LOUDSPEAKER CROSS-OVER NETWORKS

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SEPTEMBER
1958

The RADIO Constructor

RADIO · TELEVISION · AUDIO · ELECTRONICS

The Teletron "TRANSIDYNE"

6-TRANSISTOR

POCKET PORTABLE SUPERHET RECEIVER

described by
EDWIN MARSHALL

Included in this issue

DATA Publications 1/9

This splendid new AVO Instrument has been developed to meet a definite demand for a sturdy pocket-size multi-range test meter at a modest price, suitable for use on modern electronic apparatus as well as for radio and television receivers, motor vehicles, and all kinds of domestic appliances and workshop equipment.

Readings are obtainable quickly and easily on a very open scale, and range selection is by means of a robust clearly marked rotary switch of the characteristic AvoMeter type. Measurements of A.C. and D.C. Voltage, D.C. Current and Resistance are made by means of only two connection sockets.

19 Ranges

D.C. Voltage
0—100mV
0— 2.5V
0— 10V
0— 25V
0— 100V
0— 250V
0—1000V

A.C. Voltage
0— 10V
0— 25V
0— 100V
0— 250V
0—1000V

D.C. Current
0— 100μA
0— 1mA
0— 10mA
0— 100mA
0— 1A

Resistance
0—20,000Ω
0—2MΩ

Sensitivity
10,000 Ω/V on D.C. voltage ranges
1,000 Ω/V on A.C. voltage ranges

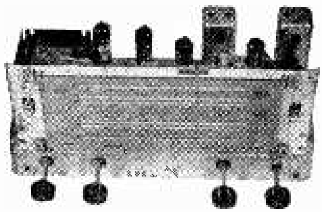
Accuracy
3% of full scale value on D.C.
4% of full scale value on A.C.

To meet special requirements, instruments can be supplied to a higher degree of accuracy for a small additional charge.

THE MULTIMINOR

List Price: **£9 : 10s.**
complete with Test Leads and clips
Leather Case if required **32/6**
Size: 5⅝ x 3⅝ x 1⅜ inches
Weight: 1lb approx.
Write for fully illustrated pamphlet

AVO Ltd. **AVOCET HOUSE · 92-96 VAUXHALL BRIDGE ROAD · LONDON · SW1**
Telephone: VICtoria 3404 (9 lines)



1958 RADIOGRAM CHASSIS

THREE WAVEBANDS — FIVE VALVES
S.W. 16 m.–50 m. — LATEST MULLARD
M.W. 200 m.–550 m. — ECH42, EF41, EBC41,
L.W. 800 m.–2,000 m. — EL41, EZ40

12 month Guarantee. A.C. 200/250V, 4-way switch. Short-Medium-Long-Gram. A.V.C. and negative feed-back. 4.2 watts. Chassis 13½" x 5½" x 2¼". Glass dial 10" x 4½" horizontal or vertical available. 2 pilot lamps. Four knobs, walnut or ivory, aligned and calibrated. Chassis isolated from mains. Immediate delivery.

BRAND NEW £9.10.0 Carr. 4/6

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

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

£8 **AUDIO PERFECTION** **POST FREE**

Designed to play 16, 33, 45, 78 r.p.m. Records, 7", 10", 12". Lightweight Xtal pick-up, GC2 turnover head, two separate sapphire styli. Standard and L.P.

BUILD THIS REPRODUCER BARGAIN

SPECIAL SINGLE PLAYER KIT

COLLARO 4-speed Gram-Pick-up Unit	**£4.12.6**
Handsome portable case 17½" x 13½" x 7"	**£2. 5.0**
Ready-built 3 watt amplifier with two valves and 7" elip. speaker, printed circuit	**£3.12.6**

All available separately

£9.15.0 complete kit post free

I.F. TRANSFORMERS 7/6 pair
465 kc/s slug tuning miniature can 2½" x 1" x 1". High Q and good band width. By Pye Radio. Data sheet supplied.
Wearite M800 Midget I.F.S. 465 kc/s **12/6** pair
Wearite 550 Standard I.F.S. 465 kc/s **12/6** pair

New boxed VALVES 90-day Guarantee

1R5	8/6	6K8	8/6	EA50	1/6	EZ81	11/6
1S5	8/6	6L6	10/6	EABC80	10/6	E1148	1/6
1T4	8/6	6Q7	10/6	EB91	6/6	HABC80	12/6
2X2	2/6	6SA7	10/6	EBC33	8/6	HVR2A	7/6
3S4	8/6	6SJ7M	10/6	EBC41	10/6	MU14	10/6
3V4	8/6	6SN7	8/6	EBF80	10/6	P61	6/6
5U4	8/6	6V6G	7/6	ECC84	12/6	PCC84	12/6
5Y3	8/6	6V6GT	8/6	ECF80	11/6	PCF80	11/6
5Z4	10/6	6X4	7/6	ECF82	11/6	PCF82	11/6
6AM6	8/6	6X5	7/6	ECH42	10/6	PCL82	11/6
6B8	5/6	7S7	10/6	ECL82	12/6	PEN25	6/6
6BE6	7/6	12AH8	10/6	EF39	7/9	PL82	10/6
6BH6	10/6	12AT7	10/6	EF41	10/6	PY80	10/6
6BW6	10/6	12AU7	9/6	EF50	5/6	PY81	10/6
6CH6	10/6	12AX7	9/6	Equip.		PY82	10/6
6D6	7/6	12BE6	9/6	EF50	8/6	SP61	5/6
6F6	7/6	12K7	8/6	Sylv.		UBC41	10/6
6H6	3/6	12Q7	8/6	EF80	10/6	UCH42	10/6
6J5	6/6	35L6	9/6	EF92	5/6	UF41	10/6
6J6	7/6	35Z4	9/6	EL32	5/6	UL41	10/6
6J7	8/6	80	10/6	EL84	10/6	UY41	10/6
6K6	6/6	807	6/6	EY51	12/6	U22	10/6
6K7	5/6	954	1/6	EZ40	10/6	X79	10/6

C.R.T. ISOLATION TRANSFORMERS
For Cathode Ray Tubes having heater-cathode short circuit and for C.R. Tubes with falling emission.
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**
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
Type C. Low capacity transformer for 2V tubes with falling emission. Mains input. Output 2, 2¼, 2½, 2¾, 3V at 2A, **17/6** each

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

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

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

3W Lab. Colvern, etc. Standard size Pots, 2¼" Spindle, high grade. All values, 100 ohms to 50k, **5/6**; 100k, **6/6**
W/W EXT. SPEAKER CONTROL 10Ω, **3/–**

MAINS TRANSFORMERS

STANDARD. 250-0-250, 80mA, 6.3V tapped 4V 4A. Rectifier 6.3V 1A tapped 5V 2A and 4V 2A	**22/6**
Ditto 350-0-350	**22/6**
MINIATURE. 200V 20mA, 6.3V 1A	**10/6**
MIDGET. 220V 45mA, 6.3V 2A	**15/6**
SMALL. 220-0-220, 50mA, 6.3V 3A	**17/6**
STANDARD. 250-0-250, 65mA, 6.3V 3.5A	**17/6**
HEATER TRANS. 200/250V, 6.3V 1½A	**7/6**
Ditto, tapped sec. 2, 4, 6.3V 1½A	**8/6**
Ditto, sec. 6.3V 3A	**10/6**
Mullard "510" Mains Transformers	**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.** Mullard "510" 6k or 8kΩ, **30/–**
L.F. CHOKES 15/10H 60/65mA, **5/–**; 10H, 85mA, **10/6**; 20/15H, 120/150mA, **12/6**; 5H, 250mA, **15/–**

CRYSTAL MIKE INSERT by Acos, **6/6**
Precision engineered. Size only ⅞" x 3/16"
ACOS CRYSTAL HAND MIKE, complete, **25/–**

ALADDIN FORMERS and cores. ¼" **8d.**, ⅜" **10d.**
0.3" FORMERS 5937/8 and cans TV1/2. ¾" sq. x 2⅞" and ½" sq. x 1¾", **2/–** complete with cores
SLOW MOTION DRIVES. Epicyclic ratio 6-1, **2/3**
TYANA. Midget Soldering Iron. 200/250V or 230/250V, **16/9.** **SOLON MIDGET IRON,** 25W, **24/–**
MAINS DROPPERS. 3" x 1¼". Three adj. sliders, 0.3A 750 ohms, **4/3**; 0.2A 1,000 ohms, **4/3**
LINE CORD. 0.3A 60 ohms per foot, 0.2A 100 ohms per foot, 2-way, **6d.** per foot; 3-way, **7d.** per foot
MIKE TRANSF. 50:1, **3/9**; 100:1, potted, **10/6**
LOUDSPEAKERS. P.M. 3 ohm. 2½" and 5", **17/6**; 7" x 4" Goodmans, **21/–**; 4" Hi-Fi Tweeter, **25/–**; 8" Plessey, **19/6**; 6½" Goodmans, **18/6**; 10" R.A., **30/–**; 12" Plessey, **30/–**; 8" 2.5k field tapped, o.p. trans., **24/6**; 15 ohm Plessey 10W 12". with tweeter, **97/6**; Stentorian HF1012 10" 3 to 15 ohms 10W, **99/6**
CRYSTAL DIODES. G.E.C., **2/–**; GEX34, **4/–**
40 CIRCUITS FOR GERMANIUM DIODES, 3/–
TUNING AND REACTION CONDENSERS 100pF, 300pF, 500pF, **3/6** each, solid dielectric
H.R. HEADPHONES 4,000 ohms, brand new, **16/6** pr.
SWITCH CLEANER FLUID, squirt spout, **4/3** tin
TWIN GANG CONDENSERS. 365pF, miniature. 1⅜" x 1½" x 1¾", **10/–**. 0.0005 standard with trimmers, **9/–**; less trimmers, **8/–**. Midget **7/6**; 50pF single, **2/6**

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Midget size
Long spindles. Guaranteed 1 year. All values 5,000 ohms to 2 Meg.

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Coaxial Plugs 1/- **Double Socket** 1/3
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50 cps voltage 30% of above ratings
Mains Type RM1, 125V 60mA, **5/-**; RM2 100mA, **6/-**; RM3 120mA, **8/-**; RM4 250V 275mA, **16/-**; RM5, **20/-**
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Coils. Wearite "P" type, **3/-** each. Osmor Midget "Q" type, adj. dust core, from **4/-** each. All ranges
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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/-**. Expanded metal, silver, 15¾" x 9½", **2/-** each;
Tygan. 4' 6" wide, **10/-** ft; 2' 3" wide, **5/-** ft. Samples

SUPERHET COIL PACK 27/6
Miniature size high Q coils. Short, Med., Long. Gram. switching, with connection diagram. 465 kc/s i.f.

Condensers. New stock, 0.001μF 7kV T.C.C., **5/6** ditto 20kV, **9/6**; 100pF to 500pF Micas, **6d.**; Tubular 500V 0.001 to 0.01μF, **9d.**; 0.05, 0.1, **1/-**; 0.25, **1/6**; 0.5, **1/9**; 0.1/350V, **9d.**; 0.01/2,000V, **1/9**; 0.1/2,000V, **3/6**
Ceramic Condensers. 500V 0.3pF to 0.01μF, **10d.**
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/-**

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

12/6 PURETONE RECORDING TAPE
1,200ft on standard fitting, 7" metal reels. Spare reels 7" metal, **2/3**; 5¾" plastic, **3/-**; 7" plastic, **4/-**
SUPERIOR 1,200ft plastic tape, **21/-**, 7" plastic reel
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"TRANSIDYNE" Superhet Portable

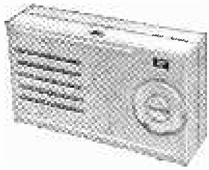
6 Transistors, T.C.C. Printed Circuit

Ferrite aerial, cabinet and all parts. For medium and long wave reception

Our price

£12.19.6

post free



Size 6" x 4" x 1¾"
Plans and parts list
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6 GENUINE PYE GOLTOP TRANSISTORS ARE INCLUDED WITH THIS KIT, FOR MAXIMUM RESULTS

TRANSISTORS. **Pye Goltop Audio** V10/15A, **15/-**. R.F. 3 Mc/s, V6/R2, **24/-**. **Sub-miniature Electrolytics** 5μF 12V, 8μF 6V, 16μF 12V, 25μF 6V, **3/-** each

THE HIGH GAIN BAND III TV PRE-AMP
Tunable Channels 8, 9 and 10, Gain 17dB, Cascode Circuit. Complete kit with ECC84 valve, plans and instructions, **29/6** less power, or **49/6** with power pack. Plans only, **6d.** Band I version available for channels 1 to 5, same prices

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

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

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TV Fault Finding. Data Publications **5/-** each
Radio Valve Guide. Books 1, 2 or 3 **5/-** each

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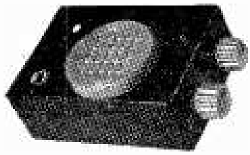
PRINTED CIRCUIT TRANSISTOR THREE

£5.15.0

WITH 3 PYE GOLTOP TRANSISTORS



Pocket receiver kit, 4½" x 3" x 1½" with plans, cabinet, all parts and batteries. Fitted speaker reproduces strong local stations on Ferrite Aerial. Distant reception with simple aerial or earth

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MAY BE BUILT FOR **7 GNS.**

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H.T. **10/-** (Type B126) or equivalent.

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- ★ Size only 8" x 8" x 4½"
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- ★ Backed by an up-to-date Technical Information Dept.
- ★ Components available separately if desired
- ★ Simple to construct, using normal soldering methods
- ★ Instruction book 1/6

THE "PETITE" PORTABLE & REPRODUCER

MAY BE BUILT FOR **13 GNS.**

plus 5/- post. & pkg.

Batteries extra: H.T. **10/-** (Type B126 or equiv.) L.T. 996, 3/6

45 r.p.m. Single Record Player **£5.5.0** including P.T.

"Petite" Components **£5.13.0**

Portable Case **£2.10.0**

- ★ Size 10¼" x 9¾" x 6"
- ★ Weight including batteries 7lb
- ★ 45 r.p.m. single record player complete with pick-up
- ★ 6V battery operated
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- ★ Construction simplicity itself
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- ★ Instruction Book **1/6**

THE ARGONAUT

AM—FM MW—VHF TUNER—RECEIVER

First published in the March and April 1956 issues of this magazine this high quality tuner-receiver has aroused considerable interest. In this reprint the text has been revised and enlarged, and additional diagrams, including a map of present and projected coverage areas, have been included as a result of suggestions by readers

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A new publication—and the first devoted entirely to the subject of radio control linkage mechanisms. Complementary to *Radio Control for Model Ships, Boats and Aircraft* and to other books on radio control.

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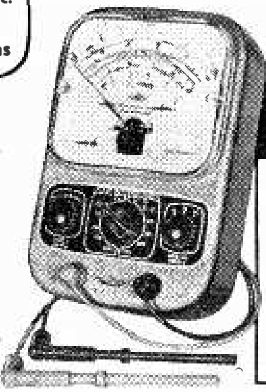
100 Microamps a.c.
0 to 1 Megohm
0 to 10,000 ohms

How would you like to have one of the newly stylised and redesigned M.I.P. Series 100 Multi-Range Test Sets on your bench almost by return of post? It's easy, you just send **47/6** as deposit and pay the rest in six monthly instalments of **£1.16.0.** The cash price is **£12.7.6.** Post the coupon for full details.



★*There is also the* **SERIES 90 MULTI-RANGE TEST SET** having 19 SELF-CONTAINED ranges,
ac/dc Volts up to 1000V
dc current „ „ 500mA
ac „ „ „ 200μA
Resistance 0–200,000Ω
Deposit **35/-** and six monthly payments of **28/10** (Cash price **£9.15.0**)
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MULTI-RANGE TEST SET - SERIES 100

To **MEASURING INSTRUMENTS (Pullin) Ltd**
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Please send illustrated leaflet of the Series 100 Test Set with details of new easy payment scheme ... ... ☐
Ditto Series 90... ... ... ☐
**Please indicate instrument required*

NAME ....

ADDRESS ....

.... F958

MULTI-PURPOSE NEON TESTER
(*Page 135 this issue*)

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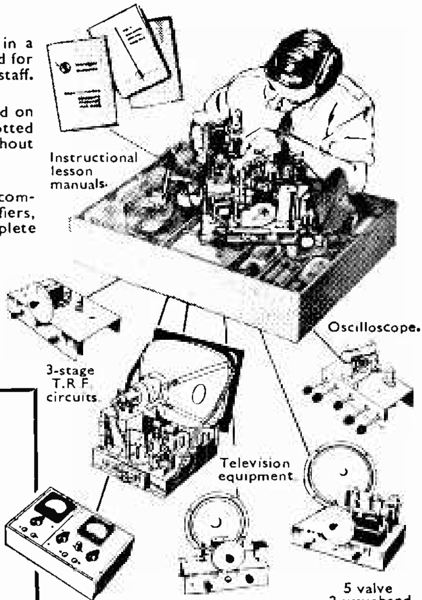

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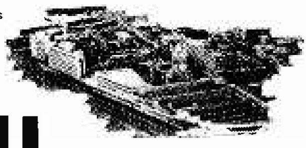

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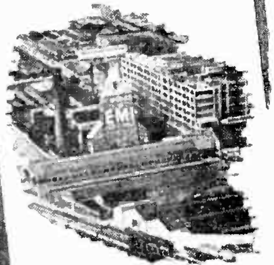

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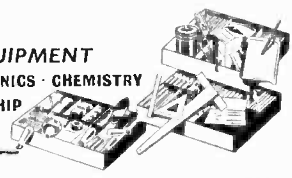

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THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should preferably be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as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

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

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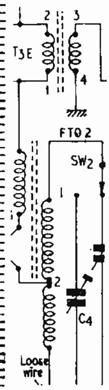


No. 94 Two & Three-Stage Sequential Neon Circuits

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

VERY FAMILIAR IN THE ELECTRONIC FIELD are devices which continually change from one state to another and back again. Typical of such devices is the multivibrator, in which two valves are interconnected such that either valve alternately passes current or is cut off. It is possible to employ neon bulbs in circuits which similarly alternate between one state and another, neon bulbs being suitable for this application due to the fact that their striking potentials are higher than those at which they burn. What is, perhaps, of more interest is the point that, by taking advantage of the properties of neon bulbs, it becomes possible to have *three* neon bulbs interconnected such that they ignite sequentially.

In this month's contribution the writer describes two- and three-stage sequential neon circuits, both of which he has developed with the aid of working prototypes. The three-stage circuit is that most worthy of attention, but the two-stage arrangement still has its uses. An understanding of two-stage operation is, in any case, helpful when the three-stage circuit comes to be discussed.

The Two-Stage Circuit

The two-stage sequential circuit is illustrated in Fig. 1. Two neons are shown in this diagram, and the purpose of the circuit is to cause them to be ignited alternately at a regular frequency.

To understand the functioning of the circuit, let us assume that the device is running and that neon NE_1 is illuminated and neon NE_2 is extinguished. Due to the fact that condenser C_1 has been previously charged from the negative supply line via R_2, the current maintaining illumination in NE_1 flows from this condenser. The current from C_1 flows, also, through resistor R_1, with the result that the bottom end of this resistor has a potential lower than that of the positive supply line. At the same time condenser C_2 charges up via resistor R_3.

During the time that NE_1 draws current from C_1, the potential across the plates of this condenser decreases. After a period this potential falls to too low a value to maintain illumination and neon NE_1 becomes extinguished. In consequence no further current is drawn through R_1, and the potential at the bottom end of this resistor rises very rapidly to the potential of the positive supply line. When it reaches a potential which is sufficiently high above that on the lower plate of C_2, neon NE_2 strikes. After striking, NE_2 remains illuminated, drawing current from condenser C_2 and causing, once more, a voltage drop in R_1.

As soon as NE_1 became extinguished no further current was drawn from C_1, whereupon this condenser is now in process of charging up via resistor R_2. When the potential across C_2 becomes too low to maintain illumination in neon NE_2, this neon extinguishes, causing the bottom end of resistor R_1 to rise once more to the potential of the positive line. Immediately it has risen sufficiently high above the potential held by the lower plate of C_1, neon NE_1 strikes and a new cycle commences.

Summing up the above description, it may be said that each neon, when it is illuminated, draws current from its attendant condenser, this current being maintained until the potential across the condenser is too low to sustain illumination. Also, if a neon is not illuminated, its attendant condenser recharges, ready for the next period of illumination, via the resistor which connects it to the negative supply line. Due to the presence of R_1 the extinguishing of one neon causes a striking potential to be applied to the other, its attendant condenser having in the meantime acquired sufficient charge to maintain illumination.

In practice, the circuit of Fig. 1 should not prove very difficult to get into working order. The writer employed G.E.C. Button Tuneons in the prototype and these gave reliable results. When neons of this type are used it is important to ensure that their tips are connected as shown and that the polarity of the supply is that indicated in the diagram. If these points are not observed, the device may not function satisfactorily.

Resistor R_1 is not very "critical" so far as value is concerned. Due to what appears to be differences between neons it may, however, be necessary to adjust the values of R_2 or R_3 in order to get approximately 50:50 periods of illumination. In the writer's prototype different pairs of neons gave times of illumination between the approximate limits of 30:70 and 50:50. The process of adjusting the values of R_2 or R_3 is quite simple. If, for instance, neon NE_1 remains illuminated for longer periods than does neon NE_2 the value of R_2 should be increased, in steps of 0.5MΩ, until approximately 50:50 operation is obtained. Similarly, the value of R_3 should be increased if the period of illumination of NE_2 is longer than that of NE_1.

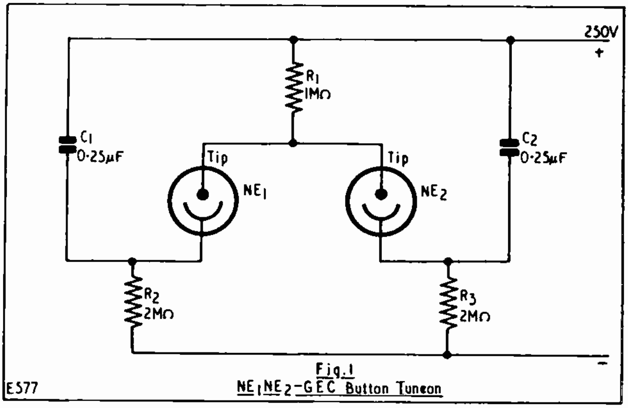


Fig.1
NE1 NE2–G.E.C. Button Tuneon

The condensers C_1 and C_2 may be conventional $\pm 20\%$ components, as changes in value here do not seem to have as great an effect on illumination times as do discrepancies between neons. The reason for this may be that these condensers are charging and discharging over a potential range which is low compared to the total potential applied by the supply. It is, of course, necessary to ensure that the components employed in the C_1 and C_2 positions have good insulation resistance.

Using the component values given in Fig. 1 the frequency of operation is approximately 1.5 cycles per second. Should it be desired, this frequency may be altered, this being done by varying the values of C_1 and C_2. Increasing capacity should cause a reduction in frequency, and vice versa. The writer has not checked the circuit with condenser values other than those shown in Fig. 1, and would like to pass on the hint that, if large differences in condenser values are tried, it may be necessary to experimentally alter the value of R_1.

The Three-Stage Circuit

Fig. 2 illustrates the three-stage circuit. As may be seen, this is basically similar to that of Fig. 1 with the exception that all the resistive sections are made partially variable in value. As will be explained later, it is not entirely necessary to employ variable resistors in the R_4, R_6 and R_8 positions. However, it is helpful to include them during construction of the device as they assist considerably in initial setting-up.

To describe the operation of the circuit of Fig. 2 it is desirable to assume that the neons are igniting in the order NE_1, NE_2, NE_3, and that we commence our examination at a time when neon NE_1 is illuminated.

Due to the fact that it is illuminated, neon NE_1 draws current from its associated condenser C_1, causing thereby a potential drop across the two resistors R_1 and R_2 in series. (These two resistors carry out the same function as did R_1 in Fig. 1.) When condenser C_1 is sufficiently discharged, neon NE_1 becomes extinguished, and current flow through R_1 and R_2 ceases. In consequence the lower end of R_2 rises very rapidly to the potential of the positive supply line. When the lower end of R_2 rises sufficiently high above the potential held by the bottom plate of either C_2 or C_3, the associated neon strikes and the potential at the bottom end of R_2 drops again. Of the two condensers, the bottom plate of C_2 has a lower potential than has that of C_3, and so it is NE_2 which strikes. The lower potential on the bottom plate of C_2 is due to the fact that this condenser has been charging during the period when NE_3 and NE_1 were, consecutively, illuminated, whilst C_3 has been charging only during the time when NE_1 was illuminated.

When, in its turn, condenser C_2 becomes sufficiently discharged, neon NE_2 extinguishes and the bottom end of R_2 once more rises towards the positive supply potential. Of the two remaining condensers, C_3 has a lower potential on its bottom plate than has C_1 because it has now had two illumination periods (given by NE_1 and NE_2) in which to charge whereas C_1 has had only one (that given by NE_2). As a result NE_3 strikes and remains illuminated. When NE_3 extinguishes, condenser C_1 will have acquired sufficient charge to cause NE_1 to strike, and the next cycle commences.

It will have been noted that, in the description of circuit operation just given, it is assumed that the neons ignite in the order NE_1, NE_2, NE_3. In practice, the application of the supply voltage may cause the neons to ignite either in the order NE_1, NE_2, NE_3, or in the reverse order, the initial choice being random. However, as soon as the order of ignition has shown itself it remains constant until the supply is switched off.

As was mentioned above, the potentiometers R_4, R_6 and R_8 are included in the circuit to simplify the process of setting up. In Fig. 1 it was possible to take up apparent discrepancies between neons by simple variations in the values of R_2 and R_3, this being due to the fact that the circuit should still give sequential operation even if neons with widely varying characteristics are used. In the case of Fig. 2, however, circuit operation is somewhat more complicated and the device may not give sequential operation until the resistors connected between the charging condensers and the negative supply line have been given suitable values. It must be emphasised that this point should not be interpreted to infer that the settings of R_4, R_6 and R_8 are at all "critical," because this is by no means the case. The reason for the

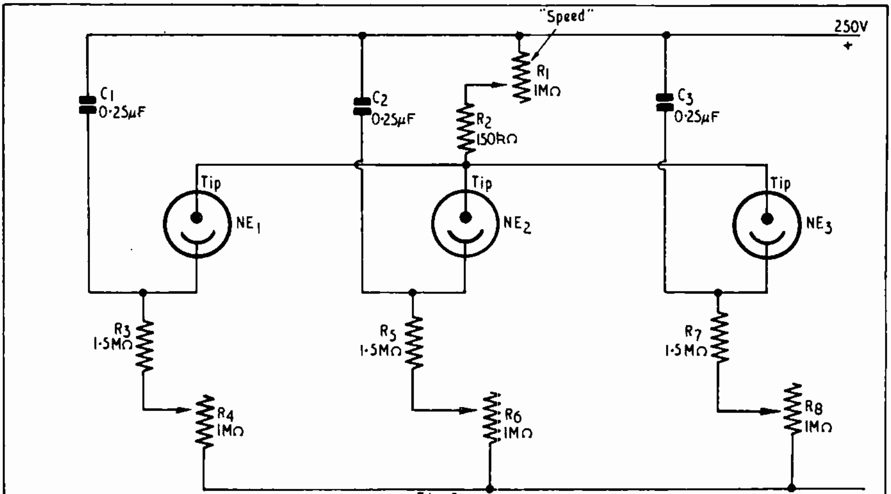


Fig.2
NE1 NE2 NE3-GEC Button Tuneon

E578

inclusion of variable resistors at these positions is that the values required for practical operation are liable to be widely variant.

To set up the circuit of Fig. 2, the power supply should be initially switched on and R_1 set to a central position. The neons should then commence to flash in order, whereupon R_4, R_6 and R_8 should be adjusted to ensure that the neons remain illuminated for approximately equal periods of time. Increasing the resistance inserted by any of the three variable resistors causes the associated neon to flash for a shorter period of time, and vice versa. If it is found that the neons do not flash consecutively, that which flashes most frequently should be identified, and the resistance inserted by its associated variable resistor increased. Similarly, it may be necessary to decrease the resistance inserted by the remaining variable resistors in order to allow the other neons to flash more frequently. Once the neons are running consecutively it will be found that the final settings of R_4, R_6 and R_8 fall within quite broad limits. The variable resistors should be set such that reliable operation is obtained for all positions of the "Speed" control R_1.* After R_4, R_6 and R_8 have been set up, the resistance arms in which they appear may be replaced by single fixed resistors, should this be desired.

The "Speed" control, R_1, enables the frequency at which the circuit runs to vary, approximately, from 0.5 to 2 c/s. If frequencies outside this range are required, these would probably best be obtained by varying the values of C_1, C_2 and C_3. The writer has not, however, checked operation with condensers having values other than those shown in Fig. 2.

As with the device of Fig. 1, it is important to ensure that the neons (when Button Tuneons are employed) are connected as illustrated in the diagram and that the power supply is applied with correct polarity. The charging condensers must, of course, have good insulation resistance.

* The values for R_3 to R_8 shown in Fig. 2 were found to provide adequate control in the writer's prototype for all neons checked in the circuit. Should it appear that sufficient resistance range does not appear to be offered by R_4, R_6 or R_8, the value of the associated series fixed resistor may be increased, or decreased, accordingly.

Applications

Apart from the novelty of the circuits of Figs. 1 and 2 from the theoretical point of view, the devices have certain functional applications. Probably the most obvious of these is that they can be used as very effective warning indicators. It will be realised that a continually changing flashing signal is much more liable to catch attention than is a steadily illuminated light. The circuit of Fig. 2 may also lend itself very well to decorating displays, wherein the impression of movement of a light source may be conveyed. Such an impression is heightened if the neon bulbs are mounted close together in a circle.

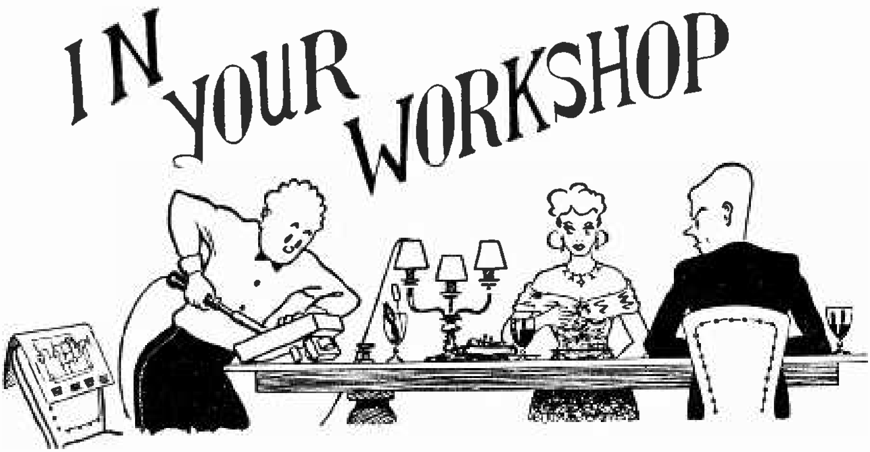
For more serious applications, both circuits are capable of offering control voltages, these appearing across the condensers associated with each neon. Also, sharp-fronted pulses appear across R_1 in Fig. 1, and across R_1 plus R_2 in Fig. 2, these occurring when each neon strikes.

Brussels Exhibition—Amateur Radio Station ON4UB

It would be quite impossible to even attempt to mention all of interest to the radio enthusiast to be seen at the great Brussels Exhibition. Such is the magnitude of this spectacular show that it would be quite impossible to see all that is on view.

On the radio side your reporter has singled out the things of particular interest to the radio constructor. It was, for instance, interesting to see some quite elaborate radio control equipment on a stand devoted to model aircraft, some of it being by our English firm of E.D. Electronics. The Dover-Ostend shipping line had some good working models of their ships, radio controlled and being expertly manoeuvred on a wide stretch of water. Just round the corner from the main Radio TV Building was to be found the Exhibition's Amateur Radio Station ON4UB, in charge, at the time of your reporter's visit, of ON4IT and ON4IZ. The station is well displayed and is a real credit to those Belgian Amateurs who have organised it, and it has been visited by amateurs from all over the world. YV, W's, KH, LU are just a few of the DX prefixes to be seen in the visitor's book. The TX is a rebuilt 1131, using two 814's in the final, and feeding a long wire antenna on all bands. The receiver in use was an AR88, and we were soon working G2YJ in Croydon on 7 Mc/s. A Geloso TX and RX were also a prominent feature of the station, amongst numerous other items of interest.

Any other radio enthusiasts, be they Amateurs or not, will be given a real welcome, should they call in on ON4UB whilst visiting the Brussels Exhibition, a visit to which is very well worth the effort and expense incurred. A.C.G.



This month Smithy the Serviceman, aided by his able assistant Dick, deals with an elusive h.t. short-circuit, and crosses figurative swords with our contributor G. A. French

"I THINK," SAID DICK THOUGHTFULLY TO nobody in particular, "that I have a ground on my B-plus."

Smithy the Serviceman looked up and regarded his assistant gravely.

"I am strongly tempted," he said, heavily, "to remark that I hope it isn't catching. However, I know what you mean. Whence the correct American usage?"

Dick chuckled. It was always a little difficult to catch Smithy's attention during the first few hours of a Monday morning; the Serviceman always started his week with a feverish concentration which was probably caused by the fact that most weekends produced a large crop of sets, and Smithy hated having a wall* behind him.

"Well, now I have your attention," laughed Smithy's assistant, "I shall proceed to translate. What I meant to say was that I have a short-circuit to chassis on the h.t. positive line in the t.v. set I'm working on. To which remark I will add that I'm hanged if I can trace where it's occurring."

An Intermittent Short?

Smithy tut-tutted a little and wandered over to Dick's bench, where he noted that his assistant had taken the faulty television chassis out of its cabinet. Dick had not removed the speaker, this being connected to the chassis via a pair of flexible p.v.c. leads.

"This is a little surprising," commented Smithy at length, "I should have thought that an h.t. short was the easiest of all animals to track down. Anyway, let's hear what happened."

"Well," responded Dick, "when I first looked at the set I saw it was suffering with an acute attack of h.t. metal rectifier burn-up. The rectifier was easy to get at without removing the chassis from the cabinet, and so I swapped it straightaway. However, before connecting the chassis up to the mains I made a quick check with the meter to see if any obvious short-circuits to chassis had caused the original trouble." Smithy nodded approvingly. "On applying the testmeter prods I found that there *was* a short and that its resistance, as measured between the smoothed h.t. line and chassis, was of the order of twenty ohms or so. To my mind twenty ohms pointed to a component failure, such as would be given by the smoothing electrolytic."

"That's a reasonable enough diagnosis," observed Smithy, "and I must certainly add that you were very sensible in trying to evaluate the short circuit in terms of ohms, because this often gives a valuable clue to its nature and position. If you had had a really dead short-circuit with negligible resistance you could have assumed physical contact between chassis and, say, a tag connected to the h.t. positive line. Plus, of course, the possibility of breakdown in the h.t. electrolytic or any other component connected directly across the h.t. supply. Whilst it

* "Wall": a slang term used in manufacturing circles to define an excess of units for repair, or for a particular production operation.—EDITOR.

would be silly to attempt to lay down hard and fast rules here, the existence of your twenty ohms does rather argue against such things as tags touching chassis, although it still allows suspicion to fall on broken-down electrolytics and the like. If your h.t. short had shown up as having a resistance of several thousand ohms, I would have suspected tracking across a tag-strip, or something of that nature. When the surface insulation of a tag-strip breaks down and a spark travels across that surface, the resultant carbon track often shows a resistance of several thousand ohms or so when checked with an ohmmeter. At the same time, when h.t. is applied to the tag-strip the effective resistance is very liable to drop and cause quite heavy currents to flow. I've seen carbon tracks on faulty tag-strips glowing red quite brightly on occasion."

"Wouldn't a resistance of several thousand ohms also indicate that there was a short to chassis on the other side of a decoupling resistor?" asked Dick. "Decoupling resistor values around two thousand ohms are very common in t.v. chassis, you know."

"I don't think so," replied Smithy, "mainly because such decoupling resistors usually have low wattage ratings, and they would burn out, themselves, long before the rectifier packed in. Anyway, we're getting off the subject of the particular receiver we have in mind. I presume you checked for a short on the rectifier side of the smoothing choke?" (See Fig. 1.)

"I next discovered that I would have to remove the chassis from the cabinet before I could reach its tags. This component was not so easy to get at as the rectifier. Consequently, and in pursuance of my duties, I duly proceeded to remove said cabinet, only to find, on re-checking, that the short had disappeared! Indeed, so well did it disappear that I even connected the set to the mains to try and get it back again. Instead, the set worked perfectly: I got a beautiful picture and excellent sound, with not a single puff of smoke to be seen anywhere. Nor was there the slightest suspicion of the delicate odour of cooking h.t. rectifier."

"Hmmm," commented Smithy. "It sounds as though this may be one of those awkward ones. I presume you checked that there was no risk of the chassis securing bolts touching any h.t. point when the chassis was boxed."

"That was one of the first things I did when I found that the short had cleared," declared Dick. "But no dice."

"A pity," remarked Smithy. "I don't like these indeterminate faults. Of course, the short *might* have been caused by a blob of solder or a bit of wire in the works, this becoming dislodged when you handled the receiver."

Smithy ceased conjecture and decided to examine the chassis. He carefully followed the red h.t. positive line on its route along the chassis, looking for traces of previous sparking.

"Well, everything seems to be above-

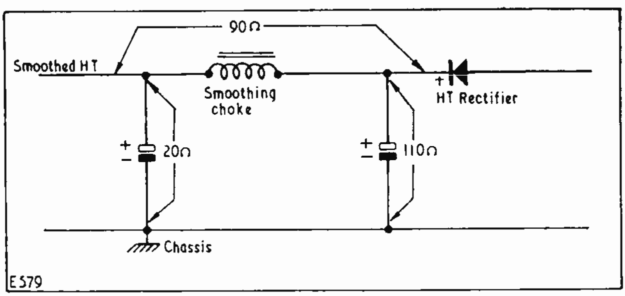


Fig. 1. A short-circuit between h.t. positive and chassis could have occurred on either side of the smoothing choke, or in the choke itself. By taking quick resistance readings, such as those shown here, it is possible to locate the short-circuited section with a reasonably high degree of certainty

"I did, indeed," confirmed Dick, "and the resistance to chassis here was about 110 ohms. Also, the resistance of the choke winding is 90 ohms, so that almost certainly confirms that the short to chassis is on the smoothed h.t. line."

"O.K." said Smithy. "What happened next?"

"Having decided that the smoothing condenser might be faulty," continued Dick,

board," he remarked eventually. "If an h.t. short in a t.v. set causes sparking it usually leaves quite noticeable traces, such as blackening of the chassis and so on. But there's nothing like that here."

Smithy leaned back and looked once more at the faulty chassis and its cabinet.

"Hey, wait a minute," he said. "I think you forgot something when you unboxed this chassis."

The Serviceman pulled out from inside the cabinet a flexible lead fitted with a solder tag.

"What about this?"

"Oh, that," said Dick, carelessly. "That's just the lead from the speaker frame to chassis. I didn't bother to re-connect it after I had taken out the chassis."

"That was a silly thing to do," commented Smithy.

"Why?" queried Dick, a little hotly.

"Just think," said Smithy.

Dick frowned.

"I'm sorry," he remarked at length, "but I just can't understand why disconnecting the speaker bonding lead should cause an h.t. short to disappear."

Smithy looked impatient.

"Well, I'm not going to argue about it," he said, somewhat stiffly, "firstly, because you may be right and, secondly, because I always hate arguments about the rightness or wrongness of technical points. So I'll just ask you to carry out the simple and practical act of connecting your ohmmeter between that speaker frame lead and the h.t. positive line of the chassis."

"As you like," said Dick.

He made the connection and looked at the scale of the instrument.

"Well, I'll be jiggered," he remarked, surprised. "My old friend, the twenty ohm leak, has returned!"

"Which means?" prompted Smithy.

"Which means," continued Dick, thoughtfully, "that, if I were to re-connect this speaker frame lead to chassis, the h.t. short would re-appear. I'm sorry, Smithy, but you were quite right about that lead after all."

"To be quite frank," said Smithy, "it was more luck than anything. But it does make the point that, in servicing, it's much better to actually check every point, however remote some of them may be, than to rely on assumptions. Don't forget that, in this game, *nothing* is above suspicion."

Tracing the Fault

Smithy drew Dick's attention to the wiring of the receiver. (Fig. 2.)

"Now, first of all," said Smithy, "we want to trace the route between the speaker bonding lead and the h.t. positive line. As you can see, the lead connects to the speaker frame at a solder tag which is held under a wood screw. Also connected to that tag is one of the two leads from the chassis to the speaker voice coil. We follow these leads back to the chassis whereupon we find ourselves at the speaker transformer. There is no sign of either of the leads to the voice coil having poor insulation, or showing signs of having touched any h.t. point, so it looks as though the transformer itself is at fault." Smithy picked up a soldering iron and disconnected the speaker leads from the transformer.

"As you can now see," he continued, "the secondary tags are connected to no external circuit at all. I next apply the ohmmeter, and what do we find?"

"Twenty ohms resistance between h.t. positive and the secondary," responded Dick dutifully.

"Exactly," remarked Smithy. "In other words a short between primary and secondary. And I should imagine that the twenty ohms is appearing in the carbon which constitutes part of the short. It *could* happen that there is twenty ohms-worth of primary winding between h.t. positive and the actual short itself, but this is a little doubtful as the wire would probably have burnt out in quite a short time. Anyway, these points needn't worry us, as all we need to do is to fit a new transformer."

"One sound output tranny coming up," said Dick, who was already at the spares cupboard.

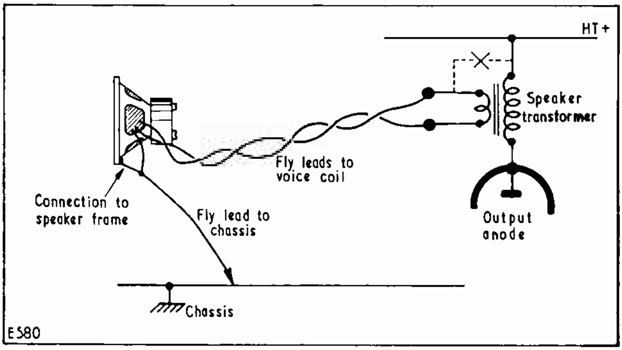


Fig. 2. According to production methods, the manner in which a loudspeaker frame is connected to chassis may vary from receiver to receiver. The slightly unusual method shown here assisted in drawing attention away from a faulty speaker transformer

Smithy paused a moment to watch Dick fit the new transformer, and he pulled out his cigarettes. Before he could put one between his lips, however, his assistant had offered him one from a packet which was lying on a bench.

me that we're due for a rag-chew ourselves very soon. Over a cup of tea."

Smithy filled the battered Workshop kettle, placed it on its ring, and returned to his own work, leaving Dick to finish repairing the faulty t.v. set.

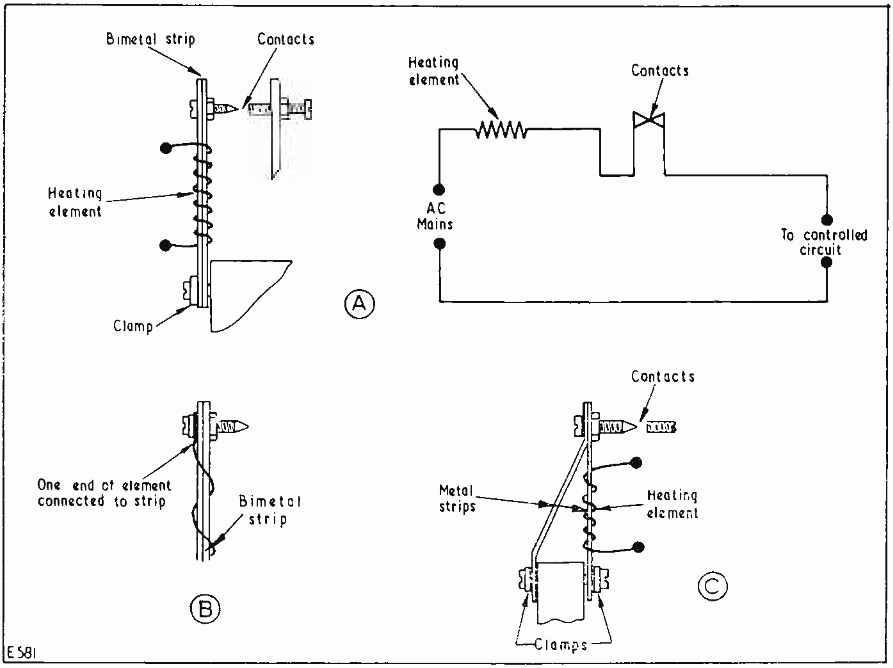


Fig. 3. A simple timing switch, which is described fully in the text. The switch is capable of continually switching on and off equipment running from a.c. mains

"Have one of mine," said Dick, "they're 6dB down!"

"6dB down?"

"That's right," replied Dick, "each cigarette has its own built-in attenuator."

Smithy examined the cigarette Dick had offered him, chuckling a little at Dick's description of its filter tip.

"Since when," he commented, lighting up, "have you been smoking snouts with spats on? And American snouts at that?"

"If by snouts and spats you mean cigarettes and filter tips," replied Dick, primly, "I've been smoking these American versions off and on since Saturday. We had a visit from an American who was billeted on us during the war. He's something of a Ham back in the States and so, apart from swapping cigarettes, we had quite a rag-chew together."

"Which explains the American terminology earlier on," said Smithy. "And that reminds

Simple Devices

When, later, Smithy and his assistant sipped their tea, Dick became more and more ruminative.

"You know, Smithy," he said, at length, "my experience this morning makes we feel that most of the things we bump into in electronics are really very simple."

"I suppose that's true enough," commented Smithy, "although that h.t.-short snag wasn't as obvious as all that. The method employed for earthing that speaker frame was not entirely conventional, but it was by no means untypical of the way some commercial receivers are wired up.

"However, your talk of the simplicity of some aspects of electronics reminds me of something which appeared in *The Radio Constructor* for last March. I don't know if you can remember it, but in that issue G. A. French published a Suggested Circuit in which a relay functioned as a periodic circuit timer in company with a condenser and a resistor. He stated, in his article, that 'if it were possible to make a periodic relay switch any simpler he would be very interested to hear of it.' "*

"Oh yes," Dick remarked, "I remember that circuit quite well. G. A. French certainly cut everything down to the bone."

"True enough," replied Smithy. "Yet at the same time, there is another type of simple periodic switching device which can be used for a.c. mains circuits and which, whilst not being truly a *relay* gadget, certainly runs neck and neck with G. A. French's from the simplicity point of view.

"This switching gadget† consists of a bimetal strip clamped at one end, and which is heated by means of a coil of asbestos-covered resistance-wire, such as is available from line cords and the like. (Fig. 3 (*a*).) Alternatively, the bimetal strip could be heated by ordinary resistance wire, this being insulated from the strip by asbestos tape; or, again, if the circuit to be switched carries a heavy current, the heating element could be ordinary copper wire.

"The heating element is connected in series with the device to be switched. When the current is first switched on, a circuit is made to the controlled equipment via the heating element, the bimetal strip and its contact. The bimetal strip then warms up, breaks its contact, and the equipment switches off again. When the strip becomes cool the contacts make once more, and we start another cycle. Dead simple, isn't it?"

"It is indeed," remarked Dick, "but aren't you liable to lose a lot of volts in the element?"

"Not necessarily," replied Smithy. "At worst it should be some five volts for low current devices which take 200mA or so. You can, incidentally, shunt the element if you want to get a finer control of the voltage it drops and, in consequence, the length of each timing cycle."

"What about the insulation between the heating wire and the bimetal strip? Asbestos tape doesn't seem to me to be very effective in this direction."

"It doesn't need to be," replied Smithy. "One end of the element is permanently connected to the strip and the only voltage difference given is that between the other end of the element and the strip. You can, in fact, connect one end of the wire to the strip at the point where the latter does most waggling, thereby keeping the voltage difference lowest at the point where most physical movement occurs. (Fig. 3 (*b*).)

"A useful alternative to the bimetal strip consists of using two strips of the same material and of heating one of them. (Fig. 3 (*c*).) Small hacksaw blades would cope quite nicely here."

"Very neat," remarked Dick approvingly. "I especially like the hacksaw blade idea, because that uses parts which are easy to obtain. I shall have to think about knocking up one of these gadgets for Christmas."

"If you hurry," remarked Smithy, gently, "you'll get it done in time for Thanksgiving."

* Suggested Circuits No. 88, *The Radio Constructor*, March 1958, page 542.

† This device is due to reader J. B. Leonard, of Oxford.

NEW ANTENNAS FOR RADIO AMATEURS

Amateurs throughout the world soon will be able to buy Mosley Trapmaster rotary and vertical antennas for fixed and mobile stations everywhere.

Carl Mosley, president of Mosley Electronics, Inc., of St. Louis, Missouri, U.S.A., a leading American manufacturer of short-wave antennas and other electronic equipment, has announced that Mosley will begin operations in England soon.

"We are opening an English manufacturing plant," Mosley said, "in order to satisfy the great demand from all parts of the world for Mosley antennas."

O. J. Russell, G3BHJ, prominent English authority on electronics and nucleonics manufacturing and exporting, has been appointed manager of the Mosley plant in England, which will be located at 15 Reepham Road, Norwich, Norfolk, England. Russell has contributed many articles to leading American and English electronic publications.

RADIO AMATEUR'S EXAMINATION

Grafton Radio Society announce that they have again made arrangements with the Islington L.C.C. Men's Evening Institutes for official courses in the RADIO AMATEUR'S EXAMINATION and MORSE (both for beginners) to be held this winter at the Montem School, Hornsey Road, Holloway, London, N.7. The classes will meet on Mondays, with a repeat lecture on Wednesdays, commencing 22nd September for the R.A.E., 7-9 p.m. (instructor S. H. Iles—G3BWQ), followed by the Morse 9-10 p.m. (instructors L. Barber and A. Ralph). The fee is 20s. for either course, or 22s. 6d. for the two, and application in the first instance should be made to the Hon. Secretary of the Grafton Radio Society, A. W. H. Wennell (G2CJN), 145 Uxendon Hill, Wembley Park, Middlesex, at once so that a place may be assured. In last May's City and Guilds examination 26 passes were obtained, making a grand total of 85 in the five years this course has been run.

UNDERSTANDING TELEVISION

PART 9

By W. G. MORLEY

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

WITHIN THE FIRST EIGHT ARTICLES IN THIS series we have considered the television system in very basic terms, starting with the system itself and the information it contains. We have also spent some time on a detailed discussion of the cathode ray tube, our treatment of this particular subject terminating in last month's issue of *The Radio Constructor*.

Logically, we should now turn to the circuits which cause the television signal to be applied to the cathode ray tube and which keep the receiver deflection circuits in synchronism with those at the transmitter. Unfortunately, it is difficult to discuss the video signal when it is in a form suitable for application to the cathode ray tube without a prior understanding of the processes to which it has previously been subjected. In consequence it now becomes necessary to deal with the r.f. and i.f. stages of the receiver, as these handle the television signal after it has been picked up by the aerial. In this month's issue, therefore, we shall commence right at the "front-end" of the television receiver, and shall introduce one of its more important parts—the tuner unit.

Television Tuners

When, in this country, television receiver production commenced after the end of the war, there was no necessity for sets to have complex tuning arrangements in the aerial input circuit. The very simple reason for this state of affairs was that there was, at that time, only one transmitter. This transmitter —sited at Alexandra Palace—broadcast on what is now described as Channel 1. In consequence, earlier televisors were designed to receive this transmitter only, no facility being provided for reception on any other channels. Indeed, many early post-war receivers were of the t.r.f. (tuned radio frequency) or "straight" variety, wherein all the tuned circuits before the video and sound detectors were aligned at signal frequencies. A second station, Sutton Coldfield, later commenced transmissions on what is now called Channel 4, but even this event did not materially affect commercial production; receivers, including a proportion of t.r.f. models, being still marketed for reception of a single channel only. Superhet receivers of this period were normally capable of adjustment from one channel to the other, but this usually necessitated the receiver being handled by a service engineer.

A little later, however, receivers began to appear which had some means of simple adjustment from Channels 1 to 5, and it was at this period that the television tuner unit began to take form as a sub-assembly in its own right. Also, this was the period which marked the final demise of t.r.f. receiver production. Despite the fact that more transmitters later became available in Band 1, there was still, incidentally, no necessity for the viewer to change channels, as only one programme (that radiated by the B.B.C.) was available. As a result, controls for channel selection were rarely brought out to the front panel. Usually, the channel selector control was situated at the rear of the chassis and it was, in many cases, simple enough to be operated by most laymen.

As we already know, the tuners employed at this time were intended for reception of Channels 1 to 5 only, these lying within the Band 1 frequency range of 41 to 68 Mc/s. Without devoting too much space to them, it would now be instructive to examine the techniques employed in two of the more typical examples of these early Band 1-only tuners as, apart from their own interest, they are of assistance in leading up to the techniques currently employed in 13-channel tuners.

circuit form the device could be depicted as consisting of three tuned circuits having a "three-gang" adjustment of inductance. When the arrangement of Fig. 46 was employed in a television receiver the three coils were connected into the aerial input circuit, the r.f. circuit (that between the r.f. amplifier valve and the mixer valve), and the oscillator circuit. Especial care in design was needed to ensure that accurate tracking was given. ("Accurate tracking" defines the condition when the three coils are all tuned to the correct frequency at all points in the range of the tuner unit.)

Another, and mechanically simpler, method of obtaining channel selection in Band 1 was provided by "incremental inductance" tuner units. In these units selection was obtained with the aid of a rotary switch, this causing small values of inductance to be put into circuit for each switch position. A circuit diagram showing the basics of an incremental inductance tuner is given in Fig. 47. In this diagram we have three sets of variable inductances, these being connected, as with

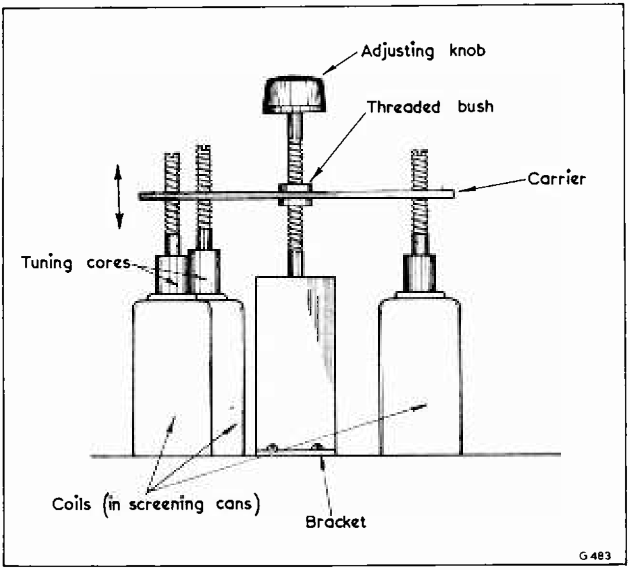


Fig. 46. An example of a Band 1 tuner unit coil assembly. Rotating the knob causes the three cores to be inserted into, or withdrawn from, the coils. The positions of the three cores relative to the carrier are themselves adjustable (for purposes of initial setting up) with the aid of their threaded stems

Fig. 46 illustrates a Band 1 tuner in which the inductances of three coils are varied by means of tuning cores fitted to a common carrier. A simple screw device enables the carrier to be raised or lowered, thereby causing the three tuning cores to be inserted into, or withdrawn from, the three coils. In

the device of Fig. 46, into the aerial, r.f. and oscillator circuits of the associated television receiver. When the switch of Fig. 47 is set to Channel 5, as it is in the diagram, the inductance put into each of the three circuits is that inserted by L_1, L_6 and L_{11}. These coils are provided with adjustable cores so that their inductances may be raised or lowered, as desired. All the remaining inductances, those shown connected across the switch contacts, are short-circuited by the switch. When the switch is set to Channel 4, coil L_2 is connected in series with L_1, coil L_7 is connected in series with L_6, and coil L_{12} is connected in series with L_{11}. In consequence, the inductance presented to the associated receiver circuits increases, and the lower-frequency Channel 4 is selected. Setting the selector switch to positions 3, 2 and 1 inserts further inductance into the three circuits, thereby enabling these channels, whose frequencies become progressively lower, to be selected.

When the incremental inductance tuner unit is initially aligned, the coils L_1, L_6 and L_{11} are adjusted for correct inductance on Channel 5. These three coils should then present the required inductance for all the remaining channels, it being assumed that, provided they are wound with the correct number of turns, etc., the incremental inductances have so relatively low a value that the total inductance obtained is sufficiently accurate for correct tuning.[1] In practice the incremental inductance coils were very often self-supporting, being solder-

[1] In some cases small adjustments of incremental inductance might be achieved by opening or closing the turns of any particular coil.

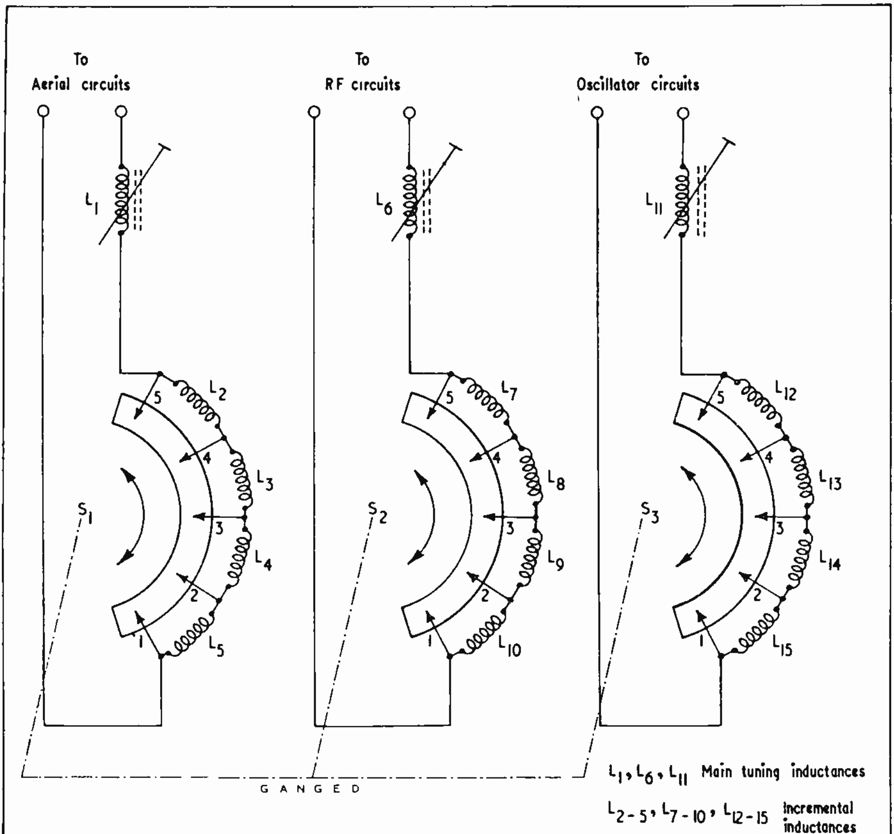


FIG. 47.

Fig. 47. The basics of an incremental inductance Band 1 tuner unit. The three switch "short-circuiting bars" are in the Channel 5 position. On switching to Channel 4, L_2 is connected in series with L_1, L_7 with L_6, and L_{12} with L_{11}. If a coupling winding were required for any of the coil circuits, this could be fitted to the main inductance section

It should be noted that the incremental inductance type of tuner required some degree of oscillator fine frequency control, as it would be difficult to ensure that each discrete step in inductance provided by the switch would allow the oscillator to be set to the exact frequency required on all channels. A fine control of oscillator

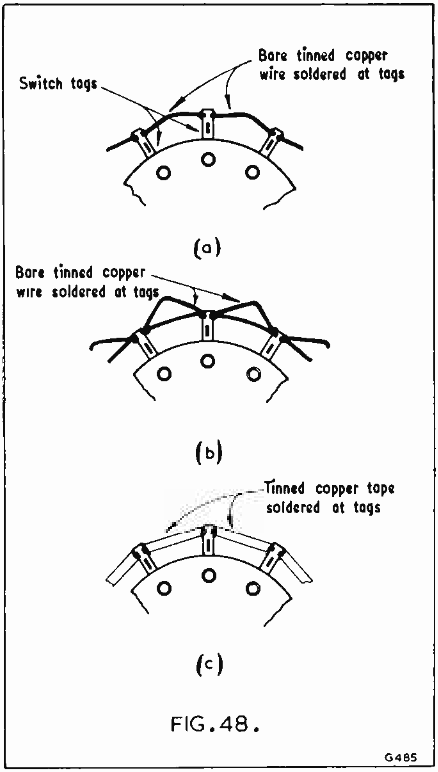


Fig. 48. *When incremental inductance techniques are employed at Band 3 frequencies, very small values of incremental inductance are required when changing from one channel to the next. As examples, a single piece of tinned copper wire provides the inductance in (a), whilst two wires "in parallel" are employed in (b). Tinned copper tape is used in (c)*

frequency would be provided by adjustment of the core of L_{11}. (The necessity of providing a fine frequency control for the oscillator is due to the fact that it is the oscillator frequency which, by beating with the incoming signal, causes the latter to be applied to and amplified by the relatively highly selective intermediate frequency stages of the receiver. Whilst a small amount of de-tuning is permissible in the aerial and r.f. circuits, the oscillator must always function at the correct frequency.)

The tuner units of Figs. 46 and 47 are representative of early Band 1-only design and they are of especial interest here because they represent the first instance, in this country, of the tuning circuits of a television receiver being fitted in a separate sub-assembly. As sub-assemblies, these tuner units were similar in design to the more complex Band 1–Band 3 tuner units which followed later, insofar that the Band 1 units carried their own valves and circuitry, the connections to the main part of the receiver chassis consisting of h.t. and heater supplies, automatic gain control and contrast control wiring,[2] and the aerial and i.f. output circuits. The first i.f. coil of the receiver, that connected in the anode circuit of the mixer valve, might also be fitted in the tuner unit. It is worth mentioning that these tunit units were, in some cases, manufactured by specialist firms for general sale to set-makers.

Band 3

When Band 3 transmissions commenced in Great Britain, the tuner unit situation altered considerably. There were two main reasons for this change. Firstly, equipment intended for operation at Band 3 frequencies requires special components, valves and design techniques if adequate amplification and stability are to be achieved. Secondly, since the domestic television receiver was now capable of presenting an alternative programme, the tuner unit fitted to the receiver had to become a simple foolproof device capable of customer control. This latter point carries with it the corollary that the tuner unit would be switched from one channel to another very frequently, with the result that such details as contact and mechanical wear had to receive much greater attention in the design stages.

If an attempt were made to classify the various types of Band 1–Band 3 tuners which have been employed in Great Britain since the inception of Band 3 transmissions, it could be said that these have consisted, in the main, of incremental inductance switching devices, of units wherein channel selection is achieved by ganged core insertion methods (similar to those shown in Fig. 46) and of turret tuner units. It is interesting to note that the incremental inductances fitted to switch type units frequently consisted of straight pieces of wire or flat metal tape between the Band 3 contacts. Fig. 48 shows

[2] To be discussed in a later article.

three typical examples. The ganged core insertion units employed switching circuits which ensured that the large gap in inductance occurring between Band 1 and Band 3 was automatically allowed for when the selector passed from Channel 5 to Channel 6.

on the original design, almost universally employed. The reason for this fact is that the turret tuner offers, both electrically and mechanically, the best possible answer to the conflicting requirements of Band 1 and Band 3 reception, together with the feature

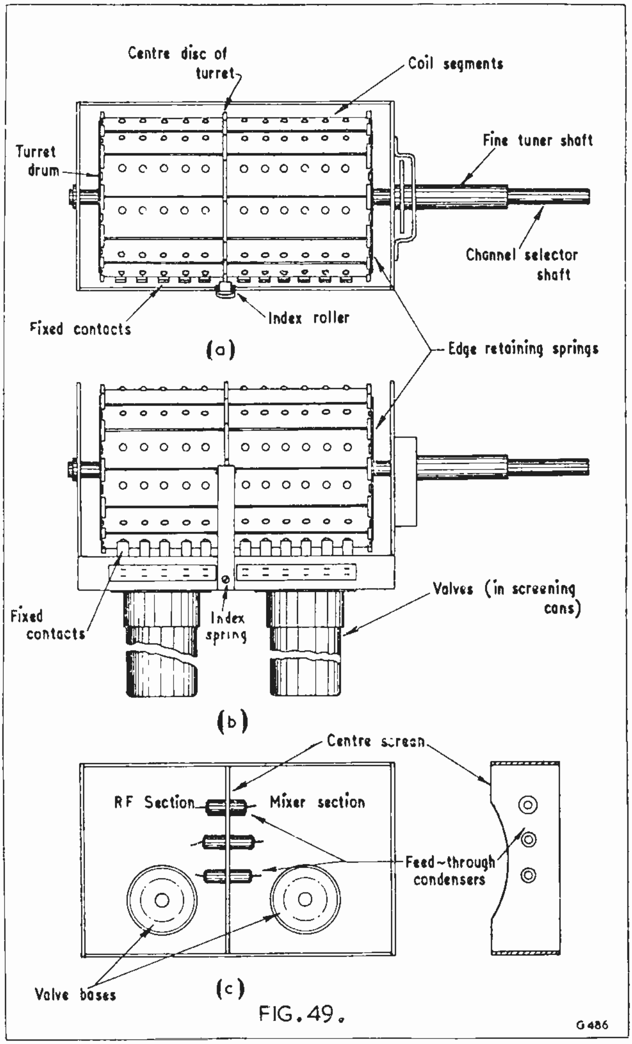


FIG. 49.

Fig. 49. (a) and (b) The basic construction of a typical turret tuner. (c) The internal screen of the tuner, visible when the drum is removed. The inset shows a side view, illustrating the curved edge which approaches the underside of the drum. The screen usually passes across the r.f. amplifier valve base, so that the anode tag may be isolated from the input circuit. Feedthrough condensers are frequently employed for coupling together supply circuits (h.t., heater, etc.) on either side of the screen

Of the three main types of television tuner, the turret unit has always been used most frequently. At the time being, indeed, it has practically ousted the other types of tuner unit, and it is now, with some slight variants

of considerable adaptability. Since, in most designs, turret tuner coils are capable of being individually fitted or removed, it becomes possible for a turret tuner to select channels in any order with no alteration in

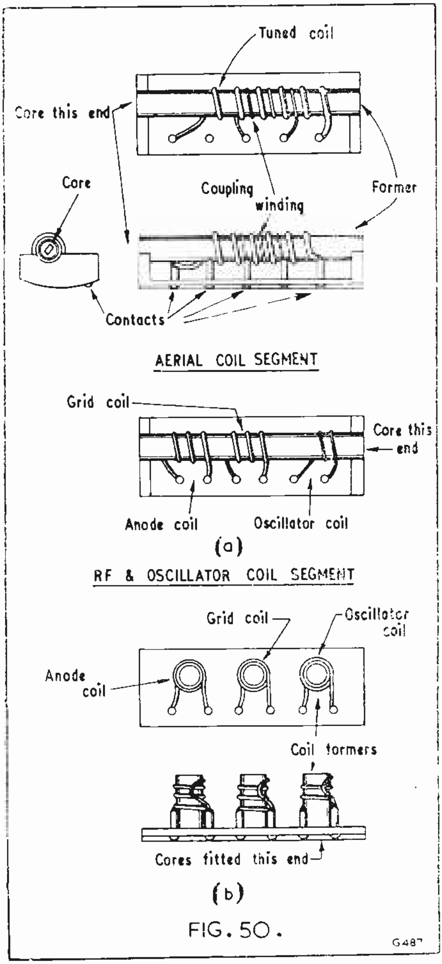


Fig. 50 (*a*). *This diagram gives top, side and end views of a typical aerial coil segment, and a top view of an r.f. and oscillator coil segment. The aerial coil is tuned by an adjustable core, as is the oscillator coil of the lower assembly. The anode and grid coils of the latter are tuned by moving the turns of the coils along the former*

Fig. 50 (*b*). *It is possible for one or more of the coils on an r.f. and oscillator segment to be mounted radially (i.e. with their axes pointing inwards towards the actuating shaft when the segment is mounted in the turret), in the manner shown here. In such a case each radially mounted coil may be tuned by its own adjustable core*

basic design at all. A typical example of turret tuner adaptability is the fact that these units may be fitted with coils suitable for reception of f.m. signals in Band 2 (v.h.f.) should this be desired, the basic layout remaining unchanged.

The Turret Tuner

Since the turret tuner is by far the most important tuner unit currently employed, we shall now deal with it in greater detail. A typical turret tuner is illustrated in Fig. 49. In this diagram we see the turret "drum," this being the rotating section of the turret which contains the coil segments. The coil segments are held in position on the drum by means of edge springs, and they are readily capable of being fitted or removed. The coil segments connect into the tuner circuits via a row of fixed contacts mounted on the chassis. An internal screen is also fitted to the chassis in order to isolate the aerial circuits from the r.f. and mixer circuits and this screen, together with the centre disc of the drum assembly, provides almost complete shielding between the two sections. The shaft which rotates the tuner drum, and which thereby provides channel selection, is normally concentric with a second shaft which controls the "fine tuner." The centre disc of the turret drum usually has a serrated edge, this engaging with a roller on an indexing spring to ensure that positive location is provided at each channel setting.

A pair of typical turret coil segments is illustrated in Fig. 50 (*a*). One of these segments is an aerial coil, this consisting of an r.f. transformer which is tuned by an internal core. The core is usually brass or aluminium, but it might be iron-dust at Band 1 frequencies. An r.f. and oscillator segment is also shown in Fig. 50 (*a*). The oscillator coil is tuned by means of a brass or aluminium core (or, possibly, iron-dust core at Band 1 channels), the turret mechanical design being such that it is possible to adjust this core readily without the necessity for disassembly of the tuner unit.[3] In segments of the type shown in Fig. 50 (*a*) cores are not fitted to the two r.f. coils. This is due to the fact that access to a core in the right hand coil would be impeded by the oscillator core, and access to a core in the left hand coil would be impeded by the aerial core (when both aerial and r.f. coil segments were fitted on the drum). Because of the absence of cores, the r.f. coils are tuned by physically moving the turns on the formers. Since these coils function in a

[3] In many designs the oscillator cores are accessible through the front of the tuner chassis, allowing adjustment to be made, when the tuner is fitted to a receiver chassis, without removing the latter from its cabinet.

band-pass circuit the distance between them is of considerable importance, and this distance is also adjusted by moving the coil turns along the former.

Coil segments intended for r.f. and oscillator circuits may be designed differently from those shown in Fig. 50 (*a*). In some cases the coils may be mounted radially (so that their axes point towards the actuating shaft), whereupon cores can be fitted which are readily adjustable when the segment is fitted to the turret drum. See Fig. 50 (*b*). Coils mounted in this manner are then tuned with the aid of these cores and not, normally, by moving individual turns.

Next Month

In next month's contribution we shall commence a study of the circuitry employed in Band 1–Band 3 tuners.

BAND 1, 2 AND 3 CHANNEL FREQUENCIES (BRITISH)

Band	*Channel*	*Vision Carrier (Mc/s)*	*Sound Carrier (Mc/s)*
1	1	45.0	41.5
1	2	51.75	48.25
1	3	56.75	53.25
1	4	61.75	58.25
1	5	66.75	63.25
2	F.M. Band	(87.5—100 Mc/s)	
3	6	179.75	176.25
3	7	184.75	181.25
3	8	189.75	186.25
3	9	194.75	191.25
3	10	199.75	196.25
3	11	204.75	201.25
3	12	209.75	206.25
3	13	214.75	211.25

Can Anyone Help?

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

M. J. BALDWIN, "Evenden Cottage," Hook Green, Meopham, near Gravesend, Kent, wishes to obtain a copy of the April 1958 *Practical Wireless* containing information on converting the Mk. 19 No. 2 for amateur band use. Any expenses involved will be covered.

* * *

P. WOOLARD, 10 Brookside, Glapthorn, Oundle, Peterborough, Northants, wishes to buy or borrow the circuit and/or servicing manual, or any data such as instructions, aerial and power supply details, etc., of the U.S.A. Collins TCS.12 type 52245 radio transmitter.

* * *

W. LOWE, 28 Allenby Road, Cadishead, Manchester, wonders if any reader can supply him with data on the Kolster Brandes "Rejectostat" receiver type 510 or the K.B. battery personal receiver model F.P.11, serial O1956.

* * *

J. JOHNSTONE, 118 Hertingfordbury Road, Hertford, Herts, needs the circuit diagram or service sheet for the Haynes Tuner Unit type B.12 and Amplifier type B.9. All letters will be answered and all information paid for.

W. WINTER, 10 Siding Street, Bacup, Lancs, would like to buy or to borrow the service manual or any information on the R.1475 set, receiving unit type 88, and also the conversion data for the BC.348.N.

* * *

G. C. BARROW, 45 Old Oscott Hill, Kingstanding, Birmingham 22C, wishes to borrow, hire or purchase the circuit, manual, or any relevant data on the U.S.A. communications receiver SCR.291A (Rx.1147).

* * *

D. R. COAD, 14 Sandy Lane, Fair Oak, Eastleigh, Hants, wishes to obtain data on the following: BC-624-A receiver, BC-625-A transmitter, R.5019 receiver, T.5017 transmitter, Buzzer-oscillator pattern 2207, R.1132.A receiver, the type 71 receiver, and handbook (on loan or willing to purchase) and capacitance calibration charts for the Test Set TS.27/TSM.

* * *

R. H. CLIFTON, 278 London Road, Staines, Middlesex, asks if anyone can supply the circuit connections, frequency coverage, and alignment details of the Denco type C.T.3 6-waveband, aerial, h.f. and oscillator coil-pack manufactured in 1946. The makers can no longer supply this data.

(*continued on page 125*)

A PRE-TUNED SUPERHET RECEIVER

by S. E. KEELEY

MARY, A BACHELOR GIRL, IS SHORTLY moving into a flat of her own. "I'd be very grateful," she said to me the other day, "if you would build me a radio. I can't afford to spend much more than £7 or £8, so perhaps if you made me one that would get only the three B.B.C. programmes, nice to listen to, and fixed so that I can use my record player with it . . ."

I thought about it. Three stations . . . they could be pre-tuned and switched. Easy with a T.R.F. But that would bring a few snags in its train. Feeding a pick-up into a T.R.F. is always a bit messy, I think. And with no a.v.c., the stations always seem to be unbalanced in volume when you switch them.

A superhet? Yes, but a 465 kc/s superhet is not easy to pre-tune. The oscillator tuning is critical: you get the receiver on line, screw the chassis into the cabinet and switch on. Bump, bump, bump goes the bass notes . . . and in a few weeks' time the set needs re-aligning.

So it would have to be 1.6 Mc/s i.f. This would give a bandwidth allowing pleasant quality, no trouble in lining-up, stability once it was adjusted, ample selectivity to separate local signals, easily arranged gram input, and the a.v.c. would keep the volume of the stations balanced.

When I came to sketch out the circuit, I found that it was going to be both interesting and inexpensive. With 1.6 Mc/s i.f. the coil situation could be somewhat unorthodox.

For the Light Programme (200 kc/s) the local oscillator would have to operate on 1,800 kc/s; for the Third Programme (647 kc/s) the frequency would be 2,247 kc/s; and for the Midland Region (1,088 kc/s) 2,688 kc/s. For any other medium wave station, the oscillator would still lie within the 1.8–3.0 Mc/s range. This frequency range is covered by Wearite "P" coil PA6.

This meant that three coils, Wearite PA1 and PA2 on the mixer side and *one oscillator coil*—PA6, *not* PO6—would do the job.

Components List

Condensers

C_1	0.01µF
C_2	0.01µF
$C_{3,4,5}$	See text
C_6	0.1µF
C_7	0.1µF
C_8	100pF
$C_{9,10,11}$	See text
C_{12}	0.01µF
C_{13}	0.01µF
C_{14}	0.1µF
C_{15}	0.1µF
C_{16}	0.1µF
C_{17}	0.01µF
C_{18}	100pF
C_{19}	100pF
C_{20}	0.1µF
C_{21}	0.1µF
C_{22}	25µF
C_{23}	50pF
C_{24}	0.1µF
C_{25}	50µF
C_{26}	0.05µF
C_{27}	16µF
C_{28}	8µF
C_{29}	0.1µF

Resistors

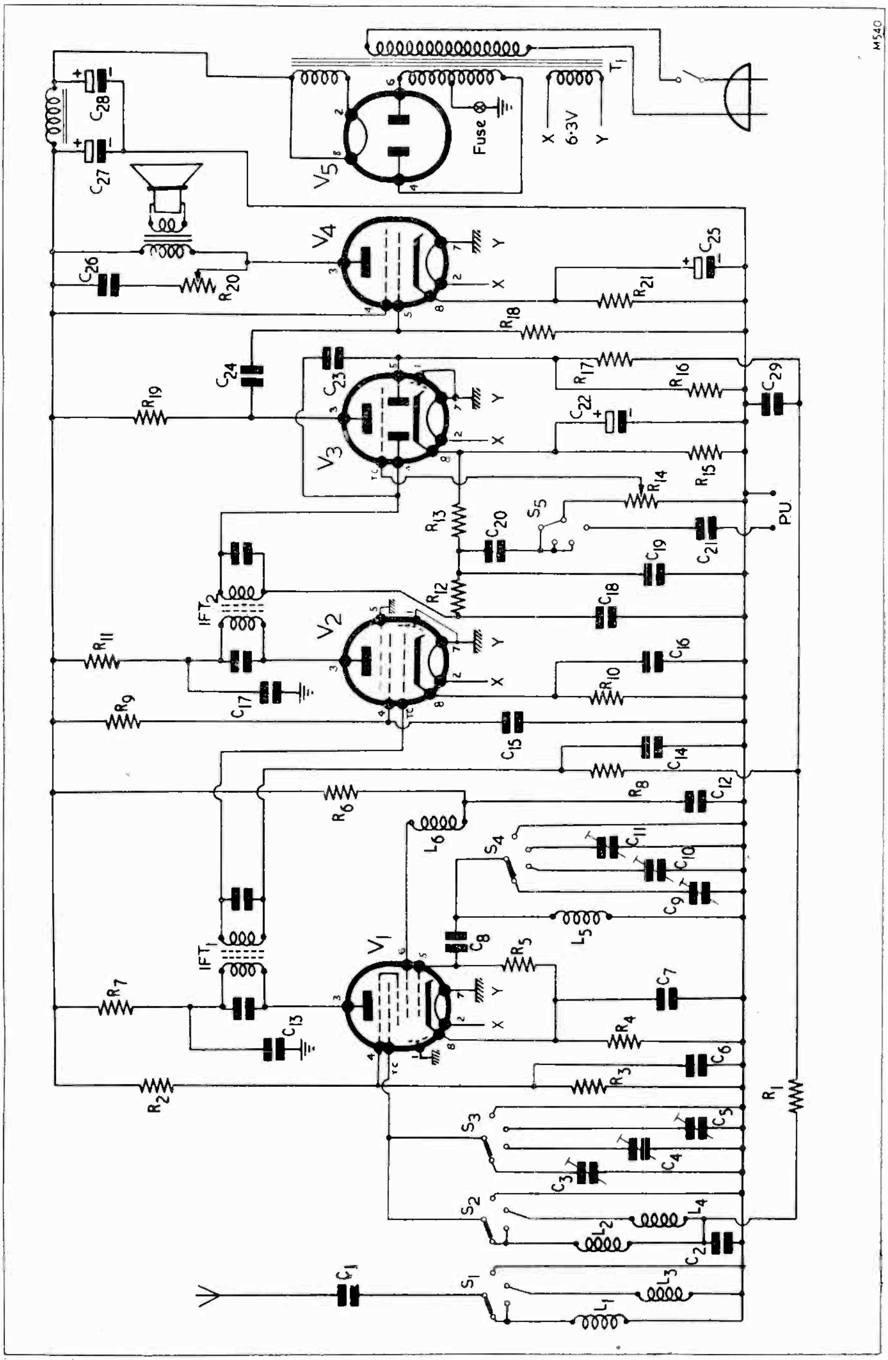
R_1	100kΩ
R_2	22kΩ
R_3	15kΩ
R_4	470Ω
R_5	47kΩ
R_6	10kΩ
R_7	4.7kΩ
R_8	100kΩ
R_9	68kΩ
R_{10}	330Ω
R_{11}	4.7kΩ
R_{12}	47kΩ
R_{13}	470kΩ
R_{14}	500kΩ pot
R_{15}	2.2kΩ
R_{16}	1MΩ
R_{17}	1MΩ
R_{18}	220kΩ
R_{19}	220kΩ
R_{20}	50kΩ pot
R_{21}	220Ω

Valves

V_1	EK32
V_2	EF39
V_3	EBC33
V_4	6V6
V_5	Rect.

Miscellaneous

- L_1, L_2 PA2 (Osmor QA8)
- L_3, L_4 PA1 (Osmor QA9)
- L_5, L_6 PA6 (Osmor QA4)
- IFT_1, IFT_2 1.6 Mc/s I.F. trans. (see text)
- T_1 Main trans. 250–0–250V 6.3V and rectifier winding
- S_1, S_2, S_3, S_4, S_5 2 wafer Yaxley, each wafer 4-pole 3-way


M540
Fuse
6·3V
PU

I stripped a pair of 465 kc/s i.f. transformers down to 1.6 Mc/s. approximately. (The frequency is not really critical.) If you would like to know how I did this, the drill was as follows:

1. Unsolder the outside connection of one of the i.f. coils, strip off about six or eight feet of wire, cut it off and resolder the end of the coil wire back where it came from.

2. Connect one end of the i.f. coil to an aerial, and plug a lead from the other end of the i.f. coil into the aerial input socket of your domestic receiver. (The i.f. coil is now working like a wave trap or whistle filter—a rejector circuit offering great resistance to signals of a frequency equal to that of the resonant frequency of the i.f. coil/condenser tuned circuit.

3. Switch the set to the medium waves, and tune in the B.B.C. regional stations in turn, beginning with North Region. At each station, adjust the trimmer attached to the stripped i.f. coil, and see if you can "peak it" so that it blots out, or reduces, the volume of the station. Somewhere along the medium waveband, you will note this effect, and you will know what frequency you have stripped the coil to.

4. Carry on stripping and testing in the manner described until you can "peak out" the Third Programme on 1,546 kc/s. A few more turns off and you will have a 1.6 Mc/s bobbin. If you have noted how much wire you stripped off one coil, you will know how much to take off the other three bobbins, and the job can be finished in minutes. (As a guide, I might mention that I had to strip 19 *feet* off each bobbin of a pair of Wearite 465 kc/s i.f. transformers to bring them down to 1.6 Mc/s.)

I used the TR1196 line-up for the valves—EK32, EF39, EBC33. A two-wafer Yaxley is used for switching the stations and the EBC33 grid circuit from radio output to gram. In the "gram" position, the coils are earthed.

For the mixer signal grid trimming condensers, I used the trimmers from defunct i.f. transformers. For the oscillator trimmers, 100pF for the Home Service, 200pF for the Third Programme and 250pF for the Light Programme served admirably. They can be bought in these values mounted in pairs on ceramic blocks which bolt neatly to the chassis.

The rest of the circuit is standard superhet practice and calls for no comment.

After a few hours with the soldering iron, the job was done. The results far exceeded my expectations—high sensitivity, most excellent quality, the three stations, correctly tuned in, at a flick of a switch. The cost—including the 10in speaker—was only £8 10s.

It's a pity it's so good, really—we can't bear to part with it!

Audio Has Big Place in

Britain's SILVER JUBILEE Radio Show

Forecast of Features and Trends

The British radio industry, through the Radio Industry Council, is putting all it knows into the organisation and presentation of its annual National Radio and Television Exhibition to be held at Earls Court, London, from 27th August to 6th September, 1958, with a preview for overseas visitors and other special guests on 26th August.

It is the 25th National Radio Show and will be distinguished by very attractive designs in radio and television receivers and radiograms, making use of the latest transistor and printed circuit techniques, with some special emphasis on export models, as well as by lively demonstrations of all kinds, some technical and some for entertainment.

Audio equipment for high fidelity reproduction of sound, always included among the exhibits, is being given a hall to itself this year, occupying a huge area on the first floor previously used by the B.B.C. for its exhibition studio, scenery dock, dressing-rooms and executive offices. Forty-five firms will have sound-proof rooms for demonstrating the equipment in the manufacture of which Great Britain excels, and which accounts for more than 20 per cent of British radio exports, the U.S.A. being the biggest buyer. The exhibits and demonstrations will include microphones, speakers, amplifiers, gramophone components, disc and tape recordings. The new stereophonic records will be demonstrated for the first time, and for the first time in an exhibition in Britain there will be a studio for stereophonic recording on tape.

Radio Miscellany

THIS COLUMN'S INTEREST IN STEREOPHONIC sound brings to light an anecdote told by W. E. Thompson (G3MQT). The name might not at first ring a bell as strongly as some of the others associated with *The Radio Constructor*, so perhaps it would be helpful if I reminded you that he does the Book Reviews.

At the time of the slump in the early 'thirties he was "axed" under an economy drive, from the technical development section of Standard Telephones and Cables, so he went to help out his mother who had recently acquired a business near Southend. The shop carried a fair stock of gramophone records and a few quite-good-for-their-period cabinet gramophones.

Surrounded by such a galaxy of material it wasn't long before Bill hit on the idea of playing two discs of the same recording simultaneously in an endeavour to obtain a stereophonic effect. His experiments along these lines were as a matter of personal interest rather than with any idea of exploiting it commercially. Naturally he had fun and games keeping the clockwork motors in step and getting the discs to start off exactly together. Even when he acquired the knack it required so much attention to operate, that little or no time was left for listening to the resultant distribution of sound. Improving on the idea, he swapped the mica-diaphragmed sound-boxes for electric pick-ups. Incidentally, the early pick-ups were often heavier than the sound-boxes they were intended to replace. Generally they were used in conjunction with the old-fashioned tone arm. Combined, they acted on the record surface rather like a miniature drill, penetrating deep in the grooves. The facetious types used to swear they threw their records away because after a few playings they alleged the loud passages from the other side would start breaking through! Nevertheless, record wear had to be sacrificed to the slightly wider frequency range and the possibility of having effective forms of tone and volume controls.

Bill, of course, being progressive, soon added pick-ups and separate amplifiers using LS6A triodes plus mains-energised speakers mounted on 3ft square baffles. In the early 'thirties, anything less than nine square feet of baffle was distinctly non-U. To simplify synchronisation he mounted two turntables and pick-ups, one mounted above the other; the turntables were coupled by means of a keyway on the spindle to keep them in step, and one of the pick-ups was adjustable through a small arc. It was then only necessary to locate the records so that the run-in grooves came in roughly the same place. Adjustment of the upper pick-up arm forwards or backwards enabled perfect synchronisation or stereophonic reproduction to be obtained at a touch.

Bill used this scheme for a long time and it created a great deal of customer interest. When the discs were timed to be slightly out of step, the variation in the stereophonic effect was most marked—the source of sound appearing to shift from one speaker to the other, or it could be made to sound as if coming from the space between the two. This scheme was, of course, a complete basis of the latest innovation in stereo-gramophone reproduction except that Bill was using two discs instead of a dual recording on one —nearly thirty years before its commercialisation.

Perhaps the ironic part of this little story is that he wrote up a description of it and sent it to one of the radio magazines of the period. They did not even reply, let alone publish it! This was by no means a unique experience with certain periodicals of that era, due possibly to a form of prejudice by "professionals" disdaining the work of mere amateurs. Or, maybe, the idea of anybody wanting to wear out their records two at a time, even for the sake of stereo, was too much for some unimaginative editorial assistant.

By the way, Bill mentions two of the old type wax double-sided twelve-inchers which showed up on his coupled-turntable stereo to advantage. They were recordings of "Finlandia" (Tone Poem) and "Petite Suite de Concert" (two 12in discs). How about these titles for our Aberdonian friend's quest for an ideal Test-cum-pleasure record? No one has mentioned them yet.

Double Decker

While on the subject of "E.P. Test" records, a further letter covering several interesting points comes from our old friend J.G. of Rickmansworth who, it will be remembered, sent along a couple of useful suggestions. He starts off by asking if our Aberdonian reader found any of the titles put forward were to his satisfaction. Well, I haven't heard from Aberdeen since. Apparently he is a canny lad, and when he does finally settle on one to his liking I'll bet it will be a winner!

J.G. is once again able to be helpful in the matter of keeping garden workshops dry, and he expresses surprise that the mailbag was so light on a subject that must be something of a problem to many enthusiasts. His den is an underground brick-built air raid shelter with a concrete roof, situated half-way down the garden. It offers the obvious advantages that one can hammer and saw, making as much noise as one likes, without inconveniencing anyone. Before he got to work on it, the dampness and condensation made it uncomfortable to stay in and anything left in it was ruined within a few days. He overcame the problem by making alcoves in each of the end walls and installing burner paraffin lamps (cottage lighting type) in each, with a vent slightly to the side and about 18in above the lamps. Three-inch metal tubing runs from above the lamps to the vents. It is now beautifully dry and cosy. The floor was concreted and the ceiling and walls were lined with roofing felt and distempered, and light and power laid on. It is fitted with a lathe, workbench and a couple of old chests of drawers strengthened and adapted for storage. It sounds a most attractive proposition, and will no doubt put ideas into other readers' heads. He finds that it seldom needs extra heat, and an extractor fan is being fitted for summer use.

Now Joe is a tidy sort of bloke—after my own heart—and having such an efficient and comfortable interior to his den he feels more than a little uneasy about the appearance of the outside, especially as it is right in the middle of the garden. At present it is a jungle of mint and other profuse growing vegetation with a few potted tomatoes, etc., thrown in for luck. Such things may well serve as camouflage if used for its original purpose—an air raid shelter—but they become rather an eyesore when you have to live with them. Hence he plans to make it a two-storey affair, and the upper part is to become a smartly painted greenhouse—with automatic ventilation! Thus he has applied his lively mind to the problem and has been good enough to send along details of the scheme he has devised.

The idea, although perhaps a little complicated, is very sound, but rather dependent on one or two important factors, namely, a sizeable collection of odds and ends including a synchronous clock, a suitable motor and gearing, plus a well equipped workshop and a natural aptitude for improvisation.

I am afraid my gardener friend lacks these, although quite a number of readers might well meet the requirements. In fact, Joe, your letter really scared him and I suspect he is still wondering if he wasn't born a couple of centuries too late. At least, he became quite eloquent about the good old days when life was far less complicated and grape-growers had plenty of time to stroll round in a leisurely manner screening their vines from variable winds by the simple expedient of opening and shutting the windows by hand.

J.A.C. (Polegate) is also helpful in throwing a little more light on the question of automatic ventilation, in which I gather he has a professional interest. In Britain, apparently, large scale grape growers have changed over to less exacting crops, being unable to find nimble-footed youngsters to scamper round opening and closing windows whenever the wind refuses to settle in one direction. In the U.S.A. a system using compressed air as its operating power is extensively used. The "sensing" is done by a valve controlled by a weathervane, and apparently it is an uncanny experience the first time one sees all the vents on one side of the house close down to the accompaniment of hissing air while those on the other side open whenever the wind changes direction.

Centre Tap talks about items of general interest

Brotherhood

In recent weeks threats of war, racial hatreds and political tyranny have dominated the news. It is thus doubly nice to feel that despite the evil-doing of violent minorities the world is still largely populated by peaceful and kindly people. Perhaps it is through one's hobbies that one can most easily get to know and understand the other fellow better, and radio serves us well in this respect. Following my recent illness I was deeply touched by friendly letters from readers, many of whom said I was not to trouble to reply. If only statesmen had more time for hobbies, what a friendly place the world would become.

The mention of readers' letters reminds me that once again I am in a sorry mess with postal replies, but I would most earnestly assure the writers that their letters were greatly appreciated. The Old Timers' Brigade were well to the fore. Is it that they are mostly retired and have more time to spare, or do radiomen become more sentimental with advancing years?

Once or twice suggestions have been made that an Old Timers' Club should be formed, and I have recently begun to wonder if they ought not to have a distinguishing mark. Possibly the chap sitting opposite to you in the train is an Old Timer too, and neither of you realises that you have so much in common. What a wasted opportunity when no doubt you would both have enjoyed swapping yarns, news and views.

Altruism

Each month I receive a copy of *Radial*—the monthly magazine produced by invalid hobbyists for other invalid hobbyists. Its cheerful chattiness gives me much pleasure, and I am sure it comes as a wonderful antidote against the depression and boredom of enforced idleness. As a contrast to the gloom of international suspicion, it is cheering to learn that *Radial* is now being printed for them by Denco (Clacton) Ltd. A very nice gesture. Even in a Welfare State, bedfast amateurs haven't much money to spare for hobbies and it is heartening to know that the directors of a firm have an interest in the hobby itself not simply confined to the business side. I often wonder how many of the helpers I see mentioned in *Radial* are Old Timers.

As for the Old Timers' letters, most of them seem to be busy building up sets such as they used in the early 'twenties, using genuine period parts. There must be something very fascinating in this "vintage" business. Indeed, I see one American firm is actually making "genuine brand new vintage" cars! Apparently there aren't enough old crocks to go round. I wonder if the idea will spread to radio receivers.

More of Yore

I am afraid we have but little space left for the rest of the Old Timer news which seems to have become almost a regular feature nowadays, so I must try to deal with their letters collectively. This month several have touched on an aspect previously overlooked—the early craze for miniature receivers. This, of course, is one of the delights denied the modern enthusiast. What with transistors and miniaturised components, tiny sets are comparatively easy to design nowadays and unless one manages to compress it to the size of a wrist-watch no-one is very greatly impressed. In the old days, to design a working set of really diminutive dimensions demanded considerable ingenuity on the part of the constructor. The first real midget I saw was fitted into a teacup, over which many hours of patient and loving care had been spent. Then came the matchbox receivers. This size somehow grew to be the accepted standard. All real enthusiasts used actual matchboxes. They were not content to simply keep it to matchbox size.

H.R.N. (Northwick Park Road, Harrow) has a really early claim and still has his Bornite-Zincite combination using the outer and inner parts of the box to form the variometer for tuning, with the rest packed away in the inner slide.

The other predominant subject this month was (*a*) the more favourable position of Old Timers in regard to component prices, and (*b*) their less favourable position in the same respect. At first this seems flatly contradictory, but I suppose a lot depends on just what period is under review.

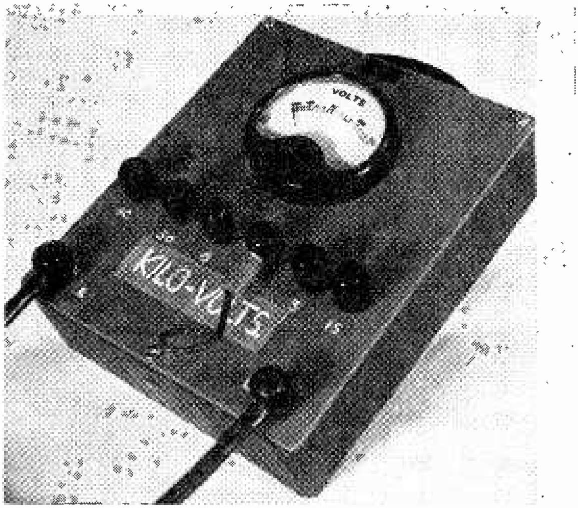
Is the newcomer really proportionally better off in this respect or not?

Personally, I should say that in the early days one could do quite a lot for a small expenditure. Then came the 1922–1930 period. One simply had to buy valves, etc., and they were mighty dear. This period in my opinion made by far the heaviest demands on the constructors' pocket, yet strangely enough home-construction proceeded on an enormous scale. Practically every household had a set built by one of the members, a friend or a neighbour. Sets were straightforward to make and were supplied in kit form so simplified that anyone who could read and use a pair of pliers became a "constructor." They were expensive (judged by comparative modern costs) but the real enthusiast could make most of his own parts cheaply.

In the 'thirties, mass production of domestic receivers began to get into its stride and vast quantities of manufacturers' "surplus" found its way on to the market. This was often sold at knock-down prices. It was too much for the handyman type to design his own set and hence, with a diminishing number of buyers for a swelling quantity of manufacturers-type over-produced components, prices fell sharply and enthusiasts bought shrewdly. These were happy days for the amateur with a lean purse.

continued on page 118

A MULTI-RANGE



ELECTROSTATIC VOLTMETER

By **B. K. POULSON and J. D. WARD,** G3HDW

A USEFUL AND INEXPENSIVE VOLTMETER can be made by utilising one of the electrostatic voltmeters which are now being sold for a moderate sum.

An electrostatic meter has the advantage of requiring almost zero current for its operation, unlike a conventional moving coil meter. Ordinary multi-range testmeters are not usually suitable for measuring high source impedance e.h.t. supplies, since the current taken by the meter loads the supply and reduces the voltage, thus giving an inaccurate reading.

The electrostatic meter overcomes this problem, and also has the advantage of measuring d.c. and a.c. without the use of a rectifier. The instrument is particularly suited to the measurement of e.h.t. supplies in t.v. receivers.

Description

The instrument to be described has an input resistance of 100MΩ but if necessary this can be increased by modifying the value of resistors as described later. The basic movement consists of an 0–1.5kV meter and range selection is carried out by means of a wander plug which can be plugged into any one of six sockets; a switch was not used, due to the difficulty of obtaining one which would withstand the high voltages encountered. The ranges available are as follows:—

0–1.5kV
0–3.0kV
0–7.5kV
0–15kV
0–30kV
0–60kV

Construction

The instrument can be built into any convenient size case, but the writers found that a neat and compact instrument could be built by using a case made of wood 5½in x 7in x 2in x ⅜in thick and a front panel made of ¼in paxolin.

ratings are applicable to resistors; the maximum voltage rating must not be exceeded. If in doubt, the manufacturer's data should be consulted.

Providing the precautions mentioned are observed, the wiring of the instrument should present no difficulty.

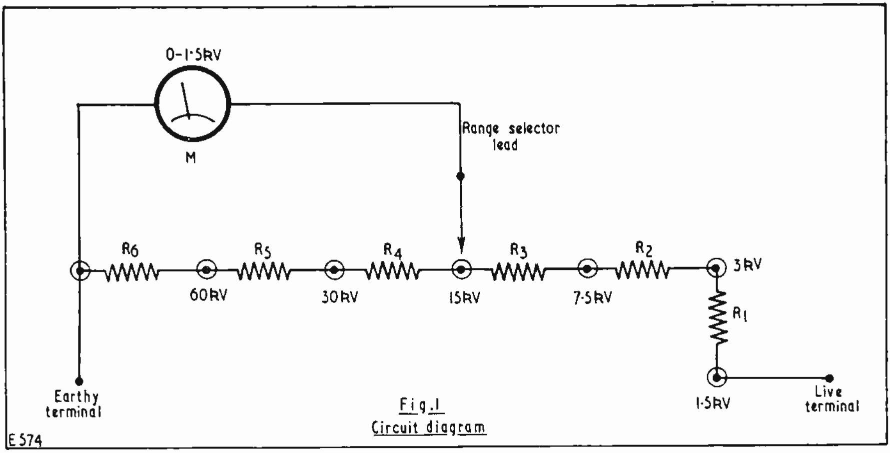


Fig. 1
Circuit diagram

Components

R_1	50MΩ	Made from a number of smaller value resistors connected in series if high voltage ones are not available.*
R_2	30MΩ	
R_3	10MΩ	
R_4	5MΩ	
R_5	2.5MΩ	
R_6	2.5MΩ	

M 0–1.5kV Electrostatic Meter
Eight Insulated Terminals
One Wander Plug

* The voltage drop across each resistor must not exceed its voltage rating. This can be calculated by simple Ohms Law.

The panel should be drilled to accommodate the meter, six range selector terminals, range selector lead, test lead terminals and case fixing screws. A few holes must also be drilled to enable the resistor supports to be fixed to the reverse side of the panel.

Due to be very high voltages encountered special consideration must be given to the insulation of components. Resistors should be supported away from the front panel by the use of good quality ceramic insulators; components and wiring should be well spaced; and the insulation of leads, particularly the test leads, must be good enough to withstand the maximum voltage to be encountered. No sharp points should be allowed on soldered joints; this is to prevent corona discharges.

If high voltage type resistors are not available, the value required can be made up by connecting resistors in series. It is not generally realised that maximum voltage

Alternative Circuit Values

If the reader wishes to use a different meter, increase the input resistance, or use

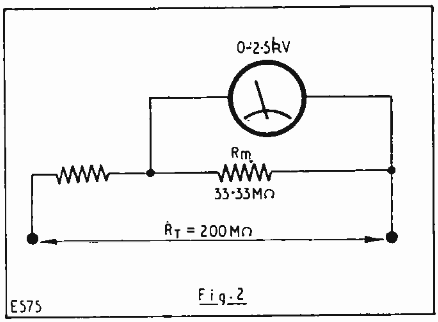


Fig. 2

different range multiples the component values can easily be calculated from the following formula: $R_m = \frac{R_T}{V_m}$. Where R_m is the value of resistance that the meter is tapped across, R_T is the total value of resistance in the series resistor chain, and V_m is equal to the voltage range required divided by the f.s.d. voltage of the meter.

Warning

The instrument and connecting leads must never be handled whilst connected to a supply. The range selector should be set to the appropriate range before use and should not be altered while measurements are being made. The earth terminal of the meter should be connected to the earthed side of the supply irrespective of its polarity.

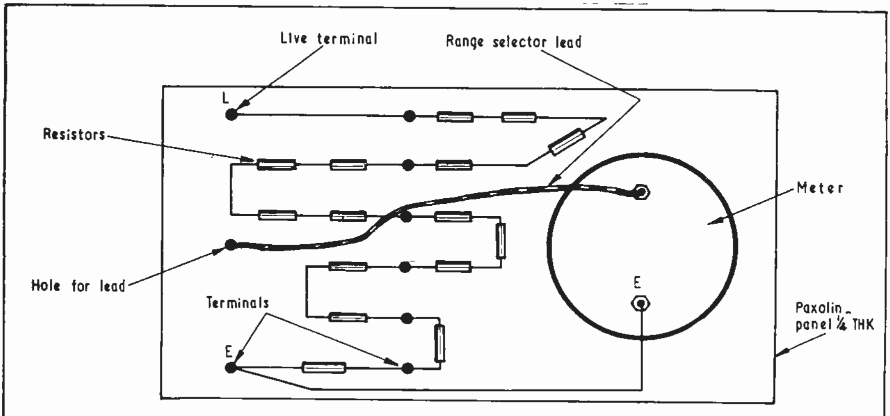


Fig.3
Rear view of panel

Example: $R_T = 200M\Omega$; the meter reads 2.5 kV. f.s.d.; the voltage range required = 0–15kV; therefore, $V_m = \frac{15}{2.5} = 6$. Thus, the value of the resistance required for this range $= \frac{200M\Omega}{6} = 33.33M\Omega$. See Fig. 2.

Providing the precautions mentioned are strictly observed, the reader will have at his disposal a safe, reliable, and inexpensive instrument which will give many years of useful service.

Radio Miscellany

continued from page 115

The immediate post-war years saw tons of ex-W.D. stuff at junk prices, and knowledgable amateurs had the time of their lives. Beginners weren't always so lucky. They often bought useful looking stuff only to find that it was of a highly specialised nature quite unsuited to their requirements. Still, it was a period in which you got a lot for your money, and generally speaking money was plentiful.

In more recent years prices have hardened again, but there are still plenty of bargains to be had—if you study the advertisement pages carefully. Modern conditions demand a much more complicated type of set and many new components and the later type valves and transistors are expensive, and I should say the latest newcomers aren't having quite such a good time of it as some groups of the older hands did when they built up the basis of their stock.

In radio, as with most other hobbies, if you want the latest and best of everything you can soon run through a three-figure bank balance. But you can still get lots of fun for the outlay of only a few shillings, and generally speaking I suppose this was true whatever period you entered the brotherhood of radio hobbyists.

The Teletron "TRANSIDYNE" 6 Transistor Pocket Portable Superhet Receiver

described by EDWIN MARSHALL

PART I

IT IS A SOBERING REFLECTION THAT FOR many long years radio enthusiasts struggled—both with components and designs—to produce a really small pocket receiver of reasonable efficiency. To the best of the writer's knowledge, none of us ever really succeeded with such a project. The comparatively large size of pre-war components effectively ruled out any hope of attaining a small and compact size and while portable designs did, of course, exist, the batteries were generally large and bulky. Various ingenious methods were tried and mooted, among them being unorthodox chassis shapes designed to pack the proverbial quart into the pint pot, frame wound aerials, batteries of smaller physical size but having less working life and even headphone reception! The portable of those days was, generally speaking, of a similar size to the small suitcase. Although the pocket portable superhet eluded the home designer and constructor, many hobbyists did succeed in producing a reasonably small "straight" receiver using the then new 1.5V valves.

With the advent of the transistor, a comparatively recent component to the home constructor, new and vast horizons began to appear, opening up new ways of thought, a fresh outlook of design and setting many of us blazing new trails with this latest acquisition. In support of this, several of the firms specialising in the supply of components to the home constructor, and the industry, developed and designed the necessary miniature components consistent with transistor usage. These small items, coupled with the introduction of ferrite rod aerials, laid wide open the road to the small pocket superhet so sought after by most of us in the past.

The design about to be described—the "Transidyne"—is a six-transistor pocket portable superhet receiver having a class "B" push-pull output stage. It is tunable over the entire Medium waveband and has semi-variable tuning for reception of the 1500 metres Light programme. In addition to all the advantages imparted by the inclusion of small and compact components, the whole assembly is built up around a printed circuit board. This latest method of assembly has, in the opinion of the writer, great advantages for the home constructor as against the more normal method of wiring in a receiver of such small dimensions. Perhaps the greatest of these advantages is that the greater portion of the wiring is already in existence in impeccable and faultless form as received by the purchaser. In turn, this obviates several bugbears common to the more orthodox

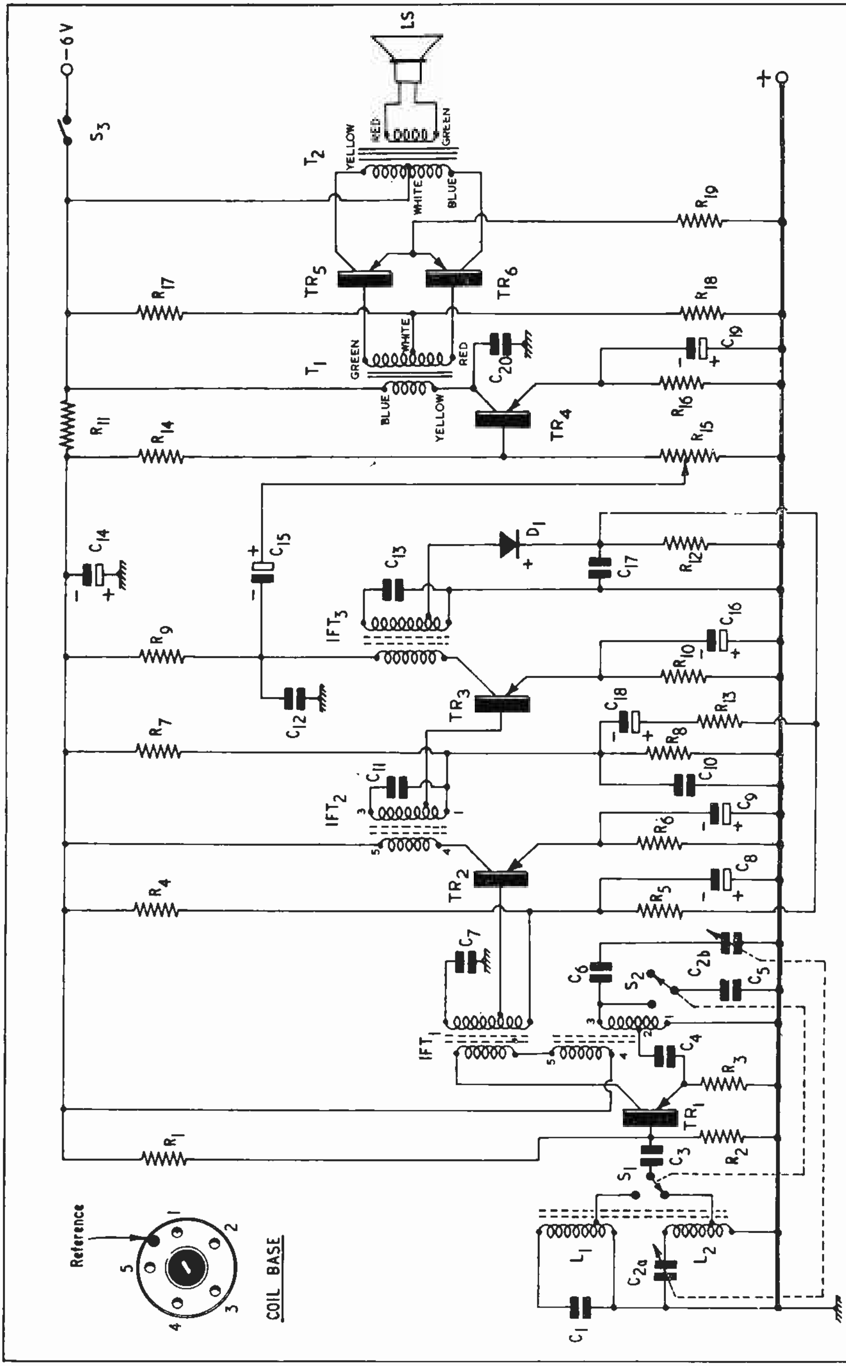


FIG. 1. THE TELETRON "TRANSIDYNE" 6~TRANSISTOR POCKET PORTABLE SUPERHET

presentation in that wiring errors are, as far as possible, eliminated; bad joints, at this stage, non-existent; a bad component layout impossible and long unsightly wires, together with all the associated troubles thereof, entirely absent. In addition to these very obvious advantages, a great saving of time and trouble is imparted to the constructor, it being merely necessary to solder into the printed circuit—hereafter termed the chassis—the required components as specified within the instructions.

Circuit

The circuit of the Transidyne is reproduced in Fig. 1, and a study of this is well worth while before commencing the actual constructional details of the receiver. As previously stated, the receiver is tunable over the entire Medium wave range, this being effected in the input stage by C_{2a} in parallel with the winding L_2. Semi-variable tuning is used on the Light programme channel, the fixed condenser C_1 across the winding L_1 being the r.f. tuning components. Some variation is obtained on this band by switching into circuit C_5 across the oscillator winding. Rotation of C_{2b} slightly varies the oscillator tuning, to enable "dead-on" tuning to be achieved.

The ferrite rod aerial used is the Teletron type FML22. Both the windings L_1 and L_2 are so fitted to the ferrite rod material that they may be moved along it, thus enabling some variation of tuning inductance to be achieved. The switches S_1 and S_2 are ganged and are, in fact, the wavechange control.

The transistor TR_1 functions as the frequency changer. L_3 primary functions as the feedback winding, while the secondary winding operates as the oscillator tuned coil. On the Medium waveband, this secondary is tuned by the gang half-section C_{2b} in series with the padding condenser C_6. The Light programme is pre-tuned by the fixed component C_5 and varied slightly by the C_6–C_{2b} combination. The padding component C_6 assists in ensuring that good tracking is achieved over the frequency coverage.

The collector of TR_1 feeds the selected signal via the 1st i.f.t. primary winding into the i.f. stages, these operating at a frequency

Component List

Set out for easy reference to Fig. 1

Resistors

R_1	47kΩ 1/8W ±10%
R_2	3.3kΩ 1/8W ±10%
R_3	1kΩ 1/8W ±10%
R_4	47kΩ 1/8W ±10%
R_5	4.7kΩ 1/8W ±10%
R_6	1kΩ 1/8W ±10%
R_7	4.7kΩ 1/8W ±10%
R_8	4.7kΩ 1/8W ±10%
R_9	560Ω 1/8W ±10%
R_{10}	1kΩ 1/8W ±10%
R_{11}	220Ω 1/8W ±10%
R_{12}	4.7kΩ 1/8W ±10%
R_{13}	8.2kΩ 1/8W ±10%
R_{14}	22kΩ 1/8W ±10%
R_{15}	5kΩ pot w/switch (S_3)
R_{16}	220Ω 1/8W ±10%
R_{17}	3.3kΩ 1/8W ±5%
R_{18}	120Ω 1/8W ±5%
R_{19}	10Ω 1/8W ±10%

Transistors

TR_1	Red/Yellow spot
TR_2	Red/Yellow spot
TR_3	Red/Yellow spot
TR_4	Green/Yellow spot
TR_5	Green/Yellow spot
TR_6	Green/Yellow spot or equivalents
D_1	GEX34 or equivalent

Inductances

L_1, L_2	Teletron type FML22
L_3	Teletron type FT04
IFT_1	Teletron type FT4E
IFT_2	Teletron type FT4E
IFT_3	Teletron type FT4D

Condensers

C_1	100pF ±10%
$C_{2a/b}$	Variable 2-gang, Jackson type "OO"
C_3	0.01μF, Hunts type W99, 150V wkg
C_4	0.01μF, Hunts type W99 150V wkg
C_5	200pF ±5%
C_6	300pF ±5%
*C_7	500pF ±5%
C_8	25μF, electrolytic
C_9	4μF, electrolytic
C_{10}	0.01μF, Hunts type W99, 150V wkg
*C_{11}	500pF ±5%
C_{12}	0.01μF, Hunts type W99, 150V wkg
*C_{13}	500pF ±5%
C_{14}	25μF electrolytic
C_{15}	4μF electrolytic
C_{16}	25μF, electrolytic
C_{17}	0.05μF, Hunts type W99, 150V wkg
C_{18}	4μF, electrolytic
C_{19}	25μF, electrolytic
C_{20}	0.01μF, Hunts type W99, 150V wkg.

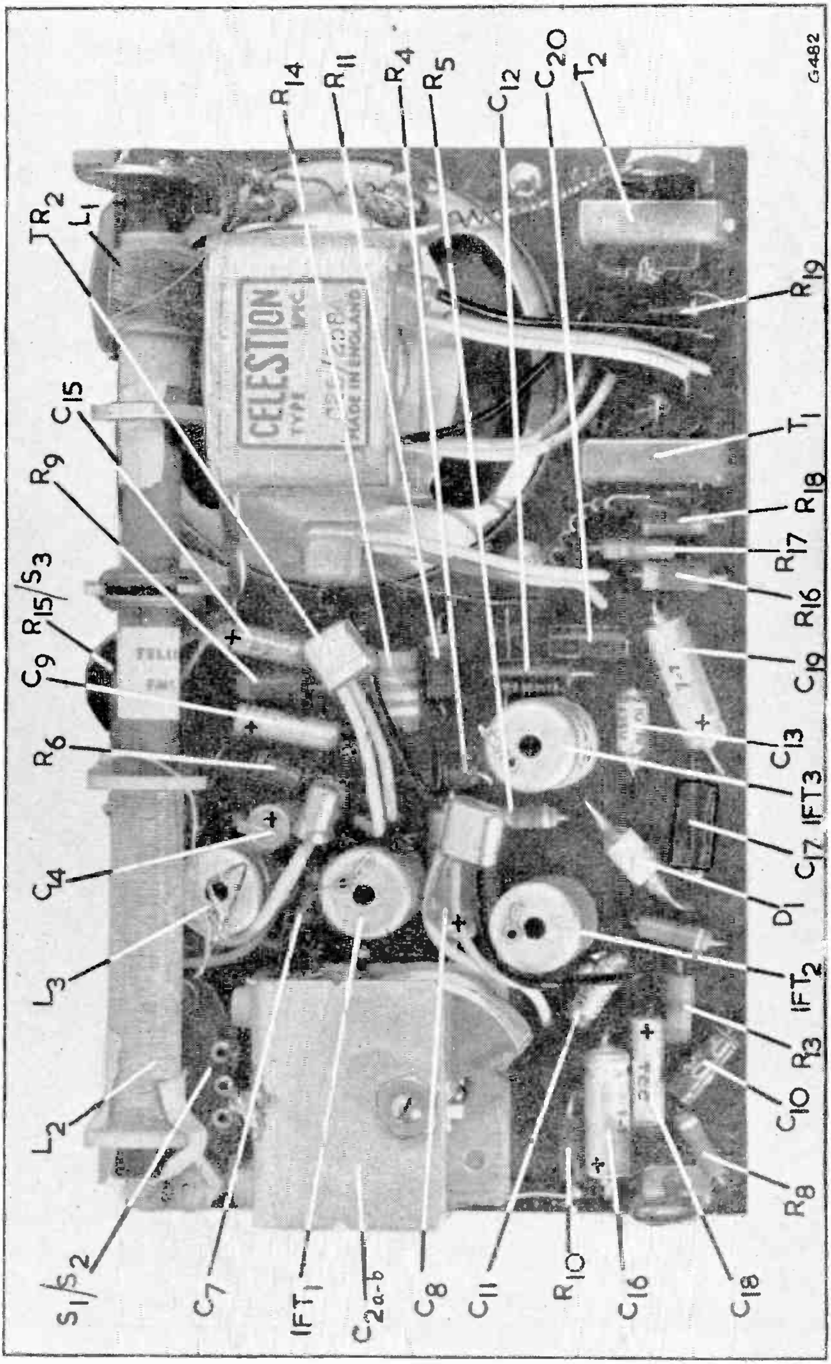
(*Supplied with i.f. transformers)

Transformers

T_1	Ardente type D131
T_2	Ardente type D132

Miscellaneous

Speaker—Celestion C25
S_1/S_2 Wavechange switch
Printed Circuit Panel (Teletron)
Cabinet (Teletron)
Dial (Teletron)
2 No. 8 batteries
Ferrite Rod mounting bracket (Teletron)



Photograph of underside of prototype—compare with Fig. 2 of 470 kc/s. I.F. amplification is provided by both TR_2 and TR_3, each operating in the earthed emitter mode. It will be noted here that each of the three i.f. transformers consists of an aperiodic winding coupled inductively to a tapped, tuned secondary, these having been so designed as to produce optimum performance at the low impedances occurring with transistor applications. The second i.f. stage is reflexed in order to provide some measure of additional audio gain.

The secondary of IFT_3 feeds into the diode detector circuit, the diode rectifying the applied signal and also providing an a.g.c. voltage. This voltage, together with the impressed a.f. signal is fed back into the respective bases of TR_2 and TR_3 via the i.f. secondary windings and associated decoupling components. The reflexed audio component is passed by C_{18} into TR_3, but prevented from reaching TR_2 by C_8.

The amplified a.f. output is taken, via C_{15} to the "first" a.f. amplifier TR_4, being controlled by the potentiometer R_{15}.

The amplified signal from TR_4 is then applied via the phase inverting transformer T_1 to the two class B output transistors TR_5 and TR_6, these in turn driving the loudspeaker via the output transformer T_2.

It will be gathered, from the details already given, that the Transidyne circuit is capable of providing a high degree of both i.f. and a.f. amplification, the degree of additional gain provided by the reflex arrangement allowing adequate audio reproduction with that reserve required for a satisfactory volume level when receiving distant Continental stations on the Medium waveband.

The power requirements of the Transidyne are very modest indeed, a six volt supply being required, which is provided by two 3-volt batteries series connected.

This completes the discussion of the actual circuit and it now remains to describe the assembly of the component parts, wiring of the receiver, and alignment procedure.

Assembling and Wiring the Transidyne

The following operations should be carried out in the order and manner described. The order of both assembly and wiring has been very carefully planned so that even the not-so-far-advanced hobbyist may confidently undertake the construction of this receiver.

Firstly, fit the i.f.t.'s and the oscillator coil. When mounting these, note particularly that the reference mark on the base is intended to show the correct orientation of each component. A pencil mark, made on the side of the metal can, will greatly assist in this operation. The tags on the top of the cans must be earthed to the nearest point marked "E" (Fig. 2). The use of 15A fuse wire is ideal for this purpose, and it may also be used in other positions when insulated with 1mm. sleeving. The use of heavy gauge wire should be avoided as it may damage, by strain, the small components. The reason for fitting these components before any others is that some difficulty may be experienced in view of the fact that the short i.f.t. pin connections have to be first fed through the chassis holes and then soldered into position. Were other components to be mounted into position first, it would make the fitting and soldering of the necessary i.f.t. connections somewhat awkward and difficult to see.

The next items to be assembled are the loudspeaker and ferrite rod brackets. The 2½ inch speaker is first fitted into its position through the chassis with the flange being sited on the printed circuit side. The speaker is securely held into position by means of 6BA countersunk screws and nuts, the latter being fitted on the plain side of the chassis. Reference again to Fig. 2 will show that a solder tag and the ferrite rod mounting bracket are also mounted at the same time as the speaker.

Next, fix in position the variable tuning condenser C_{2a}/C_{2b}, but prior to so doing, ensure that the spindle is only some $\frac{3}{16}$ of an inch in length. On some condensers this will already be the case, but it will be as well for the individual constructor to check this before finally securing the component in position. Only two 4BA x ¼in countersunk screws are used here—the third hole nearest to the wavechange switch is used for retaining the chassis in the cabinet.

We deal next with the volume control R_{15}, securing this in position by an 8BA x ½in countersunk screw and nut. The wavechange switch is next fixed by means of two 8BA x ½in countersunk screws and nuts. Follow this by fitting the two a.f. transformers, these being positioned as shown in Fig. 2 and secured by inserting the lugs through their respective holes in the printed circuit chassis and bending them over so that a secure fixing is obtained. Fig. 2 also shows the correct terminations for the coloured lead-out wires which should be wound, in the manner of a spring, around a short length of 18 gauge wire. Removing the large gauge wire, the ends of these wires can then be cleaned and stretched in order to reach their respective termination points.

With the exception of the ferrite rod aerial and the transistors, the main components have now been fitted in position and we must now proceed to solder in the various resistors and condensers. Before doing so, however, a few words about soldering to a printed circuit board, for the benefit of those who

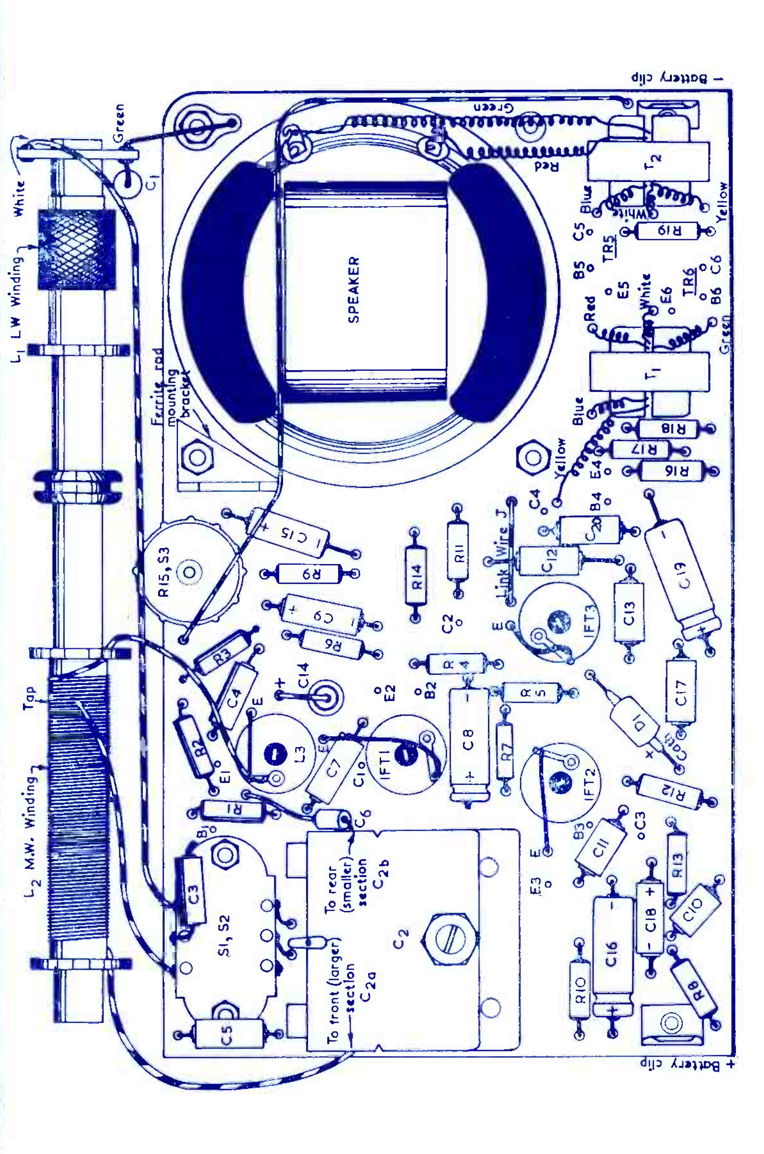


FIG. 2. COMPONENT LAYOUT OF THE TRANSIDYNE

have not undertaken this type of work before, may not come amiss.

When soldering components to the printed circuit board, the lead-out wires should be pushed through their respective holes, the ends cut off to a suitable length, a little *non-corrosive* flux applied and then, preferably with a small 25 watt iron, soldered neatly. Surplus flux may afterwards be removed with a little methylated spirit and a small piece of clean rag. All components must be securely soldered to the printed wiring; large "blobs" of solder formed with a cold or untinned iron just will *not* suffice if the outcome is to be at all successful.

The various resistors and condensers should now be soldered into their respective positions, omitting R_6 at this stage, the value of this component being fully discussed later in this article under the heading "Biasing". Great care should be taken to observe the correct polarity of the electrolytic condensers and, where the metal cans of these are liable to be in contact with other components, they should be insulated with two layers of Sellotape material.

The correct positions of all resistors and condensers are clearly shown in the drawing of Fig. 2 and the accompanying photographic layout also greatly assists with the identification of the various components.

The condenser C_6 is connected between the rear (smaller) section of the tuning condenser and the printed panel. In some cases, a small condenser, not included in the component list, having a value of between 5–10pF may be required to be fitted across C_{2a}.

C_{14} is mounted so that the negative end is towards the chassis, the positive end being insulated with sleeving and soldered where shown in Fig. 2 (to the right of L_3).

Having wired all these components into position, the remaining wiring links should now be soldered into the circuit, these being the two a.f. transformers, variable condensers, and the switch; leaving the transistors and the ferrite rod aerial still to deal with in the following manner.

The transistor lead-out wires should be first insulated with 1mm. sleeving, the wires themselves should *not be cut short*. The various leads should now be fed through the appropriate apertures, as shown in Fig. 2, and soldered to their respective terminations. A pair of pliers should be used here as a heat shunt when soldering these transistor leads into position. The transistors themselves may be positioned in any advantageous manner; but the output transistors TR_5 and TR_6 should not, under any circumstances, touch the metal casing of the speaker as some transistors may have the collector internally connecting to the transistor outer casing.

Having wired the transistors into circuit, we deal next with the ferrite rod aerial. When mounting the aerial, the grommets may be required to be moved along the rod. The Medium wave winding is that positioned nearest to the ganged condenser. The connections of the Light programme winding are as shown in Fig. 2. The connections of the Medium wave winding are as follows: yellow to C_1; white to S_1; and green to earth (6BA solder tag held in position by the speaker fixing nut.)

Biasing

The nominal value for R_6, which was referred to previously, is $1k\Omega$, but due to the somewhat wide variations of gain existing from transistor to transistor, this value may vary between that of 500Ω and $2.2k\Omega$. The best arrangement here would be for the constructor to temporarily connect into circuit a variable resistor of some $10k\Omega$ in value during the alignment process, and to adjust this during alignment to a value which will maintain stability. Once this value has been found, the resistance of the variable component should be measured (disconnected from the set) and a fixed resistor of this value soldered into position.

Battery

To provide power for the receiver, two No. 8 batteries should be inserted into the paxolin tube provided so that the brass cap of one is held into position against the zinc case bottom of the other battery. It is rather important to note here that the brass cap is the *positive* connection and that this must be in contact with the battery clip nearest to the *tuning condenser*. Intending constructors are warned that a reversal of the batteries will destroy the transistors.

In Part 2 of this series, to be published next month, alignment and fault finding procedure will be fully explained.

Can Anyone Help (*continued from page 109*)

J. PATTERSON, 29 Leadale Road, Leyland, Lancs, requires information on the Test Set 43, in particular what it was specifically designed for, its sensitivity, and the timebase speeds.

* * *

F. CORDING, 1 Stirling Buildings, Tavistock Street, London, W.C.2, wonders if any reader has any information or a manual, to lend or to sell, on the Synchroscope type P4E, serial 306.

J. F. PORTER, 448 Rochdale Road, Royton, Lancs, wishes to obtain the circuit and any other data concerning the 58 Mk. 1 Transmitter/Receiver, and is willing to purchase or pay for the loan of this.

* * *

B. M. HALSTEAD, "Clovelly," Stubbing Drive, Hebden Bridge, Yorks, appeals for help in obtaining a service sheet or data (sale or hire) of the Pye Radio model 946 Console (1939).

MODELS FOR RADIO CONTROL

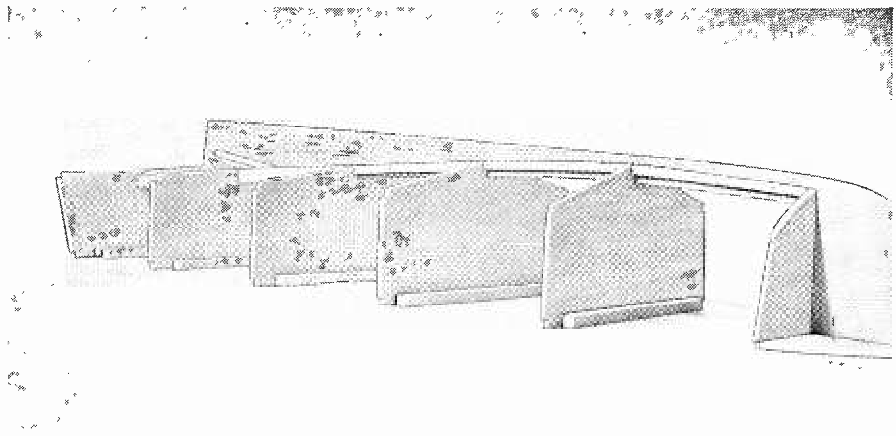
THE "WAVEMASTER" KIT

Part 2

by Raymond F. Stock

THE "WAVEMASTER" COMES PACKED IN A strong cardboard box, which is 36in long to accommodate the main longitudinal members of the hull.

A clearly printed sheet of drawings is included in the kit and gives a full-size plan of the model, a full-size side elevation and a number of diagrammatic, exploded and cutaway views of detail to augment the instructions. The latter are printed in a separate 6-page leaflet which also carries a parts list.



Early stage in assembling bulkheads and keel

Most readers will have had some contact with kits of model aircraft, and the "Wavemaster" might be considered to be a marine equivalent of this type of product. Unlike most aircraft kits, however, all the parts of the hull are prefabricated so that building the model is a matter of assembly rather than true construction. In general, this also applies to the cabin structure—though one or two parts here need a little carving to shape; no difficulty should, however, be anticipated on this score.

Like most similar products, the "Wavemaster" is a "dry" kit, i.e. it does not include glue or paint. This is quite reasonable since it avoids any possibility of deterioration during storage, and it gives the builder the choice of materials. It is suggested that the instructions could usefully include some recommendations regarding the adhesive and perhaps some further notes on painting and finishing.

Modifications

Before commencing construction it is worth considering whether modifications to the basic design might be included to permit greater versatility. The manufacturers of kits provide materials and a design which can be made up exactly as detailed into a very satisfactory model; but individual requirements vary so widely that builders invariably graft their own ideas on to the basic model.

being about ¾in. By cutting the frames in this way, chassis and other items of equipment need not be confined between bulkheads. Alternatively, as shown in Fig. 2 (right) the top part of the frame, acting as a deck beam, can be completely removed, in which case the verticals should be increased

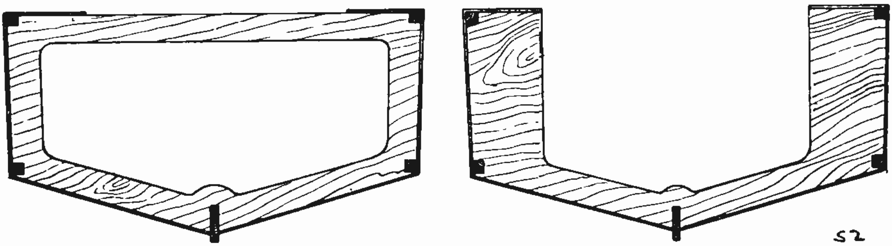
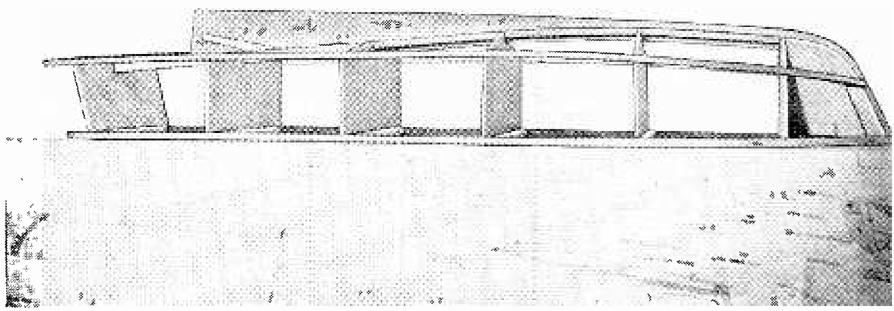


Fig. 2. Cutting away bulkheads to make open frames

As supplied, the hull is divided into six compartments by transverse bulkheads. This produces an enormously strong hull if properly made and is virtually indestructible.

in width—to the same width, in fact, as the deck at that point. This gives unobstructed access to the interior of the hull over a rectangle measuring about 25in by 6in. The



Stringers in position

It would be entirely reasonable to cut away the centre portions of the bulkheads so that they become open frames. Provided the wood is cut cleanly, and well radiused at the corners, the resulting structure would still have a wide margin of strength.

Fig. 2 shows (on the left) a typical frame shape, the average width of the plywood

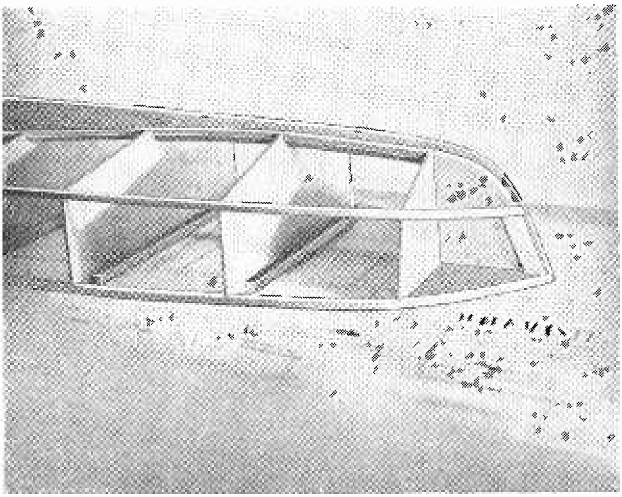
strength of the hull would still be more than adequate.

A careful consideration of these points should be given, as it is extremely difficult to modify the hull in this way after building. When such work is decided upon, it should be carried out straight away, with the aid of a fretsaw and wood-cutting blades having not fewer than 16 or so teeth to the inch, after which building can still be carried out exactly as detailed in the instructions.

Bulkheads should not, of course, be cut away needlessly, and there are at least two further reasons why complete transverse members may be a useful feature. When an internal combustion engine is fitted the builder is well advised to box it in so that the fuel is unable to attack the radio gear, and the most convenient method of doing so is to make one section of the boat, between bulkheads, a separate engine room, as indeed is indicated on the plans. Builders having no previous experience of miniature compression ignition and petrol engines will find that they are inclined to be "messy," though this vice can be cured by the appropriate treatment. Largely, this requires attention when filling the fuel tank to avoid spilling the liquid into the bilges, and needs a proper exhaust system to convey the unburnt fuel (always present) well outside the boat. Generally speaking, the engines encountered will be basically aircraft motors. Some of these can be purchased in marine versions which have a water cooling jacket and exhaust stub pipes which must be continued outside the hull by suitable extensions. The details must obviously be left to the ingenuity of the builder, but the aim must be to avoid joints which can leak oil into the hull. Such pipes can most easily be led straight out through the sides of the hull with a slight fall away from the engine, though a long exhaust pipe to the transom may be more typical of the class of hull.

These points must obviously be taken into account before starting work on the hull so that the appropriate holes may be cut into the bulkheads. Similarly, it is necessary to consider interconnection of control gear, some of which will almost certainly be sited both fore and aft of the engine. Small holes are provided in the bulkheads which may be opened out to take wires. It is a wise plan, however, to pass a ½in diam. aluminium or paxolin tube through the engine room from bulkhead to bulkhead, thus providing a protected conduit for future use.

It will be seen that it is advisable to purchase the engine before starting the construction, and this will also permit details of the mounting to be decided, and any special structure to be more easily fitted, at an early stage.



The completed structure ready for attachment of the side skins

PLEASE NOTE: **We cannot undertake to answer queries over the telephone.**

See also Notice re queries on page **93**

ERRATA: The following errors occurred in the Components List on pages 40, 41, last issue, of the Jupiter Stereo Amplifier: R_{15} should read 220Ω ¼W, EL34's should be EL84's, and ECC81's should be ECC83's.

A CORNER REFLECTOR AERIAL

Details of an efficient t.v. aerial specifically designed for Channel 10. Details are given which will enable a similar aerial to be constructed for any other channel

By **J. C. Belcher,** G3FCS

THE WRITER'S HOUSE IS SITUATED IN A valley which runs in a direction at right-angles to the line of sight of the local television transmitting stations. A diagram showing the geography of the site is shown in Fig. 1. Now being in a zone of high field-strength, television reception is naturally marred by a large number of reflections or "ghosts." To complicate matters still further, as shown, about fifty feet from the foot of the house the ground rises fairly steeply to a height of about 100 feet, and, being in the "shadow" of this high ground, the strength of the direct ray from each transmitter is severely attenuated. The problem presented is, therefore, one of extremes. A maximum of interference, and a minimum of signal from the transmitter.

The problem on Band I had previously been successfully overcome by providing a horizontal slot aerial with a mesh reflector in the under-drawing of the house, i.e. in the

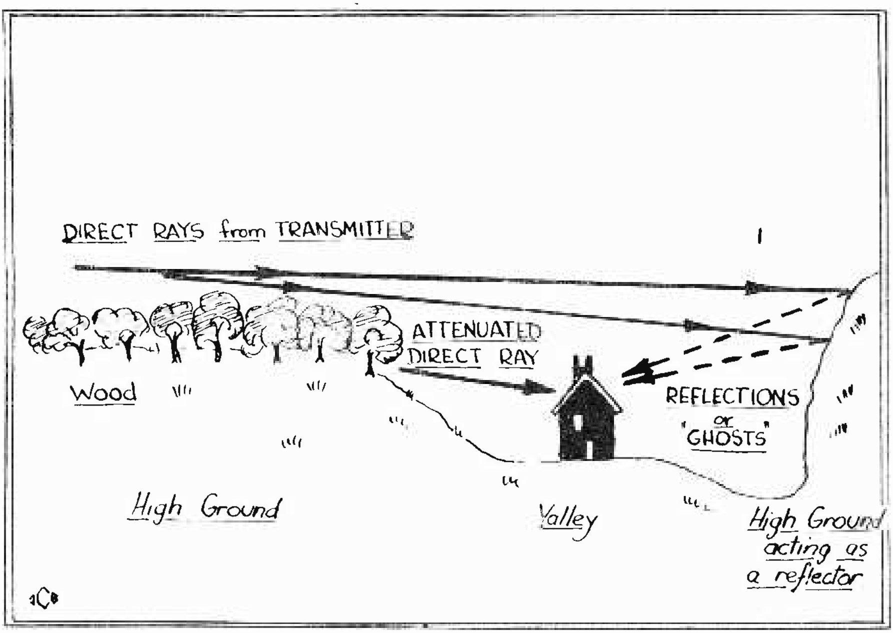
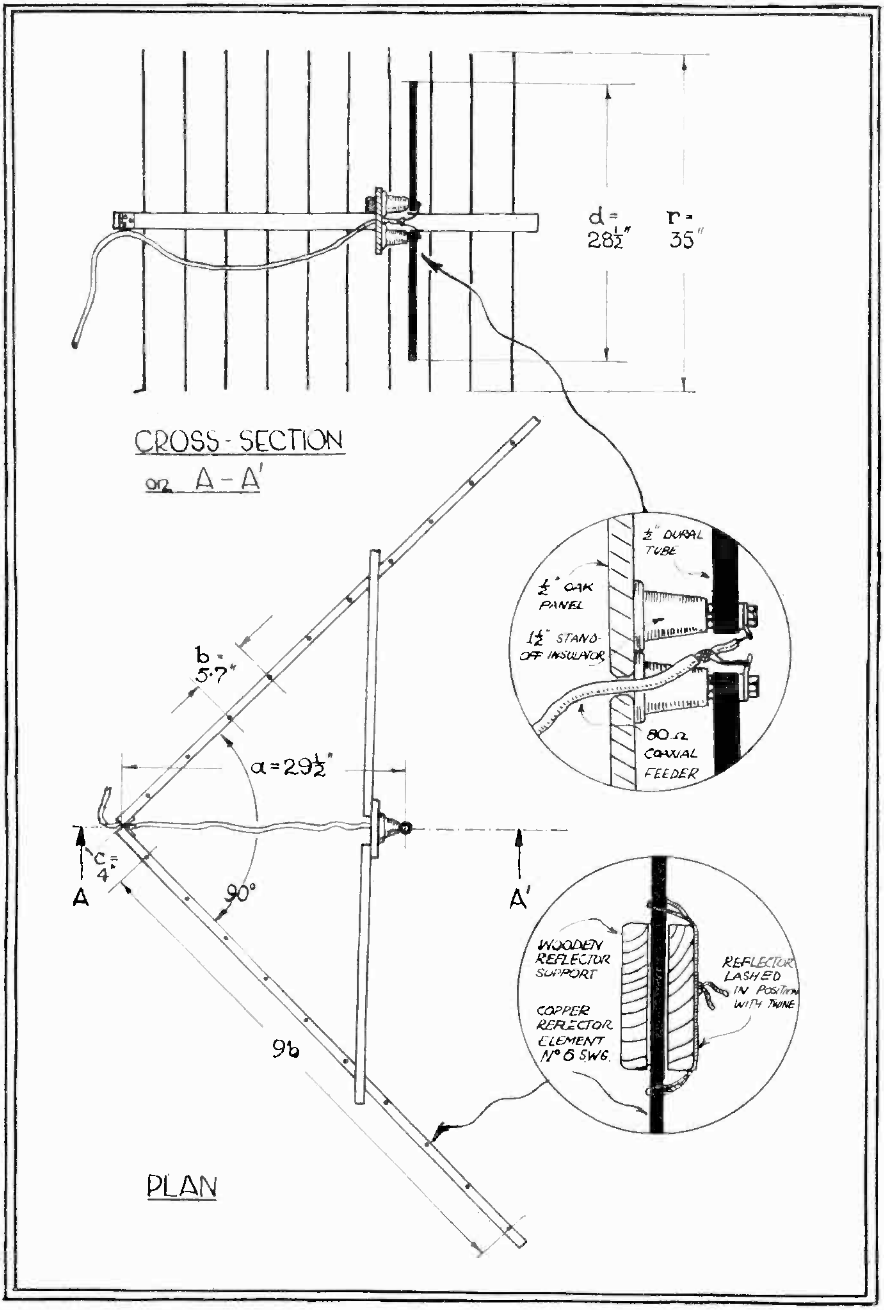


Fig. 1. Diagram showing production of "ghosts" and weak signal at the site in question



Note that the dimensions given in the above diagram refer to Channel 10. *For other Channels see Table* 1 roof-space. The resulting array of chicken-wire and bamboo may not have been particularly pleasing in the aesthetic sense. Nevertheless, its performance considerably out-pointed that of commercial multi-element external beams in the immediate neighbourhood.

When conversion to Band III became imminent, it was only natural, therefore, to consider the provision of a slot aerial with an added refinement in the shape of a completely enclosed hemispherical reflector. Although this proposal had considerable technical appeal, in practice, however, it was rejected on the subsequent grounds of lack of both time and small-mesh chicken wire.

The family was to blame. For once it was unanimous in presenting its ultimatum: "Channel 10 by tomorrow—or else." So the problem had to be considered anew. High gain together with a high front-to-back ratio was the specification, and the contract was to be completed within twenty-four hours.

The immediate solution which presented itself was a parabolic beam. The construction of a parabolic curve, however, involves certain difficulties which might not be easily overcome during the permitted time given. In addition, it was felt that the location of the dipole at the focus of the parabola might prove rather tricky, to say the least of it.

And so the idea of the corner reflector was born. The idea of using it, that is. Half-an-hour's figuring with pencil and paper produced a 21-element array with a theoretical performance which seemed to fill the requirements. A forward gain of about 10dB, and a front-to-back ratio of about 35dB. From the constructional point of view, the right-angled reflector is not at all complicated, and the only stipulation regarding the position of the dipole is that it must lie on a line bisecting the corner angle.

The next problem was that of raw materials. Armed with a torch, and protected by gum-boots, a survey of the garden shed brought to light the following collection of loot—or junk, if you have a critical mind. One of those striped canvas garden shelter affairs yielded two lengths of wood, each 6ft x 1½in x ¾in. These were filched for the purpose of supporting the reflector elements, and normally wouldn't be missed by the family until the fine weather came. In any case they were due for replacement sooner or later. A third piece of wood of similar size would have been useful for supporting the dipole, but to wreck the shelter entirely was not considered to be good policy. Vandalism could be tolerated under the circumstances, but not sheer cannibalisation—especially when it involved a reconstruction job later on in the year! However, that problem was solved when an old clothes horse fell to

TABLE I

Dimension	Length (inches)
Overall length of dipole (d) ..	5480/f
Overall length of reflector (r) ..	6750/f
Distance of dipole from apex (a)..	5650/f
Spacing between reflector elements (b)..	1095/f
Spacing between apex and first element (c)	767/f

pieces in the writer's hands! A search in the wood pile disclosed an oak panel, 6in x 6in x ⅛in, quite suitable for mounting the dipole after very little modification. The next thing was the metalwork. One brass hinge, complete with six brass screws, seemed the very thing to fasten the two reflector supports together. Why brass? Well, iron or steel-work never does seem quite appropriate in an r.f. field. A pensioned-off Channel 2 H-array provided some lengths of ½in dia. dural tube; and, most useful of all—hung on a hook in the corner of the shed was a sizeable coil of hefty copper wire, about No. 6 s w.g. Finally, a couple of ancient Raymart stand-off insulators—1½in size—were brought to light, together with some 4BA screws, washers, nuts, and soldering tags. Returning to the dining room via the kitchen, a reel of twine was successfully liberated from the household stores. Then, with the family safely out of the way in the living room in the company of Channel 2, the manufacturing process commenced with just twenty-three hours to go to zero hour.

The two 6ft lengths of wood were sawn off to a length of 60in and, commencing at 4in from one end, ⅛in dia. holes were drilled through the longer dimension of each piece at 5.7in intervals, a total of 10 holes being provided in each support. These were to take the reflector elements. The brass hinge was then used to join the two lengths together, and also allow the array to be folded up flat for carrying it through the trap door and up into the under-drawing. Another torch-and-gumboot expedition was made into the garden, where one end of the coil of wire was secured to a concrete gate-post. The coil was then unrolled to the far end of the garden, and fourteen stone of bone, muscle and blubber engaged in a tug-of-war with the gate-post. The verdict was given in favour of the B M and B as the wire gave a reluctant stretch of about eight inches and finished up free from kinks and wrinkles. Returning once more to the living room—via the french windows this time—a fifteen minutes stint with a pair of side-cutters resulted in the production of twenty reflector elements, each 35in in length. With the aid of two chairs and the dining table as a support, the elements were threaded through the holes in the wooden supports, and lashed in position with liberated twine. So far, so good!

The two stand-off insulators were mounted next as close together as possible in the centre of the oak panel, and a ¼in dia. hole was drilled through the panel to take the coaxial feeder. A couple of lengths of dural tube —each about 15in long—were then drilled 4BA clearance at one end, and fixed to the insulators with the screws, washers and nuts —soldering tags being provided for the coax termination. As a final adjustment, the extremities of the dipole were trimmed off with hacksaw and file until the overall length of the dipole was 28½in. The two pieces of clothes-horse were then screwed to the oak panel in such a way that the centre of the dipole would lie in the same plane as the centre of the reflector elements when the assembly was finally fitted together. Next, the dipole support was laid across the reflector supports, the former providing the hypotenuse of the right-angled triangle thus described. The distance between the dipole and the vertex of the reflector was then adjusted to 29½in and the supports permanently lashed together with twine. A length of available—but, of course, very lossy —Channel 2 coax was finally soldered to the dipole terminations, passed through the hole in the oak panel, and lashed to the apex of the reflector support.

A plug fitted, the t.v. set connected up, and with the corner antenna firing through the french windows, the writer settled back to sample his first taste of commercial telly —home-brewed! While it must be mentioned that the family's first reactions at the sight of the creation were not exactly complimentary, it is now pleasant to report that discipline is once more maintained and relations are on a more respectful footing!

The following day, the whole contraption was taken up into the under-drawing and suspended from the rafters with a length of twine at each corner of the reflector. With the installation of a diplexer unit the job was finished, the whole project taking only a total of four hours from picking up paper and pencil to closing down the trap-door. In spite of the losses over about 30ft of Band I coax, the signal was more than adequate—with plenty of contrast to spare, and absolute freedom from "ghosts."

The design of the array, together with constructional details, is shown in Fig. 2, the diagrams being more or less self-explanatory. Should the reader wish to design a similar aerial for a different channel—even on a different band—design formulae is scheduled in Table I, *f* being the mean channel frequency in Mc/s, and the lineal dimensions being in inches.

AUDIO

LOUDSPEAKER CROSS-OVER NETWORKS

By **C. M. PEARSON**, B.Sc.

It is almost impossible to design and manufacture a moving coil loudspeaker which will satisfactorily reproduce the range of frequencies required for high fidelity sound systems. For this reason, it is better to divide the audio frequency spectrum into two or more bands and to use a separate, optimally designed loudspeaker for each band. This division is usually accomplished by a loudspeaker cross-over network.

Consider, first of all, a two-speaker system comprising a bass and a treble unit. Suppose the bass unit is designed to operate from low frequencies with a level response up to, say, 10 kc/s, and the treble unit from 2.5 kc/s upwards. In order to drive these loudspeakers satisfactorily, we require a filter for each loudspeaker. The filter for the bass unit is required to pass all frequencies from zero to 5 kc/s and the filter for the treble unit is required to pass frequencies from 5 kc/s upwards, with a flat response and low attenuation in the pass region in each case. The cross-over frequency is chosen in this instance as 5 kc/s, since the change from pass to stop is not very sudden, and this frequency prevents overloading either speaker around the cross-over region.

These two filters are known as "low pass" and "high pass" filters, for obvious reasons. If the two loudspeakers have the same voice coil impedance, the design of these filters is quite a simple matter, the usual type being a single-section constant-k type as illustrated in Fig. 1. The values of L and C may be calculated from the formulae:—

$$L=\frac{Zo}{\sqrt{2}\,\pi\,fc} \qquad C=\frac{1}{2\sqrt{2}\,\pi\,fc\,Zo}$$

where Zo is the speech coil impedance and fc is the cross-over frequency. Thus, for an impedance of 15Ω and a cross-over frequency of 5 kc/s, $L_1 \simeq 675\mu H$, $C_1 \simeq 1.5\mu F$.

In use, the inputs of the two filters would be connected in parallel to the 15Ω amplifier output connections as shown in Fig. 2.

converting the 3Ω bass speaker impedance to 15Ω should be tapped at 4/9 of the winding (i.e. $\sqrt{3/15}$). The actual number of turns required will depend on the power level, the lowest frequency to be handled and the core size of the transformer.

Consider now a three loudspeaker system, consisting of a bass speaker, a mid-range speaker and a treble speaker. Suppose that the cross-over frequency for the mid-range speaker is 750 c/s and for the treble speaker 5 kc/s as before. We now use what is in effect two cross-over networks, one designed for 750 c/s and one for 5 kc/s, as shown diagrammatically in Fig. 4 and in circuit form in Fig. 5. L_1 and C_1 are the components of the 5 kc/s cross-over network, with the same values as before, i.e.

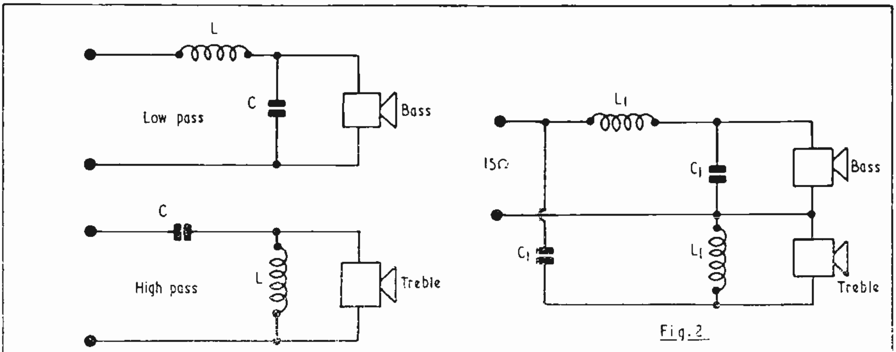


Fig. 1

Fig. 2

Fig. 3

If the two loudspeakers have different speech coil impedances, a matching transformer will have to be used to make them alike. An autotransformer should be used and is best applied to the bass speaker. Referring to Fig. 3, if Zin is the input impedance, Zout is the output impedance, N is the total number of turns and Nt the number of turns to the tap, then

$$\frac{Nt}{N}=\sqrt{\frac{Zout}{Zin}}$$

In a system using a 3Ω bass speaker and a 15Ω treble speaker the autotransformer

$L_1=675\mu H$, $C_1=1.5\mu F$, and L_2 and C_2 are the components of the 750 c/s cross-over network and are $L_2 \simeq 4.5mH$, $C_2 \simeq 10\mu F$.

It will probably be necessary to incorporate an attenuator in the treble and mid-range loudspeaker circuits in order to balance the overall response of the system to individual taste, since the efficiency of the mid-range and treble speakers will be rather higher than that of the bass speaker. A very simple attenuator is quite satisfactory, and a circuit and values for 15Ω speakers are given in Fig. 6.

The components used in cross-over networks are fairly critical. The capacitors, for instance, must be of the paper or mica variety, electrolytics being quite useless since there is no d.c. polarising voltage in the circuit. The inductances must be air cored or wound on a core of thin transformer laminations, stacked one way with a large air gap.

Cross-over chokes should not be mounted near metal since, being air-cored, the inductance value will be affected.

speakers may be obtained complete from Goodmans Industries Ltd., Axiom Works, Wembley, Middlesex, or through stockists of their products.

Goodmans also sell a 15Ω attenuator switched from 0–12dB in 2dB steps, and 4.5mH chokes suitable for home construction of the 750 c/s cross-over network.

Osmor Radio Products can supply both chokes; the 675μH one is their type QCO1, and 4.5mH is type QCO2.

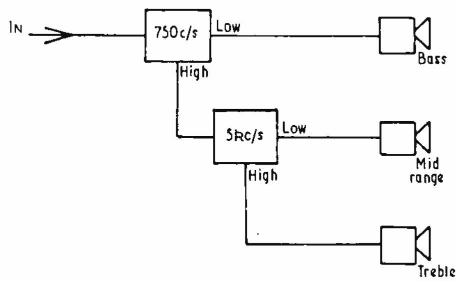


Fig.4

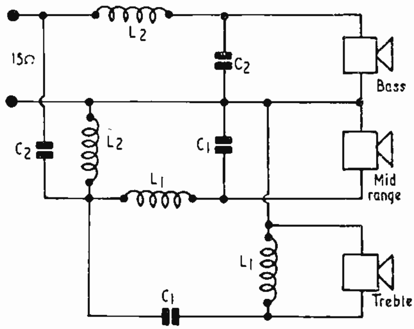
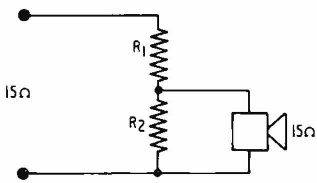


Fig.5



Attenuation	R1	R2
2dB	2·7Ω	56Ω
4dB	5·6Ω	25Ω
6dB	7·5Ω	15Ω
8dB	9·1Ω	10Ω
10dB	10Ω	6·8Ω
12dB	11Ω	5Ω
14dB	12Ω	3·9Ω

Fig.6

E584

The actual cross-over frequencies chosen depend on the loudspeaker design, and for any particular type of loudspeaker the manufacturers should be consulted. The examples worked out in this article are (1) for the twin loudspeaker system, Goodman's "Axiom 300" and "Trebax"; (2) for the triple loudspeaker system, Goodman's "Audiom 70", "Midax 400" and "Trebax." The cross-over network described for these

When connecting up in their cabinet, the phasing of the loudspeakers should be checked. This can be done by connecting a single cell battery in series with the output transformer secondary. There will be a "plop" and the cones of the speakers will move; check that they all move in the same direction. With 3Ω speakers it is wise to put a 10Ω resistor in series with the battery to limit the current.

continued from facing page

other fixture is the socket for the earth and positive leads. This socket has one large and one small diameter contact, and two-pin plug to suit, in order to prevent accidental reversal. All other components are floating.

The neon itself may be of nearly any type, and if unmarked it may be assumed to be an ex-W.D. type which will strike at around 90V.

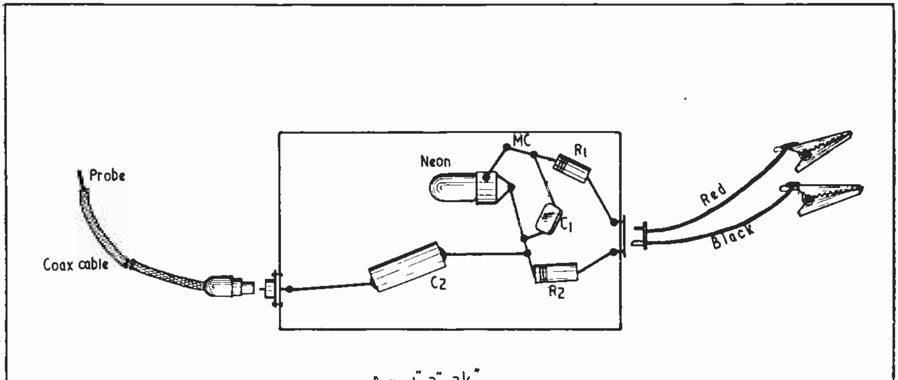
If a variable tone is required, C_1 or R_1 may be variable components.

A Multi-Purpose Neon Tester

by M. J. ROGERS

THE INSTRUMENT TO BE DESCRIBED IS compact, economical and versatile. It may be used for signal tracing, as a morse oscillator, and mains tester; it takes very little h.t. indeed; and it may be constructed in an old pen case.

The circuit is a conventional neon relaxation oscillator, where the voltage across the neon builds up as C_1 is charged. At just over 90V the neon strikes and discharges the condenser. This cycle of operation is repeated.

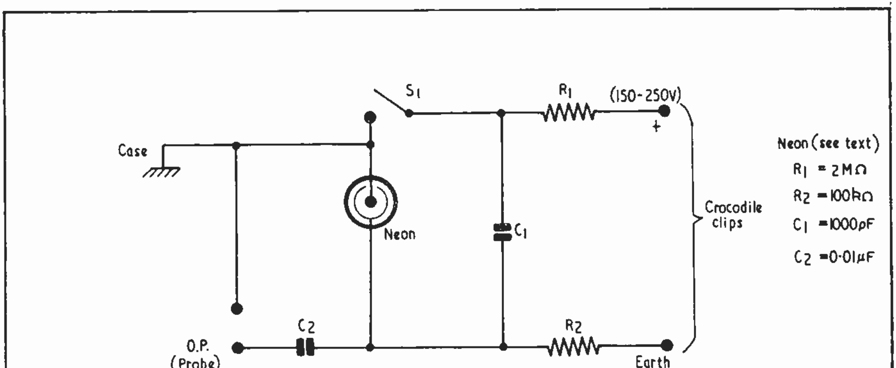


Box – 1" x 2" x 2½"

The output is taken from between C_2 and case ("chassis"). When required to be used as a mains polarity tester, the switch S_1 is opened, the case held in the hand, and the probe used to test with. In this instance the positive and earth leads are unused, and should preferably be disconnected.

The construction will obviously vary from one constructor to another, and while the more experienced can easily build the instrument in a split pen case, it will be described as fitted in a box. A very useful type of case for this purpose is the small 2oz rectangular variety of tobacco tin.

The neon will be fitted in a holder with one side earthed to the case—to this one side of the coax socket is connected. The only



A multi-purpose neon tester

continued at foot of page 134

A NEW
DETECTOR AND AUDIO AMPLIFIER

This article describes a new detector and audio amplifier of excellent quality. No claim for hi-fi reproduction is made, though the author has heard hi-fi systems which, to his ears, sounded worse.

By **K. E. MARCUS**

THIS NEW ARRANGEMENT OWES ITS development directly to the deplorable habit of the lady of the house, who likes to tune from one of her favourite stations to the next one with great rapidity, putting the tuning "somewhere" and turning up the volume control to compensate for the loss of sensitivity by her mistuning, and as the author cannot believe that Mrs. M. is the only offender in this respect, he settled down to design a receiver with the following qualities:

(1) Pretuned to the three or four favourites on the medium wave band.
(2) No volume control.
(3) But roughly equal audio-output on all three or four channels.
(4) Good quality of reproduction.

The first requirement was easily met by using a rotary switch which switches on and brings into circuit pre-set trimmers, which tune a normal medium wave coil to the favourites. A rotary switch was used as there were three circuits to be handled (r.f. grid, mixer grid, oscillator). However, push-buttons or "piano-keys," now so extensively used in Continental sets, will do just the same if one button moves three contacts and the difficulties of screening between them can be solved.

The other three requirements led to the system to be described here.

Fig. 1 shows the schematic circuit. Six things will be noted at once by the studious reader:

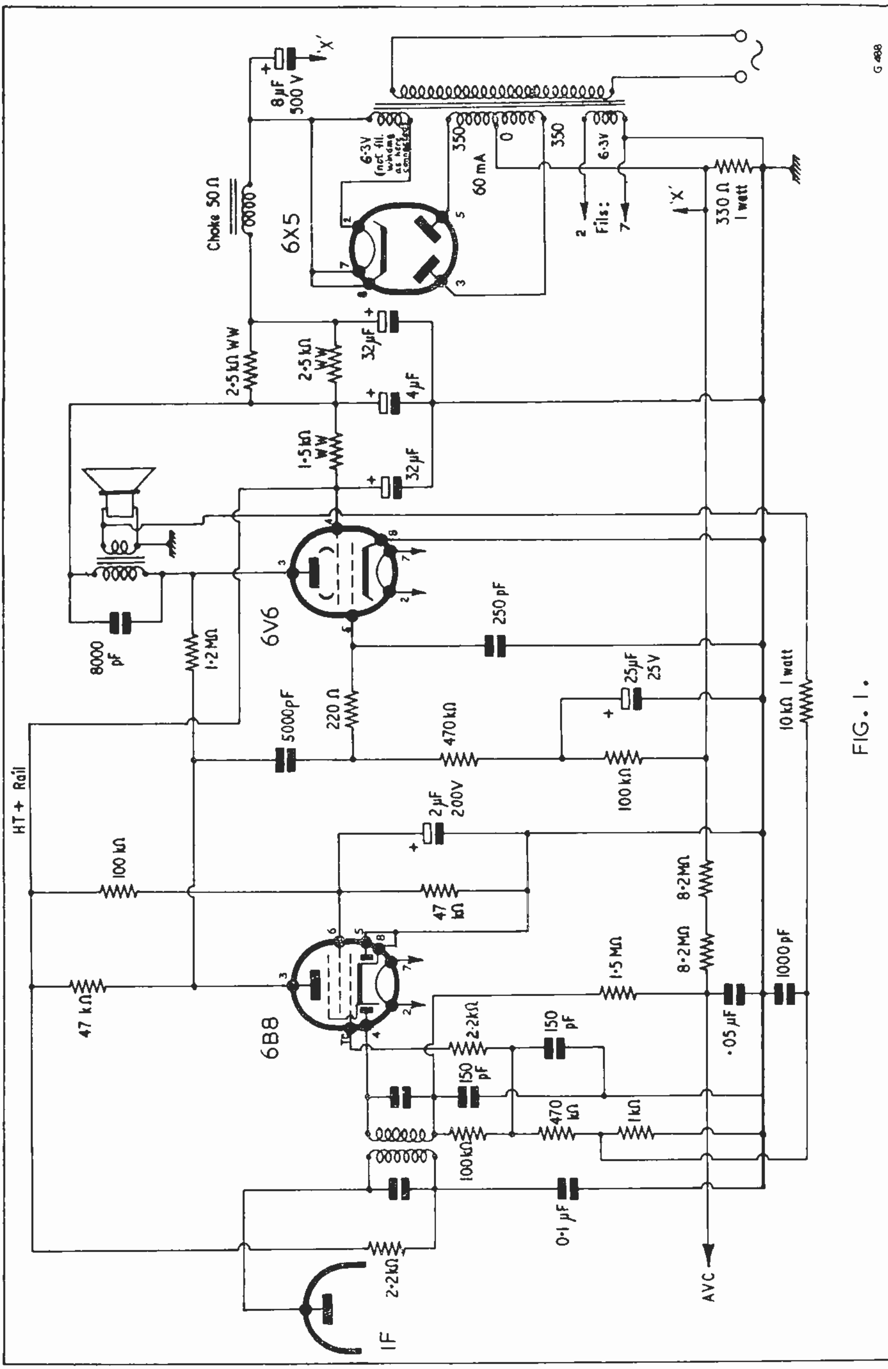
(*a*) There is direct coupling from the detector load to the audio pre-amplifier,
(*b*) There is no volume control.
(*c*) Both valves have their cathodes tied to chassis; in fact, all the other three valves of the experimental station (r.f. amplifier, mixer and i.f. amplifier) have earthed cathodes as well.
(*d*) One negative supply point is arranged in the power pack, from which all grids are supplied with their negative bias and with a.v.c.
(*e*) There are two negative feedback loops.
(*f*) There is extensive smoothing applied everywhere.

Let us take these points in order. In a conventional receiver the detector stage looks something like Fig. 2.

This rather cumbersome arrangement is too well known to merit a new description. Here are only a few details which may have escaped the casual observer: Rc biases the audio amplifier triode and delays the a.v.c. production, while the demodulator load is returned to cathode so as not to delay the associated diode as well. The gain of the amplifier triode is usually around the 20 mark, so that with about 3V i.f. on the detector diode we can reckon with about 50V a.f. on the triode anode with the volume control full on.

Now compare this with the diode-pentode arrangement in Fig. 1. The grid of the pentode section is joined directly, via an h.f. filter, to the demodulator load. Therefore the pentode is a.v.c.-ed. The gain of the pentode would, without a.v.c., be about 60 times; therefore we would expect, again with 3V i.f. on the diode, about 150V a.f. on the anode. This, of course, will never occur because of the a.v.c. action and because of the negative feedback from the loudspeaker-speech coil into the bottom resistor (1kΩ) in the diode load. But it will now be clear why a volume control is unnecessary: with the amount of feedback required to "tame" the circuit, a "control" just does no controlling any more, and we are getting improved quality into the bargain.

The whole bias system of the new arrange-



Choke 50 Ω
8 µF 500 V
'X'
6·3V (not fil. winding as here connected)
350
0
350
6·3V
60 mA
6X5
Fils: 2 7
330 Ω 1 watt
G 498
2·5 kΩ WW
2·5 kΩ WW
32µF
4µF
1·5 kΩ WW
32µF
6V6
8000 pF
1·2 MΩ
250 pF
25µF 25V
220 Ω
5000pF
470 kΩ
100 kΩ
10 kΩ 1 watt
HT + Rail
100 kΩ
2 µF 200V
47 kΩ
47 kΩ
6B8
1·5 MΩ
8·2 MΩ
8·2 MΩ
2·2 kΩ
150 pF
150 pF
·05 µF
1000 pF
470 kΩ
1 kΩ
100 kΩ
0·1 µF
2·2 kΩ
AVC
IF

FIG. 1.

ment needs now to be explained. For this refer to Fig. 3.

As can be seen, this is simply another way of drawing the relevant parts of Fig. 1, but it shows quite clearly how the different bias voltages are obtained.

Between the negative supply point (—18V) and chassis there is round about 18.5MΩ resistance, therefore just under 1mA will flow through this chain. In consequence there will be about —2V d.c. on the a.v.c. line, which is the usual no-signal bias of the previous stages. A bias of about —0.5V is applied to the detector diode, muting it nicely, while a little less (about —0.45V) is applied to the grid of the pentode section. amount of r.f. would be amplified in the pentode section and produce havoc in the output stage. And the screen grid voltage of the pentode section has to be stabilised by a bleeder resistance (47kΩ), as otherwise audio distortion would occur.

The coupling between the audio stages is quite conventional. Again the cathode of the output stage is earthed, and the negative supply is fed into the grid after smoothing through the 100kΩ/25μF filter. For safety's sake there is another r.f. filter 220Ω/250pF in the grid. Finally, there is a voltage feedback resistor (1.2MΩ) between the anodes of the pre-amplifier and the output stage.

The anode of the output stage is fed

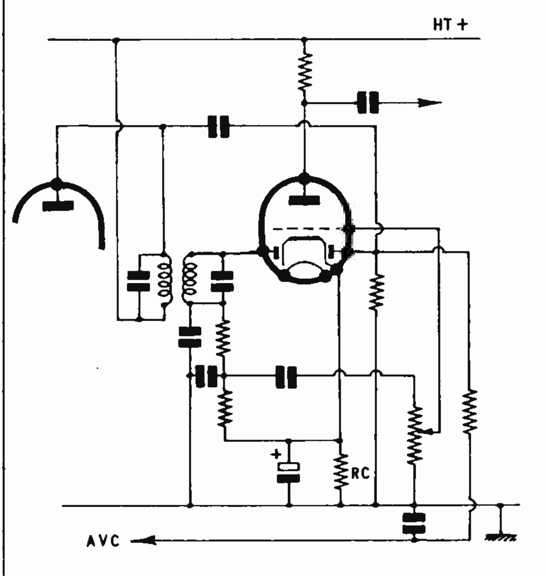


FIG. 2.

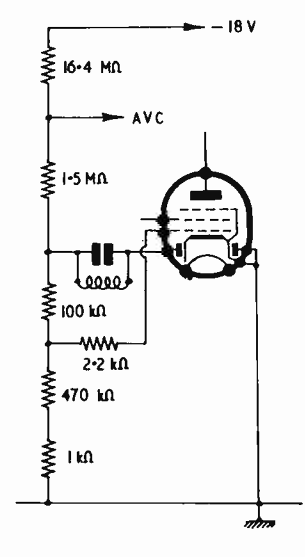


FIG. 3.

G489

Now, with signals arriving the diode starts producing, across its load proper (100kΩ+470kΩ+1kΩ), a.v.c. which increases the negative supply to the previous stages in the usual manner, the 1.5MΩ acting as the audio filter resistor; and because of the high resistance (16.4MΩ) between a.v.c. line and negative supply point, no a.v.c. can leak away across it. The pentode section does, fortunately, not get the full a.v.c. but only, say, 5/6 of it.

Two further things in this stage need a short explanation: the 2,200Ω resistor in the grid is an i.f. stopper; without it a minute through the output transformer from a higher voltage point (+320V) of the power supply than the screen grid (+270V). On the secondary side of the output transformer one side of the speech coil is earthed, whilst the other connects via a 10kΩ resistor to the bottom resistor (1kΩ) in the diode load. Experiment will show to which side of the speech coil this feedback loop has to be connected: the wrong side produces positive feedback and a mighty howl.

As stated at the beginning, the new detector-amplifier produces excellent quality. To achieve this only a minimum of hum can be tolerated, and extensive smoothing and short connections are required.

In the experimental set (r.f. amplifier + mixer + i.f. amplifier + detector − amplifier + output) the whole h.t. consumption is 55mA, therefore a resistor of 330Ω in the negative h.t. line produces the required −18V bias. The valves used, as they were just available, are: for the detector-amplifier, 7R7 (6B8); for the output-stage, 7C5 (6V6); for the rectifier, 7Y4 (6X5); but the valves in brackets can be substituted as they are equivalent in performance.

The lining up of the i.f. did not set up any problems. The r.f. alignment, however, produced a surprise: up to a quarter of a turn off-tune on the pre-set trimmers the set was so uncannily quiet that the author feared he would not hit the signal with the capacities provided. But then they romped in!

TEST EQUIPMENT

A STABILISED AUDIO OSCILLATOR

by G. K. FAIRFIELD

The essential equipment for carrying out any serious audio-frequency work consists of a low-frequency oscillator, covering the range from 20 kc/s down to at least 25 c/s, and some means of accurately measuring the amplitude of the signal output from the piece of equipment undergoing test.

The set-up when making measurements (frequency response characteristics, input/output curves, etc.) will be as shown in Fig. 1. Although the meter can be switched to measure the input to the tested equipment at any given frequency setting, it is more convenient if the oscillator is arranged to give a constant amplitude of output, independent of frequency, and the meter switched permanently to the output during a frequency run.

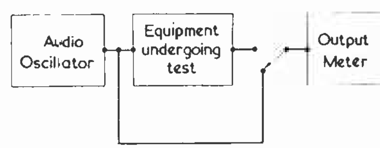


FIG.1.
Set-up for making gain and/or frequency measurements.

One way of doing this is to arrange that the positive feedback network in the oscillator circuit contains some element which is independent of the frequency of oscillation but which remains sensitive to changes in the current through it, or potential developed across it. Such an element is found in the familiar tungsten lamp, the filament of which behaves as a resistance whose value is dependent on the current flowing through it (Fig. 2). We may arrange this to act as one arm of a positive feedback potential divider shown in the simplified diagram of Fig. 3.

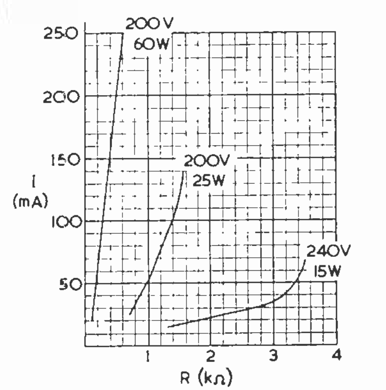


FIG.2.
Resistance characteristics of Tungsten Lamps.
M541

Here V_1 is an amplifier, the output of which is coupled to a cathode-follower V_2. The positive feedback loop is completed by the lamp L connected between the cathodes of the two valves. There is also a negative feedback loop via a frequency-determining network N, but more will be said about this later.

The oscillator will resonate at a frequency fixed by N, due to the positive potential feedback from the output of V_2 to the cathode circuit of V_1. As the oscillations build up so the resistance value of L increases and the amplitude of fed-back potential across R decreases. This in turn reduces the output from V_1 and an equilibrium state is quickly reached where the circuit is just maintained in a state of oscillation with a constant amplitude of oscillation developed across R_1. The conditions for good waveform are at the same time automatically realised, for with V_1 handling the minimum amplitude of signal, overload conditions are avoided.

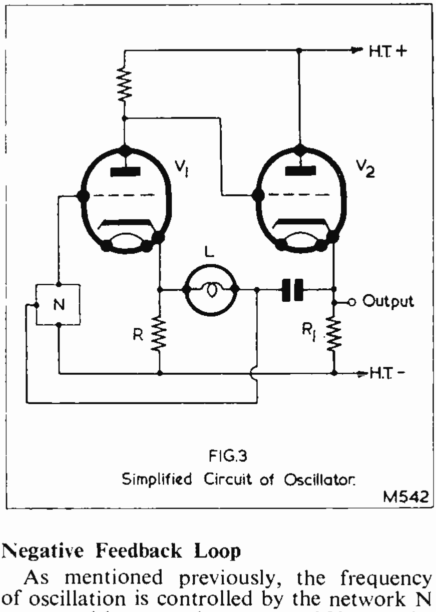


FIG.3
Simplified Circuit of Oscillator.

Negative Feedback Loop

As mentioned previously, the frequency of oscillation is controlled by the network N connected between the output of V_2 and the grid circuit of V_1. This is a resistance-capacity network arranged to supply a large negative feedback voltage to grid at all frequencies except the required oscillatory frequency. The amplitude of this feedback is normally arranged to exceed that due to positive feedback and oscillation prevented at all but this frequency.

Several networks are suitable for this purpose. We can use a Wien Bridge or a Twin-T network, but the one favoured by the writer is the asymmetrical circuit resembling that of a twin-T circuit shown in the complete circuit diagram of Fig. 4. This has a considerable advantage over other networks in that control of frequency can be secured by the use of a single potentiometer R_2 and, apart from range-switching of capacitors C_1 and C_2, the use of ganged potentiometer or capacitors avoided.

The circuit can be analysed and reduced to a twin-π circuit where the series arm will be electrically equivalent to a parallel-tuned LC circuit. At the resonant frequency this will have a high impedance and very little of the output voltage from V_2 cathode will be fed back in antiphase to the grid of V_1. At other frequencies the equivalent LC circuit is off-resonance and has a low impedance allowing a large amount of negative feedback to take place. The range of frequencies to be covered by variation of R_2 is governed by choice of capacity values for C_1 and C_2. With the values shown continuous coverage is obtained from 18 c/s to 20 kc/s using three sets of capacity values.

The Complete Circuit

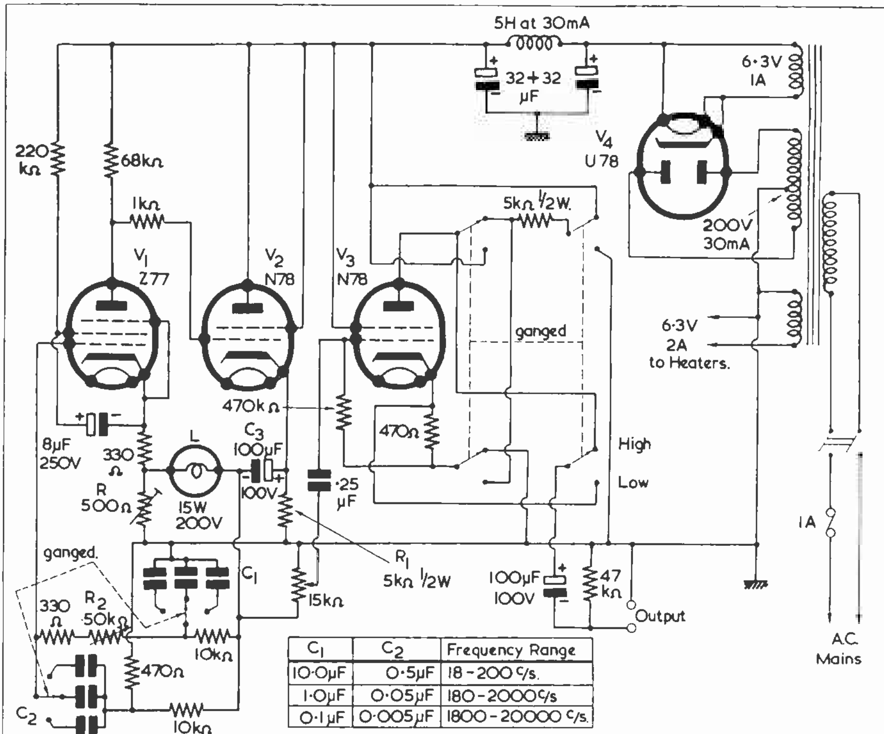
In Fig. 4 is shown the complete circuit diagram for the oscillator. V_1 is the amplifying valve which is directly coupled to the cathode-follower V_2. The lamp L is a 15W 200V pigmy lamp and is connected to the cathode of V2 via a large capacitor C_3. This should be at least 50μF if constant signal amplitude is desired down to the lowest frequencies.

The lower half of the feedback circuit R is made adjustable and in initial setting-up is adjusted until oscillation is just obtained at all points over the frequency range. This ensures minimum harmonic distortion of the output waveform.

In order to obtain a linear frequency/dial-reading calibration curve the frequency-determining resistor R_2 should have a logarithmic law (a suitable type is Dubilier type CD). Some cramping of frequencies at one end of the scale will be evident if a linear-law potentiometer is used, although this can be improved, at the expense of frequency coverage, by increase of the 330Ω resistor in series with R_2.

An output stage V_3 is shown following the oscillator. This has been arranged to function either as an amplifier having a fairly high impedance output at a maximum amplitude of 4.5 volts (r.m.s.); or as a cathode-follower giving 0.5 volts (r.m.s.) at a much lower impedance level.

Although small glass-based valves were used in the writer's equipment, it would be possible, by means of a few alterations to ensure correct bias conditions for V_1 and V_2, to use easily obtainable "surplus" valves such as an EF50 for V_1, 6V6 for V_2 and for V_3, and a 6X5 for V_4.



C_1	C_2	Frequency Range
10·0μF	0·5μF	18 – 200 c/s.
1·0μF	0·05μF	180 – 2000 c/s
0·1μF	0·005μF	1800 – 20000 c/s.

All Resistors to be ¼ Watt unless otherwise stated.

FIG. 4.

Complete Circuit Diagram of Oscillator

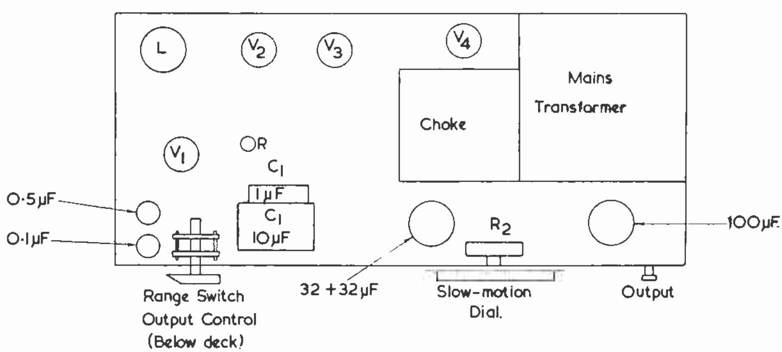


FIG. 5.

Layout of Oscillator.

M543

The layout used by the writer, and shown in Fig. 5 requires little comment. It is not critical, although care should be taken to avoid 50 c/s modulation of the output by suitable disposition of mains transformers and heater leads. Adequate smoothing of the h.t. supply is required for a similar reason.

Finally, in order to retain the advantage of the low output impedance when the instrument is switched to "cathode-follower" position, a large electrolytic capacitor is used to couple V_3 to the output terminal. The polarity and voltage rating of this must be borne in mind should the oscillator be connected to a circuit having a substantial and/or inverse polarity potential. This will rarely be the case, however, as it is more likely to be used fed into the grid circuit of amplifier valves, etc.

The amplitude of oscillations over the entire frequency range was found to be constant within ± 0.5 dB, and in order to fully utilise this a detecting instrument is required which is capable of measuring the output of the tested equipment accurately and independently of frequency. A suitable instrument will be described in a later article.

BOOK REVIEWS

HI-FI YEAR BOOK (1958 Edition). Edited by Miles Henslow. 208 pages. 340 photographs and diagrams. Published by Miles Henslow Publications Ltd., 99 Mortimer Street, London, W.1. Price 10s. 6d.

Some people, when wishing to indulge in a spending spree on high fidelity reproducing equipment, dash into the nearest radio shop and buy the first thing they see (provided it is cheap enough), while others devote more time to comparing the merits and suitability of what is displayed and choose with more care. On the other hand, there are those who gather round them vast piles of leaflets, brochures, catalogues and such like, possibly with some considerable expense in postage for both themselves and those who supply the stuff; they then pore over it for hours on end and finish up by buying something entirely different because none of their precious catalogues shows exactly what they want.

Apart from those who may fall into any of the three broad categories listed above, there are those who, at some time or another, desire to augment or improve upon their present equipment; they, too, are then likely to adopt a similar approach to their intention to purchase. It is at such times, either for initial purchases or for supplementary acquisition, that a compendium of available equipment can be very useful, for its contents can be perused at leisure and a carefully considered choice made after stated performance, appearance and price have been studied.

This book seems to fill such a need, for it lists a considerable quantity of equipment and provides a great deal of information concerning it. Twenty pages are devoted to equipment suitable for stereo reproduction, and about a hundred pages to monaural equipment. Within this compass are contained details of amplifiers, pickups, microphones, speakers, radio tuners, motor units, speaker enclosures, hi-fi furniture, tape recorders, and so on. It is noted that transcription turntable units only are listed, so presumably autochange mechanisms do not find a place in the hi-fi enthusiast's scheme of things. The publishers are also careful to point out that tape recorders are not necessarily hi-fi in the accepted sense of the term, even though they are included.

Several short articles are contributed by various writers in which different items of apparatus or equipment are discussed. Following some of these short but informative papers there are directories giving details of several manufacturers' products. The manufacturers are listed in alphabetical order for easy reference, and with a few exceptions all the products ascribed to them are depicted in clear photographs. About a third of the book is given over to advertisements, though in fairness it must be said that many of these are concerned with equipment not listed in the text.

AN ELECTRONIC ORGAN FOR THE HOME CONSTRUCTOR. By Alan Douglas, M.I.R.E., M.A.I.E.E. 100 pages, 93 diagrams and illustrations. Published by Sir Isaac Pitman & Sons Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 15s.

The contents of this rather unusual book make extremely interesting reading, and it is quite easy to imagine that the construction of the musical instrument described could form an absorbing undertaking, particularly during the longer evenings when more time could be given to the task. Provided that its constructor would be able to play it, he would have a fascinating new instrument upon which to exercise his talent for many years.

There does not seem to be a wasted word in the book, for it describes in full detail every stage of construction. It is to be noted that the author provides a comprehensive list of sources from which necessary parts can be obtained. The electronic circuits employed are simple in design and should not present any difficulty in construction to anyone who has had a fair amount of experience in such work. It would seem that the builder will need to possess a reasonably high standard of woodworking ability if he is to make a presentable job of the carpentry involved, though in all fairness it must be said that this aspect of the instrument's construction has also been reduced to the simplest possible terms.

The finished electronic organ is by no means a "one-finger" instrument, nor is it lacking in versatility. In the first chapter the author briefly discusses the musical basis of the design and his reasons for deciding on this particular one. It comprises two manuals, each having a compass of 61 notes, and a pedal board with 30 notes. The pedal specification is Major Bass 16ft, Bourdon 16ft, and Great to pedal; the Great manual has Tibia 8ft, Flute p.p. 8ft, Viole 8ft, Oboe 8ft, Trumpet 8ft, Harmonic key, Tremulant, Octave coupler and Swell pedal, while the Solo manual has Harmonic flute 8ft, Saxophone 8ft, Viole 8ft, Horn 8ft, Suboctaves I and II, Tremulant and Swell pedal.

The cost, though reduced to a minimum, would no doubt run into several pounds, but this would be spread over the period of construction and even then be far cheaper than a manufactured instrument.

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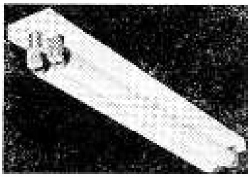

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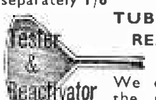

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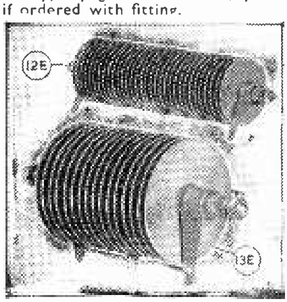

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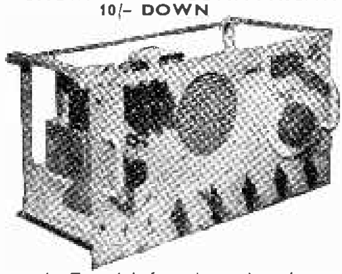

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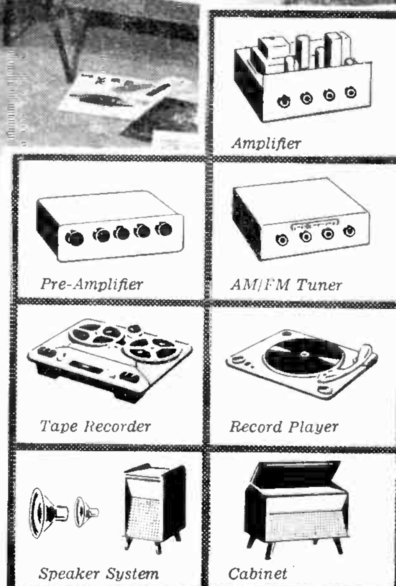

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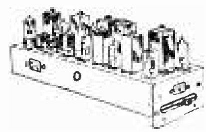

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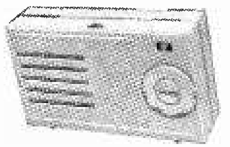

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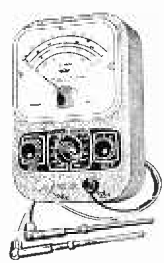

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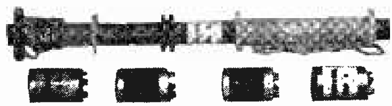

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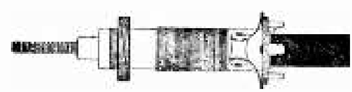

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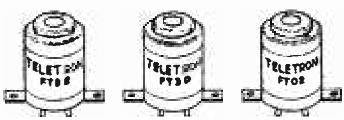

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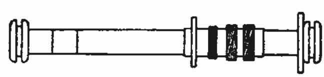

Wound on high permeability Ferroxcube rod. No external aerial required. Full sensitivity. Ideal for battery portable receivers. Medium wave, type FRM 4" x $\frac{5}{16}$", **8/9**. Dual wave type FRD, 8" x $\frac{5}{16}$", **12/9**. Miniature R.F. Chokes, wound on iron dust cores, with wire end terminations. 2.5 and 5mH, **3/–** each; 10mH, **3/6**

BAND III PRE-AMP COIL SET

(*as featured in March issue*)

Types 20T, 21T and 22T **9/–** per set

Send 5d. in stamps for complete data and circuits. All types available from advertisers in this Magazine and local component stockists

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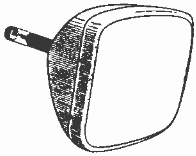

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6 months full replacement, 6 months progressive. Made possible by the high quality of our tubes. Ins. carr. 15/6. 9″, 10″, 14″, 15″ and 16″ round tubes. Our special offer of these sizes **£5**; 12″ TV Tubes **£6.** Three months guarantee on round tubes. Ins. carr. 15/6 **14″ RECTANGULAR TV TUBES** with burns **30/–**. Ideal as a stand-by or testing. Carriage 10/–

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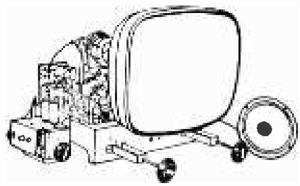
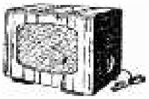


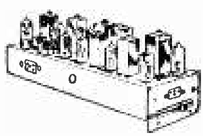
17″ Rectangular Tube on modified chassis. Supplied as single channel chassis covering B.B.C. channels 1-5 or incorporating Turret Tuner which can be added as an extra, at our special price to chassis purchasers **50/–**, giving choice of any 2 channels (B.B.C. and I.T.A.). Extra channels can be supplied at **7/6** each. I.F.s 10.5-14 Mc/s. Chassis size 12″ x 14½″ x 11″. Less valves. Similar chassis were used by well-known companies, because of their stability and reliability. With tube and speaker, **£19.19.6.** With all valves **£25.19.6.** Complete and working with Turret Tuner **£28.9.6.** 12 months guarantee on the tubes, three months guarantee on the valves and chassis. Ins. carr. (including tube) 25/–



BEAUTIFUL EXTENSION SPEAKERS—29/9

Fitted with 8″ p.m. speaker, W.D. or Goodmans, of the highest quality. Standard matching to any receiver (2-5 ohms). Switch and flex included. Unrepeatable at this price. Money back if not completely satisfied. Ins. carr. 3/6

8″ p.m. SPEAKERS 8/9. Those extra speakers are required for STEREOPHONIC SOUND. With o/p transformer fitted, **10/–**, post 2/9



PLESSEY SOUND AND VISION STRIP—25/6

Superhet. Tested. I.F.s 10.5 Mc/s sound, 15 Mc/s vision. 8 valve basis (6 6F1's and 2 6D2's, not included). Size 8½″ x 5″ x 4½″ high. Post and packing 2/6. The Turret Tuner plugs directly into this chassis.

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POWER PACK AND AMPLIFIER 19/6. Output stage 6V6 with o/p trans. Smoothed h.t. 350V 250mA, 6.3V at 5A, 22V at 3A, 6.3V at 4A centre tapped. Less valves. Free Drawings. Ins. carr 5/6

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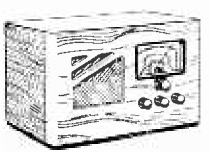
CHASSIS 1/– each. 6 or 8 valve. Latest type midget valve design for a.m. or f.m. Brand new cadmium plated. Size 12¼″ x 7¼″ x 2⅜″. Post 1/9. 4 for **4/–**, post 3/–; 12 for **10/–**, carr. 5/–



HOME RADIO 79/6. 5 valve (octal) superhet. 3 waveband receiver. Can be adapted for your gram. p.-u. at a little extra cost. Two a.c./d.c. sizes: 9¼″ x 18½″ x 11¾″ and 9″ x 20½″ x 12″. Wooden cabinets. Ins. carr. 4/6. Please state size required when ordering.

MAINS TRANSFORMERS 9/9. 350-0-350V 250 mA, 6V at 5A, 4V at 4A, 22V at 6A, extra winding for 2V or 4V tubes. Primary 200-250V 50 c/s. Postage and packing 3/9

MAINS POWER TRANS. 15/6. 350-0-350V 250 mA, 6V heater at 5A, 4V at 5A, 4V centre tapped. Drop through type. Primary 200-250V (4½″ x 5″ x 5″). Post 3/9

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MAINS TRANS. 5/9. 280-0-280V 80mA, 6V, 4V heaters. 200-250V prim. Post 2/3

O.P. TRANS. 1/3. Standard size. 2-5 ohms. Post 1/–. 20 for **£1**, post 5/6

MAINS TRANS. 12/9. 425V 300mA. Single secondary. 6.3V at 12A, 6.3V at 0.6A. 200-250V screened primary. Post and packing 3/6

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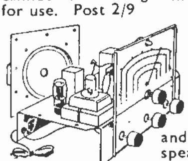
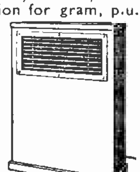


SUPER CHASSIS 99/6. 5-valve superhet chassis, including 8″ p.m. speaker and valves. Four control knobs (tone, volume, tuning, w/change switch). Four w/bands with position for gram, p.u. and extension speaker. A.C. Ins. carr. 5/6



ELECTRIC CONVECTOR HEATER 99/6.

A.c./d.c. Switched for 1 or 2kW. Illuminated grille. Size 26″ x 18″ x 7½″ deep. Ins. carr. 10/6

Send for FREE 1958 Catalogue Liverpool St. to Manor Park Stn. 10 mins. OPEN SATURDAY ALL DAY THURSDAY CLOSED 1 p.m.

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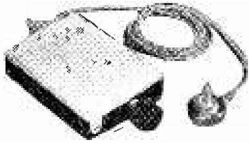
TRANSISTOR NEWS FROM HENRY'S RADIO

ANNOUNCING THREE COMPLETELY NEW EASY-TO-BUILD POCKET TRANSISTOR RECEIVERS

THE MINOR (*Supersedes Mini-2*)



★ Size 3" x 2" x ¾"
★ Less than 2 oz. weight
★ Variable tuning over medium waves
★ Three stage reflex circuit
★ No aerial (in areas of reasonable reception)
★ Economical (less than 1mA)
★ Easy to build
★ Drilled and mounted chassis
★ May be built within half an hour
★ Complete layout diagrams

Complete set of components can be supplied for

52/6 post free

All parts sold separately

Circuit diagram and shopping list FREE

CALL AND HEAR DEMONSTRATION MODEL

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STAR FEATURES

★ **Variable tuning over medium waveband**
★ **Home, Light and Third programmes**
★ **Foreign stations (in areas of reasonable reception)**
★ **Drilled and mounted chassis**
★ **Four-stage reflex circuit**
★ **Highly efficient**
★ **No aerial or earth**
★ **Economical (1½mA)**
★ **May be assembled within an hour**
★ **Complete layout diagrams**

We can supply all items including battery, case and personal earphone for 72/6 post free

All components sold separately

Circuit diagrams and shopping list FREE

CALL AND HEAR DEMONSTRATION MODEL

SEE NEXT MONTH'S EDITION FOR FULL WRITE-UP

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JUNCTION TYPE P-N-P

RED SPOT 800 kc/s Audio Amp. 30mW diss	7/6
WHITE SPOT 2.5 Mc/s c/o Osc./mixer R.F. and I.F. Amp.	15/–
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RED/YELLOW 1.8 to 6 Mc/s R.F. Osc./mixer	15/–
MAZDA TRANSISTORS	
XA102 8 Mc/s c/o Osc./mixer, R.F. Amp. ...	40/–
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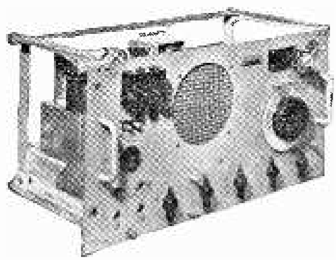
XB102 600 kc/s Audio Amp.	21/–
XB104 800 k/cs amplifier	18/–
XC101 for up to 325mW Audio ... pair	60/–

SPUTNIK-SPECIAL

SHORT-WAVE RECEIVER 10-60 MC/S (5-30 Metres) RECEPTION SET TYPE 208



Complete with 6 valves, 2 6K8G, 2 EF39, 6Q7G and 6V6G. Internal mains power pack and 6V vibrator pack. Built-in 6½" speaker. Muirhead slow-motion drive. B.F.O. and R.F. stage. I.F. freq. 2 Mc/s. Provision for phones and muting and 600 ohms. **Input 110/250V** a.c. 6V vibrator pack included for battery operation. All sets in new condition and air tested. **£6 . 19 . 6** carr. 15/6

NOW! **with stamped-out chassis and mounting brackets for aerial and battery.**
Free colour code chart with every **"EAVESDROPPER"**

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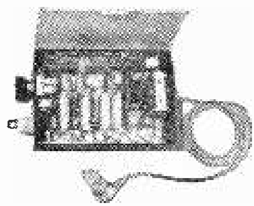
THREE-TRANSISTOR POCKET RADIO

(*No Aerial or Earth required*)



Medium wave, Variable tuning. Total cost, as specified, including Transistors, Transformers, Coils, Condensers and Battery, etc., with circuit and plastic case. All items sold separately. **70/–** POST FREE. With Min. Hearing Aid **86/–**

TRANSISTOR BASES ... ... **9d. each**

Mini-7 Pocket Transistor Portable

Seven-transistor Superhet, supplied with Plastic Case Size 5½" x 2⅛" x 1$\frac{11}{16}$" and all Components as listed for **£9.19.6** **P.P 2/6**

All components sold separately. Send 1/6 for Plans and Price List

TRANSISTOR SIGNAL TRACER

Complete Kit with 2 Transistors, components, phones, with circuit and plastic case **37/6**

PUSH-PULL AUDIO AMPLIFIER

An ideal miniature for transistor amplifier for baby-alarms, low volume crystal pick-ups and microphones. Output approx. 250mW from 4½ volt battery. Cost of components less speaker, **69/6** post free. 325mW version **40/–** extra

We stock transistors and components from the following manufacturers: Ediswan-Mazda, Ardente, Repanco, Teletron, Jackson Bros., G.B. Electrical, Hunts, B.T.S., etc. Send stamp for free list.

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PRIVATE

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ONE R3118, TWO VCR97's, two Indicators, e.h.t. trans. for VCR97, new. One new 1355 all valves with one copy Data Book No. 4, *Inexpensive Television*. S.A.E.—C. Coleman, Upper Ventnor, I.O.W.

CR500 COMMUNICATIONS RECEIVER. Lately checked by makers. Owner going abroad shortly. Best offer around £20 secures.—Boyd, 36 Egerton Gardens, Chelsea, S.W.3.

FOR SALE. Stromberg-Carlson amplifier with auto-transformer, £11. HRO receiver, £5. Pre-amplifiers, communications sets, valves, CRT's, etc., S.A.E. for list.—Box No. E.179.

RADIO CONSTRUCTOR Nov. 1956 to July 1958, 15s. Partridge Williamson output transformer with matched pair KT66's, £4. Power pack for same, £3. New ECL80, 8s. B.J. arm, 25s. Pre-set M.W. chassis, 25s.—9 Brenda Crescent, Thornton, Liverpool 23.

TRIPLETT 1632 SIGNAL GENERATOR, 100 kc/s–120 Mc/s, xtal check, r.f. level meter, £13. BCR139A tube in case, suit oscilloscope, 15s. Wave-meter W1649, 140-240 Mc/s, xtal check, 30s. A.C. power pack for same, 30s. D.C. motor generator, 6.5V to 20V and 300V, 30mA, 10s. Power pack 350V 200mA, 6.3V 5A, ex-modulator 67, 15s.—Meekums, 1 Clinton Road, London, N.15.

TRANSISTOR-8, built, tested, unused, less transistors and speaker, £9 12s. 6d.—Egan. 43 Hamilton House, Hogarth Lane, Chiswick, W.4.

FOR SALE. Repanco "Transeven" pre-set M/L wave 7-transistor superhet portable, complete, working, 10 gns. Post free.—Folds, "Maidwin," Lye Hill, Breachwood Green, Hitchin, Herts.

OSCILLOSCOPE, American, 3in tube, timebase 60 kc/s, good condition, £10. Power supply, 1,000V, 250mA, relay controlled, Canadian manufacture, £9. 6½in speaker in communications style metal case, with transformer, 30s. 400 c/s audio oscillator, 3 EF91, 30s. New matched pair OC72, 17s. 6d. 6BA6, 4s. 12AT7, 4s. Please add postage.—Box No. E.180.

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EDDYSTONE 358, complete. £15 o.n.o.—R. C. Lambert, 1A New Broadway, Ealing, W.5.

MAGNAVIEW S/V strips with tuner, all specified parts. BBC only received, aligning assistance wanted; Midlands, will recompense.—Box No. E.177.

continued on page 159

SMALL ADVERTISEMENTS

continued from page 157

PRIVATE—*continued*

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LEARN as you do it—we provide practical equipment combined with instructions in Radio, Television, Electricity, Mechanics, Chemistry, Photography, etc. Write for full details to E.M.I. Institutes, Dept. RC47, London, W.4.

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FREE. Brochure giving details in Home Study Training in Radio, Television and all branches of Electronics. Courses for the hobby enthusiast or for those aiming at the A.M.Brit.I.R.E., City and Guilds, R.T.E.B., with other Professional examinations. Train with the college operated by Britain's largest Electronics organisation. Moderate fees.—Write to E.M.I. Institutes, Dept. RC28, London, W.4.

SERVICE SHEETS, radio and television, for sale and hire, s.a.e. enquiries. Valves and components cheap, list, s.a.e.—J. Palmer (RC), 32 Neasden Lane, London, N.W.10.

INCORPORATED Practical Radio Engineers home study courses of radio and TV engineering are recognised by the trade as outstanding and authoritative. Moderate fees to a limited number of students only. Syllabus of Instructional Text is free. *The Practical Radio Engineer*, journal, sample copy 2s. 6,000 Alignment Peaks for Superhets, 5s. 9d. Membership and Entry Conditions booklet, 1s., all post free from the Secretary, I.P.R.E., 20 Fairfield Road, London, N.8.

continued on page 160

SMALL ADVERTISEMENTS

continued from page 159

TRADE—*continued*

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TECHNICAL ASSISTANT required in Service Dept. with a good working knowledge of radio and allied subjects. Duties include the handling of technical correspondence, preparation of literature and liaison between dept. and factories. Should have a wide knowledge of English and good appearance. Education to O.N.C. or equivalent. Permanent staff position with good prospects. Apply Siemens Edison Swan Ltd., Ref./JAR, 155 Charing Cross Road, London, W.C.2.

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TELEVISION SETS, RECEIVERS AND TRANSMITTERS

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A "Scottish" special policy for Television Sets, Receivers and Short Wave Transmitters provides the following cover:

(*a*) Loss or damage to installation (including in the case of Television Sets the Cathode Ray Tube) by Fire, Explosion, Lightning, Theft or Accidental External Means at any private dwelling-house.

(*b*) (i) Legal Liability for bodily injury to Third Parties or damage to their property arising out of the breakage or collapse of the Aerial Fittings or Mast, or through any defect in the Set. Indemnity £10,000 any one accident.

(ii) Damage to your property or that of your landlord arising out of the breakage or collapse of the Aerial Fittings or Mast, but not exceeding £500.

The cost of Cover (*a*) is 5/- a year for Sets worth £50 or less, and for Sets valued at more than £50 the cost is in proportion. Cover (*b*) and (ii) costs only 2/6 a year if taken with Cover (*a*), or 5/- if taken alone.

Why not BE PRUDENT AND INSURE your installation—it is well worth while AT THE VERY LOW COST INVOLVED. If you will complete and return this form to the Corporation's Office at the above address, a proposal will be submitted for completion.

NAME (Block Letters) ....
If Lady, state Mrs. or Miss
ADDRESS (Block Letters) ....
.... /JB

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The New AVO MULTIMINOR

A first quality pocket instrument

Sensitivity 10,000Ω/V 0 to 1A in five ranges, 0 to 1,000V in 7 ranges. A.C. volts 0–1,000 in 5 ranges. Resistance 0–2 Meg in two ranges.

PRICE £9.10.0 *Leather Case* **32/6**

or **63/4** *Deposit and 6 Payments of 22/2 or 9 monthly payments of 23/3*

ALL AVO INSTRUMENTS IN STOCK

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3 valve 3W, Printed Circuit, twin speaker. Beautifully kitted by Cossor Radio and Television Ltd to the last nut and bolt.

COMPLETE KIT £9.15.0

or **65/-** *Deposit and 6 monthly Payments of 23/4*
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