowen, 31 The Crescent, Donnington, Wellington, Shrops.

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FOR SALE. Taylor multimeter, model 71, guaranteed perfect working order, new condition, ranges up to 3000V. AC/DC ohms ranges only, £7 10s.—*Telephone* CLI 6335 (London) after 6 p.m.

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continued on page 399

SMALL ADVERTISEMENTS

continued from page 397

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150 TAPE JACKS. Receives any two local stations on Medium Wave. Switch tuned, fit any make of recorder. S.a.e. details, 12 months guarantee. A gift at 27s. post free.—Jackson Recording Service, 68 Harteford Road, Boreham Wood, Herts.

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