THE
RADIO CONSTRUCTOR

Vol. 24 No. 7 FEBRUARY 1971 3/6 (17½p)

THE 'MINISETTE' TWO-TRANSISTOR RADIO

★ AUDIO – ELECTRONICS – NEWS – TEST EQUIPMENT
SHORT WAVES – TELEVISION Etc. ★

Special IN THIS ISSUE

TEN Constructional Projects For The Home-Constructor

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	£/Np
NKT80214	75
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NKT80216	75
OA5	20
OA10	25
OA47	8
OA70	8
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IN4003	10
IN4004	10
IN4005	12
IN4006	15
IN4007	20
IN4148	7

	£/Np
2G302	19
2G371	15
2G374	25
2N174	80
2N385A/2N388A	75
2N404	23
2N696	15
2N697	17
2N698	30
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2N1091	33
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2N2906	44
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2N3709	9
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2N3819	35
2N3820	60
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2N4058	17
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2N4061	20
2N4062	20
2N4284	15
2N4287	15
2N4289	15
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40309	33
40310	45
40312	48
40320	36
40360	43
40361	48
40362	58
40406	56
40407	39
40408	51
40409	54
40468A	35
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RESISTORS

Carbon Film ¼ & ½ Watt 5%. **2 Np** each
Packs of 10 (of one value/wattage) **15 Np per pack.**

PRESETS

P.C. Type 0.3 Watt
Standard size **7 Np**
Sub-miniature **5 Np**
(Available vertical or horizontal mounting).
Usual values 100 ohms to 5 Meg.

POTENTIOMETERS

Log or Lin Less switch – **17 Np**
Log or Lin DP switch – **27 Np**
Log or Lin Stereo L/S – **50 Np**
Values: 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1 Meg, 2 Meg.

CAPACITORS

Mullard Miniature Electrolytic – C426 Series

Mfd.	Volt.Wkg.	
2.5	16	8 Np
10	16	6 Np
20	16	6 Np
40	16	6 Np
80	16	6 Np
1.6	25	8 Np
6.4	25	6 Np
12.5	25	6 Np
25	25	6 Np
50	25	6 Np
80	25	6 Np
1	40	8 Np
4	40	6 Np
8	40	6 Np
16	40	6 Np
32	40	6 Np
50	40	6 Np

Mullard Metallised Polyester 250v

Mfd.		Mfd.	
.01	3 Np	.22	5 Np
.015	3 Np	.33	7 Np
.022	3 Np	.47	8 Np
.033	3 Np	.68	11 Np
.047	4 Np	1.0	14 Np
.068	4 Np	1.5	20 Np
.1	4 Np	2.2	24 Np
.15	5 Np		

Mullard Electrolytic – C437 Series

Mfd.	Volt.Wkg.	
250	16	9 Np
400	16	12 Np
640	16	15 Np
1000	16	18 Np
160	25	9 Np
250	25	12 Np
400	25	15 Np
640	25	18 Np
100	40	9 Np
160	40	12 Np
250	40	15 Np
400	40	18 Np

Mullard Sub-Miniature Ceramic Plate – C333 Series
63 volt working. Range 1.8pf to 220pf (usual pref. values)
Packs of 6 (any values) – **30 Np**

NEONS

Miniature neon bulbs: 0.6mA 65vac 90vdc. Pack of 5 for **30 Np**
Panel neon indicators, mains voltage. Red lenses – round, square or arrow-shaped faces Each **20 Np**

VEROBOARD

2.5" x 17" x .15"	57 Np
2.5" x 5" x .15"	23 Np
2.5" x 3.75" x .15"	19 Np
3.75" x 17" x .15"	79 Np
3.75" x 5" x .15"	30 Np
3.75" x 3.75" x .15"	22 Np
2.5" x 5" x .1"	25 Np
2.5" x 3.75" x .1"	23 Np

Spot face cutters – 38 Np
Veropins: pack of 50 for 21 Np
Bargain Pack, 36 square inches of various sizes. .15" &/or .1" **50Np**

HEATSINKS

T0-5 (Clip-on) pack of 4 for **15 Np**
FINNED type for 2 x TO-3 ready drilled at **43 Np**
FINNED type undrilled for plastic power at **34 Np**

BOOKS

G.E. Transistor Manual	£1.47
R.C.A. Transistor Manual	£1.40
Designers' Guide to British Transistors (data book)	£1.25
R.C.A. Hobby Circuits Manual	£1.40
110 Semiconductor Projects (Marston)	£1.25
Zener Diode Handbook	84 Np
Photocell & Solarcell Handbook	84 Np
Thyristor (S.C.R.) Handbook	£1.00

NEW! SN74N SERIES TTL LOGIC

NOW FROM L.S.T. – FULL SPECIFICATION TEXAS INDUSTRIAL INTEGRATED CIRCUITS AT ECONOMY PRICES

		1–49	50–99	100+
SN7400N	Quad 2-input NAND gate	32	27	22
SN7401N	Quad 2-input NAND gate open collector			
SN7402N	Quad 2-input NOR gate			
SN7403N	Quad 2-input NOR gate open collector	35	30	25
SN7404N	Hex Inverter	32	27	22
SN7410N	Triple 3-input NAND gate			
SN7413N	Schmidt Trigger	45	40	35
SN7420N	Dual 4-input NAND gate	32	27	22
SN7430N	8-input NAND gate			
SN7440N	Dual 4-input NAND Buffer			
SN7442N	BCD to decimal decoder TTL output	£1.12	£1.00	88
SN7450N	Expandable Dual 2-wide 2-input AND–OR–INVERT gate	32	27	22
SN7453N	Expandable 4-wide 2-input AND–OR–INVERT gate			
SN7460N	Dual 4-input expander			
SN7470N	J–K Flip-flop	45	40	35
SN7472N	J–K Master-Slave Flip-flop			
SN7473N	Dual J–K Master-Slave Flip-flop	50	45	43
SN7474N	Dual D-type Edge-Triggered Flip-flop			
SN7475N	Quadruple Bistable Latch	65	60	55
SN7476N	Dual J–K Master-Slave Flip-flop with Preset & Clear	55	50	47
SN7483N	Four-bit Binary Full-Adder	£1.30	£1.20	£1.10
SN7490N	Decade Counter	£1.12	£1.00	87
SN7492N	Divide-by-12 Counter			
SN7493N	Four-bit Binary Counter			
SN74141N	BCD to decimal Decoder/Driver (Replaces the obsolete SN7441AN)	£1.45	£1.30	£1.15

MIX PRICES: Devices may be mixed to qualify for quantity price.
Larger quantities – prices on application.

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R.C.A.

CA3004	£1.80
CA3005	£1.20
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CA3013	£1.05
CA3014	£1.25
CA3018	85
CA3020	£1.30
CA3028A	75
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CA3044	£1.20
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CA3047	£1.40
CA3048	£2.05
CA3049	£1.60
CA3052	£1.65

BARGAIN OP-AMPS!!

LM709C – 60 Np (DIL high gain op-amp)
LM741CN 95 Np (equiv. SN72741P)

PC1006/1 Multimeter Sensitiser packaged circuit KIT includes all accessories £7.55

FAIRCHILD

	1–11	12–24	25+
μL900	40 Np	35 Np	32 Np
μL914	40 Np	35 Np	32 Np
μL923	53 Np	50 Np	47 Np

Devices may be mixed to qualify for quantity price.

G.E. (USA)

PA230	Pre-amp	£1.10
PA234	1 Watt Amp	£1.00
PA237	2 Watt Amp	£1.87
PA246	5 Watt Amp	£2.63
PA424	Zero Volt Switch	£2.45

MISCELLANEOUS

TH9013P	Toshiba 20 Watt Hybrid IC Amp	£4.47
IC10	Sinclair	£2.75
SL403A	Plessey New Design	£2.12

MULLARD

TAA263	Linear Amp	75 Np
TAA293	General Purpose Amp	£1.00
TAA310	Record/Playback Amp	£1.50
TAA320	MOS LF Amp	65 Np
TAD100	IC Receiver	£1.97
TAD110	AM/FM Receiver	£1.97

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Operate at 40kc/s. Can be used for remote control systems without cables or electronic links. Type 1404 transducers can transmit and receive. FREE: With each pair our complete transmitter and receiver circuit. PRICE £5.90 Pair
(Sold only in pairs)

IOR

DD119	Heat sink compound – Silicone grease	30 Np
DD170	Bargain pack of five 1 Watt Zener diodes	97 Np
DD175	4 pieces 100 PRV Rectifiers 500mA	50 Np
DD176	2 pieces 200 PRV Rectifiers 500mA	30 Np
DD177	2 pieces 400 PRV Rectifiers 500mA	50 Np
DD180	Bargain Transistor pack 2 AF + RF	57 Np
DD184	Assortment of RF, audio & power transistor solar cell & diode	£1.67
DD190	Pack of 4 assorted solar cells	50 Np
EP50A	Solar motor (operates from S4M)	£1.97
S1M	Silicon Solar cell 10–16mA	95 Np
S4M	Silicon Solar cell 25–40mA	£1.67
B2M	Low cost Selenium solar cell	63 Np
B3M	Selenium cell in protective case	75 Np
CS120	Cadmium Sulphide photoconductive cell	98 Np

Only part of the International Rectifier "Diamond Line" range are listed.
Send for free catalogue or ask your local component stockist.

TRIACS

2N5756	2.5A (RMS) 400 PIV TO-5 Mod.	95 Np
40486	6 Amp (RMS) 400 PIV TO-5 Mod.	£1.20
40430	6 Amp (RMS) 400 PIV TO-66	£1.01
40432	6 Amp (RMS @ 75° Amb.) 400 PIV*	£1.50
40512	2.2 Amp (RMS @ 25° Amb.) 400 PIV*	£1.45

*These types have integral triggering.

40576	15A (RMS) 400 PIV TO-66	£1.70
SC146B	10 Amp 200 PIV Plastic Flat-pack	£1.25
SC146D	10 Amp 400 PIV Plastic Flat-pack	£1.75
ST2	Bi-lateral avalanche trigger diode	47 Np

ZENER DIODES

400mW 10% GLASS CASE TEXAS Mfr.

1S2036	3.6 volt	1S2082	8.2 volt
1S2039	3.9 volt	1S2100	10 volt
1S2043	4.3 volt	1S2110	11 volt
1S2047	4.7 volt	1S2120	12 volt
1S2056	5.6 volt	1S2160	16 volt
1S2062	6.2 volt	1S2180	18 volt
1S2068	6.8 volt	1S2270	27 volt
1S2075	7.5 volt	1S2300	30 volt

Prices: 1-24 15Np 25-99 11Np 100+ 9Np

THYRISTORS

CR1/051C	1 Amp 50 PIV TO-5	40 Np
CR1/401C	1 Amp 400 PIV TO-5	50 Np
2N3525	5 Amp 400 PIV TO-66	£1.09
40739	10 Amp 400 PIV Stud Mtg.	£1.65

ENCAPSULATED BRIDGES

Type No	Current	Rms.Volts	
W005	1 Amp	50	50Np
W06	1 Amp	600	65Np

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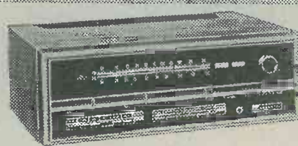
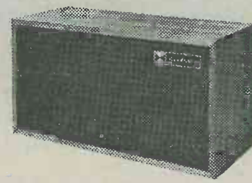
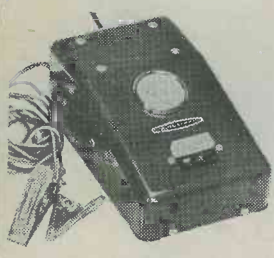
MARINE



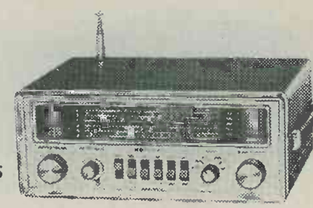
HI-FI & AUDIO



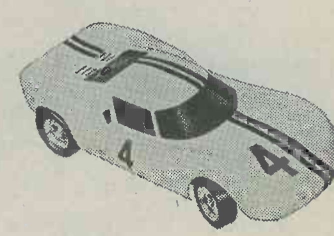
TRENT SPEAKER



CONSUMER



SW. RECEIVERS



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53/2/71

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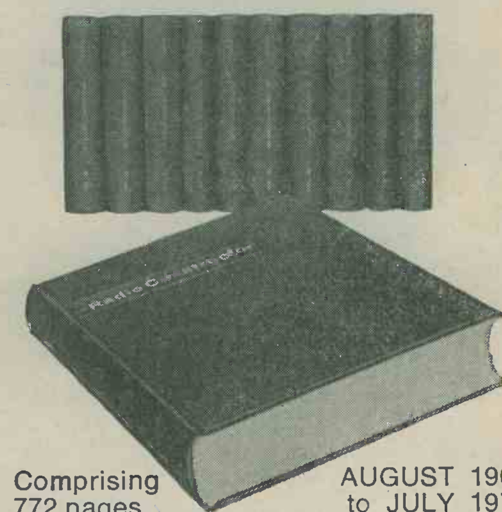

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AF139	.13	2G303	.13
AF186	.37	2N711	.50
AF239	.37	2N1302-3	.20
BC154	.25	2N1304-5	.25
BC171 = BC107	.13	2N1306-7	.30
		2N1308-9	.35
BC172 = BC108	.13	2N3819FE	.45
		Power Transistors	
BF194	.15		
BF274	.15	OC20	.50
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BSY25	.37	OC25	.25
BSY26	.13	OC26	.25
BSY27	.13	OC28	.30
BSY28	.13	OC35	.25
BSY29	.13	OC36	.37
BSY95A	.13	AD149	.30
OC41	.13	AUY10	1.25
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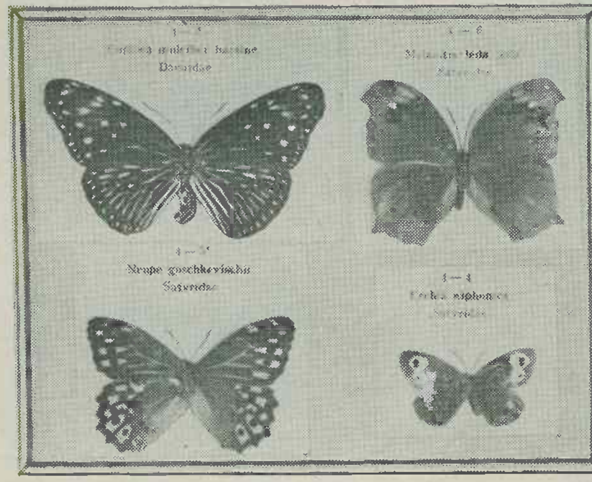

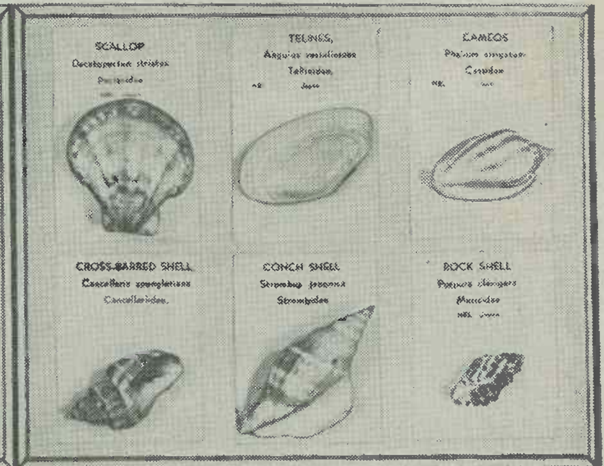

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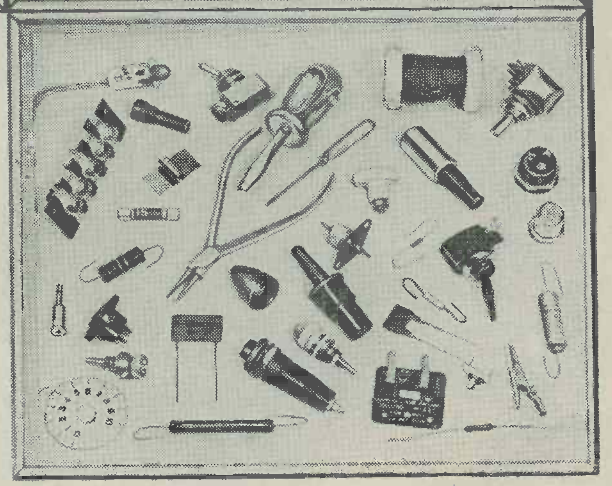

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MARCH ISSUE WILL BE PUBLISHED ON MARCH 1st

Comprehensive Burglar Alarm System

by

P. CAIRNS, A.M.I.P.R.E., G3ISP

Protect your premises against theft and vandalism by installing the burglar alarm system described here. Circuit principles are easy to understand, and the system can be adapted to cover a wide range of applications

THIS ARTICLE DESCRIBES A REASONABLY CHEAP, simple and effective alarm system which can be built and fitted by most amateur constructors. The writer has at various times been asked whether the design of such a system would be a practical proposition both with regard to installation and cost. The circuits described in this article would seem to answer these points in the affirmative.

The form of scheme adopted depends very much upon the type, size and situation of the premises to be protected. Obviously a large detached building would require a more elaborate and expensive system than a small upper story flat. The system described could also be used other than for private residences, these being small lock-up shops, garages (whether attached to the house or not), outbuildings, work-sheds, etc. Whether the systems described are rigidly adhered to or not, they should certainly provide the interested experimenter with plenty of scope for personal ingenuity.

While the first protection is obviously to have good quality locks fitted to all doors and windows, a few pounds spent on an alarm scheme is well worth while if it helps protect one's property from damage and theft. While the system described here will meet a wide range of requirements, the actual scheme adopted will be a matter of individual choice.

MAGNETIC SWITCHES

Basically the system uses magnetically operated dry reed switches in all alarm positions. A dry reed

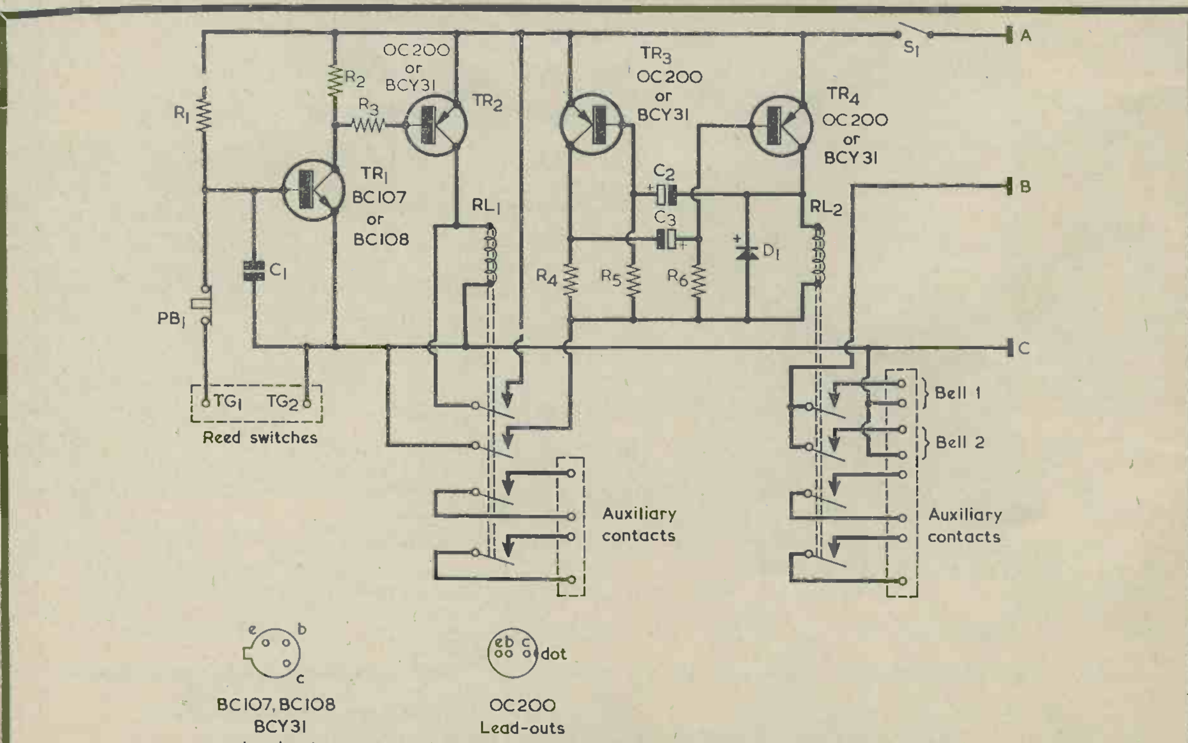


Fig. 1. The circuit of the transistor and relay section of the alarm system

COMPONENTS

Resistors
(All ½ watt 10%)

R1	100kΩ
R2	4.7kΩ
R3	2.2kΩ
R4	270Ω
R5	6.8kΩ
R6	6.8kΩ
R7	22Ω
R8	1kΩ
R9	120Ω

Capacitors
C1 1μF, paper or polyester, 50V wkg.
C2 200μF electrolytic, 12V wkg.
C3 200μF electrolytic, 12V wkg.
C4 2,500μF electrolytic, 15V wgk., T.C.C. Micropack, Cat No. 2CL28 (Home Radio)

Semiconductors
TR1 BC107 or BC108 (Mullard)
TR2-TR4 OC200 or BCY31 (Mullard)
D1 OA200 (Mullard)
D2-D5 Silicon diodes, 50 p.i.v. 0.5A min., BY100 or similar

Relays
RL1, RL2 P.O. Type 3000, 250Ω coil, 4 normally open contacts (see text)
RL3 P.O. Type 3000, 250Ω coil, 2 change-over contacts (see text)

Transformer
T1 Mains transformer, sec. 12V 0.5A min.
Heater or charger transformer; suitable type is Cat. No. TH11 (Home Radio)

Switches
S1 Key switch, s.p.s.t., Bulgin List No. S319D; Cat. No. WS125 (Home Radio)
PB1 Push-button, panel mounting, push to break
PB2 Push-button, panel mounting, push to make

Lamp
PL1 6V 60mA pilot lamp and holder

Reed Switches, Magnets
Quantity as required. Suitable types are (switch) Cat. No. WS120 and (magnet) Cat. No. WS124 (Home Radio)

Battery
B1 9V battery type PP9 (Ever Ready)

Flexible connecting wire (see text)
Printed board or Veroboard
Tag or terminal strip
Material for panel, chassis and battery clip, etc.
Grommets
Cabinet Type W, 8 x 6 x 6in. (H. L. Smith & Co. Ltd.)

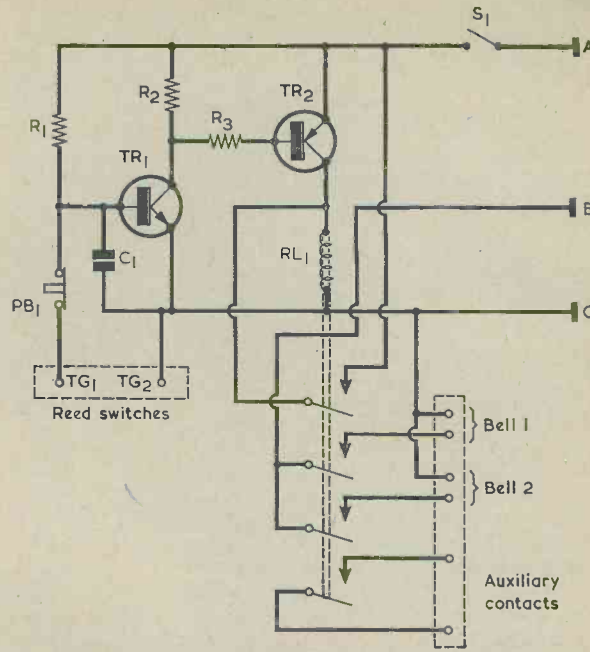
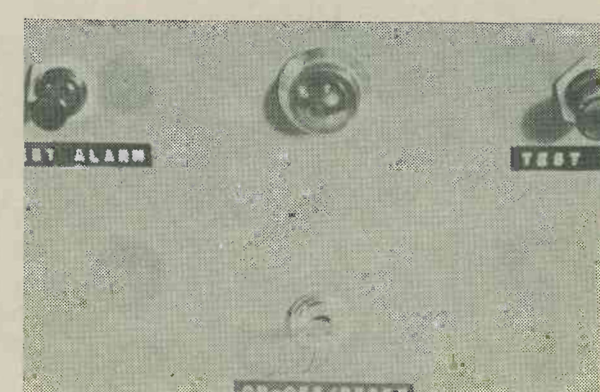


Fig. 2. A simplified version of Fig. 1, which omits the interrupted ringing circuit. Component values are the same as for the corresponding components in Fig. 1

switch closes when a permanent magnet is brought close to it, whereupon it may be mounted on the frame of a door or window with a magnet fitted to the moving part alongside. When the door or window is opened the switch then opens. The system described here operates on a normally closed circuit principle. Thus, should the alarm wiring be cut, the alarm will be immediately triggered on. There is no reasonable limit to the number of switches which can be used. As the complete contact alarm circuit only has a running current of about 90μA and is fed from a nine-volt supply via a very high source resistance, the wiring is completely safe should it be accidentally cut or tampered with by children or pets. The system can operate with one or two bells, either indoor, outdoor, or both, while a number of spare contacts allow for auxiliary alarm circuits if required. Either



A view of the front panel, illustrating the special key switch mains, battery, or mains/battery automatic changeover power supplies may be used. Alarm, control and resetting is by means of a single key switch.

The control unit also has facilities for testing both battery supply and the actual alarm circuit, testing being by means of push buttons. As the complete circuit is transistor operated with a normal operating current drain of about 90µA, battery life is greatly extended.

The system described uses an interrupted rather than a continuous alarm, it having been shown that an intermittent noise is more effective in attracting attention than a continuous noise. Facilities are available however for a continuous alarm should one be required.

The complete circuit for both continuous and interupted alarms is shown in Fig. 1, while the simplified system only is shown in Fig. 2. Both circuits can be either mains, battery, or mains/battery changeover operated. The circuits for these three conditions are shown in Figs. 3, 4, and 5 respectively. Interconnections are standard via the three wires A, B and C. The accompanying Components List specifies the parts required for the most comprehensive version of the system. Readers wishing to construct simpler systems can, of course, select the components required accordingly.

CIRCUIT OPERATION

The functioning of the circuit is quite straightforward and extremely effective. Consider the complete circuit in Fig. 1 with a mains/battery changeover supply as in Fig. 5. The high gain n.p.n. transistor TR1 forms a trigger circuit which is clamped in the off position via the series-connected normally closed dry reed switch contacts, these holding the base at emitter potential. A bleed current is fed via R1 through these contacts, this current being in the region of 90µA. With TR1 off, its collector is at the positive supply level and, as it is d.c. coupled via limiting resistor R3 to the p.n.p. transistor TR2, TR2 is also clamped off. The relay RL1 which forms the load of this transistor is therefore unoperated.

Immediately one of the reed contacts is broken the current flowing through R1 is transfered to the base of TR1 which then conducts and switches from off to on. The flow of current through load R2 drops the collector voltage to almost negative supply line and the base of TR2 follows. This causes TR2 to switch on and operate RL1. A seal-in contact on this relay ensures that the relay remains energised, even if the reed contact is re-closed and the electronic circuit reset. The relay can only be reset by manually opening the key switch in the control unit.

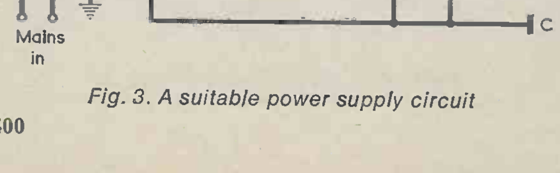


Fig. 3. A suitable power supply circuit

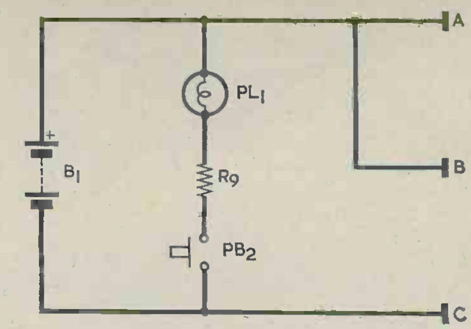


Fig. 4. A battery supply, with test lamp

The action of the trigger circuit is extremely fast, being less than 100 microseconds, thus, using a P.O. relay as listed, the overall operating time is well under 20 milliseconds. As the circuit is self-sealing, quickly reclosing the door or window will not silence the alarm. Only the necessary key for the control unit switch, S1, can do this.

Two spare contacts on RL1 allow for continuous alarm functions which will be mentioned later. C1 prevents spurious operation due to transients or "spikes" picked up in the reed switch wiring. A normally closed test button, PB1, connected in series with the outgoing reed circuit allows for a manual check on the alarm circuit and system.

A fourth contact on RL1 switches the supply to TR3 and TR4, these forming a conventional multivibrator having relay RL2 in the output of one side. The time constants of this circuit allow an on-off period of approximately one second for each condition. The first pair of contacts on RL2 are used to switch one or two alarm bells from the unit supply. A spare pair of contacts allows for auxilliary alarm circuits. This circuit will continue to switch as long as RL1 is sealed in.

It will be noticed that silicon transistors are used throughout, thus keeping leakage currents to a negligible level and allowing the circuit to function satisfactorily over a wide temperature range.

The supply circuit shown in Fig. 5 consists of a transformer having a 12 volt secondary across which is connected a full wave bridge rectifier using silicon diodes. R7 and C4 form a simple smoothing circuit, R8 providing a constant current bleed. The coil of relay RL3 is connected across the unsmoothed output, the smoothed and unsmoothed outputs being taken to the make contacts of this relay. The centre changeover contacts connect to the control unit while the break contacts are connected to the battery. Under normal running conditions the transformer will be energised and RL3 will be operated, the control circuit being supplied via the make contacts. Should the mains supply fail or be tampered with, RL3 immediately de-energises and automatically switches the control and alarm circuits over to the battery supply.

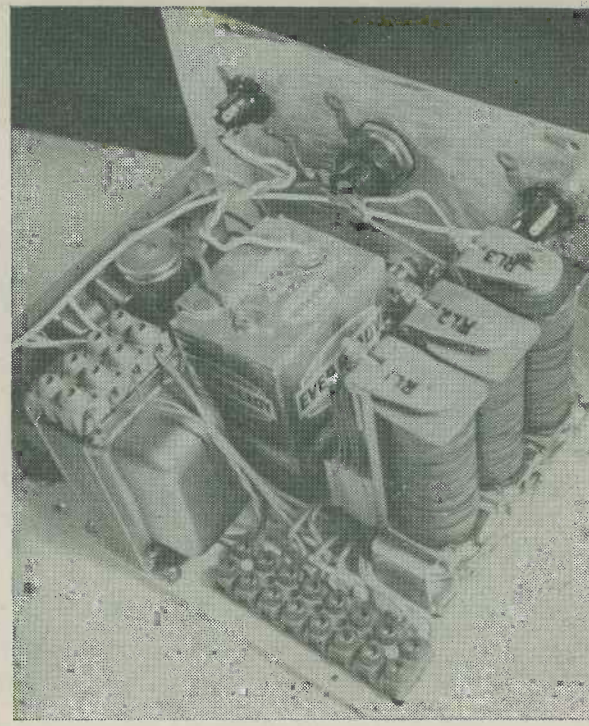
Conversely, either a battery-only or mains-only supply may be used. When a battery is used the battery checking circuit connected with test push PB2 can be inserted if required.

It will be noted in Figs. 3 and 5 that the core of mains transformer T1 is earthed, the requisite connection being taken from the earth point at the mains socket. The chassis of the control unit in which the transformer is mounted is, in consequence, also earthed. However, no earth connection is made at any point to the control unit circuitry fed from the secondary of the mains transformer or to the reed switch wiring, which remains "floating". Similarly, no earth connection whatsoever is made to the system if this is run from a battery-only supply. One reason for not having the system earthed is that a surprising amount of so-called mains interference can be carried by domestic earth wiring, particularly fast switching transients. If high enough, such transients might cause mal-operation of the alarm, despite the presence of C1.

ADVANTAGES

From the preceding paragraphs it can be seen that the circuits described have the following advantages. Magnetically operated reed switches are used and these have virtually unlimited life with no moving parts and are unaffected by temperature or climatic conditions. As many reed contacts as required may be employed. A normally closed alarm circuit loop is used, this being "fail safe". There is complete electrical safety throughout the alarm and reed contact wiring loops, whether mains or battery operated. Provision is made for more than one bell, whether indoor or outdoor. Provision is also made for a number of auxiliary alarm circuits if required. Internal battery test and alarm test facilities are provided. The system can only be switched on, off and reset by means of a single key switch; thus the alarm can be locked in either the on or off positions and if operated can only be reset by the same key. There is exceptionally low power consumption during normal running. The control unit is compact in size, using silicon transistors only. A great many of these advantages are only obtained in the more expensive commercial types of system.

The particular alarm system to be used is largely a matter of personal choice and judgement. Generally speaking, the simpler system using one or two small bells is suitable for smaller houses and flats. A battery-only supply is usually adequate where the alarm will be in service only for limited periods or for installation in garages and outhouses, etc. Larger or detached premises call for more elaborate precautions and it is advisable that at least one bell of the industrial type be mounted outside. A mains or mains/battery supply is advisable if a number of larger alarm bells are used.



Components on the chassis of the prototype. Layout is neat and compact. In this particular unit some of the rear terminals are mounted on top of the mains transformer

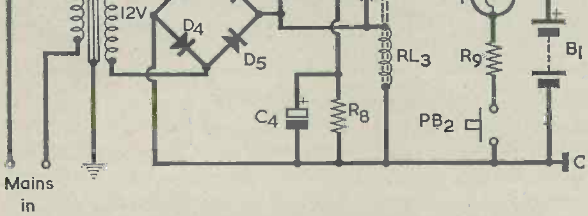
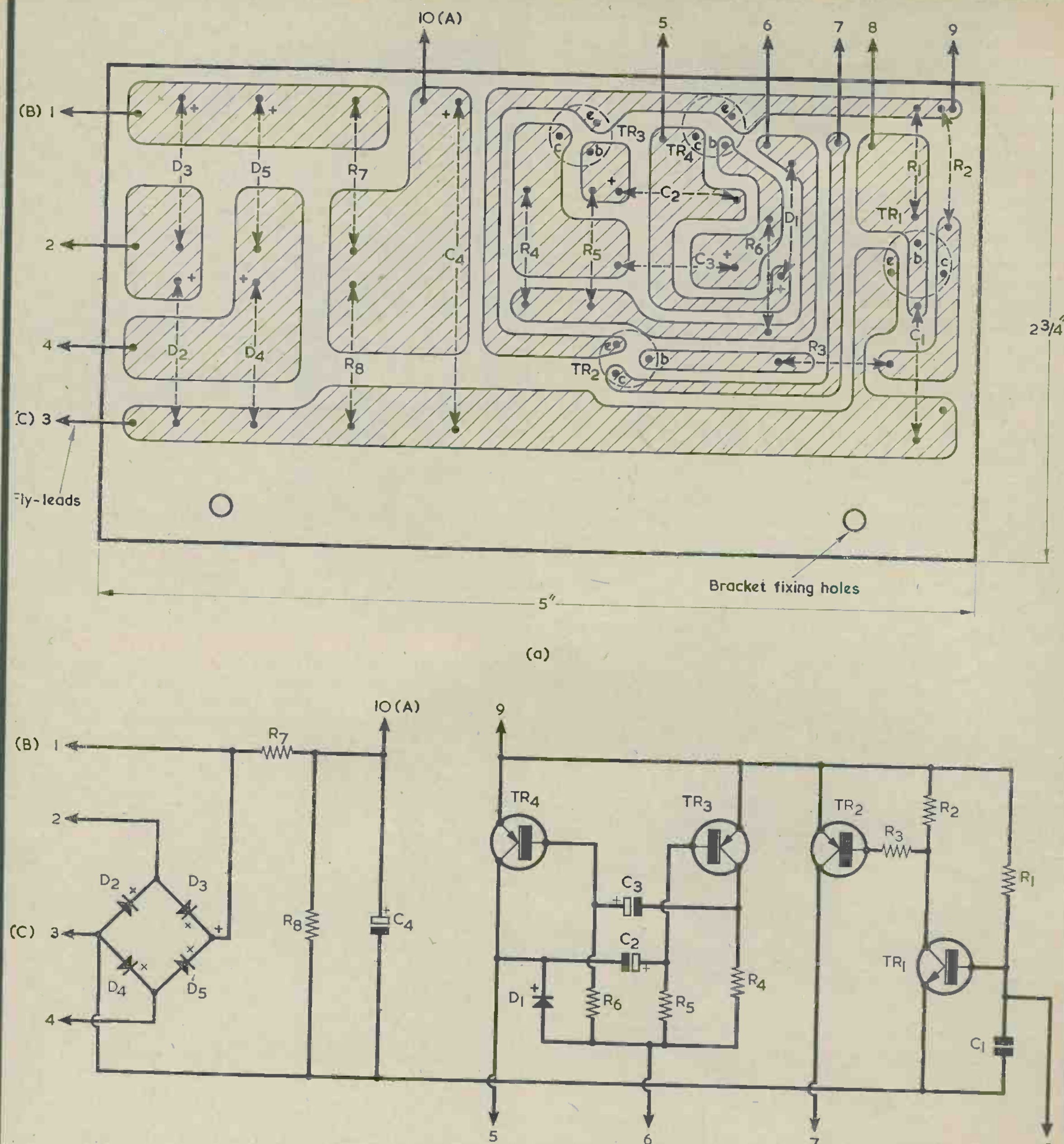


Fig. 5. A combined mains-battery supply, with automatic switching to battery operation in the event of mains failure

The choice of windows and doors to which reed switches are fitted is again a matter of individual judgement. Generally speaking, ground floor windows and rear or side doors should be protected. Upper floor windows, unless they can be reached by water pipes or the roof of an outhouse, should not need protecting. It is not generally convenient to fit a switch to the front door due to the difficulty of the person entering or leaving having to overcome the switch in some way. While mortice locks which also incorporate an electrical switch are available to overcome this difficulty, they tend to be rather expensive. A simpler method is to fit one or two reed switches to doors inside the house, doors which an intruder would automatically open should the front door be forced.

CONSTRUCTION

The construction of the control unit is quite straightforward. The electronic components are mounted on a printed circuit board or Veroboard. A suitable printed board layout is shown in Fig. 6. This component board is mounted vertically by



(b)

Fig. 6(a). The copper side of the printed board in the control unit. This is reproduced full-scale and may be traced. The power unit section is omitted when a battery-only supply is used (b). The circuit carried by the printed board. Consult the circuit diagrams given previously when connecting the fly-leads to components external to the board

means of an angle bracket to the chassis. The chassis is simply an aluminium plate with a small right angle bend on one edge for mounting to the front panel. The layout of components on the chassis, together with relevant dimensions, is shown in Fig. 7. The front panel layout, again with dimensions, is given in Fig. 8. The printed circuit or Veroboard is connected to the rest of the circuit by means of fly-leads which can be soldered on before the board is mounted in position.

While the dimensions and layout shown relate to the cabinet specified in the components list, any suitably sized box or case may be utilised. An aluminium bracket or clip holds the battery in place while the relays are mounted on a suitably drilled aluminium bracket, bent so as to raise the contacts

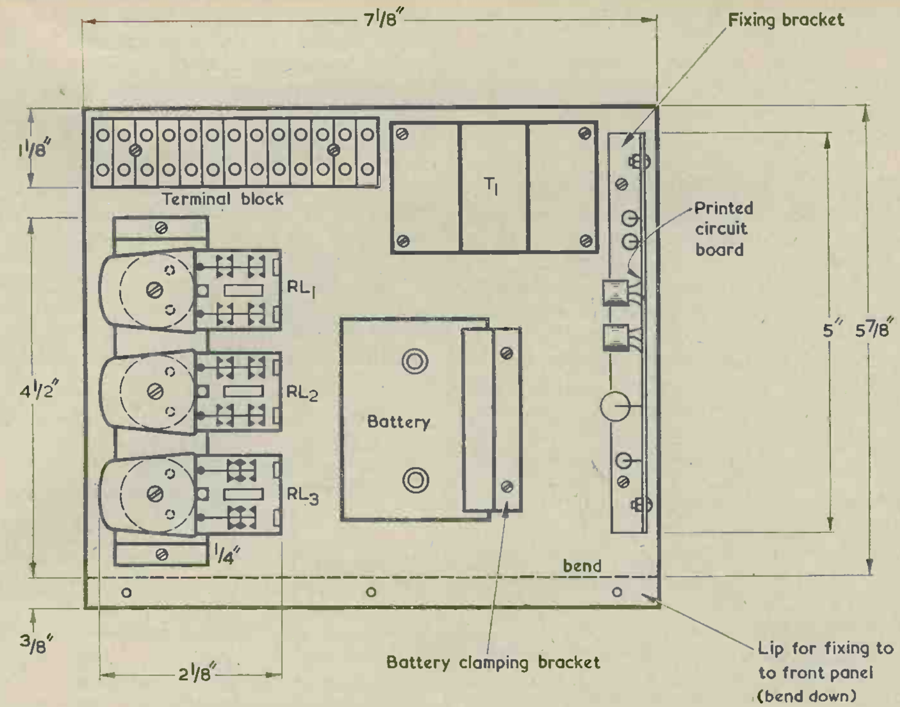


Fig. 7. Component and printed board layout on the control unit chassis

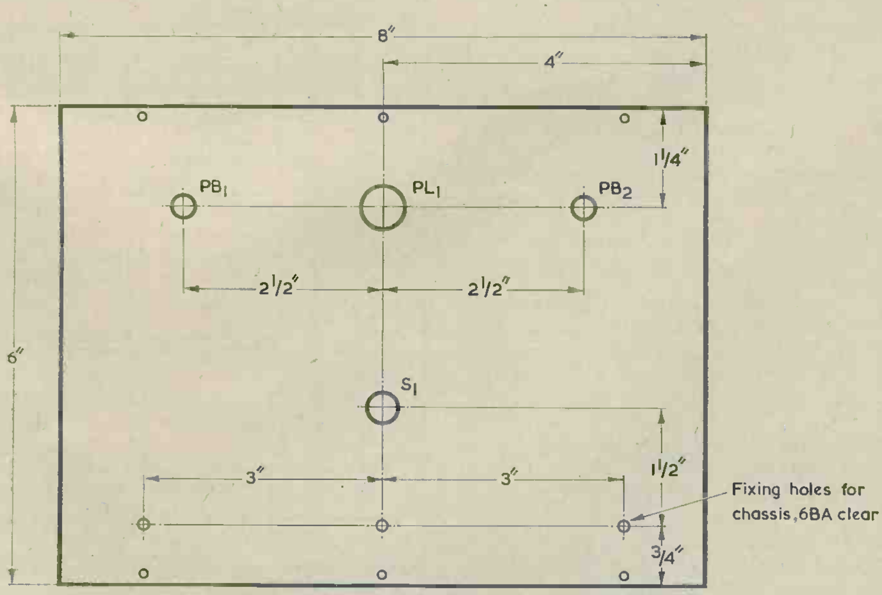


Fig. 8. Drilling and layout details for the front panel

clear of the chassis. A tagstrip or terminal block along the rear of the chassis for outgoing connections completes the assembly. In the prototype unit some of the terminals were mounted on top of the mains transformer as a relatively large type of terminal strip was employed. The sides of the outer case should be drilled and fitted with grommets for external wiring.

While an abundant supply of P.O. type 3000 relays is normally available on the surplus market, it is not always possible to aquire some having the required value of coil resistance. The coils specified can be easily made however by stripping off the existing wire and rewinding with about 8,000 turns of 36 s.w.g. (about 450 yds). This will give a value within 10% of the resistance specified and will completely fill the coil former.

(P.O. 3000 relays may also be obtained, made up to the customer's specification, from L. Wilkinson (Croydon) Ltd., Longley House, Longley Road, West Croydon, Surrey. – Editor.)

FITTING THE SWITCHES

The reed switches are mounted in a notch or groove cut into the edge of the selected window and door frames. As these switches are only about $2\frac{1}{4}$in. long and $\frac{1}{4}$in. diameter (smaller types are available) a slot about $2\frac{1}{2}$in. long and $\frac{3}{8}$in. deep cut with a wood chisel in the edge of the frame is all that is required. Fine flex is soldered to the reed contacts and brought out at the top or bottom of the slot. Suitable flex is p.v.c. 14/0048. The reed is held in place and the slot filled up with Araldite, Polyfilla or any other similar hard-setting material. When dry the surface can be sanded flush with the frame and painted over to match.

Small bar magnets can be mounted into the moving part of the door or window in a similar manner. (If small circular ferrite magnets are used, a larger portion of wood needs to be taken away.) The faces of the reed and magnet should be parallel and as close together as possible when the door or window is closed. The air gap between the reed and magnet should not be greater than $\frac{3}{8}$in. and should preferably be less. The wiring from the reed switch can be run down the edge of the frame or recessed and painted over if required. The fixing arrangements are illustrated in Fig. 9.

It should be mentioned that reed switches of the type described are not suitable for use on window frames made of any ferrous metal. In such cases small microswitches must be used. As there are several types on the market, most of which have a single changeover contact, no problem should be encountered if the switch is mounted in the operated position and the closed contacts connected in circuit.

TESTING

Each switch can be tested after installation by connecting an ohmmeter across the ends of the flex. With the window or door closed and the magnet correctly positioned, the meter should give a short-circuit reading. The interconnections between reed switches can be made of the same flex as is used at the switches themselves. As there is only a negligible d.c. voltage and current present in this wiring it can be run under carpets and other floor coverings, tucked under skirting boards, etc., with complete safety. The reed switches are all connected in series, the two ends of the ring circuit being brought out into TG1 and TG2 tags in the control unit.

The completed control unit should be tested before installation. After checking all wiring and connecting the battery, temporarily connect a shorting clip across the reed switch output tags, TG1 and TG2. Switch on S1 and ensure that neither of the relays RL1, RL2, operate. When one end of the shorting clip is removed RL1 should operate immediately and RL2 will alternate between on and off at approximately one second intervals. When the shorting clip is reconnected the relays should still operate as described. They can now be reset by momentarily turning S1 to the off position. With the unit reset depress the test alarm button PB1, whereupon the relays should again operate as described. Reset as before. When the battery test button PB2 is depressed the indication lamp will give a bright glow.

In the case of a mains/battery unit ensure that RL3 is energised immediately T1 is connected to the mains. Repeat the above tests with T1 in circuit. Reset the unit and remove the mains supply. RL3 will drop off and switch in the battery. Again repeat the above tests. In all cases, once the alarm link is opened RL1 will seal in and RL2 will switch on and off until the system is manually reset by S1. When carrying out the above tests, a d.c. voltmeter connected across the bell supply terminals will check that the switched bell supply is available.

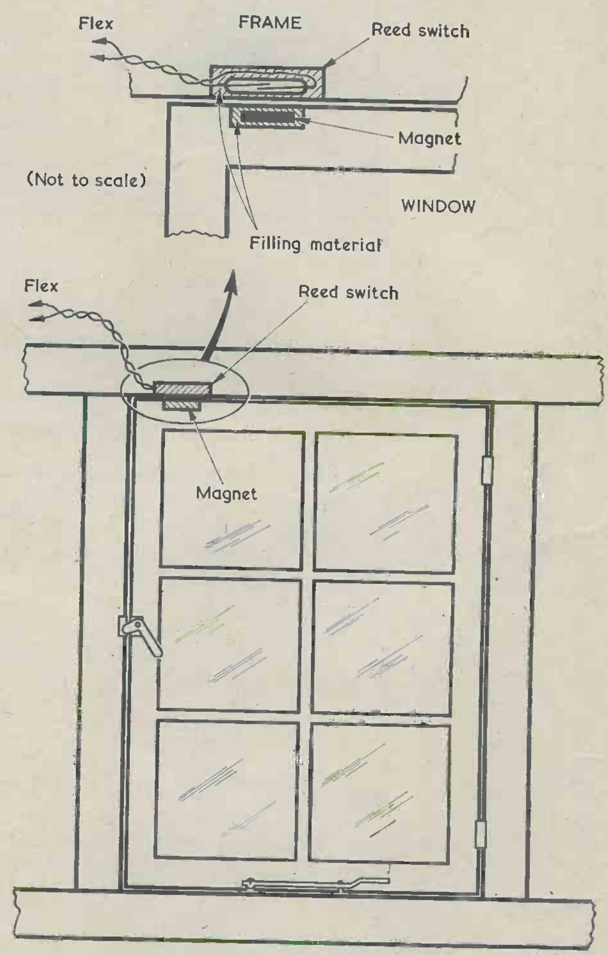


Fig. 9. Illustrating the manner in which a dry reed switch and its associated magnet are fitted to a window

After checking, the control unit can be installed in some central but unobtrusive place which is reasonably convenient for personal access and for wiring to reed switches and alarms. Ideal places are cupboards under the stairs, little used bedroom or kitchen cupboards, box rooms, etc.

The wiring to alarm bells should be heavier than that used for the reed switches, a twisted pair of 14/0076 or similar flex being suitable. Indoor bells should be sited in an open space such as a hall, staircase or passage. They should be positioned as high as possible from the floor. Outside bells should again be positioned as high as possible on a clear wall and well out of reach from nearby buildings, windows, etc. The wiring to outside bells should preferably be run from an upper floor window or ventilator and should not be accessible from the ground.

It is impossible to lay down hard and fast rules regarding layout of switches, wiring, alarms, etc., as installations will differ greatly. A little time spent first on planning the installation and wiring layout is very well worthwhile.

AUXILIARY CIRCUITS

The use to which the spare contacts on RL1 and RL2 may be put is very much a matter of choice. Small auxiliary personal buzzer alarms or indication lamps are one suggestion. Conversely, RL1 can be purchased with heavy duty contacts suitable for household mains use (or can be used to operate a following contactor with such contacts). These contacts can be wired in parallel with the light switches of any room, hall or stair lights; thus when RL1 operates the light or lights will go on and remain on until S1 is reset. It must be remembered, however, that the relay or contactor used for this purpose must have the necessary heavy duty contacts with suitable insulation and that wiring to the lighting circuit must be of the correct type and comply with local electricity board regulations.

When the installation is complete a final check should be carried out. With the control unit switched on and all windows and doors in the alarm loop closed, depress the alarm test push. This should immediately set off the bell or bells and any auxiliary circuits used. Reset by S1. Next open a window or door in the alarm loop. Again the alarm will operate and closing the window or door again should not cancel the alarm. This can only be done by S1. It is not therefore advisable to lose the key for this switch, particularly if the system has been first switched on.

The system in effect is self-checking and should a window or door in the protected loop be accidentally left open when the control unit is switched on, the resulting alarm will be an immediate reminder of one's own carelessness. ■

'UNDERSTANDING BASIC PRINCIPLES'

We continually receive requests from beginners and newcomers to the hobby of radio construction for articles which explain the fundamental aspects of radio. These were covered in the 'Understanding Radio' series which ended in the March 1970 issue, but many of the more elementary aspects were dealt with in the earlier articles of that series and the issues concerned are now out of print. In consequence we feel that the time is ripe for a short series giving succinct details of basic radio theory and practice. The first article in this series, 'Understanding Basic Principles', will appear in next month's issue.

Pecking Order

TRUTH TO TELL, OUR KNOWLEDGE OF THE SHORT waves matched our ability to wind a coil – it was almost nil!

We had at this time acquired some experience of 'wireless' construction with respect to long and medium wave coverage receivers, albeit of simple design, but had never actually ventured on to the higher frequency bands. Least of all had we any idea of coil winding. Those we had previously used were of commercial manufacture and had been obtained by various methods, nefarious or otherwise, in the firm belief that the end justified the means!

Knowledge had come to us that a local amateur had the habit of playing part of a gramophone record and mentioning SWL's by name during a regular Sunday morning and afternoon QSO. Not being noted for attendance at Church, we had decided that this was the time to listen-in. However, the calculated absences from afternoon Sunday School was a different matter – we had perforce to get our cards marked with a small black attendance 'star'. How to get round this apparently foolproof adult device taxed our ingenuity for some while – until we made the discovery that the stamping device was part of an inexpensive printing set that could be obtained from a local toy shop! Enough said!

Now complete with the paraphernalia of coil-winding, a partly completed 'straight' receiver and a printing set, we carried on our activities within the dark confines of the shack, secure in the knowledge that we could look forward to endless free weekends undisturbed by those in authority over us.

After many attempts at coil-winding, most of which ended in failure, we finally ended up with some that worked after a fashion. At the time, of course, we thought they were the cat's whiskers – no pun intended. At any rate, they looked very scientific-like, each with the three separate windings, all laboriously wound with each wire end terminating and soldered to pins which pierced the cardboard formers at the appropriate spots. Needless to say, an endless supply of pins had been discovered in the workbox of an unsuspecting sister!

The end results were tested one dark Autumn evening and we gathered round the bench with the elder member of the trio at the controls. Within our small group we did have a pecking order – the eldest had confidently invested himself with the title of 'Chief Operator'.

With the 'high tension' battery plugs inserted, the accumulator 'spades' tightly screwed into position and the aerial/earth crocodile clips suitably connected, we waited with bated breath for the smile of success to spread across the face of the Chief Operator. It did. He had the one pair of headphones clamped to his ears; we two lesser mortals could only stand by and await the outcome.

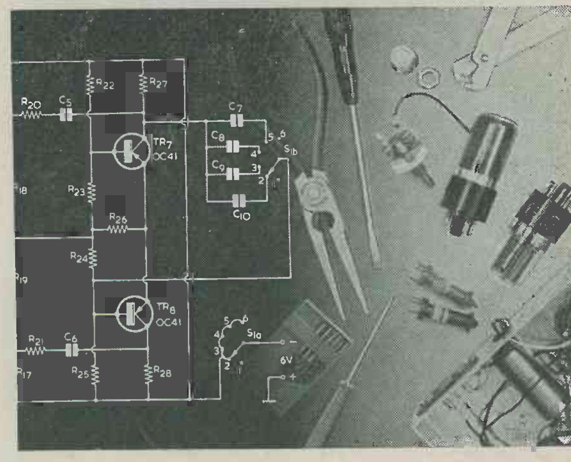
The headphones, by now placed in a metal basin, conveyed the information that "this is G6 – calling CQ". We listened to our very first amateur QSO.

Elated with success at last, we had no foreboding of impending dire events. I'll tell you about *them* next month.

C.W. ■

Transistor Gain Checker

by G. A. FRENCH



IT IS ALWAYS USEFUL TO HAVE available an item of test equipment which is capable of offering an approximate measurement of the current gain of transistors in the common emitter configuration. For constructional and servicing work measurements of transistor gain do not need to be precise, as they will be mainly directed at evaluating whether a transistor is serviceable or faulty, and at sorting out high and low gain devices.

The unit to be described in this article in the 'Suggested Circuit' series provides reasonably accurate measurements of transistor gain and can be employed to check all transistors other than power types. With the latter the checker is capable of indicating whether or not the transistor is faulty, but does not give a current gain figure under conditions similar to those under which the transistor will normally function. The only meter required for the unit is a 0-10mA instrument, and it is impossible for this to pass an excessive current if a short-circuited transistor is connected to the test terminals. The circuit is arranged such that the reversal of polarity required when changing over from p.n.p. to n.p.n. transistors, and vice versa, is carried out by a single double-pole double-throw toggle switch. The unit is capable of measuring current gain from 20 to 900 times.

BASIC GAIN MEASUREMENT

The usual method of measuring the current gain of a transistor in the common emitter configuration employs a circuit whose basic form is illustrated in Fig. 1. The variable resistor in this diagram is adjusted for a given reading in either the collector current meter or the base current meter. The gain under these conditions is then equal to the collector current divided by the base current. Thus, if a base current of 25μA (=0.025mA) results in a collector current of 1mA, the gain is 1 divided by 0.025, or 40 times.

In practice, a disadvantage with the circuit of Fig. 1 is that the base current meter needs to be a sensitive instrument having a full-scale deflection of the order of 50μA. Such instruments are delicate and expensive, and are susceptible to damage in a busy workshop. Also, the process of dividing the collector current reading by the base current reading tends to be time-consuming, a feature which can prove irksome to the busy amateur or service engineer.

It will be appreciated that, if the supply voltage in Fig. 1 is known and is maintained constant, there is no necessity to have a base current meter. Assuming a constant base emitter voltage drop in all transistors to be tested, the base current can be calculated from the supply voltage and the resistance inserted by the variable resistor, using the familiar Ohm's Law equation $I = \frac{E}{R}$. To take this approach a stage further, if the variable resistor is adjusted for the same, arbitrarily chosen, collector current for all transistors being checked, it can be fitted with a pointer and scale calibrated directly in terms of transistor current gain. The transistor to be tested is then connected into the circuit and the variable resistor adjusted to provide the arbitrarily chosen collector current. After this, the current gain of the transistor is simply read directly from the scale of the variable resistor.

WORKING CIRCUIT

This fundamental approach is employed in the full circuit of the transistor gain checker, which

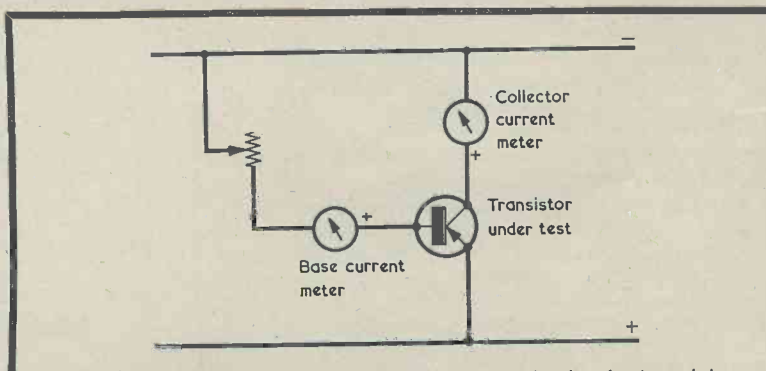


Fig. 1. Basic method of measuring the current gain of a transistor. A p.n.p. transistor is assumed here; all polarities are reversed for an n.p.n. transistor

appears in Fig. 2. Here, the variable resistor of Fig. 1 is replaced by R1 in series with VR1 or VR2 according to the position of range switch S1. VR1 and VR2 are both fitted with pointers and scales calibrated in terms of transistor current gain. The scale of VR1 is calibrated from 20 to 100, and that of VR2 from 100 to 900.

The collector of the transistor under test couples to the upper supply rail via R2, S3 and the bridge rectifier circuit around meter M1. This rectifier circuit ensures that the meter always gives a forward reading of current regardless of the polarity of the upper and lower supply rails.

The arbitrary collector current for which the variable resistor is adjusted is 5mA, this representing a reasonable compromise for most small transistors. Also, this figure is large enough to ensure that the corresponding base currents are sufficiently high to be well above the leakage current range for the transistors under test, whereupon realistic current gain figures are provided.

Resistor R2 has a value which causes approximately 10mA to flow through the meter when, due to too low a value in VR1 or VR2, the transistor under test is fully bottomed. It also ensures that excessive current cannot pass through the meter if the transistor under test is short-circuited. When, after setting up VR1 or VR2, collector current is 5mA, the transistor under test has approximately 2 volts across its emitter and collector if it is a germanium type, and approximately 2.6 volts across its emitter and collector if it is a silicon type. These voltages are well above the knee of the collector current-collector voltage characteristic for a transistor.

When the transistor under test is a silicon device, switch S2 is set to position 'S', whereupon the emitter of the transistor connects direct to the lower supply rail. If the transistor under test is a germanium type, switch S2 is set to 'G', causing the silicon diodes D5 and D6 to be interposed between the emitter and the lower supply rail. According to the polarity of the supply either D5 or D6 will be forward-biased, with the result that the voltage appearing between the base of a germanium transistor and the lower supply rail will be approximately the same as that between the base of a silicon transistor and the lower supply rail.

Switch S3 is a push-button which, when depressed, switches the meter rectifier circuit across the supply rails via R3. The meter then gives an indication of battery voltage.

The changeover of supply rail potentials that is necessary to accommodate both p.n.p. and n.p.n. transistors is provided by S4(a)(b).

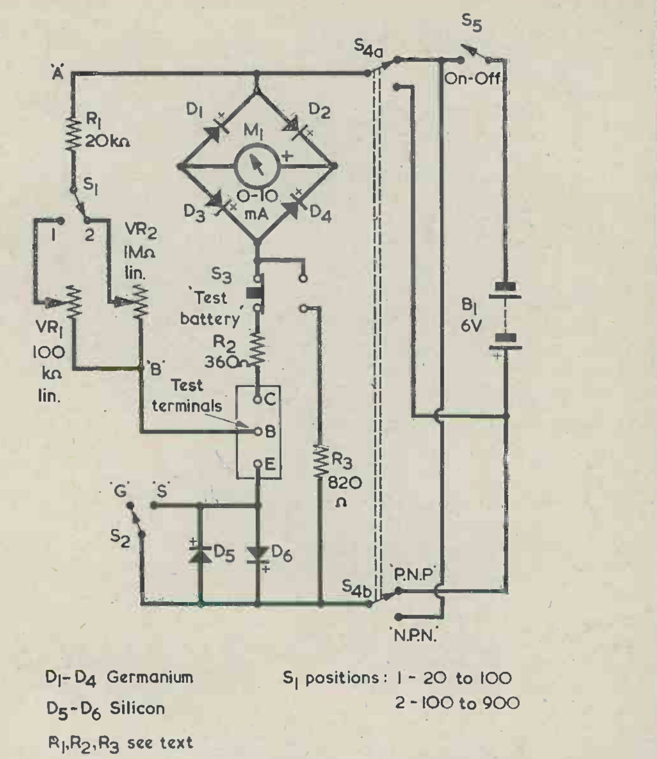


Fig. 2. Complete circuit of the transistor gain checker

When this switch is in the 'P.N.P.' position the upper supply rail is negative, and when it is in the 'N.P.N.' position the upper supply rail is positive. S5 is the on-off switch for the checker.

CALIBRATION

Calibration is carried out by connecting a resistance-measuring meter between points 'A' and 'B' and marking up the scales of VR1 and VR2 at specific resistance values. Obviously, no transistor is connected to the test terminals when this process is being carried out.

The specific resistance values are calculated under the assumption that the battery provides exactly 6 volts and that 0.6 volt appears between the base of the transistor under test and the lower supply rail. This 0.6 volt figure is in accordance with measurements taken with the prototype circuit. Thus, 5.4 volts is dropped across R1 and VR1 or R1 and VR2.

Since it is intended that VR1 or VR2 be set up to give a collector current of 5mA, the current flowing between points 'A' and 'B' will then become 5mA divided by the gain of the transistor being checked.

From Ohm's Law $R = \frac{E}{I}$, therefore in our present instance $R = \frac{5.4 \times \text{gain}}{5}$, where R. is in kilohms.

Therefore, the gain figure multiplied by 1.08 gives the corresponding resistance in kilohms. Table 1 shows calculated resistance values between points 'A' and 'B' corresponding to gains of 20 to 100 and applies to the situation where S1 is at position 1, whilst Table 2 gives calculated resistance values between points 'A' and 'B' for gains of 100 to 1,000 and applies to S1 being in position 2. Resistance values for gains of 950 and 1,000 are included in Table 2 despite the fact that the quoted upper limit for this range is 900; should the particular potentiometer employed for VR2 have a resistance that is slightly higher, then its nominal value the 950, or 950 and 1,000, calibration points can be added for completeness.

COMPONENTS

VR1 and VR2 should be good quality components. Ideally both should be wirewound, but wirewound potentiometers above 100kΩ are not generally available. A good alternative choice would be given by carbon potentiometers having what are described as 'moulded low-noise' tracks.

Diodes D1 to D4 are all germanium point contact types and may be 0A79, 0A81 or similar. It is preferable that all four diodes be of the same type number as this will more readily ensure equal readings in M1 for either polarity of supply, but this is not essential. In fact, the writer found that the meter gave no perceptible difference in reading when S3 was pressed with either polarity when he experimentally checked the effect of mixed type numbers for D1 to D4.

TABLE 1

Range 1 (Calibration of VR1).

Gain	*Resistance between 'A' and 'B'*
20	21.6kΩ
25	27kΩ
30	32.4kΩ
35	37.8kΩ
40	43.2kΩ
45	48.6kΩ
50	54kΩ
55	59.4kΩ
60	64.8kΩ
65	70.2kΩ
70	75.6kΩ
75	81kΩ
80	86.4kΩ
85	91.8kΩ
90	97.2kΩ
95	102.6kΩ
100	108kΩ

R3, which is a ½ watt component, should have a value which causes the meter to read 6mA with a battery at exactly 6 volts when S3 is depressed. In the prototype circuit, this reading was given when R3 had a value of 820Ω, as indicated in the circuit diagram. However, the value required for R3 is dependent upon the forward resistance in the particular germanium diodes employed and cannot be quoted precisely. The reader is advised to adjust the value of R3 until the 6mA indication at 6 volts is obtained. A good plan would consist of initially fitting a 910Ω ½ watt resistor and of then experimentally shunting it with higher value resistors until the required 6mA indication is obtained. High-stability resistors are desirable here, but normal carbon components should prove satisfactory enough in practice. It should be remembered that the values of some carbon resistors tend to shift slightly if they have been overheated during soldering.

The value of R2, another ½ watt resistor, was also found experimentally. In the prototype, the value shown in Fig. 2 caused the meter to read approximately f.s.d. when a transistor under test was bottomed by reducing the resistance in its base circuit. If necessary, the value of R2 may have to be adjusted to obtain a reading at approximately f.s.d., although an exact reading is not essential in this case. There may be a small difference between the reading given with a bottomed germanium transistor and with a bottomed silicon transistor, but this has no consequence so far as the general operation of the checker is concerned.

Resistor R1 is a standard 5% ½ watt component.

Diodes D5 and D6 may be any silicon diodes. The author used Lucas DD000, but any other similar type of diode would have sufficed.

Switches S1, S2 and S5 may be rotary or toggle, as desired. S3 is a double-throw push-botton, which is available in various constructions. Alternatively, a spring-biased toggle switch can be used. S4 *must* be a type having break-before-make contacts because it will otherwise momentarily short-circuit the battery each time it is operated. A d.p.d.t. toggle switch is recommended here.

The battery can be any 6-volt type but it would be to advantage to use one having a relatively large capacity since it has to be discarded when its voltage falls seriously below 6 volts. Two 3-volt cycle lamp batteries (Ever Ready type 800) in series would represent a good choice. If a variable voltage bench power supply is available the checker may be operated from this at an output setting of 6 volts, instead of from the battery. A number of designs for variable voltage supplies have appeared recently in these pages.

The test terminals for the checker are left to the choice of the reader. A suitable approach is to fit three separate insulated terminals in parallel with a transistor holder. The transistor under test can then be connected to the terminals or plugged into the holder, as desired.

CONSTRUCTION AND USE

The circuit can be built up in any suitable case whose front panel is large enough to take the meter, the five switches, the test terminals, and VR1 and VR2 with their respective scales. No connection is made to the case if this is of metal.

When construction is complete, and the values of R2 and R3 have been adjusted as required, VR1 and VR2 are calibrated. The method of carrying out this calibration has already been described.

The unit is then ready for use. Connect a transistor to be checked to the test terminals and set up S2 and S4 to the appropriate positions. Put S1 to position 2, adjust VR1 and VR2 so that they insert maximum resistance into circuit and switch on by means of S5. Decrease the resistance inserted into circuit by VR2 until the meter reads 5mA. The current gain of the transistor can then be read directly from the scale of VR2. If this reading is lower than 100, set S1 to position 1 and repeat the process with VR1.

Power transitors may be checked for serviceability. However, the gain readings given may not be in accord with the current gain offered by such transistors in operational circuits, where they are called upon to pass much higher currents than 5mA.

TABLE 2

Range 2 (Calibration of VR2).

Gain	*Resistance between 'A' and 'B'*
100	108kΩ
150	162kΩ
200	216kΩ
250	270kΩ
300	324kΩ
350	378kΩ
400	432kΩ
450	486kΩ
500	540kΩ
550	594kΩ
600	648kΩ
650	702kΩ
700	756kΩ
750	810kΩ
800	864kΩ
850	918kΩ
900	972kΩ
950	1,026kΩ
1,000	1,080kΩ

Press-button S3 should be pressed whenever the checker is brought into operation to ensure that the battery voltage is correct. The battery should have a long life because the only current drawn from it is that which is indicated by the meter, plus the negligibly small current which flows in R1 and VR1 or VR2 when a transistor is under test. ■

NEW ELECTRONIC VOLTMETER

ITT Components Group Europe has introduced a new electronic voltmeter, the VX208A. This instrument will measure the average of an a.c. voltage from 10Hz to 10MHz.

The VX 208A has a preamplifier and attenuator giving a high input impedance (10MΩ shunted by 30pF) and a low noise factor. Twelve ranges enable the VX 208A to measure a.c. voltages from 1 to 300mV and from 1 to 300V.

For further information contact ITT Electronic Services, Edinburgh Way, Harlow, Essex – telephone: Harlow (02796) 26877, ext 790.

EXTENSION DOOR BUZZER

by

A. G. D. CHANNON

A buzzer circuit which operates when the supply is removed

THE BUZZER (ACTUALLY AN A.F. OSCILLATOR) described in this article was installed to overcome complaints that the front door bell could not be heard in the back garden. As there already was a bell push at the back door it became possible to utilise the bell wiring already installed in the house, whereupon the system had the advantage that no additional wiring had to be fitted.

Fig. 1 shows the existing system, the points 'XX' now being taken to the additional buzzer. For the buzzer to operate the system must be mains transformer operated. In the writer's case the front door bell push operates via an interrupter, giving a continuous 'ding-dong', whilst the back door push operates direct, giving 'ding' then 'dong'. The buzzer will function either with or without the interruptor in the front door circuit.

SOLUTION

The solution to the problem is given by the fact that 'XX' are live when the pushes are not operated, and dead (or alternatively live-dead if there is an interruptor) when operated.

Fig. 2 gives the buzzer circuit which is employed. Here, the a.c. is half-wave rectified by D1 and D2, these giving opposite polarity outputs. That from D1 supplies the collector and normal base connections of the blocking oscillator consisting of R2, C3, T1 and TR1. The output from D2 supplies a hold-off bias to TR1 base, via R3. C1 is chosen so that it remains substantially charged for the duration of a typical 'push' (or for the period of the interruptor, if this is fitted). C2 however is only large enough to give a small degree of smoothing of the bias, and when the front door push is operated it discharges rapidly. This allows the circuit to oscillate, giving

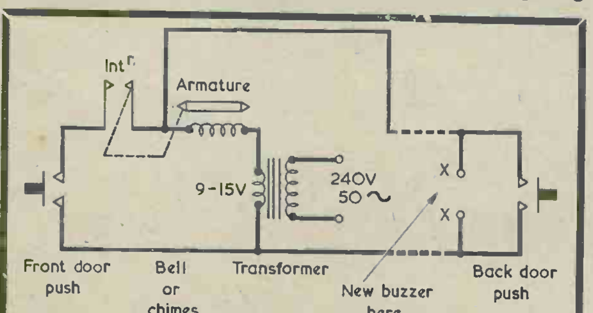


Fig. 1. The existing bell wiring system

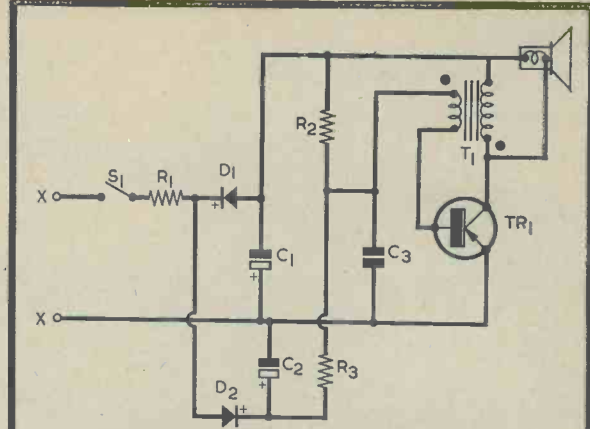


Fig. 2. The additional buzzer circuit, which is installed at the back door. Components are discussed in the text

a slowly decaying buzz, or with the interruptor a buzz-buzz-buzz. The note is fairly raucous and can be heard 20 yards away—with the door open of course!

Readers who wish may try modifying the tone by connecting a capacitor across either the loudspeaker, or between collector and base, the value being chosen by trial.

Resistor R1 is included in case of component failure, when the buzzer could short-circuit the wiring to give a permanent 'ding', and it also serves to limit the peak diode current. The switch disconnects the buzzer when not required, and is optional.

COMPONENTS

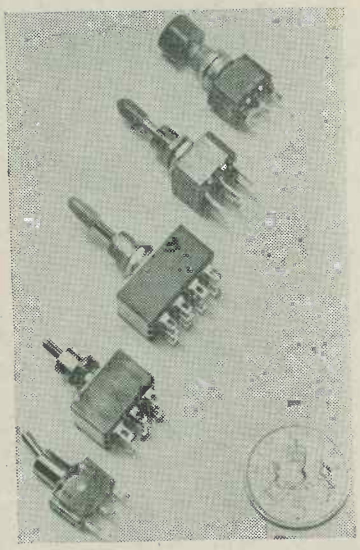
There is considerable latitude in component values. R1 may be 47Ω 1 watt, or may be one 12 volt or two 6 or 6.5 volt bulbs in series, the bulbs having a current rating between some 0.15 and 0.25 amp. R2 can be 47kΩ to 100kΩ and R3 18kΩ to 33kΩ. However, a low value within its range for R2 necessitates a low value within its range for R3, and similarly with high values. C1 may be 250μF to 1,000μF at 15 working volts, the higher capacitance being used if there is no interruptor. C2 is 1μF, 15 volts working, and is fairly critical. C3 is of the order of 0.05μF, being chosen for the desired tone.

The semiconductors are similarly non-critical. D1 and D2 can be any rectifier diode rated at 50mA with a p.i.v. of 50 volts or more. TR1 can be any general purpose germanium p.n.p. transistor with a collector voltage rating of 25 volts or more, and a reverse base-emitter voltage rating of eight volts or more. The popular ACY18 would be satisfactory.

T1 is any small audio transistor transformer with a ratio of 1:1 to 3:1. For ratios other than 1:1, the winding with the fewer turns is in the base circuit. A transistor driver transformer could be employed. Note the winding directions: the two dots in Fig. 2 indicate corresponding winding ends (i.e. both outer or both inner ends). If in doubt, try the circuit with the windings connected at random, then reverse the conections to one winding if it does not oscillate. Finally the loudspeaker can be any miniature type with an impedance between 30 and 100Ω. ■

NEWS . . . AND .

BIRCH-STOLEC INTRODUCE RANGE OF SUB-MINIATURE TOGGLE AND PUSHBUTTON SWITCHES



Birch-Stolec Ltd., Hastings, Sussex, announce the introduction of a complete new range of sub-miniature toggle and pushbutton switches, claimed to be the most comprehensive in the world and the most competitively priced in Europe.

They include Toggle, Lever Lock, Rocker and Momentary Push-button switches, all of which combine maximum performance with minimum weight and size. Available as one, two, three or four pole models, they can be supplied in standard form or in special configurations for printed circuit board mounting, angled mounting, wire-wrap and soldered mounting. Short and long toggles with nine different colour caps are offered.

Contact ratings include: Coin silver contacts – 5 amps resistive load at 115V a.c. or 28V d.c., or 2 amps at 250V a.c.: Brass contacts with gold over nickel plate – 0.4V-amps max at 20V max (a.c. or d.c.); Coin silver contacts with gold over nickel plate – 5 amps resistive load at 115V a.c. or 28V d.c., or 2 amps at 250V a.c. – and 0.4V-amps max (a.c. or d.c.).

The new range can be supplied immediately ex-stock, quantity prices ranging from as little as 5/- for single-pole toggle switches.

LARGE THEFT OF RADIO EQUIPMENT

Between the 2nd and 3rd of December there was a large theft of radio equipment from the Mullard Works at Buuts Lane, Blowick, Southport, Lancashire.

A list of the stolen property valued at well over £2,000, as supplied by the County Police, Hutton, Preston, Lancashire – Preston 54811 – is as follows:-

1. Tektronix Curve Tracer. t/t blue. 18 × 18 × 2ins. Serial Number. 10042. Value £1,100.
2. Telequipment Oscilloscopes
   S.51.B Serial No. 151046
   S.51.B Serial No. 15273
   S.54.A Serial No. 30237
   S.54.A Serial No. 302268
   S.54.A Not Known
3. Racal Frequency Counter. Type 9529. Serial No. 2124
4. Autometers. Mk. 8. Serial Nos. 93937 93845 106167 1547 10664.
5. Unlilex Power Packs. EP.9002. Serial Nos. 11287 11291 11391 11440 11448 11452 11288 11295 11436 11447 11451 11455.
6. Phillips H.F. Generator. P.M. Serial No. 5321.
7. Airmec Galvamp. 391.
8. Phillips Milliameter P.M.2454.
9. Phillips Multimeter PM.2400.
10. Phillips Oscilloscope GM.5605.
11. Ether Mini Temperature Controller. 0-450c. Type. 17-90B. Built into a blue box with a Phillips Transformer.

FIRST MOBILE RADIOTELEPHONES FOR LONDON BUSES

With reference to our article under the above title, featured in last month's issue, we only had space to show the 'Star' radiotelephone in the driver's cab. The photograph herewith shows the 'other end'.

The bus driver is able to communicate directly with the route controller, located at Mansion House, in the City. From here the progress of buses on all routes is monitored but only in the case of routes 74 and 74B can instructions be radioed directly to the drivers while they are in their cabs.

No doubt our London readers will keep a sharp look out for buses using these radiotelephones.

. . . COMMENT

JUST PUBLISHED ——

We have now added to our Data Book range by publishing a 140-page book entitled *Simple Short Wave Receivers* by F. A. Baldwin.

If you are interested in the hobby of receiver construction and short wave listening, this is the book for you. It covers the whole field of short wave listening from construction to operating on both the Amateur and Broadcast Bands. It explains how the circuits work, how to assemble the components, how to wire up the circuits with step-by-step instructions, point-to-point diagrams and how to test and operate the completed project. The Introduction explains in a comprehensive manner all that you need to know to become a 'top flight' short wave listener.

Contents include:–

Introduction To The Short Waves

Fourteen sections explaining in comprehensive terms all you need to know about short wave listening as a hobby.

Workshop Practice

Describes the tools you will require for constructional work, how to prepare chassis and panels, test equipment and much other useful workshop information.

Soldering Notes

All about correct soldering, dry joints, etc.

Receiver Designs

'Saxon' (1-Valve); 'Voyager' (1-Valve); 'Explorer' (2 or 3 Valves); 'Sentinel' (2 or 3 Valves).

Receiver & Bench Power Supply

Power supply for the 'Explorer' or 'Sentinel' receivers or as a bench supply.

The 140 pages include 21 photos of equipment, and 60 diagrams including circuits and point-to-point wiring diagrams; these illustrations greatly aid the newcomer to radio construction.

Written by an acknowledged authority in this field, this book represents experience gained over many years.

INSTANT NEWS OF YOUR BANK BALANCE

Audio and visual communication in 20 years' time will be far more sophisticated than the telephone, radio and television sets which equip modern homes, prophesied a British Post Office research engineer, Mr. Bob White, in a BBC broadcast. He was speaking in World Radio Club, the BBC World Service programme for radio amateurs.

Cheap facsimile printing equipment to reproduce the printed page is one of the advances he expects. Instead of a printed newspaper being delivered on your doorstep, it may roll out of a machine in your lounge. One advantage might be that you could select whatever form of specialised news you want. By dialling the appropriate number you could get the latest racing results, the Stock Exchange quotations, or next week's football fixtures. You could use the same machine to get your financial balance from your bank. Of if you needed information from a library you could get a page of a particular book reproduced on your machine.

Something unlikely to come so soon would be a machine to accept information, to save us form-filling for government-voting or for the electricity accounts. It is relatively easy to distribute a lot of information from a central point; but the reverse, bringing information into a central point, presents great problems of queueing and sorting out.

THE RADIO AMATEUR OPERATOR'S HANDBOOK

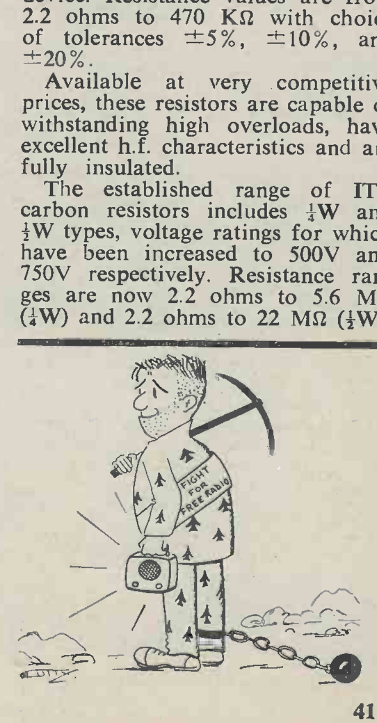
We regret that this book is now temporarily out of print. As considerable care and research is necessary to maintain its authoritative standing it may be a month or two before the next, 12th, edition is available. We shall, of course, make an immediate announcement in these pages when it is published.

$\frac{1}{8}$W RESISTOR ADDED TO ITT RANGE

The ITT range of carbon composition resistors has been augmented by the addition of a $\frac{1}{8}$W device. Resistance values are from 2.2 ohms to 470 KΩ with choice of tolerances ±5%, ±10%, and ±20%.

Available at very competitive prices, these resistors are capable of withstanding high overloads, have excellent h.f. characteristics and are fully insulated.

The established range of ITT carbon resistors includes $\frac{1}{4}$W and $\frac{1}{2}$W types, voltage ratings for which have been increased to 500V and 750V respectively. Resistance ranges are now 2.2 ohms to 5.6 MΩ ($\frac{1}{4}$W) and 2.2 ohms to 22 MΩ ($\frac{1}{2}$W).



THE 'MINISETTE' TWO-TRANSISTOR RADIO

by

H. WILLIAMS

A simple little medium wave receiver employing two readily obtainable transistors. The earphone jack is modified to switch off the receiver when its plug is removed

Although most constructional articles on radio receivers describe superhets or sophisticated t.r.f. sets, it is possible to build a small radio operating an earpiece using only a dozen components, and from which perfectly satisfactory reception is available over the complete medium wave band.

The 'Minisette' receiver described here is built into a small plastic box and is small enough to be carried in a pocket or handbag. Although small, the various components are far from crowded and with a little care the size could easily be reduced.

Before starting the prototype it was decided to use a PP3 battery. Batteries for small receivers are always a problem and although mercury cells or other hearing aid batteries can be used, these are expensive and difficult to mount.

Reflexing the first stage was rejected; it is fairly easy to use the first transistor for both r.f. and a.f. but this can introduce instability. Also, the cost of the two diodes and associated components needed equals the cost of a second transistor which can, unlike a reflexed transistor, be operated for maximum performance.

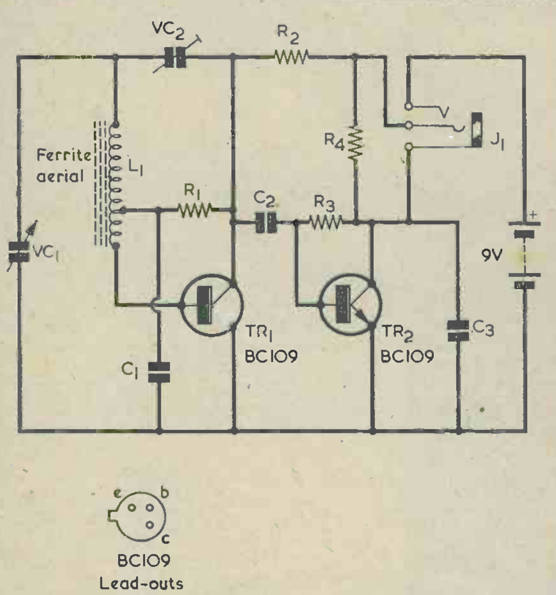


Fig. 1. Circuit diagram of the 'Minisette' two-transistor radio

COMPONENTS

Resistors
(All $\frac{1}{8}$ watt 10%)

R1	680kΩ
R2	2.2kΩ
R3	270kΩ
R4	2.7kΩ

Capacitors

C1	0.01μF, miniature plastic foil
C2	0.01μF, miniature plastic foil
C3	0.01μF, miniature plastic foil
VC1	250pF variable, miniature solid dielectric (see text)
VC2	See text

Inductor
L1 Ferrite aerial (see text)

Semiconductors
TR1 BC109
TR2 BC109

Jack
J1 3.5mm closed-circuit jack

Battery
9-volt battery type PP3 (Ever Ready)

Miscellaneous
Plastic case (see text)
Plain Veroboard, 0.15in. matrix
Battery clips

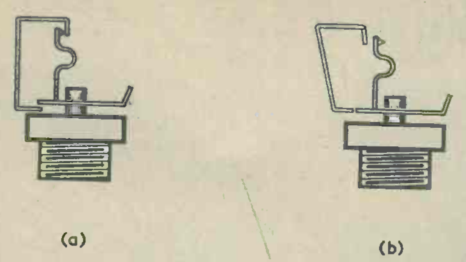
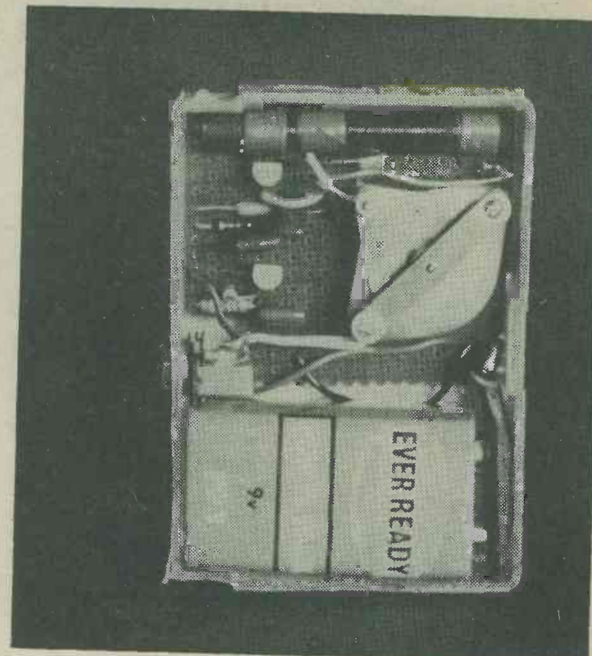


Fig. 2(a). The closed-circuit jack in its normal condition
(b). The modification which causes it to close a circuit when the phone jack plug is inserted



The layout inside the plastic case of the 'Minisette' receiver. Alternative transistors were wired in when this photograph was taken

THE CIRCUIT

TR1, a BC109, is a high gain, low noise transistor. Although designed for audio usage it has a high frequency cut-off point and is ideal in the present type of circuit. The tuned circuit, L1 and VC1, couples to the base. The tapping on L1 earths that point of the coil via C1, so that only the section above it operates as the tuned inductance.

The lower section of L1 transforms the r.f. signal to a suitable impedance to feed TR1. Base bias for TR1 is provided by R1, and a small measure of positive feedback is coupled from TR1 collector back to the tuned circuit by VC2. R2 acts as the collector load.

C2, a 0.01μF capacitor, couples the r.f. signal to the base of TR2 which is biased as a detector so that only the positive-going peaks are amplified. (It is possible also that some detection takes place in TR1, whereupon TR2 provides a.f. amplification.) C3 is necessary to bypass r.f. from the signal which is finally developed across the collector load, R4.

In small radios, switches are a nuisance to fit and so the output jack is altered to perform this function; Fig. 2 shows how this is done. This "trick" was widely used at one time and has applications in other types of equipment.

A crystal earpiece is used by the author but high impedance magnetic types, about 2,000Ω, can be substituted, in which case R4 is unnecessary.

CONSTRUCTION

First the ferrite rod aerial should be wound, the rod itself being 2in. long by ¼in. diameter. Initially wind a few turns of Sellotape about ⅛in. wide around one end of the rod. Using 32 s.w.g. enamelled copper wire, trap one end in the tape and wind 72 turns then wind on more narrow strips of tape, leave a loop and continue with seven more turns. Finally trap the end in further layers of Sellotape. The wire loop should be twisted so that it can be soldered into circuit as one wire. Both the 72 and seven turn sections are close-wound. (If a 2in. by ¼in. ferrite rod cannot be obtained, it could be broken from a longer rod of the same diameter. Alternatively, a 2in. by 5/16in. rod—Home Radio Cat. No. FR1A—could be used instead. This slightly larger rod may necessitate removing several turns from the 72 turn winding to obtain the desired range.—Editor.)

The components are mounted on a piece of plain 0.15in. Veroboard approximately 2in. square, with a small piece cut away to avoid fouling the earphone jack. See Fig. 3. The component leads are bent to allow connctions to be made on the underside, these being soldered afterwards.

The tuning capacitor employed for VC1 was a miniature 250pF solid dielectric component. In case of difficulty in obtaining this value a 300pF component may be employed instead.

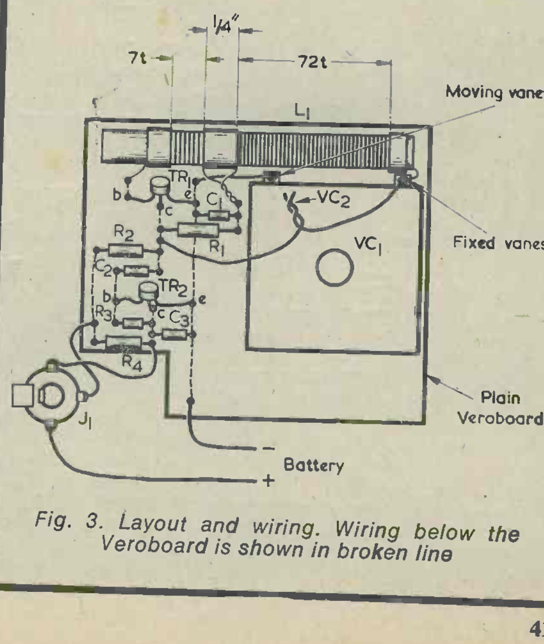


Fig. 3. Layout and wiring. Wiring below the Veroboard is shown in broken line

The dimensions of the case depend mainly upon the size of the capacitor employed for VC1. The plastic case used by the writer measures 3 by $2\frac{1}{4}$ by $\frac{3}{4}$in. and is fitted with a hinged clip-on lid. It is made by the Plastic Box Company. The writer has found it a very simple matter to obtain boxes of this nature from chemist's shops, as they have plenty of samples supplied in them. A PP3 battery with clips fits nicely across the internal width, and the boxes are very useful for a variety of purposes.

Holes should be drilled in the plastic case to take the spindle of VC1 and the earphone jack.

VC2 needs to be very low in value and usually a length of insulated wire connected to the collector of TR1 and laid near L1 will suffice. If not, a second insulated wire can be connected to the non-earthy side of VC1 and twisted with the first wire to provide the capacitance required.

The regeneration should be set so that oscillation just fails to occur at any point on the dial. When this has been done correctly, good reception should be possible from all local stations and a number of Continental stations after dark. ■

NEW MULLARD TRANSISTORS

Three new silicon n-p-n transistors announced by Mullard complete what is believed to be the most comprehensive range of economic semiconductors for use in mobile u.h.f. communications systems. Development types 351BLY, 352BLY and 353BLY, they are intended as drivers of transistors BLY53A and 266BLY in transmitters with outputs up to 17W.

These new transistors are so robust electrically that they can be used in circuits containing no protection against aerial mismatch or variation in the supply voltage. Therefore they are also particularly suitable for use as output stages in the smaller portable transmitters at v.h.f. and u.h.f.

The 351BLY, 352BLY and 353BLY contain basically similar chips, but have different encapsulations being particularly suitable for one type application. The 351BLY and 352BLY have capstan encapsulations for use where stray inductance must be a minimum; the 352BLY is studless so that it will fit easily in situations where low height is important. The 353BLY has a TO-39 encapsulation.

With a drive signal of 0.35W at 470MHz, the 351BLY and 352BLY will each give an output of at least 2.5W when operating from a 12.5V power supply; with a power supply voltage of 13.8V, typical output with the same drive is 3.0W. The 353BLY will give a typical output of 2.0W at 470MHz with a drive of 0.4W and a supply voltage of 13.8V.

EMI L4 PORTABLE TAPE RECORDER

The L4 solid-tape recorder operates at tape speeds of $7\frac{1}{2}$in. and $3\frac{3}{4}$in. Half or full-track versions are available. Among the features of L4 are a synchronising head for film and TV applications, separate record and replay channels allowing continuous monitoring of the recorded signal, power rewind and h.f. erase.

Other features include two microphone inputs with separate gain controls, microphone bass-cut switches, line-in and line-out sockets, A-B (input and output) monitoring facilities and a loudspeaker with a separate 200mW amplifier. Meter monitoring of battery voltage, h.f. bias, recording level and line-out is provided. The L4 is powered by a 14 volt rechargeable battery. The price of £59 includes the rechargeable battery and carrying case.

NOW HEAR THESE

Times = GMT *Frequencies = kHz*

● **INDONESIA**

YDF Djakarta can be heard on **6045** (100kW) with local news in Indonesian from 1500. Listen for local place-names such as Bandung etc.

YDK6 Djambi may be logged from around 1530 to 1600 sign-off on **4927** (7.5kW). Listen for the Hawaiian guitar melody 'Love Ambon' at close-down.

● **LAOS**

A Pathet Lao (clandestine) station has been heard on **7310** with a talk in an Asian dialect from 1455. At 1500 there is martial music followed by a programme in French.

● **SOUTH AFRICA**

SABC Johannesburg may be often heard on **4965** (20kW) with identification in English, National Anthem and closing on this channel at 2110.

● **CHINA**

The PLA transmitter at Fukien on **3400** has been heard often around 2100 with a talk in a Chinese dialect.

Peking is on many channels, one of which is **4905**. Listen around 1450 when it has been heard with a programe of Chinese songs and music.

● **PAPUA**

VLK the ABC station on **4890** (10kW) at Port Moresby has been tentatively logged from 1345 with a programme of song and music record requests. This one signs-off at 1402. The schedule is listed from 2030 to 2200 and from 0715 to 1401 weekdays.

● **REUNION IS.**

St. Denis has been heard at 2040 on **4807** (4kW) with a programme of light music and announcements in French.

● **PAKISTAN**

Quetta on **3915** (10kW) heard several times with Asian-type music and songs from 1515 till around 1600.

● **INDIA**

VUD Delhi can be logged on **3905** (20kW) with songs and music in Asian-style around 1510.

Delhi can also be heard on **3925** (10/100kW) and has been logged with a talk in Hindi at 1625.

● **KUWAIT**

Listen on **4967** (10kW) for this one around 1930. Heard with dance music, European-style, at 1957 with announcements in English.

● **NIGERIA**

Benin City has been logged on **4932** (10kW) at 2010 with a programme of African songs and music – very colourful!

Acknowledgements:- Our Listening Post. ■

The Infuriator

by

C. P. FINN

How to lose friends and infuriate people

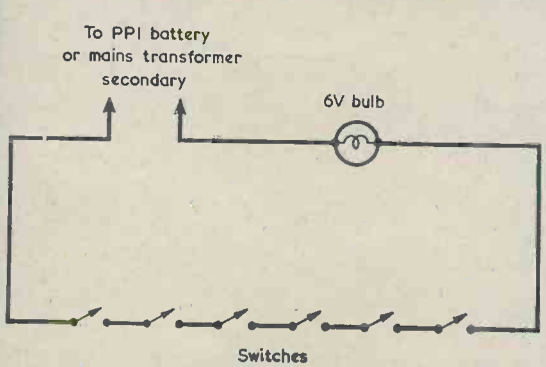
THIS LITTLE UNIT WAS DEVISED IN A SPARE MOMENT, and has proved to be instrumental in passing many more. The circuit is very simple. It consists of a PP1 battery, a 6V bulb and several switches, all wired in series. The switches are, however, of the 'push-on, push-off' variety, as fitted to some bedside lamps. Thus it is not possible to tell visually whether any switch is on or off. The object of the exercise is to light the bulb by bringing all the switches to the 'on' position – either by logical means or at random.

If there are n switches, then the number of switch positions is 2^n. Thus, ten switches would give 1,024 combinations; 20 switches well over a million! If one combination can be tried every second, then the "maximum solution time" for a ten switch model would be about a quarter of an hour, or for one with 20 switches about 12 days!

It is thus left to the reader to decide how many switches to use, and thus how "infuriating" the device is to be. The author chose six, but his colleagues found this a little too easy, and two more were fitted later.

BINARY ARITHMETIC

Mathematically-minded readers will quickly realise that the six switches can be likened to a six digit binary number, whereupon the logical solution entails treating each switch as a binary zero (whether it is actually on or off, since this is not known), and to go through all the binary numbers up to 111111, until the combination of 1's and 0's is reached which represents all switches 'on'.



The simple circuit employed by "The Infuriator"

If the binary numerical order is followed, some of the combinations will require more than one button to be pressed at once, but if the reader is prepared to do a little homework and follow the binary equivalent of the series 0 1 3 7 15 14 12 8 9 11 10 . . . then it will be necessary to press only one button for each new combination. Thus, by pressing a total of 64 times only, all the combinations of six buttons can be tried. A good memory is required, however, since if one loses one's place the only thing to do is to start again!

Possible variations include wiring the switches in parallel so that solving the puzzle will put the light *out* (this obviously calls for a mains power supply), or building units and having two persons competing (a referee would set the same combinations for both). A "champion" might accept challenges from others by setting combinations for them to beat his time.

CONSTRUCTION

Almost any box to house the components would be suitable, provided that if a mains transformer (6.3V secondary) is used, the primary connections are kept well out of the way of prying little fingers. The author's unit is battery operated and housed in an excellent plastic box in which surgical stitches are supplied to hospitals. This was exactly the right size to take the PP1 battery, and has a transparent sliding lid (used as the base) which shows all the wiring and assures the user that 'it can be done'.

The author's unit waits innocently on his desk, until the curiosity of visitors is aroused, and (provided they are not too familiar with binary arithmetic) it is likely to drive them into a frenzy in a very short time. Hence the name: "The Infuriator". ■

EMI-VARIAN LTD.
COMMUNICATIONS TRANSISTORS

Communications transistors, offering the highest gain factors in their field, are to be marketed in the UK by EMI-Varian Ltd., of Hayes, Middlesex. The equipment is manufactured in the United States by the Communications Transistor Corporation, San Carlos, California, an affiliated company of Varian Associates.

The first in this series are three compatible 12-volt devices designed primarily for land-based mobile VHF communications systems covering the 150 to 175 MHz frequency band. They are designated 'B3-12' (3 watts with 10dB gain), 'B12-12' (12 watts with 6.8dB gain) and 'B25-12' (24 watts with 6.2dB gain). An amplifier chain of one B3-12, one B12-12 and two B25-12 and two B25-12's produces 50 watts output for 250 milliwatts input.

The transistors have a rugged construction enabling them to withstand infinite VSWR at all phase angles when operated at rated power and supply voltage. Other special features include integral ballasting resistors to provide safe operating conditions and single-chip construction ensuring maximum reliability.

Hybrid a.f. Amplifiers

by

S. DANIELS

This simple a.f. amplifier employs a beam tetrode output valve and a transistor voltage amplifier, thereby combining the advantages of Class A output and transistor hum-free circuitry

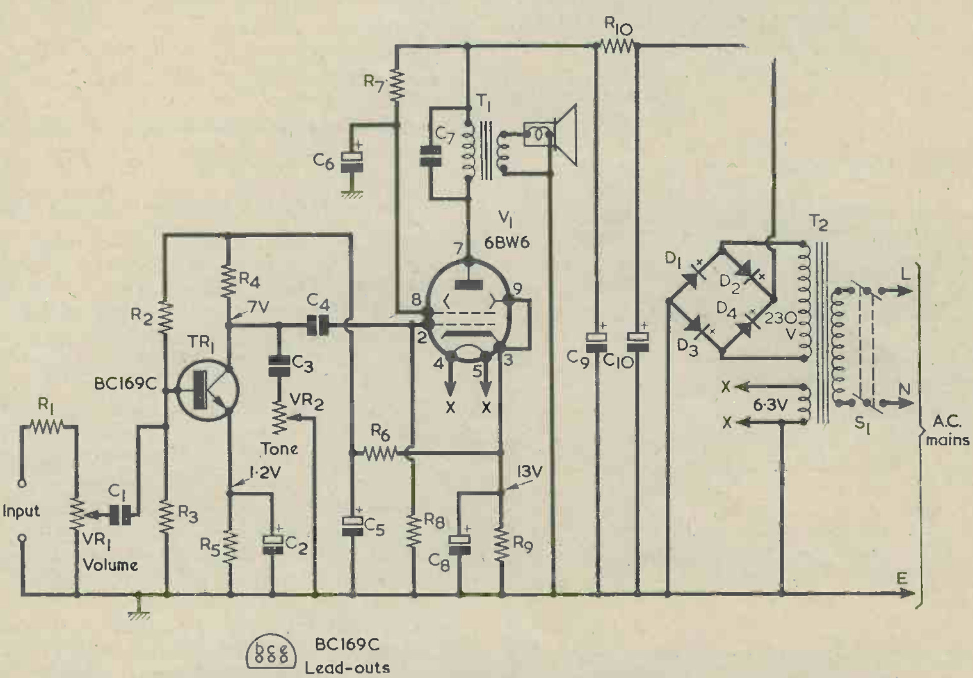
ALTHOUGH THE WRITER LOOKS UPON THE TRANsistor as being a great improvement on the valve for most applications, he still hankers after the comfortably ample and trouble-free speaker drive which can be obtained from a simple Class A output beam tetrode. Transistor a.f. output stages seem to introduce complication upon complication, and even then the output is only in Class B! Unless they are employed in quite complex circuits, transistors do not seem to offer the clean low-distortion output that is given by the valve.

It was these thoughts which spurred the writer to develop the amplifier circuit which forms the subject of this short article. The amplifier is intended to operate from a mono crystal pick-up, from a radio tuner unit, or from any similar source offering an a.f. input at around the same voltage level. The output stage employs a 6BW6, which is the B9A equivalent of our old friend, the 6V6. Indeed, a 6V6 could be employed instead of the 6BW6, if desired. The 6BW6 is preceded by a transistor stage designed around a BC169C, this being a very high gain silicon transistor retailed by Amatronix, Ltd.

So far as the writer can see, the only disadvantage with the present amplifier, when compared with an all-transistor design, is that an h.t. voltage is required for the valve, whereupon high voltage electrolytic capacitors and a mains transformer with a high voltage h.t. secondary are needed. But a mains transformer would also be required for a transistor amplifier offering the same power output, and the smoothing capacitors for a transistor version, although having working voltages that are lower than those employed for a valve, would nevertheless have much higher capacitance values. Further, a voltage regulating circuit might be required as well. Thus, the use of a high voltage h.t. supply might not be such a big disadvantage after all.

CIRCUIT

The circuit of the hybrid amplifier is given in the accompanying diagram. Here, the input signal is



The circuit of the complete amplifier. The voltage figures at the transistor emitter and collector, and at the valve cathode, are discussed in the text applied to R1 and VR1 in series, R1 being included to ensure that the input resistance is sufficiently high for crystal pick-ups. VR1 is the volume control and the signal tapped off by its slider is passed via C1 to the base of TR1. Since this transistor is required to function here as a voltage amplifier, it has a relatively high value of collector load, average collector current being approximately 0.5mA. The transistor functions well at this low current, which is not excessively removed from the figure of 2mA at which its hfe is specified. The amplified signal at the collector of TR1 is next fed, via C4, to the signal grid of the output valve, V1. C3 and VR2 form a variable top-cut tone control.

Cathode bias for V1 is developed across R9 in the usual manner. The cathode bias voltage is then employed as a d.c. supply for the transistor collector load and base bias network. It was considered advisable to decouple the transistor circuit from the cathode by means of R6 and C5.

The beam tetrode stage functions in conventional manner. In the writer's version the screen-grid is fed via R7 and C6 but it is probable that there would be negligible change in performance if the screen-grid were taken directly to the upper end of T1 primary, thereby saving a resistor and an electrolytic capacitor. This alternative arrangement can be tried by constructors, if desired. Experiment is possible, also with capacitor C7, which may be changed in value or omitted altogether to suit individual tastes and speakers.

The speaker is 3Ω impedance, and the output transformer should have a ratio which allows an impedance of approximately 5,000Ω to be presented to the 6BW6 anode. The speaker transformer should also be rated at 4 watts or more. A suitable component is retailed by Home Radio under Cat. No. TO44.

The h.t. rectifier and smoothing circuit is quite conventional, the mains transformer, T2, being an Osmabet component offering 230 volts at 45mA and 6.3 volts at 1.5 amp. This can also be obtained from Home Radio, under Cat. No. TM26A. Rectifiers D1 to D4 can be silicon diodes type BY100, or they can consist of a single bridge rectifier rated at 250 volts 45mA or more, Suitable contact-cooled bridge rectifiers are readily available, this type of rectifier being bolted flat to the metal chassis of the amplifier which then provides cooling.

The only remaining component is on-off switch S1. This is ganged with volume control VR1.

ASSEMBLY

The assembly of the amplifier raises few problems. Any suitable metal chassis may be employed, the most bulky items being T1 and T2. These should be mounted with their axes at right angles to each other. The choice of input and speaker terminals is left to the constructor. Probably the most convenient form for the input terminals is provided by a jack.

The transistor circuitry should be kept away from mains and power supply wiring and components. It is, however, essential for the mains input wiring to pass to the on-off switch ganged with VR1, and this wiring should be routed such that it does not approach the transistor components too closely. These components can be assembled on tagstrips or tagboards as desired. The transistor specified is a tiny

COMPONENTS

Resistors
(All fixed values ¼ watt 10% unless otherwise stated)

R1	270kΩ
R2	1.2MΩ 5%
R3	220kΩ 5%
R4	12kΩ 5%
*R5	2.4kΩ 5%
R6	220Ω
R7	1.2kΩ
R8	470kΩ
R9	270Ω 2 watts
R10	270Ω 2 watts
VR1	500kΩ potentiometer, log, with switch S1
VR2	25kΩ potentiometer, linear

*R5 may require adjustment in value

Capacitors

C1	0.05μF, paper or plastic foil
C2	50μF, electrolytic, 4V wkg.
C3	0.01μF, paper or plastic foil
C4	0.01μF, paper or plastic foil
C5	50μF, electrolytic, 25V wkg.
C6	8μF, electrolytic, 350V wkg.
C7	0.01μF, paper or plastic foil, 500V wkg.
C8	50μF, electrolytic, 25V wkg.
C9	32μF, electrolytic, 350V wkg.
C10	32μF, electrolytic, 350V wkg.

Transformers

T1	Output transformer, see text (Home Radio, Cat. No. TO44)
T2	Mains transformer, secondaries 230V at 45mA and 6.3V at 1.5A. (Home Radio, Cat. No. TM26A)

Transistor
TR1 BC169C

Valve
V1 6BW6

Rectifiers
D1-D4 Four silicon rectifiers type BY100 or one selenium bridge rectifier rated 250V, 45mA or more

Switch
S1 d.p.s.t., part of VR1

Speaker
3Ω speaker

Miscellaneous
1 B9A valveholder
2 knobs
Input and output terminals
3-core mains lead
Chassis, nuts, bolts, etc.

device and it may be necessary to extend one or more of its leads by soldering on an extra length of wire, with thin sleeving passed over the joint. Take care not to heat the transistor excessively during soldering.

OPERATION

When the amplifier has been completed it may be tried out, whereupon it should provide a pleasant quality of reproduction at an ample volume level.

Before the amplifier can be considered finally complete it is necessary to take several voltage checks to ensure that the transistor is working on the correct part of its characteristic. The component values specified for R2 to R5 are such that the collector voltage should, working from experience with the writer's amplifier, lie approximately mid-way between the voltage on the cathode of V1 and a potential 1 volt positive of chassis. This allows the collector to swing symmetrically, with the a.f. signal, nearly to its supply potential (which is the cathode potential minus the very small voltage dropped in R6) in one direction, and nearly to its emitter potential (which is of the order of 1 volt positive of chassis) in the other direction. A typical example of what is to be expected is given by the voltage figures given in the diagram, which show the potentials measured in the writer's amplifier. Here, the valve cathode is 13 volts positive of chassis, and the transistor collector is 7 volts above chassis, as is required. It so happens that the potential on the emitter in this case is 1.2 volts. If the cathode voltage had been 14 the collector voltage would need, ideally, to be 7.5, and if the cathode voltage had been 12 the collector voltage would need, ideally, to be 6.5, and so on. The collector voltage should be read by a valve voltmeter or by a testmeter with an internal resistance of at least 200,000Ω. The latter would be given by a 20,000Ω per volt instrument switched to read 10 volts f.s.d., or by a 10,000Ω per volt instrument switched to read 20 volts f.s.d.

The cathode and collector voltage readings are taken under quiescent conditions. If it is found that the desired collector voltage, plus or minus some 0.5 volt, is given with the components that have been fitted, then all is well and no further work is needed. If, on the other hand, the required voltage is not given, the discrepancy will be due to variations, within tolerance, of the resistors and the transistor. The value of R5 then has to be changed slightly until the appropriate collector voltage is given. Increasing the value of R5 causes the collector voltage to increase, and vice versa.

If a valve voltmeter or suitable testmeter is not available, the optimum value required in R5 can be determined in the following manner. Take a 5kΩ or 10kΩ linear track potentiometer, connect it temporarily into circuit in place of R5, and adjust it to offer a resistance slightly in excess of 2kΩ. Apply a high level signal to the amplifier and adjust the potentiometer in both directions to the settings which cause the same level of obvious distortion to be given. Then set the potentiometer carefully to the point which lies mid-way between these settings. Remove it from circuit, measure its resistance, then connect a fixed resistor of the same value in the R5 position. ■

CURRENT SCHEDULES

Times = GMT *Frequencies = kHz*

★ AUSTRALIA

Radio Australia now broadcasts to Africa, in English, from 0330 to 0500 and in French from 0500 to 0600 on **17820** and **21680**. The Broadcasts to Europe are now made via the short path over Asia on **21680** and via the long path over America on **11880** from 0645 to 0745.

★ CUBA

Among other transmissions, there are French to Europe at 1900 followed by English from 2010 to 2140 on **17705**. The English transmission to South America is from 2050 to 2150 on **15285** and **17715**.

The Spanish, Arabic and French transmissions to the Mediterranean area are from 1700 to 2140 on **15155** and **17885**.

★ TANZANIA

Radio Tanzania broadcasts in English daily from 1700 to 1815 on **15435** and continues afterwards in Portuguese and African languages. A newscast is radiated from 1800 to 1810.

★ NEW ZEALAND

Regular broadcast schedules are listed from 0600 to 0845 on **9540** and **11780** (7.5kW). Good reception has been reported in this country from around 0745 to 0820 on **11780**.

★ NEPAL

The Foreign Service of Radio Nepal is broadcast on Tuesdays and Saturdays from 1450 to 1520 on **7165** and **11970**.

★ ANGOLA

Emissora Official de Angola broadcasts in English from 1145 to 1200 daily and from 1500 to 1545 on weekdays; in French from 1130 to 1145 daily and from 1545 to 1630 weekdays on **9535** and **11875**.

★ USSR

Radio Vilnius, Lithuanian SSR, broadcasts in English on Fridays and Sundays from 2230 to 2300 on **7290, 7310** and **9685**.

★ SPAIN

Radio Nacional de Espana broadcasts to North America and Australia from 0200 to 0245 and from 0300 to 0345 on **6140, 9760** and **11921.**

★ BRAZIL

ZYZ33 Radio Clube Paranaense, Curitiba, on **6045** (7.5kW) has a schedule from 0800 to 0300.

ZYS35 Radio Clube Paranaense, Curitiba, on **11935** (25kW) operates from 1200 to 2400.

★ USA

WINB Red Lion broadcasts in English daily from 1700 to 2000 on **17720** (50kW) and from 2000 to 2200 on **11795** (50kW).

★ GHANA

The English schedule of Radio Ghana, to Europe, is from 2045 to 2215 on **9545** (100kW).

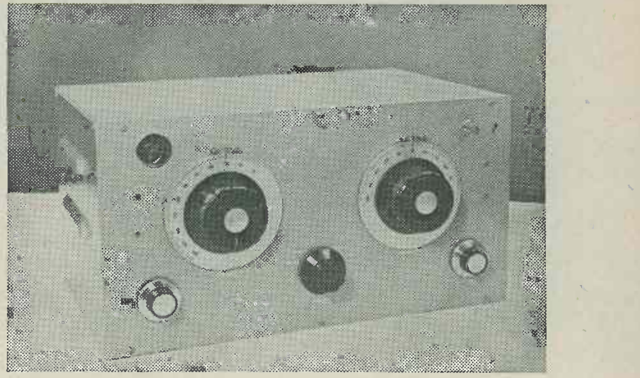
Acknowledgements:- Our Listening Post, SCDX. ■

THE 'CRUSADER' SIMPLE SUPERHET

(Part 2)

by

F. A. BALDWIN



In this article the wiring-up process is described step by step for the benefit of beginner constructors

DRILL NEXT THE HOLES FOR IFT1 AND IFT2 ON THE centres shown in Fig. 2(b). These require a central $\frac{5}{16}$in. hole for access to the lower dust core, four $\frac{3}{16}$in. holes for the solder tags, and two $\frac{1}{8}$in. holes for the 6BA mounting bolts. A paper template is provided with the transformers and this will assist in marking out the holes. Before drilling the two mounting holes, check for correct orientation of each transformer. Both transformers, when fitted later, require to have tags 1 and 6 nearest the rear chassis apron.

Cut out the central hole (octal valveholder size — $1\frac{1}{8}$in. chassis cutter) for the dual electrolytic capacitor C26, C27, and drill two holes, one to the rear and one to the front as in the above-chassis photograph, for the clip mounting bolts.

Take up the mains transformer and position it as shown in the above-chassis photograph and in Fig. 2(b). Mark out and drill its four mounting holes. This transformer requires 3 grommets in the chassis on either side to allow its leads to pass through, and their relative positions are shown in the under-chassis wiring diagram given in Fig. 5, to be published next month. The two larger grommets (Nos. 2 and 5 in the diagram) are $\frac{5}{8}$in. and the four smaller grommets are $\frac{1}{4}$in. Working from the transformer, mark out and drill the six holes required for these grommets.

Return to Fig. 2(b) and mark out and drill the hole marked 'PL1 Grommet'. This hole will later take a $\frac{1}{4}$in. grommet, and will allow the leads to PL1 to pass through the chassis.

Take up Tagstrip 1 (see Fig. 7) and place it under the chassis such that its Paxolin strip runs from front to rear, with tag 1 nearest the rear, and is centrally positioned between the V2 and IFT1 positions. Mark out and drill its two mounting holes.

Take up Tagstrip 3 (see Fig. 9) and position it approximately 1in. forward of the two front solder tag holes for IFT2. The Paxolin strip runs from side to side of the chassis with tag 1 nearest the chassis centre. Tag 2 is in line (from front to rear) with the central hole for IFT2. Mark out and drill the two mounting holes for this tagstrip. Unfortunately, due to differing dimensions, precise hole locations cannot be given for these tagstrips.

The front apron, shown in Fig. 2(c), comes next. Drill the three holes E, F and G, so that they exactly coincide with the similarly lettered holes in the panel, as shown in Fig. 2(a).

Holes C (for C1, C10) and D (for C2, C11) in the front panel follow. The $4\frac{5}{8}$in. dimension given in Fig. 2(a) for the height of these holes was correct with the prototype, but it is advisable to check the hole height required with the aid of the actual 2-gang capacitor employed for C1, C10. Temporarily assemble the panel and chassis by fitting C3 and R13 then, using the actual capacitor with the orientation shown in the above-chassis photograph, find the height required for hole C. Mark off hole D to the same height and drill these two holes $\frac{3}{8}$in. Capacitor C2, C11 is bolted direct to the front panel and its mounting holes may also be drilled at this stage. Consult the fitting instructions provided with the dial drives, then position C1, C10 so that its spindle projects through the panel by the specified amount, and then mark off its mounting holes on the chassis. Mark off, also, two holes for $\frac{1}{4}$in. grommets, these being positioned to allow wires from the lower fixed vane tags of C1, C10 to pass through the chassis. Working from the dial drive instructions, mark off the anchor

(Continued on page 422)

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300	2/3	4/6	6/6	22/–
400	2/6	5/6	7/6	25/–
500	3/–	6/–	8/6	30/–
600	3/3	6/9	9/–	37/–
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THE 'CRUSADER' SIMPLE SUPERHET

(Continued from page 419)

pin holes for both drives. Remove all components, disassemble the chassis and panel, then drill the mounting holes for C1, C10, the two holes for the grommets, and the dial drive anchor pin holes.

Refer next to Fig. 2(d) which shows the rear apron. Mark out the drill hole K to take ⅝in. grommet. Points H, I and J are the centres of the loudspeaker, aerial-earth and a.f. input socket strips respectively. These are fitted with their long dimensions vertical, and each requires two ⅛in holes for 6BA mounting bolts and two $\frac{5}{16}$in. holes for the metal sockets. Ensure that, when the socket strips are later fitted, there is no risk of the sockets short-circuiting to the metal chassis.

Two more tagstrips require mounting holes in the rear apron. These are both 4-way with end tags earthed (see Figs. 3 and 4) and their positions, which are not critical, can be clearly seen in the under-chassis photograph. Mark out and drill the mounting holes for these tagstrips.

The only two components for which mounting holes have not yet been drilled are output transformer T1 and Tagstrip 2 (see Fig. 8). These are fitted to the side apron adjacent to V3 and V4. Again consult the under-chassis photograph, which shows both these components. Position T1 so that its tagstrip projects towards the rear of the chassis and mark out and drill its two mounting holes. Position Tagstrip 2 with its tag 6 nearest the rear of the chassis and mark out and drill its two mounting holes. The tagstrip should allow adequate clearance for the a.f. gain control when this is fitted later.

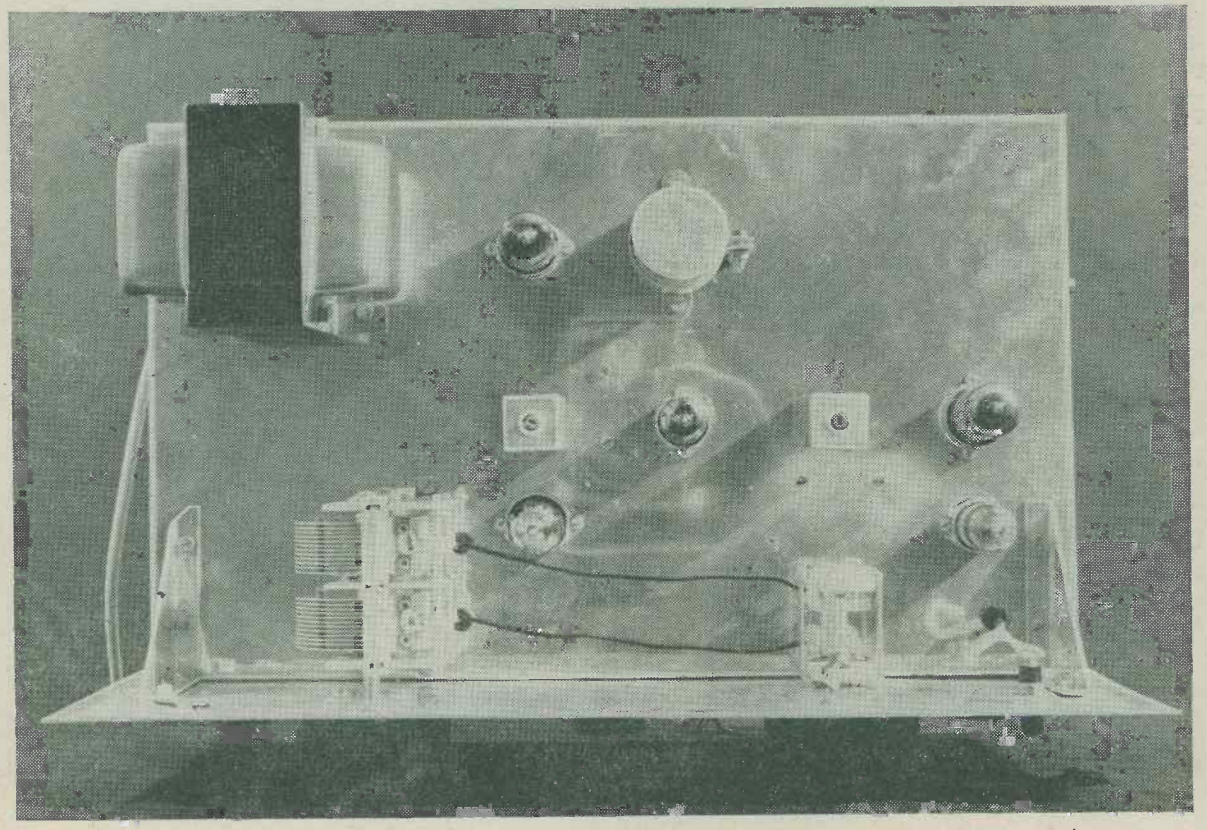
Take up the two angle brackets and drill each mounting surface with two conveniently positioned $^5/_{32}$in holes for 4BA bolts. Temporarily assemble the panel and chassis by mounting C3 and R13 and mark out the corresponding holes required in the chassis and panel, using the angle brackets as templates. The brackets take up the positions shown in the above-chassis photograph. Disassemble the chassis and panel and drill all the holes which have just been marked out.

Assembly

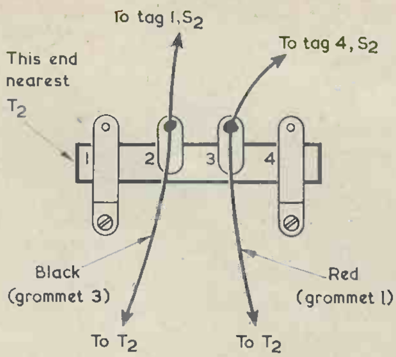
The next process consists of assembling the components of the receiver on the chassis and panel.

Commence by fitting the grommets. There are two ¼in. grommets alongside the C1, C10 position, one ¼in. grommet for the lead to PL1, four ¼in. and two ⅝in. grommets at the main transformer position (see Fig. 5), and one ⅝in. grommet in the rear chassis apron.

On the rear chassis apron mount the loudspeaker socket strip at position H, the aerial-earth socket strip at position I and the a.f. input socket strip at position J. A chassis solder tag should be fitted



Above-chassis view of the 'Crusader'. Stage spacing and layout allow short under-chassis wiring without excessive cramping of components



TAGSTRIP 4

Fig. 3. Wiring-up details for Tagstrip 4. This diagram, in company with Fig. 5, assumes a 240-volt mains supply. The connections required for alternative supply voltages are described in the text

under the aerial-earth socket strip securing nut which is further away from the chassis underside.

Mount V1 valveholder (B9A) with pin 6 nearest the chassis rear, fitting a chassis tag under the mounting nut nearer pin 9. Mount V2 valveholder (B7G) with pin 7 nearest the chassis rear, fitting a chassis tag under the securing nut nearer pin 7. Mount V3 valveholder (B7G) with pin 6 nearest the chassis rear, fitting a chassis tag under the mounting nut nearer pin 7. Mount V4 valveholder (B9A) with pin 9 nearest the chassis rear, fitting a chassis tag under the mounting nut nearer pin 9. Finally, mount V5 valveholder (B9A) with pin 2 nearest the chassis rear, fitting a chassis tag under the mounting nut nearer pin 9.

Mount IFT1 and IFT2, both with tags 1 and 6 nearest the chassis rear. It will be helpful to fit Systoflex sleeving over the solder tags before the transformers are mounted, to obviate the risk of these short-circuiting to chassis.

Mount the dual-electrolytic capacitor, C26, C27, with the red tag (corresponding to C27) nearest the chassis rear.

Take up 2-gang capacitor C1, C10 and, to each of its lower fixed vane tags (i.e. lower when the capacitor is mounted), solder *two* insulated wires one about 4in. and the other about 10in. long. The wires are soldered to the tags before the capacitor is mounted because it is difficult to reach the tags afterwards. Thread the short wire from each tag through the approximately positioned $\frac{1}{4}$in. grommet on the chassis, and mount C1, C10 in position. The two long wires remaining above the chassis will connect later to C2, C11.

Mount output transformer T1 with its tagstrip projecting towards the chassis rear.

Turn to Fig. 5 and note the different wires from the mains transformer, T2, which pass through grommets 1 to 6. Carefully pass the transformer wires through these grommets as indicated, taking care that none of the grommets is displaced, then finally mount T2 in position.

Assemble the panel and chassis together by fitting C3 and R13. The fixed vane tags of C3 should be towards the chassis centre, and the three tags of R13 should be away from the chassis underside. Using a small hacksaw, cut the spindle of R13 to the same length as that of C3.

Secure the two angle brackets to the panel and chassis.

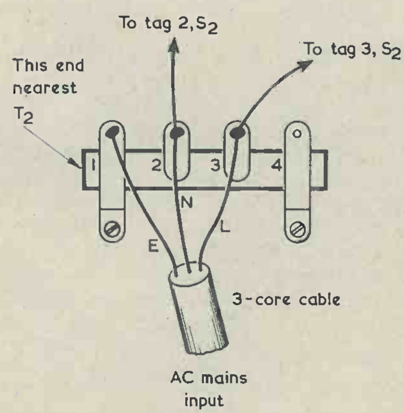
Take up the coilpack and turn to Fig. 10. Solder a $2\frac{1}{2}$in. length of insulated wire to the green coilpack tag, the free end being bared for connection later. Solder one end of R5 to the red tag of the coilpack, the lead being covered with Systoflex sleeving and allowing a spacing of about $\frac{1}{2}$in. between the tag and the resistor body. The free lead of the resistor is left uncut for the moment. These two connections are made at this stage because the tags concerned are difficult to reach after the coilpack has been mounted.

Mount the coilpack with the trimmer bank furthest away from the chassis underside. The lower edge of the coilpack will be hard against the chassis underside.

Mount the two 4-way tagstrips to the rear chassis apron.

Fit the tuning drive anchor pins to the front panel. Mount the bandspread capacitor C2, C11, then fit both tuning drives. Mount pilot lamp PL1. Fit the '*Crusader*' motif in the manner already described.

Assembly is now complete. The three tagstrips not yet fitted are mounted later after having been partly pre-wired.



TAGSTRIP 5

Fig. 4. Wiring-up details for Tagstrip 5

Wiring-up may now commence. As with the chassis-work, it is assumed that the constructor who builds the '*Crusader*' will have acquired sufficient experience to be able to undertake the wiring of this design. Nevertheless, the wiring instruc-

tions are still, for convenience, given in numbered steps. Soldering at a connection or connections should only be carried out where stated. The main points to remember are that signal-carrying wires should be kept short, and that Systoflex sleeving should be employed wherever there is any risk of short-circuits between component leads and adjacent wiring or connections. The components illustrated in the tagstrip wiring diagrams are shown spaced out for clarity. In practice, these components should be wired into circuit with short leads.

WIRING-UP

1. The first part of the circuit to wire up is the power supply section, and Figs. 3, 4, 5 and 11 show the wiring required here. Tagstrip 5, in Fig. 4, is the 4-way tagstrip which is nearer the mains transformer, T2. Tagstrip 4, shown in Fig. 3, is the remaining tagstrip on the rear chassis apron. The mains input lead connects to tagstrip 5, from which two leads then carry the neutral and live inputs to S2 on the rear of a.f. gain control R13. Two further leads return from S2, carrying the switched mains input to tags 2 and 3 of Tagstrip 4. Fig. 11 does not show the exact layout of the switch tags for S2 because tag layout varies for different switches. The constructor must, in consequence, trace through the two poles of the switch with the aid of an ohmmeter or a simple continuity tester consisting, say, of a battery and bulb in series, before making connections to this switch. The two leads from Tagstrip 5 to the switch should be twisted together, as also should the two leads from

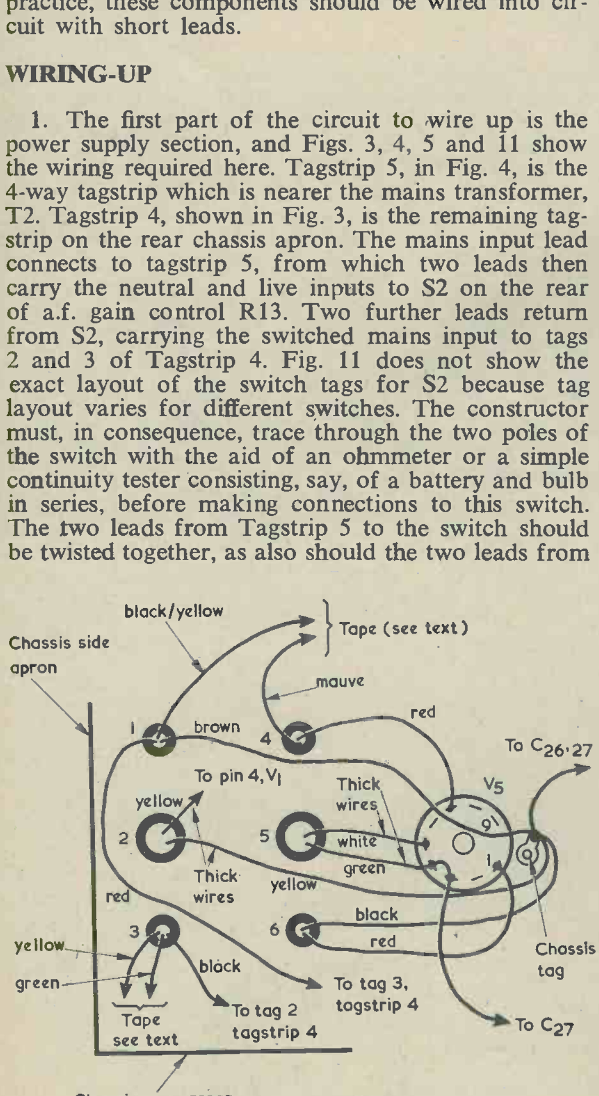


Fig. 5. Point-to-point wiring diagram for the power supply section around V5

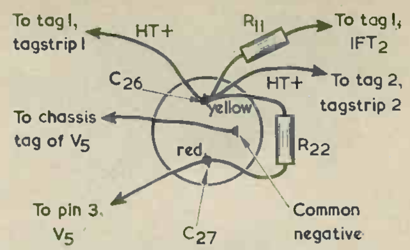


Fig. 6. The connections to C26, C27

the switch back to Tagstrip 4. The two twisted pairs should run along the rear and side (under transformer T1) on their route to the switch. Keep them well tucked into the under-chassis corner. The mains lead should be secured with a suitable clamp fitted under the securing nut of T1 which is nearest Tagstrip 5, and its free end should be terminated in a 3-way mains plug having the requisite earth pin. If the mains plug is fitted with a fuse, this should be rated at 3 amps.

The connections to the mains transformer shown in Figs. 3 and 5 assume that the receiver is to be powered from 240 volt a.c. mains. This voltage is common over most of the U.K., but a few districts may have lower mains voltages. For 220 volt mains connect the green lead from grommet 3 (Fig. 5) to tag 3 of Tagstrip 4 instead of the red lead from grommet 1. For 200 volt mains connect the yellow lead from grommet 3 to tag 3 of Tagstrip 4 instead of the red lead from grommet 1.

The black/yellow lead from grommet 1, and the mauve lead from grommet 4 are not used. These are taped up *separately* to ensure that they cannot make contact with the chassis, and neatly tucked out of the way. According to the mains voltage tapping, two of the three primary leads – red from grommet 1, green from grommet 3 and yellow from grommet 3 – will not be used. The two unused leads must be similarly taped up separately and neatly tucked out of the way.

The thick yellow lead from grommet 2 travels across the chassis to pin 4 of V1. This is the 6.3 volt heater supply, and it should be continued to pin 3 of V2, pin 4 of V4, pin 3 of V3, and (passing through the chassis grommet) to one terminal of PL1. Keep the heater wiring under the chassis close to the chassis underside. All connections made in Step 1 are soldered.

2. Carry on next to the connections at C26, C27 which are shown in Fig. 6. The free ends of the leads from C26 to tag 1 of Tagstrip 1 and tag 2 of Tagstrip 2 are connected when these are mounted later. The free end of R11 is also connected later. All connections shown are soldered.

3. Turn next to Fig. 7, which shows Tagstrip 1. Wire up all the components shown here, soldering all connections except that at tag 1. The free lead from tag 2 should be some 6in. long, but that from tag 5 need only be about 4in. in length (as should all the free leads from Tagstrips 2 and 3). The leads are shortened as necessary when they are later connected into circuit.

4. Take up Tagstrip 2 and wire this as shown in Fig. 8, soldering all connections except those at tag

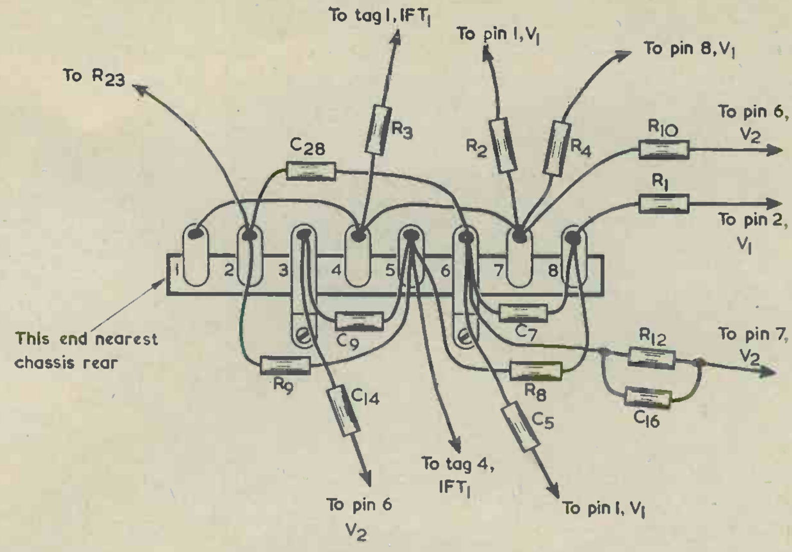


Fig. 7. The wiring and components fitted to Tagstrip 1

2. Take care to connect C24 with correct polarity (i.e. positive lead to tag 3).

5. Proceed to Tagstrip 3 and wire this as shown in Fig. 9, soldering all connections. Ensure that C21 is connected into circuit with correct polarity.

6. Mount Tagstrip 1 between V1 and IFT1, with tag 1 nearest the chassis rear. Mount Tagstrip 2 to the side apron with tag 6 nearest the chassis rear. Mount Tagstrip 3 forward of IFT2, with tag 1 nearest the chassis centre.

7. Some of the coilpack connections are now made. The coilpack layout is given in Fig. 10. Resistor R5 has already been connected to the red tag. Shortening as necessary, solder the free end of R5 to one lead of C13, connecting the other lead of C13 to pin 8 of V1.

8. Connect the free end of R1 (from Tagstrip 1) to pin 2 of V1, together with one lead of C4. Solder at pin 2. Connect the free lead of C4 to the short lead already fitted to the green tag of the coilpack, keeping the junction fairly close to the grommet through which passes the lead from C1 (front gang). Shortening as necessary, connect the lead from C1 to this junction. Connect also a lead from one of the fixed vane tags of C3 to this junction. Solder at the junction and at C3.

9. Connect the yellow tag of the coilpack to V3 chassis tag. Solder at the yellow tag.

10. Connect the chassis tag of V1 to V1 centre spigot, continuing to pin 5. Connect R6 and C8 between the chassis tag and pin 3 of V1. Connect R7 between pins 3 and 7 of V1. Solder at the centre spigot and pins 3 and 5.

11. Join pins 9 and 7 of V1. Connect one end of C12 to pin 7 of V1 and solder at pins 9 and 7. Shortening as necessary, connect to the free end of C12 the lead passing through the chassis from C10 (rear gang) and the blue lead from the coilpack (see Fig. 10). Solder this last connection.

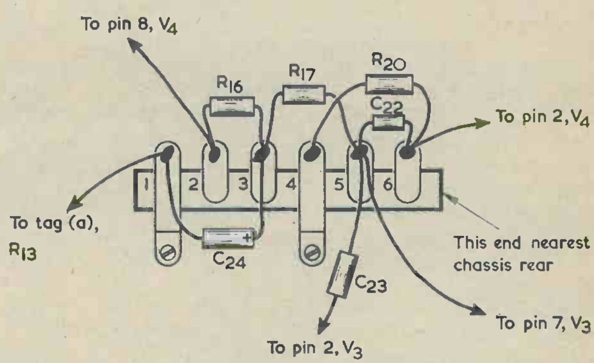
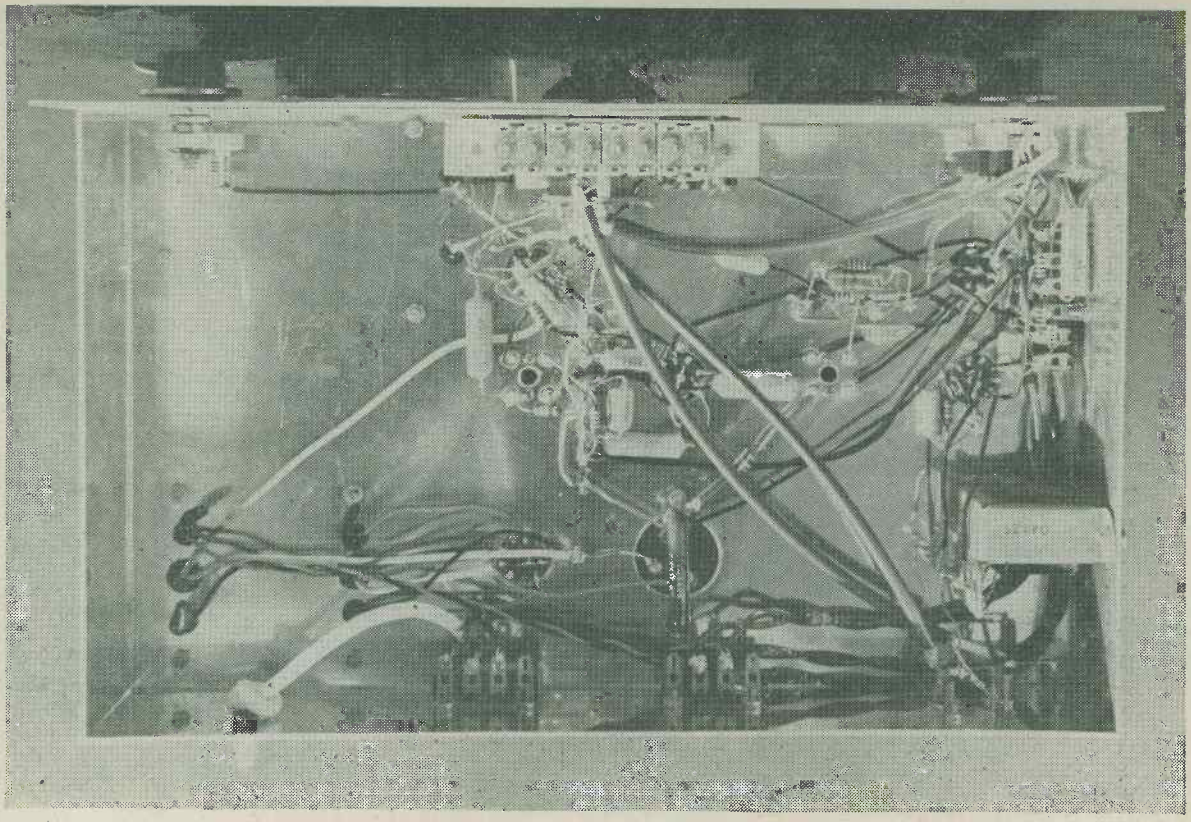


Fig. 8. Wiring-up details for Tagstrip 2

12. Connect the following components from Tagstrip 1 to V1 valveholder: R4 to pin 8, R2 to pin 1, and C5 to pin 1. Solder at pins 8 and 1.

13. Connect pin 6 of V1 to tag 3 of IFT1. Solder at pin 6 and tag 3.

14. Connect R3 from Tagstrip 1 to tag 1 of IFT1.



Underneath the 'Crusader' chassis. Note that the output transformer is mounted on a side apron

Connect C6 between tag 1 of IFT1 and V1 chassis tag. Solder at tag 1 and the chassis tag.

15. Connect the chassis tag of V2 to V2 centre spigot, carrying on to pin 4 of V2. Solder at the centre spigot and pin 4. Connect pin 2 of V2 to pin 7 of V2. Solder at pin 2.

16. Connect the following components from Tagstrip 1 to V2 valveholder: R12 to pin 7, C16 to pin 7, C14 to pin 6, and R10 to pin 6. Solder at pins 7 and 6.

17. Connect tag 6 of IFT1 to pin 1 of V2. Solder both connections. Shortening as necessary, connect the lead from tag 5 of Tagstrip 1 to tap 4 of IFT1. Solder at tag 4.

18. Connect C17 between pin 5 of V2 and pin 5 of V3. Its lead-outs may need extending, and they should be suitably covered with Systoflex. Connect pin 5 of V2 to tag 3 of IFT2. Solder at pin 5 of V2 and tag 3.

19. Connect the chassis tag of V3 to V3 centre spigot, continuing to pin 4. Solder at the centre spigot and pin 4.

20. Connect R23 between pin 5 of V3 and the lead from tag 2 of Tagstrip 1. Arrange these connections such that the body of R23 is close to V3 valveholder and that a short length of Systoflex sleeving may be passed over the junction of R23 and the lead after it has been soldered (this is achieved by initially passing the sleeving over the lead). Solder at this junction.

21. Connect R19 between pin 5 of V3 and V3 chassis tag. Solder at pin 5.

22. Connect a wire to V3 chassis tag, pass it through the adjacent grommet and connect it to the

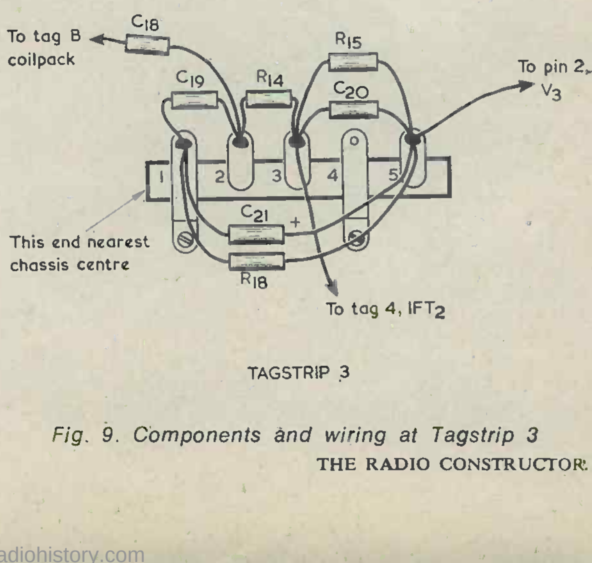


Fig. 9. Components and wiring at Tagstrip 3

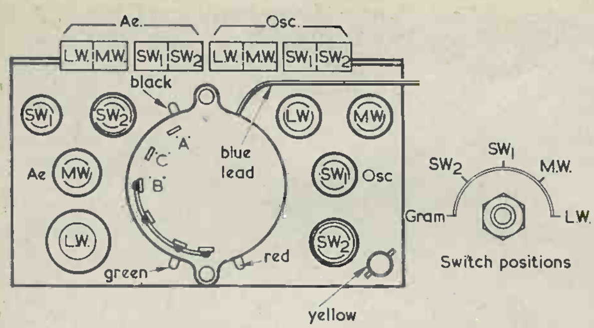


Fig. 10. The coilpack, as viewed from the rear. Also shown are switch positions as they appear on the front panel

tag of PL1 to which no connection has yet been made. Solder at PL1 tag and the chassis tag.

23. Connect the lead from tag 5 of Tagstrip 3 to pin 2 of V3. Connect C23 from Tagstrip 2 to pin 2 of V3. Solder at pin 2.

24. Connect the lead from tag 5 of Tagstrip 2 to pin 7 of V3. Solder at pin 7.

25. Connect the free end of R11 (see Fig. 6) to tag 1 of IFT2. Connect C15 between tag 1 of IFT2 and V2 chassis tag. Solder at tag 1 and the chassis tag. Connect one free lead from C26 (see Fig. 6) to tag 1 of Tagstrip 1, and the other free lead from C26 to tag 2 of Tagstrip 2. Solder at both these tags.

26. Connect the lead from tag 3 of Tagstrip 3 to tag 4 of IFT2. Solder at tag 4.

27. Connect tag 6 of IFT2 to pin 6 of V3. Solder both connections.

28. Connect pin 1 of V3 to tag (b) of R13 (see Fig. 11). Keep this lead clear of the wires connecting to S2. Solder both connections.

29. Connect V4 chassis tag to its centre spigot, carrying on to pin 5. Solder at the spigot and pin 5.

30. Connect R21 between pin 3 of V4 and its chassis tag. Connect C25 between pin 3 of V4 and the chassis tag, with its positive lead-out to pin 3. Connect together pins 3 and 9. Solder at pins 3 and 9 and at the chassis tag.

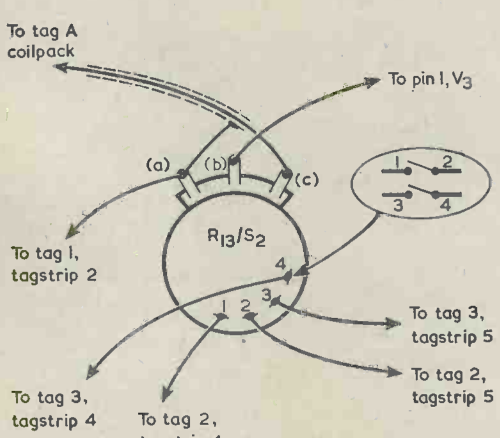


Fig. 11. Wiring to the combined a.f. gain control and on-off switch. As is explained in the text, switch tags must be identified with the aid of an ohmmeter or continuity tester before any connections are made to them

31. Connect the lead from tag 6 of Tagstrip 2 to pin 2 of V4. Solder at pin 2. Connect the lead from tag 2 of Tagstrip 2 to pin 8 of V4.

32. Connect pin 8 of V4 to tag 6 of output transformer T1 (see Fig. 12). Solder at both connections. Connect pin 7 of V4 to tag 1 of T1. Solder at both connections.

33. Connect the chassis tag at the three input sockets to the earth socket on the aerial/earth socket strip (the central strip) and to one socket of each of the remaining two strips. Solder at the chassis tag.

34. Connect tag 3 of T1 to the earthed tag of the speaker socket strip (nearest the chassis edge). Solder at both connections.

35. Connect tag 4 of T1 to the remaining socket of the speaker socket strip. Solder at both connections.

36. Connect the wire from tag 1 of Tagstrip 2 to tag (a) of R13 (see Fig. 11). Connect the centre conductor of a suitable length of coaxial cable to tag A of the coilpack (see Fig. 10). Connect the centre conductor at the other end to tag (c) of R13, and the braiding to tag (a) of R13. Solder at tags (a) and (c) and at tag A of the coilpack. Note that the braiding is earthed at the R13 end only.

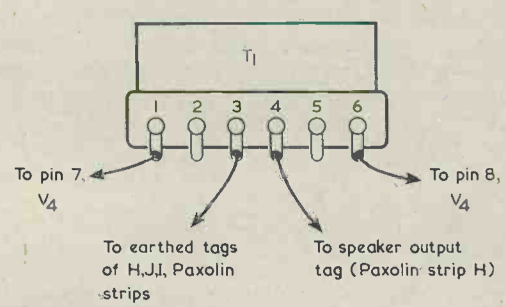


Fig. 12. The connections to output transformer T1

37. Connect C18 from Tagstrip 3 to tag B of the coilpack. Solder at tag B.

38. Connect the centre conductor of a suitable length of coaxial cable to tag C of the coilpack. Connect the braiding at the other end to the earthed tag of the a.f. input socket strip, and the centre conductor to the remaining socket. Solder at tag C and both sockets. Note that the braiding is earthed at the socket end only.

39. Connect the centre conductor of a suitable length of coaxial cable to the black tag of the coilpack. Connect the braiding at the other end to the earthed tag of the aerial/earth socket strip, and the centre conductor to the remaining socket. Solder at the black tag and both sockets. Note that, once again, the braiding is earthed at the socket end only.

40. Turn the chassis over and, shortening as necessary, connect the free lead from C to the fixed vanes tag of C2, and the free lead from C10 to the fixed vanes tag of C11. Solder at both these tags.

41. Fit knobs to C3, to the coilpack spindle and to R13. Wiring-up is now complete.

(To be concluded)

OSCILLATING VALVE E.H.T. GENERATOR

by

E. G. H. MOBSBY

If you have an old TV line output transformer lying around in your spares box you may be able to profitably employ it for the provision of e.h.t. for an oscilloscope. This short article describes one man's approach to this process, and the points discussed should fire off ideas along similar lines. The circuit used is, of course, experimental and is intended for readers having practical experience of line output transformers and the manner in which they function

THE E.H.T. REQUIREMENTS OF OSCILLOSCOPES CAN be something of a problem. Most oscilloscope circuits published recently employ either low voltage tubes, or voltage doubled or trebled circuits. The writer has used both these latter circuits and also 2,000 volt windings on home-made mains transformers. Both direct and multiplied circuits have invariably suffered transformer failures after a period around two years. It seems that insulation fails, presumably due to damp conditions and lack of impregnation of the windings. (The author used polythene between each layer of wire.)

LOW-COST CIRCUIT

It was therefore decided to design a cheap e.h.t. circuit which was *not* dependent upon the insulation of high voltage circuits. It is the familiar high frequency oscillator and transformer combination, but it employs a frequency of 6kHz so as to make use of an old TV line output transformer.

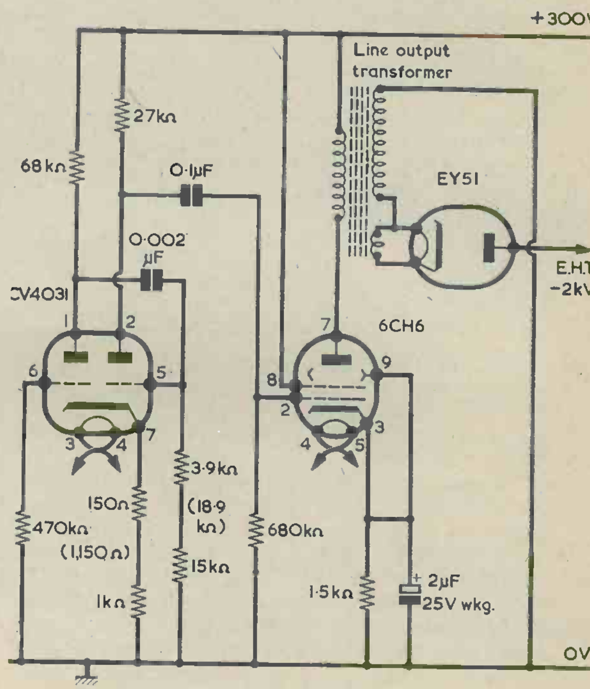
The oscillator comprises a free-running cathode coupled multivibrator whose output is amplified by a pentode and is then fed to the line output transformer. The e.h.t. rectifier – normally fitted on top of this transformer – is retained.

The cathode ray tube used in the author's oscilloscope is the still popular VCR97 which requires an e.h.t. supply of 2kV. The transformer employed was an oil-immersed type in an aluminium can which came from a 14in. TV set and presumably originally gave around 10kV. It was found that, if the maximum signal possible was squeezed from the oscillator and fed to a video output pentode, this was sufficient to produce 2.3kV, which fell to 2kV after two hours or so of operation.

As no circuit was available for the line output transformer, the author removed its case and the oil it contained in order to trace out its circuit. He afterwards replaced the can, without oil, in order to remove a 6kHz signal from the oscilloscope trace.

Operation at 2kV should not require oil immersion but, if the output had been at a considerably higher voltage, it would have been wise to have retained the oil.

The entire unit was built from the "odds and ends' box and employed a CV4031 (double triode with single cathode, equivalent to the Mullard M8081) as oscillator, and a 6CH6 (video output pentode) as an amplifier.



The experimental circuit employed for obtaining an oscilloscope e.h.t. supply

The oscillator frequency is varied by the value of the resistor from the right hand grid to chassis. The value of this is determined by the temporary use of a potentiometer which is adjusted to produce maximum volts and is then replaced by a fixed resistor of appropriate value. The circuit shows both this grid resistor and the cathode resistor made up, in practice, of two separate resistors in series. This approach was used to obtain exactly the results required by the writer in his own particular instance.

This short article is, of course, only intended to offer a suggestion to the experimenter, since it is very probable that varying e.h.t. voltages will be given with different line output transformers. Don't forget that some of these e.h.t. voltages may be considerably higher than occurred in the writer's case! The CV4031 could, very probably, be replaced by a 12AU7, the latter using approximately the same capacitance and resistance values. ■

Switch-off Flasher

by

S. A. THOMAS

A switch-off reminder circuit for transistor equipment which consumes negligible power

ONE OF THE MORE IRRITATING FEATURES OF battery-operated transistor equipment is that it is uneconomical to fit a pilot lamp to indicate that the equipment is switched on. In consequence, it is possible for such equipment to be left accidentally turned on for long periods of time.

The device described here helps towards ensuring that the user of the equipment does not forget to switch it off. It operates by having a light flash *after* switch-off, with the result that the user receives a more positive recollection of switching off than is provided by simply flicking a switch. The author, who would not be first in the queue when prizes for good memory are handed out, has used the circuit for over a year in a transistor signal generator. Whereas, previously, this generator was occasionally left switched on all night, it is now turned off immediately work with it has ended. Perhaps it is the novelty of the flashing effect which causes the writer to turn off the generator and hence activate the bulb, or perhaps it is just that the action of turning off the switch causes a subsequent *event* rather than the mere cessation of signal generator operation. Whatever the reason, a battery in that signal generator nowadays lasts a lot longer than it used to do!

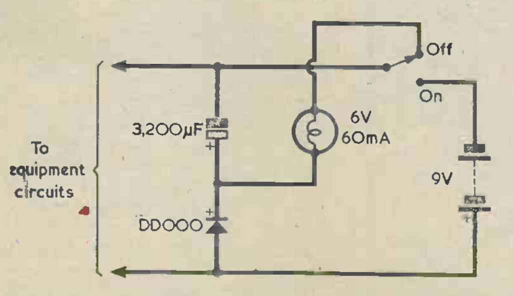


Fig. 1. The circuit of the switch-off reminder. This causes the lamp to flash when the switch is set to "Off"

CAPACITOR DISCHARGE

The circuit used is shown in Fig. 1, and is applicable to any transistor equipment running from a 9-volt battery. The only limitation is that the on-off switch must be a double-throw type, preferably of the toggle type. The circuit cannot therefore be used with a transistor radio whose on-off switch is ganged with the volume control, as volume control switches are single-throw only.

Fig. 1 shows the on-off switch in the "off" position. When the switch is set to "on" it applies the 9-volt battery to the supply rails of the associated transistor equipment and also to the electrolytic capacitor and diode in series. The capacitor charges via the diode until the voltage across it is equal to the battery voltage less the forward voltage dropped in the diode. After this process, the capacitor remains charged and draws no further current other than that due to its leakage resistance.

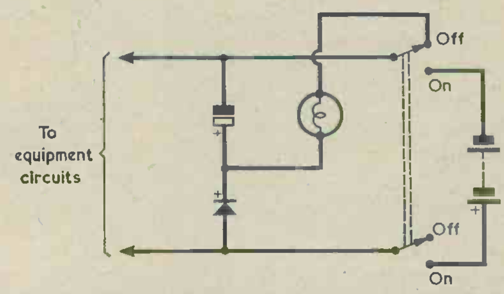


Fig. 2. The same basic circuit and components are employed with a double-pole on-off switch

When the switch is put to "off", the 9-volt battery is disconnected and the 6-volt lamp is connected across the electrolytic capacitor. The capacitor then discharges into the lamp, causing this to flash brightly. The capacitor cannot, incidentally, discharge into the circuits of the supplied equipment, because the diode prevents the flow of discharge current. If, on the other hand, the supplied equipment has a large-value electrolytic capacitor across its supply rails which would normally discharge more slowly than the capacitor in Fig. 1, this capacitor will now discharge via the diode into the lamp as well, increasing the length of the flash. With equipment of this nature it would probably be possible to dispense with the diode, the lower terminals of the capacitor and the lamp connecting direct to the lower supply rail. This modification could be checked experimentally.

The circuit may be employed equally effectively with equipment having a double-pole on-off switch, provided that a double-throw facility is available at one of the poles. The circuit used is shown in Fig. 2, and its operation, apart from the additional switch pole, is the same as that of Fig. 1.

The electrolytic capacitor is a Mullard 3,200µF component having a maximum working voltage of ten volts. The lamp is a 6-volt 60mA type retailed by Home Radio under Cat. No. PL7. The diode may be any small silicon rectifier, such as the DDOOO shown in the diagram.

As can be visualised, the circuit draws negligible current from the battery. In the author's unit the leakage current drawn by the electrolytic capacitor was measured, and was found to be 6µA only. ■

The Export Spontaflex
A 13.8 to 645 Metre Portable

by

SIR DOUGLAS HALL, K.C.M.G., M.A.(Oxon)

Specifically designed to provide reception of short wave broadcast transmissions, this receiver represents an attractive project for overseas readers as well as for constructors resident in the U.K.

In European countries, the main interest offered by the short wave bands tends towards Dx listening, entertainment being provided by the medium, long and v.h.f. bands. But there are many parts of the world where the short wave bands provide the only radio entertainment which is available. This receiver will be found especially useful by readers who live in such parts, as did the author for some 30 years. It will also, of course, provide additional entertainment for constructors in the U.K.

Coverage, by means of plug-in coils, is given for all the bands from 13 metres upwards. Provision for medium wave listening is also available although, if the self-contained telescopic aerial is employed, this is for fairly powerful stations only. Medium wave pick-up by this means, and without an earth connection, is less efficient than that given by even quite a short ferrite rod, but a ferrite rod cannot easily be used with this circuit. Far greater sensitivity will be offered of the medium wave band – and indeed on all wavebands from about 50 metres upwards – if a longer aerial and an earth connection are used, but selectivity will then suffer. However, some readers will live in places where a small number of comparatively distant medium wave stations produce no problems of selectivity. On wavelengths from 49 metres downwards sensitivity and selectivity, using the telescopic aerial only and no earth, is high. Although the addition of a longer aerial and an earth will increase sensitivity on these bands it will, in most cases, be accompanied by a loss of selectivity which cannot be tolerated, and be quite unnecessary anyhow. The receiver is designed as a self-contained portable.

As the design is primarily for 'programme' listeners, wavelength, rather than frequency coverage, will be mentioned in the text. The prototype has a tuning scale marked in wavelengths.

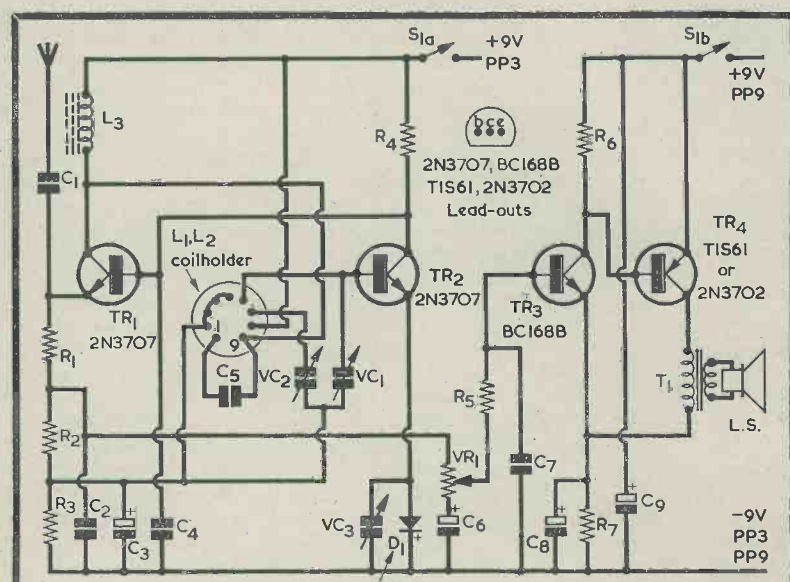


Fig. 1. Complete circuit of the receiver

THE CIRCUIT

The circuit is shown in Fig. 1, which should be studied together with Fig. 2. Fig. 1 shows connections to the contacts of the coilholder while Figs. 2(a) and (b) show the circuit which results when (a) short wave coils are plugged in and (b) the medium wave coil is used.

It will be seen that on short waves the tuner section of the circuit is similar to that used in the author's receiver described in the issue for January 1968, and later modified for silicon transistors as described in the February 1970 issue*. That is to say, the signal is applied to TR1 acting as a common base amplifier, and thence to TR2, the 'Spontaflex' amplifier which, at radio frequencies, provides current amplification as a common collector device. Demodulation is carried out by D1 which also acts as a load, first at radio frequencies and then at audio frequencies. TR2 amplifies again as a common base audio amplifier, the signal being fed back to TR1 which now acts as a common collector audio amplifier. Reaction is applied by the capacitance tap (Colpitts) method, using a variable capacitor across the diode. A choke, L3, is used in parallel, at r.f., with the tuned circuit to enable the radio frequency signal from the output of TR1 to be passed to the input of TR2. The tuning capacitor is VC1.

*Sir Douglas Hall, "The 'Spontaflex' Transistor Short Wave Receiver", January 1968 issue; and "Developing The 'Spontaflex' Short Wave Receiver", February 1970 issue.

When the medium wave coil is plugged in an additional winding is shunted across L3 and transformer coupling results. The choke L3 and the capacitor C5 become inoperative. Also the other section of the split stator tuning capacitor, VC2, is connected across the coil so that on medium waves the maximum tuning capacitance available is increased from 168 to 336pF. which allows the whole of the band to be covered with ease.

The coils used are Denco, Valve type, Miniature Dual Purpose, White, Ranges 1 to 4 inclusive. They are modified by the constructor for use in the present receiver. If any difficulty is experienced in obtaining these coils locally, Denco (Clacton) Ltd., 355 Old Road, Clacton-on-Sea, Essex. will supply direct. Similarly, the tuning capacitor and VC3 may be obtained direct from Jackson Bros. (London) Ltd., Kingsway, Waddon, Croydon, Surrey, CR9 4DG. The coils are primarily intended for use in the oscillator circuit of a valve superhet having an i.f. of 1.6MHz, so that the ranges quoted by the manufacturer are different from those appearing in the Table.

The Table also shows the modifications required for each coil. Note that, although the coupling winding must be removed from coils 2, 3 and 4, it is left in place on coil 1. The removal of windings and the joining of appropriate pins must be carried out with care. A hot iron should be used and only touched on the pins for a very short time or the material of the coil base will tend to melt. A good plan consists of fitting the coil to be modified to a B9A valveholder. which acts as a small heat sink and also holds the pins in place during soldering. The coil may then be removed when it is certain that the plastic is cool. The use of a valveholder does not mean, however, that soldering may be carried out other than quickly and with a hot iron. For the inter-pin connections, fine stranded wire should be used to enable the soldering to be carried out quickly. The reason why pins 2, 3, 4 and 5 of the coilholder are, as shown in Figs. 1 and 2, all joined together is that each coil has the earthy end of its main winding taken to a different pin. This has been done by the manufacturer to facilitate the use of different padding capacitors for different ranges when the coils are employed in an oscillator circuit.

COMPONENTS

The transistors specified should be used, transistors type BC168B and TIS61 being available from Amatronix, Ltd. The diode should be an OA81 or equivalent. An OA91 or an OA85 will be suitable, but do not use an unmarked surplus diode. The tuning capacitor is a comparatively expensive component, and some constructors may have a suitable alternative in their spares box. It is important that the capacitor should have low loss insulation, low minimum self-capacitance, and freedom from vibration of the vanes. It may be a split stator type, as specified, or a 2-gang (the only difference being the screen between the two sections), but a 2-gang capacitor of the type used in medium and long wave receivers, with metal ends and fairly high minimum capacitance, will not be satisfactory. If wavelengths higher than about 430 metres are not re-

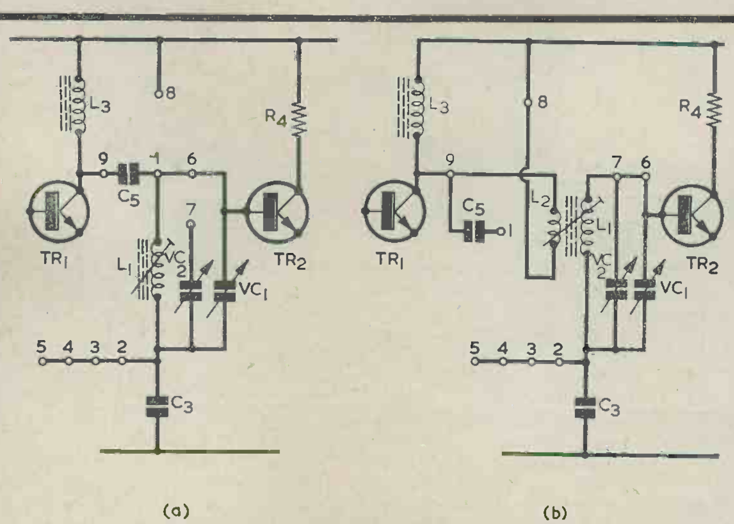


Fig. 2(a). The tuned circuit section when short wave coils are plugged in
(b). The altered circuit given with the medium wave coil

COMPONENTS

Resistors
(All fixed values $\frac{1}{4}$ watt 10%)
- R1 330Ω
- R2 1.5kΩ
- R3 1.5kΩ
- R4 68kΩ (see text)
- ~~R5~~ 330Ω
- R6 1kΩ
- R7 100Ω (see text)
- VR1 5kΩ potentiometer, log track, with 2-pole switch

Capacitors
- C1 100pF
- C2 0.1μF
- C3 100μF electrolytic, 2.5V wkg.
- C4 1,000pF
- C5 22pF
- C6 8μF electrolytic, 4V wkg.
- C7 0.05μF
- C8 1,000μF electrolytic, 2.5V wkg.
- C9 640μF electrolytic, 10V wkg.
- VC1/2 Split stator variable, 168pF each half, Type 603 (Jackson Bros.)
- VC3 100pF variable, 'Dilecon' (Jackson Bros.)

Inductors
- L1/2 Miniature Dual Purpose Coils, Valve, White, Ranges 1, 2, 3 and 4 (Denco)
- L3 2.5mH r.f. choke Type CH1 (Repanco)
- T1 Output transformer Type LT700 (Eagle)

Semiconductors
- TR1 2N3707
- TR2 2N3707
- TR3 BC168B
- TR4 TIS61 or 2N3702
- D1 OA81 or equivalent

Switch
- S1(a)(b) Part of VR1

Speaker
- 3Ω speaker. 7in. x $3\frac{5}{8}$in. (if available) or 7in. x 4in. (see text)

Batteries
- 9V battery Type PP3 (Ever Ready)
- 9V battery Type PP9 (Ever Ready)

Aerial
- Telescopic aerial, 6in. closed, 46in. open, Type TA10 (Eagle)

Miscellaneous
- 2 6-way groupboards, $2\frac{1}{2}$in. x $2\frac{1}{4}$in., Cat. No. BTS11 (Home Radio)
- Epicyclic ball drive, with flange for pointer
- Paxolin tubing for coils (see text)
- Battery connectors
- B9A valveholder
- 3 knobs (see text)
- Material for case, panels, etc.

quired, a single gang capacitor may be used provided it satisfies the other requirements just mentioned. A maximum capacitance of 160 to 170pF is suitable.

Some constructors may only be interested in the long wavelength end of the medium wave band. In Johannesburg, for example, all three medium wave transmission are on wavelengths around 500 metres. Here, a single gang capacitor could be used for VC1, VC2 being replaced by a fixed capacitor of, say, 150pF, which of course, would only be in circuit when the medium wave coil was plugged in.

Use the specified capacitor for VC3. Some alternatives have too high a minimum capacitance, resulting in uncontrollable oscillation on certain bands.

Some readers will not require all the coils. Some may find that Range 4, which covers all bands from 13 metres to 31 metres, will be all they need.

The amplifier section which employs TR3 and TR4 needs little comment. The two silicon transistors are used as common emitter amplifiers and there is direct coupling between them, this being simplified by using an n.p.n. followed by a p.n.p. type. The rather unusual volume control circuit allows bias for the base of TR3 to be taken direct from the emitter of TR1. Filtering is provided by C2, R5 and C7.

CONSTRUCTION

When components have been collected, a piece of hardboard should be cut to measure 8½in. by 7½in. This assumes the use of a speaker measuring 7in. by 3⅝in. If a 7in. by 4in. speaker is used, the width of the board should be increased to 8⅞in. A hole should be cut to make an aperture for the speaker, and its mounting holes should next be drilled. Also, drill holes to enable VC1/2 to be fitted by means of four 4BA bolts as in Fig. 4. Note that the epicyclic drive is fitted to the inside of the top panel, which means that the end of the spindle of VC1/2 should be about ⅜in. inside the edge of the hardboard panel. Neither VC1/2 or the speaker is mounted yet. It should be pointed out that a margin of ¼in. must be left free of components and wiring along all the four edges of the hardboard panel.

A small rectangular hole should be cut in the panel to allow the coils to be plugged into the holder, as shown in Fig. 4, and the bolts which serve to join the holder to one of the 6-way groupboards also serve to hold this groupboard to the panel. Next cut a hole in the groupboard, as in Fig. 3(a) and bolt holder and groupboard to the hardboard panel. The coils plug in from the other side of the panel, as may be seen from the photograph showing the front of the receiver. Wire up small components as in Fig. 3(a).

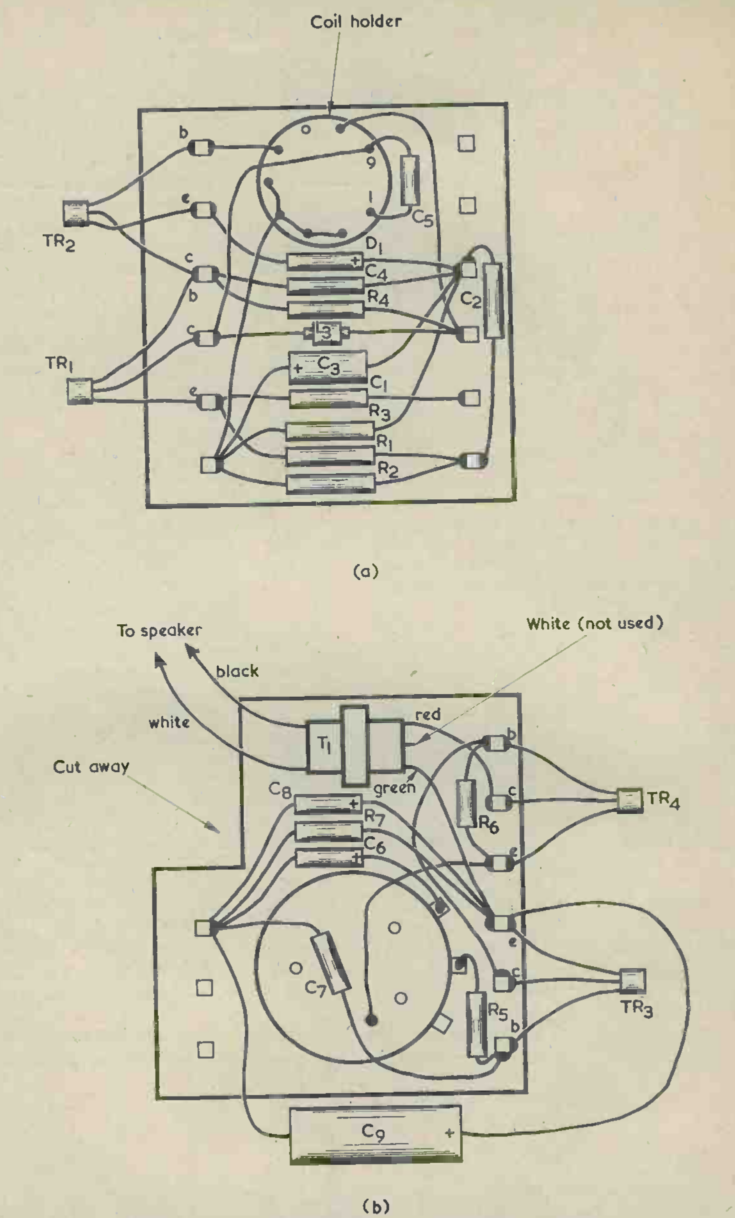


Fig. 3(a). Components and wiring on the tuner section groupboard (b). The components fitted to the amplifier groupboard

Next prepare the second 6-way groupboard as in Fig. 3(b). Note that a section is cut away to avoid fouling the speaker frame. A ⅜in. hole is required for VR1. Other components should be wired up as in Fig. 3(b).

The top panel is made of ¼in. plywood and should measure 8in. by 2½in., or 8⅜in. by 2½in. if a 7in. by 4in. speaker is used. (The 2½in. dimension may need to be increased with some speakers, as is discussed shortly when dealing with the case.) A hole about ¾in. in diameter is needed for the epicyclic drive, the exact position of which is carefully marked after fitting VC1/2 to the hardboard panel. This is done by holding the top panel in position such that the spindle of the capacitor mates with the drive which, as already stated, is mounted on the inside of the top panel. VC3 is mounted as shown, and the amplifier groupboard is held in position by the securing nut of

VR1, its spindle passing through the groupboard and the top panel.

The telescopic aerial is secured by means of a bracket at the lower end and a clip higher up, as shown in Fig. 4. A suitable hole must be drilled through the top panel to allow the aerial to protrude. It is assumed here that the edges of the speaker frame taper away, allowing the bracket and clip for the aerial to be bolted to the panel without making contact with the speaker frame. If a speaker with a fully rectangular frame is used it may be necessary to make up insulated brackets which can be secured by the speaker mounting bolts, as there must be no electrical contact between aerial and speaker.

A small metal clip should be made to hold the PP3 battery in position. It was found convenient to steady the PP9 battery by means of small curtain wire hooks screwed into the inside of the case after its assembly, with a rubber band between them.

The speaker can now be mounted and final connections between the groupboards, tuning capacitor, aerial, speaker and batteries made up, as in Fig. 4. Also, the top panel is screwed to the hardboard panel.

CASE AND COILS

The dimensions quoted for the case, which is shown in Fig. 5, assume that the speaker is not more than $2\frac{1}{4}$in. deep. If the speaker has a greater depth, the $2\frac{1}{2}$in. dimensions for the three sides and (as was mentioned earlier) the top panel must be increased accordingly. Similarly, the 8in. dimension for the base will need to be increased to $8\frac{3}{8}$in. if a 7in. by 4in. speaker is used. With the wider speaker, the $8\frac{1}{2}$in. dimension of the back will need to be increased to $8\frac{7}{8}$in.

As the top and front of the 'chassis' will be exposed, constructors will wish to tidy these up by making a false front incorporating a piece of speaker gauze, and a false top on which wavelengths and the functions of the controls can be shown. A large part of the back needs to be hinged to allow easy access to the coils and batteries.

TABLE

Denco Valve type Miniature Dual Purpose White Coils

Coil Range	*Modifications*	*Wavelength (metres)*
1	Connect pin 6 to pin 7.	188 – 645
2	Connect pin 6 to pin 1. Remove small winding.	78 – 200
3	Connect pin 6 to pin 1. Remove small winding.	33 – 85
4	Connect pin 6 to pin 1. Remove small winding.	13.8 – 34

Working to the dimensions given in Fig. 5, the base of the case is made of $\frac{1}{4}$in. plywood and measures 8in. by $2\frac{1}{2}$in. The two sides measure $7\frac{1}{2}$in. by $2\frac{1}{2}$in., and one narrow edge of each is screwed to the ends of the base. The back initially requires a piece of $\frac{1}{4}$in. plywood measuring $8\frac{1}{2}$in. by $7\frac{1}{2}$in., this being cut again, twice, to leave two strips $8\frac{1}{2}$in. by 1in. These strips are screwed to the other portion of the case as shown in Fig. 5, leaving an opening measuring $8\frac{1}{2}$in. by $5\frac{1}{2}$in. A pair of small hinges and a catch are then mounted as shown. The case may be covered with 'Fablon' or 'Contact', or otherwise tidied up, and the 'chassis' screwed to it, the $\frac{1}{4}$in. margin left round the edge of the main panel having been left for this purpose.

It will, incidentally, be found more convenient to check out receiver performance before adding the case sides and back.

It is advisable to enclose the coils in short lengths of insulated tubing, which should be $\frac{5}{8}$in. inside diameter. A 12in. length will provide ample for the four coils. A small nick should be made at one end of each tube to accommodate the pip on the coil base. These tubes will protect the coils, particularly when being carried in the case on journeys. A piece of plywood, $3\frac{1}{2}$in. by $1\frac{1}{2}$in. with four $\frac{3}{4}$in. holes drilled in it will provide a handy way of carrying coils when they are not in use. There is room for them at the base of the speaker in the completed case. Suitable Paxolin tubing is sold by Home Radio. Two 6in. lengths of $\frac{3}{4}$in. outside diameter tubing will be required, Catalogue No. ZA23.

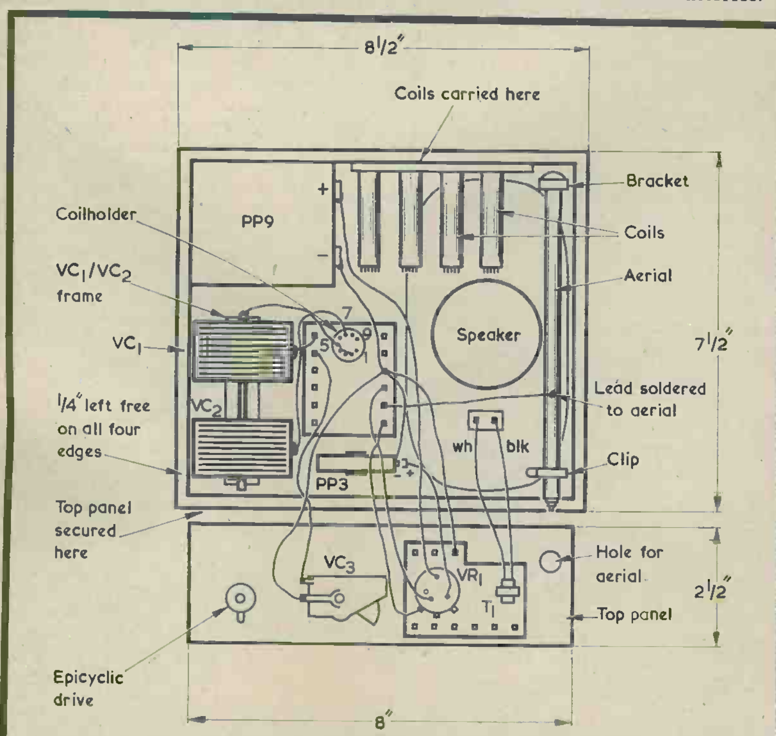


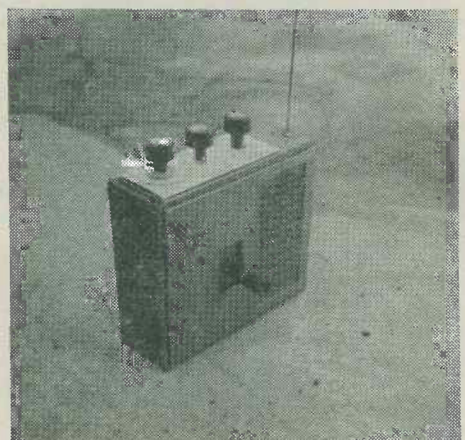
Fig. 4. Final steps in wiring and assembly. Identify switch tags with a continuity tester to ensure that they conform with the circuit of Fig. 1

CHECKING PERFORMANCE

Batteries having been connected up, the receiver may be tried out. No adjustments should be necessary except to the cores of the coils, to ensure that correct wavelength coverage takes place. It will be found that the cores of coils 1 and 4 will need to be about half-way out, the core of coil 2 about three-quarters of the way out, and that of coil 3 almost fully out, in order

The top and front panels of the receiver before the sides and back are fitted

The hinged back gives ready access to spare coils and the batteries



A front view of the completed receiver, with a coil plugged in

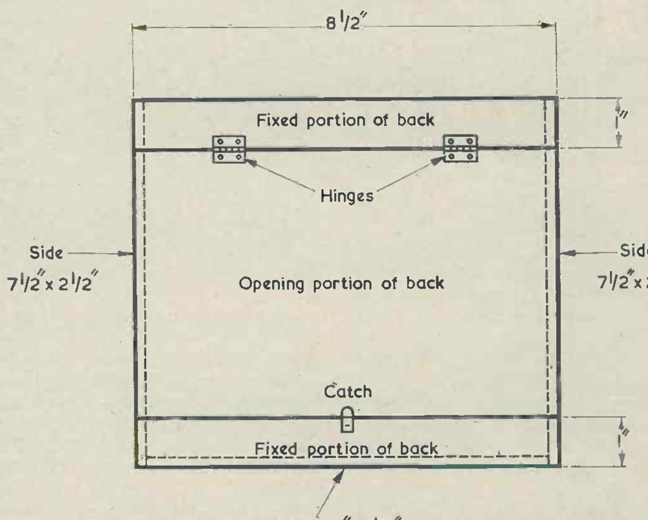


Fig. 5. Rear view of the case. As is described in the text dimensions may require altering with some loudspeakers

for comfortable overlap to take place. On coil 4 oscillation will start with VC3 only advanced a very short distance when the vanes of VC1/2 are fully open it being necessary to advance the setting of VC3 gradually as the vanes of the tuning capacitor are closed. With coil 3 the same will apply, except that VC3 will need to start with its vanes a little further enmeshed, and so on, until with coil 1 and the vanes of the tuning capacitor fully enmeshed, VC3 will need to be not far from its maximum position before oscillation takes place.

The value of R4 has much to do with the attainment of smooth reaction throughout the ranges, and has been chosen to suit the great majority of transistors used for TR1 and TR2. But if it should be found that oscillation will not take place satisfactorily with coil 4 in use and the tuning capacitor near minimum (e.g. on the 13 metre band) R4 may be reduced in value to, say, 56kΩ or 47kΩ. If, on the other hand, the position on the 13 metre band is good, but oscillation is difficult to produce at the long wavelength end of the medium wave band (coil 1) R4 may be increased in value to, say, 82kΩ or 100kΩ. For maximum selectivity VC3 should be adjusted to be as near the oscillation point as possible, volume being controlled by VR1.

The only other component which may require alteration is R7. Its value has been chosen with economy in view. The audio output can be increased, at the expense of current taken from the PP9 battery, by reducing the value of R7. It is not recommended that a value lower than 47Ω should be used. With the values of R4 and R7 as shown, the drain of current from the PP3 battery should be about 500μA and from the PP9 battery about 8mA.

The use of two separate batteries is of considerable help in maintaining a high degree of stability with this sensitive circuit. Both batteries are available internationally.

It may be found that hand capacitance is a nuisance, especially at the low wavelength end of each coil range. With the prototype a slight tendency for this was cured by using long necked knobs. In practice a long necked knob was only required for the reaction control, VC3, but for the sake of appearance the other two knobs were similarly equipped. It is not recommended that metal foil connected to the negative supply rail be fitted to the top panel in an attempt to cure hand capacitance. On short wave bands, where no external earth connection is used, this can have the opposite effect to that required, and can also introduce undesirable coupling.

The knob for VC1/2 was equipped with a Perspex disc, $2\frac{1}{2}$in. in diameter, round its lower part. This covers the tuning scale and gives a neat appearance. ■

RECENT PUBLICATIONS

TUNERS AND AMPLIFIERS. By John Earl. 187 pages, $5\frac{1}{2}$ x $8\frac{1}{2}$in. Published by Fountain Press, Ltd. Price £2.10 (42s.)

The full title of this volume is "How To Choose And Use Tuners And Amplifiers" and it represents the first of a "How To Choose And Use . . . " series planned by Fountain Press.

The book is designed both to aid the person who is considering the selection and purchase of his first set of high fidelity equipment and to provide up-to-date information for the benefit of those who already have such equipment. It covers virtually every aspect of domestic hi-fi and "mid-fi" tuners and amplifiers, with the emphasis on semiconductor circuits and devices. " . . . The days of the valved amplifiers and tuners," writes Mr. Earl in his Preface, "have now gone for ever, never to return."

Whilst not going into considerable depth when discussing technicalities, the book certainly provides more than adequate detail for the intelligent layman, assuming a surface knowledge of sound waves, radio waves, frequency ranges and the like. This is a refreshing change from the approach of some books on hi-fi which tend to be extremely elementary at technical level, although there is no reason why such books should not complement that under review.

The present work deals with all subjects in its compass from system selection to f.m. multiplex and is very well illustrated with line drawings and photographs. It deserves a place on the book-shelves of any audio enthusiast.

RADIO TRANSMITTERS. By V. O. Stokes. 208 pages, 6 x 9in Published by D. Van Nostrand Co. Ltd. Price £4.50 (£4 10s.).

This book is the latest in the Marconi series covering advances in radio and radar, and is written for the professional engineer engaged on transmitter design, the student, the post-graduate, the transmitter maintenance engineer and the amateur transmitting enthusiast. There is, indeed, a chapter devoted to the design of amateur transmitters.

The author has been with the Marconi Company since 1926. During the period 1945 to 1966 he was responsible for the development and design of all Marconi high power h.f. communications transmitters, including 1kW wideband transmitters (2–27.5MHz) and self-tuned transmitters of 30kW and 7.5kW. Also, he has been a member of the U.K. section of C.C.I.R. Study Group 1. The detail and authority which is patently evident in this book truly reflects the author's background and career.

The volume deals, in Part 1, with high power transmitters, discussing in detail such matters as multi-channel transmission, valve operation, circuit configuration, cooling systems and transmitters in parallel. Part 2 is devoted to medium and low power transmitters, the subject-matter including wideband circuits and the chapter, just mentioned, on amateur transmitters. A final chapter discusses solid-state amplifiers, and it is interesting to note here that the transistor has a long way to go yet before it overtakes the valve in all but the lower power transmitter applications. Six appendices then follow, three of these giving inductance values for single straight conductors, for turns of large diameter and for single-layer solenoids.

RADIO AND AUDIO SERVICING HANDBOOK, Second Edition. By Gordon J. King, Assoc.I.E.R.E., M.I.P.R.E., M.R.T.S. 283 pages, $6\frac{1}{4}$ x $9\frac{3}{4}$in. Published by Newnes-Butterworths. Price £3.

In this second edition of *Radio and Audio Servicing Handbook*, Gordon J. King has retained virtually all the original material of the first edition, and has expanded the text with up-to-date information taking in such new items as f.e.t.'s, complementary output stages, the latest f.m. tuners. tuner-amplifiers, integrated circuits and stereo broadcasting.

The book commences with an introduction to radio servicing, then carries on to chapters dealing with modern radio and audio equipment, mains superhet receivers, f.m. tuners and radios, and valve portable receivers. Subsequent chapters cover transistors and transistor circuits, the servicing of transistor sets, record reproducers, turntable units, and tape recorders. As the author explains in his Preface, he resisted the temptation to delete some of the material on valve equipment which appeared in the first edition since there are still many millions of valved sets, tape recorders and amplifiers which are currently giving very good service but will nevertheless require maintenance.

The text is supported by a large number of clear diagrams, including complete circuit diagrams, with component values shown, of commercially manufactured receivers and amplifiers. The approach is non-mathematical and full attention is paid to practical points, a feature that is particularly important in the servicing field. Although primarily intended for those engaged in servicing, this book will find a readership also amongst the amateur enthusiasts who are interested in recording, high-fidelity reproduction and home-construction. ■

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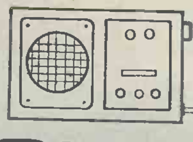


Familiar electronic components are capable of producing performances which are vastly removed from those we normally expect of them. In this month's episode Smithy devotes part of his lunch-hour to showing his assistant, Dick, that a mains transformer primary can, on its own, offer a high step-up of direct voltage, and can even function as a 'memory' unit analogous with the ferrite cores used in computer stores!

"BUT IT'S RIDICULOUS," snorted Smithy. "Who ever heard of Christmas decorations still staying up in *February*?"

His assistant threw a mutinous glance at the Serviceman, but refused to make any reply to his question.

"Dash it all," continued Smithy indignantly, patently working himself up, "this Workshop is supposed to be a place where service engineering is carried out. It's not intended to be a public dance hall. So, for goodness's sake, Dick, and for the umpteenth time of asking, will you please get those Christmas decorations of ours taken down?"

"I've already," returned Dick aggrievedly, "taken down the stuff that was on the benches and the spares cupboard and the windows."

"Perhaps you have," allowed Smithy. "But you've still left the paper chains on the walls, together with that repulsive red object hanging from the middle of the ceiling which was once a fully inflated balloon. Just look around you."

PROTECTIVE DIODE

Smithy put his lunch-time mug of tea down on his bench, then threw his arm out in a gesture which encompassed all the upper section of the Workshop. The decorations, so devotedly put up by Dick on the previous Christmas Eve, still festooned the walls and ceiling. The passage of the months had reduced some of them to a sadly bedraggled state, and they gave the Workshop an unfitting and raddled appearance.

"The trouble with you," snapped Dick accusingly, "is that you've got no appreciation for what other people do for you."

"Meaning?"

"Meaning," enlarged Dick censoriously, "that not only do you expect me to do us both a good turn by first of all putting the decorations *up*, but you then also expect me, on my tod, to take them all down again afterwards."

"Are you actually suggesting," gasped the outraged Smithy, "that *I* should go clambering all over the benches to get them down?"

"Share and share alike is what I always say," returned Dick. "What you forget is that you didn't even offer me the slightest bit of help in putting them up."

"Dash it all," retorted Smithy. "I didn't *want* the blasted things put up."

Dick directed an incredulous glance at the Serviceman.

"You didn't what?"

"I didn't want them put up."

Dick absorbed this information.

"Then why did you say they looked all right at the time?"

"Because it was Christmas and I was flannelling you along," exploded Smithy. "Christmas is the time when you're *expected* to soft-soap people, even including dim-witted twits such as you."

Smithy took a gargantuan draught from his tin mug and let his fury gradually subside. It suddenly occurred to him that there had been no response from Dick to his last statement. Looking up, he saw that his assistant had apparently turned his full attention to a recent copy of *The Radio Constructor*, which was lying open on his bench. There was an uncomfortable silence for several minutes.

Smithy cleared his throat.

Dick stiffened and displayed an even more exaggerated interest in his magazine.

Noisily, Smithy rose and replenished his mug from the tea-pot at the Workshop sink, a task normally carried out by Dick. He returned and slowly drank the tea, then glanced at his watch. A full ten minutes had passed.

Smithy cleared his throat once more.

"For pity's sake," he growled irately, "say something, even if it's only goodbye."

Dick glanced up.

"Do you wish," he remarked icily, "to hold converse."

"Not particularly," admitted Smithy. "On the other hand, though, I find it surprisingly difficult to get used to long periods of silence on your part."

"Very well," conceded Dick. "Perhaps we'd better talk about a subject on which we're more likely to agree. We could, for instance, talk about something technical."

"As you like."

"All right then," said Dick, pointing to a circuit in *The Radio Constructor* . "Here's something that's puzzling me a bit. Why do they put a diode across a relay coil when it's operated by a transistor?"

"As you would almost certainly find out," replied Smithy. "If you took the trouble to read the text of the article concerned, the diode is a protective diode and it prevents the formation of high reverse voltages across the relay coil when the relay releases."

"I don't get it."

"It's simply a question of basic inductance theory," said Smithy. "The type of circuit you're referring to normally has the relay coil in the collector circuit of a transistor. Let's assume for the moment that there's no diode across the coil. Okay?"

"Yes, all right."

"Right," said Smithy briskly. "Now, making the further assumption that the transistor is a p.n.p. type, the collector circuit will connect to a negative supply rail. (Fig.1(a)). When the relay is energised, due to a current flowing into the transistor base, a voltage will be dropped across the relay coil, the lower end of the coil being positive and the upper end negative. Also, a magnetic field will be set up in the coil and soft iron core of the relay."

Smithy paused for a moment to allow Dick to absorb this information.

"Let's next say," he resumed, "that the control current flowing in the base of the transistor suddenly ceases, so that the transistor becomes cut off and the relay releases. Now, the magnetic field in the relay coil and core will suddenly collapse, and the contracting lines of magnetic force will cut the turns of the coil, inducing a voltage in it. The lines of force are now moving in the opposite direction to that given when the relay was originally energised, and the induced voltage has reverse polarity. Another way of looking at it is to say that the coil gives up the energy it acquired when the magnetic field was initially formed, this energy being largely dissipated in the induced reverse voltage. The only component opposing the formation of this voltage is the cut-off transistor, which now offers a high resistance. In consequence, the induced voltage when the field collapses may be many times greater than that which appeared across the coil when the relay was energised. (Fig.1(b)). This voltage, added in series with the supply voltage, may well exceed the maximum collector – emitter voltage rating of the transistor, whereupon the latter breaks down."

"But surely," protested Dick, "the reverse voltage cannot exceed the original voltage which produced the field."

"Yes, it can," returned Smithy. "If the field collapses very quickly, the voltage it gives can be very high indeed. Don't forget that the reverse voltage only appears for a very short instant."

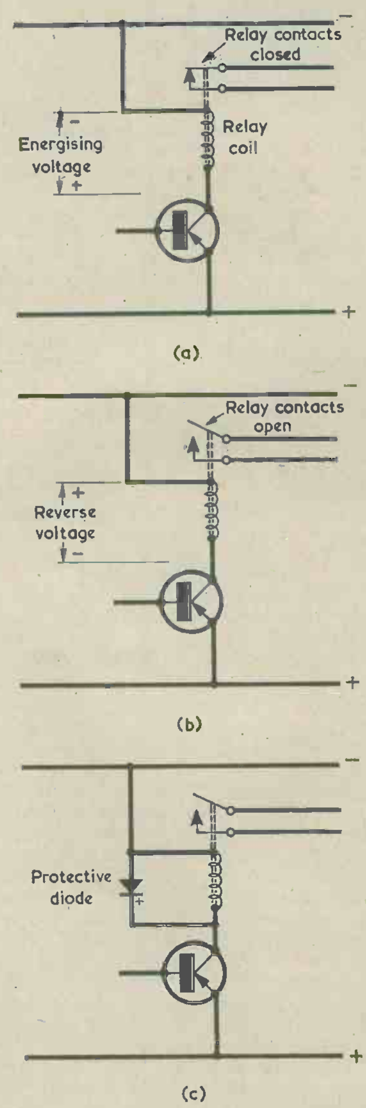


Fig. 1(a). A circuit in which a relay is energised by a transistor (b). Immediately after the transistor cuts off and the relay de-energises, a reverse voltage appears across the relay coil (c). In practical transistor-operated relay circuits a protective diode is added. This prevents the appearance of the reverse voltage

PRACTICAL DEMONSTRATION

"I suppose," said Dick dubiously, "that the idea of having the diode across the relay coil is to prevent the reverse voltage from forming at all."

"That's right," confirmed Smithy. "You connect the diode across the coil in such a manner that it's non-conductive when the relay is energised. (Fig.1(c)). When the transistor cuts off, the diode short-circuits the reverse voltage that is induced as the field collapses, and thereby protects the transistor."

"I still," said Dick, frowning, "cannot visualise this point of yours, when you say that the reverse voltage induced on release is higher than that which originally appeared across the coil. It's as though you're getting more out of the coil than you're putting into it."

"I can see," sighed Smithy, "that the only way to convince you about the magnitude of the reverse voltage is to demonstrate it to you in practice."

The Serviceman rose and walked over to the spares cupboard. After a little rummaging around he returned with a number of components and placed them on his bench.

"In a case like this," he stated, "it's always a good plan to give a really effective practical illustration. So the iron-cored coil I'm going to use to demonstrate the formation of reverse voltage is one having particularly high inductance and low losses. Actually, it's the primary of a fairly large mains transformer intended for valve equipment. This transformer has an h.t. secondary giving 250-0-250 volts at 100mA together with several 6.3 volt heater windings, but we won't be making any connections to these. The primaries of transformers in this class usually have d.c. resistances of the order of 30 to 40Ω only, which meets our present requirements very nicely."

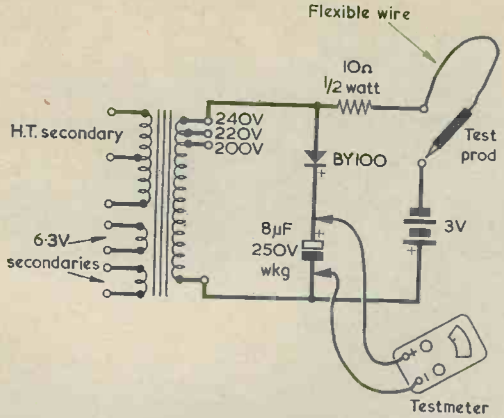


Fig. 2. The circuit used by Smithy to demonstrate reverse voltage in an inductor. The testmeter is switched to read 250 volts f.s.d.

Dick's interest rose at the sight of the components on Smithy's bench, Temporarily putting aside his vexation with Smithy's comments on the customs of Christmas, he picked up his stool and carried it over to Smithy's bench: He settled himself comfortably and watched the Serviceman.

"Right," said Smithy, picking up his soldering iron and selecting a few short lengths of p.v.c. covered wire. "I'm now going to set up a circuit which is capable of causing a field to first appear, and then collapse, in the iron-cored coil which is provided by this transformer primary. The field will be produced by a 3-volt battery in series with a 10Ω limiting resistor. The voltage produced as the field collapses will have opposite polarity to that provided by the battery and I'll cause it to charge an 8μF 250 volt electrolytic capacitor by way of a BY100 silicon rectifier."

Dick raised his eyebrows.

"A 250 volt electrolytic? he queried. "Blimey, Smithy, you're expecting a lot of reverse voltage, aren't you?"

"Just you wait and see what happens," returned Smithy confidently. "We'll be drawing a fair bit of current from the 3-volt battery, and so the type I'm using is one of those twin cell cycle lamp ones. This should be large enough to provide the current we need."

Smithy indicated the battery in question, an Ever Ready type 800, then proceeded to wire up his circuit. (Fig. 2).

"As you can see," he announced, as he busied himself with the soldering iron, "I'm connecting one end of the transformer primary permanently to the positive terminal of the battery. This is, of course, the brass strip on the top. (Fig.3). The other end of the primary connects, via the 10Ω resistor, to an insulated test prod which can be momentarily applied to the negative terminal of the battery."

"Why is the test prod insulated?"

"To save you getting shocks."

"Shocks? Dash it all, Smithy, you carry on as though this circuit is going to be connected to the National Grid! The only source of supply you've got there is a 3-volt battery."

"Dear, oh dear," said Smithy irritably. "Do stop questioning what I'm doing, and just wait and see how the circuit works. Now, the BY100 is connected to the trans-

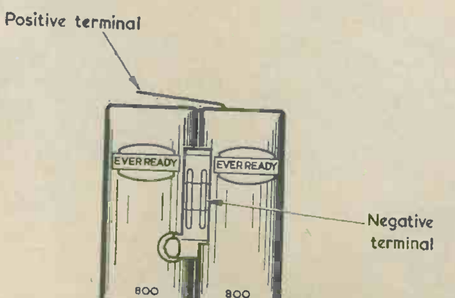


Fig. 3. The polarity of the brass terminal strips on an Ever Ready 3-volt battery type 800

former primary so that it conducts when the voltage across the primary is opposite to that provided by the battery. I'm finally going to connect my testmeter, switched to read 250 volts full-scale, across the electrolytic."

Smithy connected the testmeter clips to the electrolytic capacitor and carefully examined the simple circuit he had wired up. He gave a grunt of satisfaction.

HIGH VOLTAGE

"Everything's okay," he announced cheerfully. "You can try it out now."

"What," asked Dick doubtfully, "am I supposed to do?"

"You simply take up that insulated test prod," replied Smithy, "put it on the negative terminal of the battery for about a quarter to half a second, then take it off again."

Dick took up the prod, applied it to the battery terminal, then removed it again.

The needle of Smithy's testmeter advanced to indicate approximately 25 volts.

"Corluvaduk," said Dick incredulously. "What happened then?"

"That was the voltage produced when the field in the coil collapsed," replied Smithy. "It charged the electrolytic via the BY100 rectifier."

"The voltage," stated Dick, as he watched Smithy's testmeter with a transfixed gaze, "is falling slowly."

"Of course it is, you nit," snorted Smithy. "The electrolytic is discharging into the voltmeter and into its own leakage resistance. Have another go with that test prod."

A bewildered Dick picked up the test prod and applied it once more briefly to the negative terminal of the battery. As he removed it, the voltmeter needle rose further and indicated about 40 volts. Dick repeated the operation, whereupon the needle advanced to 50 volts.

"I can hardly believe my eyes," he said bemusedly. "There's 50 volts coming out when only 3 volts went in!"

"Keep at it," chuckled Smithy, "See how high you can get that voltmeter needle to rise."

Dick continued to apply the test prod and then remove it. After about a dozen applications the voltmeter needle advanced to the 100 volt graduation. Dick persevered a little longer, whereupon the meter needle finally hovered around 125 volts, falling between each application of the battery then returning to 125 volts when a further collapse of the field in the transformer primary coil was initiated.

"There you are," pronounced Smithy triumphantly. "The collapsing field in that transformer pridemonstration of how high a reserve of no less than 125 volts. Which is at least 40 times the voltage which produced the field. Now are you convinced?"

'I'll say I am," returned Dick fervently. "Gosh, that really *is* a demonstration of how high a reserve voltage a collapsing field can give."

"It is rather effective, isn't it?" concurred Smithy. "Incidentally, you need a fairly sensitive voltmeter to read the voltage across the electrolytic if the experiment is to be really successful. The voltmeter should have a resistance of 10,000 ohms per volt or more."

"Could this voltage step-up effect be put to any serious use?"

"Not really," replied Smithy. "The trouble is that the circuit is rather inefficient and the battery gets a pretty heavy bashing during the periods when it's connected to the coil. If you could time things such that the battery was only connected just long enough each time to build up the field, the efficiency might be reasonably good, but the requisite switching that would then be needed makes what is essentially a very simple gubbins rather too complicated for my taste. If you feel like playing around, you can get the circuit to light up a neon bulb."

Smithy quickly discharged the electrolytic capacitor by successively switching his testmeter to lower voltage ranges as the voltage fell within their f.s.d. values, thereby continually reducing the resistance the meter presented to the capacitor. He then took up a small wire-ended neon bulb and a 100kΩ resistor, both of which were amongst the components he had previously taken from the spares cupboard, and connected them in series across the 8μF capacitor. (Fig. 4).

"Try the circuit now," he invited. "See if you can get the neon lamp to light."

Dick quickly picked up the test prod and successively applied and removed it from the battery terminal. After a short while the neon bulb began to glow. Dick found that it would remain illuminated on its own for about two seconds without application of the battery, and that it remained illuminated continually if the connection and disconnection at the battery was carried out a little slower than about once every second.

TRANSFORMER MEMORY

"Well, there you are, then," said Smithy. "That mains transformer primary has quite definitely shown you the effect of suddenly removing a direct voltage from an iron-cored inductor."

"I'm fully convinced now," returned Dick, as he took the prod away from the battery for the last time and watched the neon bulb finally extinguish. "Are there any other unusual circuits you can make up using mains transformer primaries?"

"Oh yes," replied Smithy promptly. "Perhaps the most interesting one is a circuit in which the transformer exhibits a 'memory', just like the 'memory' that the ferrite rings in a computer store exhibit."

"Blimey," said Dick, impressed. "This sounds intriguing. Can you demonstrate this 'memory' business as well?"

"Pretty easily," said Smithy. "The only snag is that I'll need a couple of relays to do it with."

"I've got some relays knocking around in one of my boxes," said Dick quickly. "I'll bring them over."

Keenly, Dick rushed to the other side of the Workshop and scrabbled amongst the multitudinous collection of cardboard boxes which always seemed to accumulate under his bench.

"Ah, here we are," he said jubilantly, as he returned to Smithy's side and deposited a shabby cardboard box on the Serviceman's bench with a crash. A little puff of dust emerged from the top of the box.

Smithy opened out the cardboard flaps at the top and peered inside with an expression of distaste.

"I do wish," he remarked severely, "that you'd look after your components a bit more carefully. Relays are precision-made devices. They

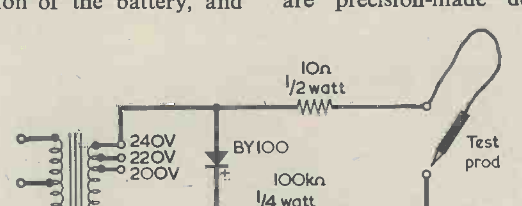


Fig. 4. The circuit of Fig. 2 can be employed to illuminate a neon bulb. A suitable bulb is the Hivac type 16L, available from Henry's Radio Ltd.

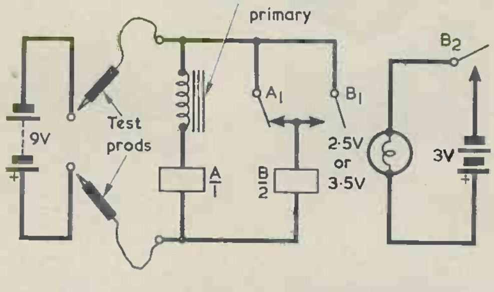


Fig. 5. A circuit in which an iron-cored coil exhibits 'memory'. The coil is the primary of the mains transformer of Figs. 2 and 4, and the relays are shown with 'detached' representation. The figure under the letter alongside each coil indicates the number of contact sets in the relay

aren't meant to be piled up in a box alongside each other just any old how."

The Serviceman reached into the box and withdrew some of the relays, examining them carefully.

"Ah," he remarked after a moment. "There are two here that should do the trick. They're both P.O. 3000 types with 500Ω coils, and it looks as though their contacts have managed to withstand the battering you've given them in that box without becoming too bent and buckled."

Smithy returned the remaining unwanted relays to the box.

"Take this horrible dust-trap away," he said, "then rustle up a small 2.5 or 3.5 volt bulb and a bulb-holder. Oh, and I'll want a PP9 9-volt battery, too."

As Dick carried out Smithy's bidding, the Serviceman drew his note-pad towards him and, after a little thought, quickly sketched out a circuit. He then reached for his soldering iron and removed the components he had previously connected to the mains transformer primary. He next proceeded to wire the relays to the transformer primary, occasionally consulting his circuit. During this process Dick returned and handed him the bulb, bulb-holder and battery. Smithy at once wired the bulb-holder into circuit and screwed in the bulb. After a final examination of his wiring, he turned to his assistant.

"Now, this circuit," Smithy stated, "has *two* insulated test prods. You'll note, incidentally, that I haven't bothered to mount the relays on a chassis or anything like that. For the present purpose they'll work quite satisfactorily lying on the bench on their sides."

"Fair enough," returned Dick. "What are the two prods for?"

"Pick them up," said Smithy in reply, "apply them to the terminals of that PP9 battery you got for me and keep them there."

Obediently, Dick picked up the prods and pressed them against the studs at the top of the battery. There was a click of relays and the small bulb became illuminated.

"Now," said Smithy, "take the prods off again."

Dick removed the prods, whereupon the bulb became extinguished.

"Put the prods back on the battery again."

Once more Dick applied the prods. This time the bulb remained extinguished.

"That's funny," he remarked, puzzled. "The bulb lit up last time."

Smithy chuckled.

"Change the prods over," he suggested. "Change them over so that the one which previously went to the positive terminal of the battery now goes to the negative terminal, and vice versa."

Dick applied the prods to the battery with transposed polarity. The bulb lit up. Dick removed the prods, whereupon the bulb extinguished. Experimentally, he applied the prods again, but the bulb refused to light up.

"This circuit's bewitched," he wailed. "First the bulb lights up, then it doesn't light up."

"Change the prods over again."

Dick once more transposed the prods, then connected them to the battery. The bulb lit up. When he removed the prods and tried a second time the bulb remained extinguished. He tried unsuccessfully once again then, on an inspiration, reversed the prods once more and re-applied them to the battery. The bulb lit up at the first application but refused to light up for any further applications. Yet once more he changed over the prods and connected them to the battery. And yet once more the bulb lit up on the first application but refused to do so on subsequent applications.

CIRCUIT OPERATION

"This circuit is enough to make anyone go screaming round the twist," growled Dick, as he put

DECIMAL CURRENCY

As U.K. readers know, the switch to decimal currency takes place on 15th February.

Will readers sending remittances after that date please ensure that cheques are written in decimal currency.

We would remind readers also that postage rates will be increased at the same time – 2½p second class, 3p first class up to 4 ozs.

down the test prods. "What on earth have you got hidden away in it, Smithy?"

"There's nothing hidden away at all," grinned Smithy. "You can see all the components and wiring yourself. There's just the mains transformer primary, the two relays and the bulb, together with a 3-volt battery to illuminate it. That battery, incidentally, is the cycle lamp battery we used for the previous little exercise. Here's the circuit."

Smithy reached over and pushed his note-pad towards his assistant. That worthy looked uncomprehendingly at the circuit Smithy had sketched out. (Fig. 5).

"Hell's teeth," grunted Dick, "there seems to be nothing in this at all! How does it work?"

"The operation is very simple, actually," said Smithy. "Although before I embark on an explanation I think I should mention that the circuit shows the relays in what is known as the 'detached' method of presentation. Each relay coil appears as a rectangle and the relay contacts are shown in the non-energised condition. Having got that little statement off my chest, I'll next tell you what happens. When you first applied the test prods the inductance of the mains transformer primary caused the energising current in relay A to rise a little more slowly than that in relay B. The result was that relay A energised a little later than relay B. Because of this, relay B was able to energise via contact A1, after which it stayed held on by means of its own contact B1. Contact set B2 then caused the bulb to light up."

"I see," said Dick, frowning as he concentrated on Smithy's circuit. "What happened after I took the prods off the battery?"

"Both relays de-energised," said Smithy, "And the bulb went out. However, the most important point is that, since a direct current had passed through the mains transformer primary, a remanent magnetic field corresponding to the polarity of the battery was left in its laminations. When the battery was next applied, it had to overcome much less opposition to increase in current flow through the transformer primary whereupon, in this case, relay A energised sufficiently early for its contacts A1 to break before relay B could energise and hold on by its contacts B1. So relay B remained de-energised and the bulb didn't light up."

"That seems reasonable enough, now you've explained it," said Dick. "Why did the bulb come on when I changed the battery leads over?"

"That's because," explained Smithy, "the remanent field in the transformer primary due to the previous application of the battery was in the opposite direction to the field which the transposed battery connections were trying to set up. The new current resulting from the transposed battery connections had not only to overcome the inductance of the primary but it had also to reverse the direction of the remanent field in the transformer laminations. In consequence, the current took considerably longer to rise to relay coil energising value than in the previous instance, and the result was that relay A energised *after* relay B. Relay B was then able to stay held on by its own contact B1, and to light up the bulb."

"I can see it all now," said Dick excitedly. "After this first application of the battery with reversed polarity the new remanent field left in the transformer laminations was in the direction corresponding to the reversed polarity. Subsequent applications of the battery would then cause relay A to energise before relay B, whereupon relay B couldn't energise and light up the bulb. For that to happen, you'd have to reverse polarity, all over again, so as to delay relay A once more."

"That's the idea," said Smithy. "In other words, the transformer laminations 'remember' the polarity of the last direct voltage that was applied to the coil. With some transformers, this 'memory' can last for a surprisingly long time. Hours, at least."

A sudden thought struck Dick.

"It was just a stroke of luck," he announced, "that the bulb lit up when I first applied the prods to the battery. The laminations in that transformer *could* have retained a remanent field in the same direction from the previous experiment we did."

"That's possible," agreed Smithy. "Fortunately it didn't happen. Even if it had, though, you would have merely had to reverse the battery leads in the present experiment to get the 'memory' action started off."

Dick looked critically at Smithy's note-pad.

"Come to think of it," he commented, "this circuit, itself, seems to rely quite a bit on luck. It seems to me, for instance, that it's asking rather a lot of two relays to expect their energising times to be as accurate in relation to each other as this circuit requires."

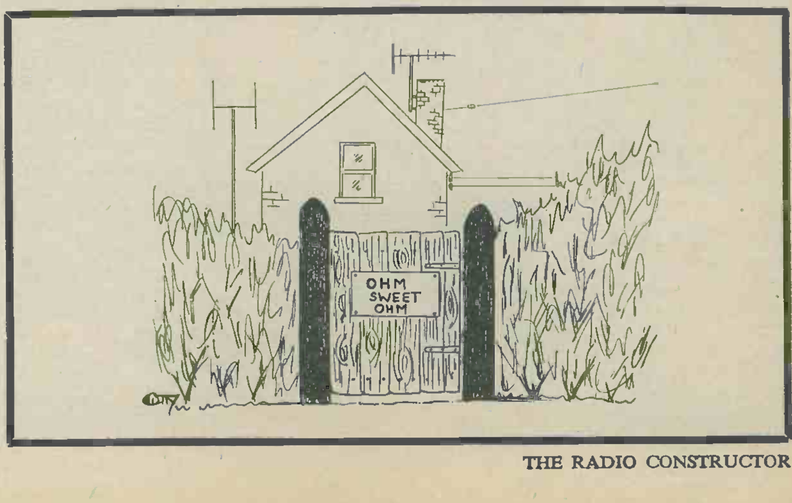
"The dodge there," explained Smithy, "is to use a component for relay A which is capable of energising a wee bit earler than the one used for relay B. If both relays are of the same Post Office type and both have the same coil resistance, this can be arranged by having fewer contact sets on relay A for its armature to actuate than there are on relay B. You then choose an energising voltage which is just a little higher than that needed to cause relay B to energise reliably. The energising voltage is, of course, that provided by the external battery to which you apply the test prods. The test prods must be insulated, by the way, or you'll find yourself picking up shocks in the same way as can occur with the previous circuit."

"What about the mains transformer?"

"The mains transformer is rather a critical component," said Smithy. "It must be a fairly large transformer of the type we've been using here, and its primary must have a d.c. resistance of 40Ω or less. Smaller transformers, and those whose primaries have higher resistances, don't exhibit the 'memory' effect as markedly as a large one with a low resistance primary does. A final point, by the way, is that the coil resistance of the relays employed should be of the order of 500Ω, as we used ourselves. Also, it may be helpful to experiment with different energising voltages for the best results."

THE ODD FAVOUR

"Well," said Dick appreciatively, "you've certainly opened my eyes to one or two things about induc-



tance during this lunch-time."

"I'm glad you've found my comments of interest," replied Smithy modestly. "Besides, I look upon the business of passing on gen to you as doing you a favour."

"Do you? Perhaps there's a favour I could do for you in return."

The opportunity was too good to lose.

"As it happens, there is," said Smithy promptly. "You could get the rest of those flaming Christmas decorations down!"

At the mention of the word 'decorations' Dick immediately froze.

"I'll give you a hand," promised Smithy.

Dick maintained a stony silence.

"And I didn't," continued Smithy, "mean what I said just now about Christmas. Also, those decorations were jolly good decorations."

"Do you really think so?"

Smithy drew a deep breath.

"Of course I do."

Dick gradually unbent.

"Oh very well, then," he said after a few further moments. "I'll get them down now."

Dick scrambled over the benches, taking out drawing pins, whilst Smithy rendered him his promised assistance by staying firmly at floor level and taking up the paper chains and other ornaments as Dick handed them over to him. Whilst he was thus engaged, Smithy's eye fell momentarily on Dick's newly acquired calendar for 1971. Open now at February, this displayed a picture even more revealing of the female form than that for January had been.

Smithy made a mental note.

That calendar would be the next thing to go . . . ■

A new electronic voltommeter nanoammeter has been introduced by ITT Metrix and is available from ITT Components Group Europe. Designated VX313B, the instrument makes extensive use of solid-state circuitry to achieve a compact size.

The VX313B can be used for measuring a.c. voltages up to 300V from 30Hz to 1MHz, d.c. voltages up to 1000V, d.c. currents up to 10mA and resistances up to 50MΩ. Equipped with a shockproof taut band suspension centre pole meter movement, the VX313B is very sensitive. With the exception of the 0.1 and 0.3V ranges (10MΩ input resistance) it features a constant 100MΩ input resistance on all d.c. ranges.

A full range of accessories is available including an r.f. probe for measurement of 0 to 30V, 10kHz to 50MHz a.c. voltages; crystal tees for measurements up to 1000MHz at 2V; and a 30kV e.h.t. d.c. probe.

Radio Topics

By Recorder

THERE ARE TIMES WHEN I FEEL that all the fun went out of servicing when printed circuits came in. Which shows, I suppose, that I'm getting a bit longer in the tooth than I like to admit.

Nevertheless, I recommend that younger readers, who have probably seen nothing other than printed boards in the factory-made receivers they handle, should have a stab at fixing one of the older sets if they ever get a chance. There are few things to beat the pleasure of fault-finding on a chassis which, by present-day standards, is built like a battleship, and on which all connections can be quickly and accurately traced out. Since those older sets used valves rather than transistors, the normal approach when fault-finding was to switch the testmeter to read 250 volts f.s.d., clip its negative lead to chassis and touch the positive prod to the appropriate valveholder tags. If this procedure didn't locate the snag, as evidenced by an incorrect voltage on one of the valve electrodes, then a little further fault-finding was called for. In most instances it was extremely easy to eventually run the trouble to ground.

PRINTED CIRCUIT DIFFICULTIES

Why was it so easy to do servicing work on those old chassis-type sets? The answer is, of course, that both the wiring *and* the components were on the same side of the chassis. It is precisely this fact which facilitated servicing on chassis-type receivers as opposed to printed circuit receivers. With printed circuits, components and 'wiring' *must* be on opposite sides of the board.

Manufacturers have, of course, appreciated that the printed circuit, whilst vastly reducing assembly costs, must inevitably increase servicing costs, and they provide assistance in the location of components and 'wiring' by such practices as printing resistor and capacitor numbers on the component side of the board.

Personally, I think that the greatest servicing aid of all would consist of reproducing, in ink, the copper pattern itself on the component side of the board. The ink pattern would follow the copper foil pattern underneath such that, if the board were held up to bright light, both patterns would be seen to coincide. One could then trace out all connections from the same side of the board, just as occurred with those old chassis-type sets. Futhermore, it would be easier to locate any points in the copper pattern where a soldering iron or testmeter prod had to be applied. Each part of a printed circuit pattern tends to have its own particular shape and size, and it fits in, in its own individual way, amongst its neighbouring pieces of copper. The mind's eye could readily identify a section of the copper pattern from the similar version printed on the component side.

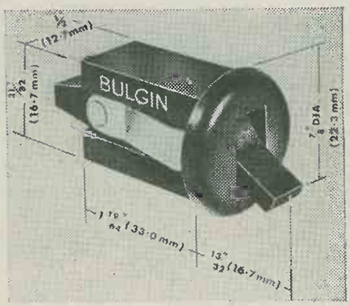
Perhaps some trend-setting manufacturer has already produced printed circuit boards having the copper pattern repeated, in ink, on the component side. If he has, I raise my hat to him in humble salute. But I have personally never encountered a board produced in this manner and I cannot help but feel that the technique would provide one of the greatest assets possible for the service engineer. The ink would, of course, require good insulating properties but, with present-day chemical techniques, this should not present any unsurmountable problems. Also, printing the ink pattern wouldn't necessarily incur an extra operation at the factory because most manufactureres already incorporate the process I referred to earlier, with which the R and C numbers are printed in ink on the component side of the board.

Next time you tackle a snag on a transistor radio or a TV printed circuit board, just imagine how much easier your work would be if you could do all your fault-tracing, just as with those early chassis receivers, from one single side of the board.

HEAVY DUTY SWITCH

The accompanying photograph shows another new product from that forward-looking firm, A. F. Bulgin & Co. Ltd., Bye Pass Road, Barking, Essex.

The switch, type S.805, is available in white or black, and there is a matching neon bulb assembly, type D.808/V. The switch has an s.p.s.t. action and is rated up to 10 amps at 250 volts, a.c. only. The body and operating button are made in highly polished phenolic in order to provide the best possible insulation and maximum safety factor, even under adverse, damp climatic conditions.



The new Bulgin switch type S.805. This is available in black or white, and is rated at up to 10 amps a.c. at 250 volts

Mounting is by push fit in a rectangular panel hole measuring 0.665 by 0.525in. An optional extra is an ON-OFF escutcheon, which may be fitted behind the switch front.

TRANSFORMER COMPENSATION

There are lots of little points in radio and electronics that sometimes get forgotten. Take mains transformers, for instance. You might think that if you used a mains transformer 'in reverse' you'd get the same voltages across the windings as appear when it's used normally. That is to say, if you were to apply an alternating voltage of 6.3 volts to a similarly rated heater winding on a mains transformer, you might expect to find 240 volts across its 240-volt primary.

In practice, that wouldn't happen. There would certainly be a high voltage across the primary but it wouldn't be 240 volts. In most cases it would be around 210 to 220 volts.

The reason for this apparent anomaly is that mains transformers are designed to operate in one direction only. All power transformers have losses, these being due to the resistance of the windings, hysteresis and eddy current losses in the laminations, and so on. The losses cause secondary output voltages to fall below the figures that are given by a simple consideration of turns ratio. The turns ratio is then adjusted to compensate for the drops by giving the secondary or secondaries a few more turns than the ratio warrants. When a secondary is employed as a primary this compensation operates in the reverse manner, so that the voltage appearing across a primary, if used as a secondary, is lower than its nominal figure even off-load.

These discrepancies are not serious, but they should always be kept in mind when using mains transformers in unconventional circuits which result in a reversal of the functions of primary and secondary. Discrepancies will also occur in autotransformers. An autotransformer designed to operate as a step-down component will offer a slightly lower than nominal output voltage when used as a step-up component.

CCTV MIRROR

I'm happy to say that my inventions continue to proliferate. You may recall that I listed some recent schemes and ideas a few months ago, these appearing in the last September issue.

My latest brain-wave is The Recorder Closed-Circuit TV Shaving Aid. This replaces the out-dated mirror above the bathroom wash-hand-basin, and consists of a TV monitor screen with a CCTV camera immediately below. The user of the equipment is thus able to directly control both the contrast and brilliance of the image of his face which is reproduced on the monitor screen before he embarks on those agonising minutes which culminate in the application of the after-shave lotion. The Recorder Closed-Circuit TV Shaving Aid is, in consequence capable of reacting to all moods, and is particularly suitable for those mornings when the last thing the user of the equipment wishes to do is to see his face reflected in the harsh glare of an old-fashioned looking-glass. A special low-contrast setting is provided for traumatic times like these.

One feature of which I'm rather proud is the manner in which lateral inversion of the reproduced picture is achieved. With normal television equipment, the user's right hand would appear at the left hand side of the monitor screen and vice versa, whereupon confusion could result. But with the Shaving Aid, the right hand of the user appears at the *right hand side* of the picture. This amazing break-through has been achieved by reversing, in the monitor, the connections to its line-scan deflection coils.

FERRITE AERIALS

Turning to more serious matters, it would be interesting to know the proportion of transistor portable radio faults in which the ferrite rod aerial is involved. Judging from my own experience, the figure could be surprisingly high.

In many sets the ferrite aerial is one of the most vulnerable components inside the cabinet. Apart from the brittleness of the ferrite rod itself, the connections between the coils on the rod and the receiver printed board are quite often carried over by means of the coil wire itself. This wire is relatively thin and can easily be broken by the more ham-handed amongst us when the back is off for battery replacement purposes. Fortunately, faulty connections here are very easy to locate. Also, if the base of the input mixer transistor is not 'held down' because its ferrite rod coupling coil has become disconnected, the set sometimes exhibits i.f. instability.

Probably the most unusual ferrite rod fault I've heard of concerned the medium wave transistor portable which mysteriously commenced to receive short wave signals. The fault? Two of the turns in the medium wave aerial coil had short-circuited together, with a consequent reduction in the aerial tuned circuit inductance. The aerial tuned circuit then peaked, after a fashion, at short wave frequencies, these beating with a harmonic of the local oscillator.

Which only goes to show that even a simple snag can produce symptoms which appear to be several orders removed from the fault itself. ■

MARCONI EARTH STATION FOR BARBADOS

Marconi Comunication Systems by Cable and Wireless will bring Barbados into the world satellite communications network for telephone and TV traffic.

The Barbados station is the standard Marconi design similar to the station in East Africa and the Goonhilly III terminal ordered by the Post Office. It has a 97 foot (29.6 metre) diameter dish aerial mounted on a reinforced concrete tower, to provide the maximum strength and stability in an area which is subject to earthquakes and hurricanes. The system will be able to operate normally in wind speeds of over 60 mph, gusting to 100 mph, while in the 'parked' position, it will withstand wind speeds of over 200 mph.

The station will communicate through the multi-access Intelsat IV satellite, due to be placed in orbit over the Atlantic Ocean next year and it will provide Barbados with simultaneous telephone, data transmission and television contact with stations in Europe and North America. Three transmitter and nine receiver chains will be provided in the initial installation, although the station has been designed to cater for considerable expansion in the future.

CURRENT TRENDS

● ELECTRONIC BATTERY PORTABLE TACHOMETER

The new 700 series of Sapphire Rechargeable Battery Portable Tachometers is an all solid-state design incorporating integrated circuits. There are no moving parts other than within the meter, ensuring long trouble-free operation. A feature of the design is the stable calibration, obviating the need for a control to constantly 'Set Calibration'. The meter used has 120° movement and suppressed zero to give increased resolution. A separate output for a chart recorder is also fitted to all instruments. The speed ranges of these various instruments will cover from very low speeds to 2,000,000 r.p.m.

There is no physical contact needed. The interchangeable magnetic and photoelectric sensors are plugged into the Tachometer, and then held in the proximity of the moving item to obtain a direct reading in r.p.m., with an accuracy of 0.5%, and the Transducers input automatic gain control locks out noise.

The Tachometer is complete with rechargeable batteries and charger unit. The built-in state of charge indicator shows when charging is required, and the charging unit is plugged directly into the side of the Tachometer.

The Tachometer has been made slimmer and lighter, and more convenient for the operator to hold. This is a great advantage for most applications especially for textile machinery. An extra sensitive version for textile use has 50% suppressed zero to give still higher resolution.

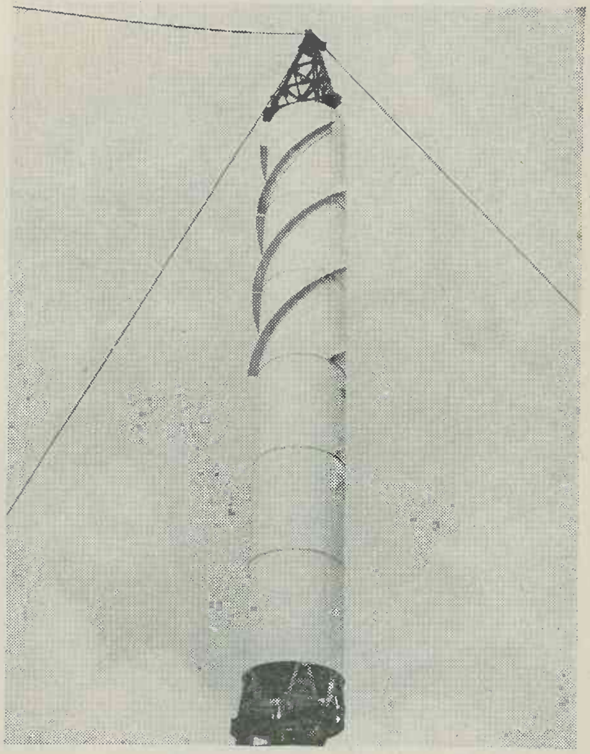
Available from Sapphire Research & Electronics Ltd., Sapphire Works, Ferndale, Glam.

● EMLEY MOOR TELEVISION AERIALS

A further contract from the Independent Television Authority covering the erection of the Emley Moor, Yorkshire, aerial systems brings the total value of the project to £207,000.

The latest contract, valued at £55,000, includes the erection and testing of two UHF aerials for the ITA and BBC and one VHF aerial for the ITA.

The aerials will be mounted on a 180ft. triangular supporting lattice on the self-supporting, 900ft. high concrete tower. The UHF aerial panels and their 5ft. diameter glass-fibre shroud will be fixed to the lattice at ground level. The tower erection contractors will then hoist this 46-ton superstructure up through the centre of the tower and into its final position.



The main feeders will then be installed between the aerials and existing transmitter equipment before overall testing of the UHF systems. The VHF aerial will be installed when the superstructure is in its final position. ■

LATE NEWS

Times = GMT *Frequencies = kHz*

★ AMATEUR BANDS

● TOP BAND DX

The last Top Band Trans-Atlantic Test in the current series takes place from 0500 to 0730 on February 14th and those who have not, as yet, experienced the thrill of working or listening to c.w. signals from across the Atlantic, are urged to 'have a go'.

As an example of what one may hear, the first Test held on 29th of November 1970 produced the following – K1PBW (**1803kHz** at 0534), W1HGN (**1804** at 0440 – warming up!), W2FJ (**1801** at 0541), W8AH (**1805** at 0513) and W8ANO (**1803** at 0600).

In addition to Trans-Atlantic Dx, some European Dx may also be heard, for example the following were active during the first Test – DL9KRA, HB9NL and OH3XZ (**1838** at 0555).

See 'Last Look Round' for even later news.

● SURINAM

PZ5RK has been heard on **14110** at 2130 and on **21279** at 1043 with a very strong s.s.b. signal.

● GABON REPUBLIC

TR8JM heard on **14270** s.s.b. at 2045; TR8MC on **14225** s.s.b. at 2047.

● PORTUGUESE GUINEA

CR3KD logged on **14095** c.w. from 2100 onwards and on **21360** s.s.b. at 1927.

● ROSS DEPENDENCY

KC4AAE heard on **14255** s.s.b. at 0920; KC4USV heard on **14280** s.s.b. at 0728 and KC4USX heard on **14310** s.s.b. at 0600.

● JOHNSTON ISLAND

KJ6CF heard on **14327** s.s.b. at 0856.

★ BROADCAST BANDS

● VENEZUALA

Radio Rumbos, Caracas, recently reported to have vacated the **4970** channel for that of **9660** is in fact operating on both channels. YVLK is the former whilst YVLM is the identification on the latter frequency. YVLK has a schedule from 0930 to 0500. Both outlets have a power of 10kW.

● AFARS & ISSAS

The British Association of Dx'ers reports, in their journal *Bandspread* dated 10th December, reception of the very rarely heard (in this country) ORTF station Radio Djibouti on a measured frequency of **4780** at 1452. Time chimes at 1500 for GMT+3 and heard with operating skill through r.t.t.y. QRM until 1520. Alan B. Thompson of Neath pulled off this feat. Moscow, normally on this channel, was off the air at the time.

● NEW GUINEA

The BADX also reports reception of VL9CD Radio Wewak **3335** (10kW) at 2020, just audible through facsimile and r.t.t.y. QRM, until 2105 with very distinctive local music. Alan B. Thompson was the operator.

● JAPAN

In 'Bandscan', the feature in *Bandspread* which reports the reception of such items of Dx, Martin A. Hall – a well-known 'old-timer' Dx'er, heard JOZ Tokyo on the **3925** channel from 2017 (mixed with signals from presumably ABC Port Moresby till 2158). When QRM cleared the Japanese language was identified.

Acknowledgements:- Our Listening Post, BADX and ISWL.

LAST LOOK ROUND

TOP BAND DX

At the time of writing, early January, the results of early Sunday mornings c.w. sessions at the l.f. end of this band have been very good, although not yet approaching those obtained last year.

The Trans-Atlantic Test held on 27th December produced three new (to the writer) calls on the band – K3MBF (**1804** at 0627), W4QCW/4 (**1803** at 0546) and W8GDQ (**1803** at 0525).

Trans-Atlantic signals logged to date also include K1PBW, W1HGT, W2FJ, W8AH, W8ANO (November 29th).

On the 13th of December, Top Band Dx conditions were excellent and although this was not a Test, the following stations were heard: K8RRH (**1805** at 0536), KV4FZ (**1806** at 0515), W2FJ (**1805** at 0545), W8AH (**1804** at 0500), and W8GDQ (**1805** at 0535). The Canadian stations VE3DDR (**1805** at 0520) and VE7HZ (**1802** at 0547) were also heard, as was YV1-Z?

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(Continued on page 449)

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(Continued from page 447)

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(Continued on page 451)

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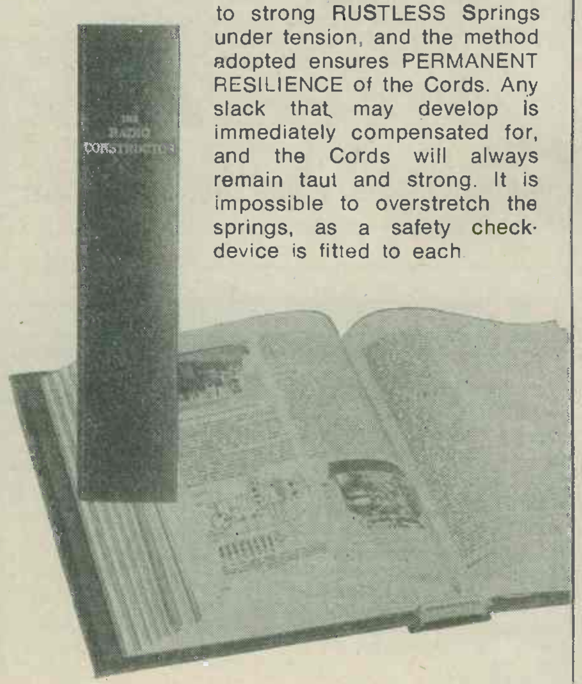

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(Continued from page 449)

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CONSTRUCTOR'S DATA SHEET

N.P.N. Transistor Lead-outs

The Table lists commonly encountered n.p.n. transistors in T0-5, T0-18 or T0-39 encapsulations whose lead-outs conform to the layout in the accompanying diagram. (The list will be concluded in Data Sheet No. 48.) The letter in brackets after each type-number indicates whether the device is germanium or silicon.

ASY28 (G)	BCY43 (S)	BFY17 (S)	BLY34 (S)	BSX78 (S)	C444 (S)	2N706 (S)	2N1715 (S)
ASY29 (G)	BFW16 (S)	BFY18 (S)	BLY61 (S)	BSY10 (S)	C720 (S)	2N706A (S)	2N1716 (S)
BC107 (S)	BFW17 (S)	BFY19 (S)	BPY60 (S)	BSY11 (S)	C722 (S)	2N708 (S)	2N1717 (S)
BC107B (S)	BFW68 (S)	BFY25 (S)	BPY65 (S)	BSY24 (S)	C740 (S)	2N743 (S)	2N1889 (S)
BC108 (S)	BFX17 (S)	BFY26 (S)	BSX12 (S)	BSY25 (S)	C742 (S)	2N744 (S)	2N1890 (S)
BC109 (S)	BFX34 (S)	BFY44 (S)	BSX19 (S)	BSY26 (S)	C744 (S)	2N753 (S)	2N1893 (S)
BC119 (S)	BFX43 (S)	BFY50 (S)	BSX20 (S)	BSY27 (S)	C760 (S)	2N914 (S)	2N2192 (S)
BC142 (S)	BFX44 (S)	BFY51 (S)	BSX26 (S)	BSY28 (S)	C762 (S)	2N915 (S)	2N2192A (S)
BC226 (S)	BFX84 (S)	BFY52 (S)	BSX27 (S)	BSY29 (S)	C764 (S)	2N916 (S)	2N2193 (S)
BD115 (S)	BFX85 (S)	BFY56A (S)	BSX28 (S)	BSY38 (S)	HK101B (S)	2N929 (S)	2N2193A (S)
BF157 (S)	BFX86 (S)	BFY57 (S)	BSX30 (S)	BSY39 (S)	HK601B (S)	2N930 (S)	2N2194 (S)
BF157B (S)	BFX92A (S)	BFY63 (S)	BSX32 (S)	BSY95 (S)	NKT0008 (S)	2N1302 (G)	2N2194A (S)
BF177 (S)	BFX93A (S)	BFY70 (S)	BSX33 (S)	BSY95A (S)	NKT0009 (S)	2N1304 (G)	2N2217 (S)
BF178 (S)	BFX94 (S)	BFY72 (S)	BSX39 (S)	C111E (S)	NKT0010 (S)	2N1306 (G)	2N2218 (S)
BF179 (S)	BFX95 (S)	BFY74 (S)	BSX44 (S)	C400 (S)	NKT0015 (S)	2N1308 (G)	2N2218A (S)
BF257 (S)	BFX96 (S)	BFY75 (S)	BSX59 (S)	C425 (S)	2N388 (G)	2N1420 (S)	2N2219 (S)
BF258 (S)	BFX97 (S)	BFY76 (S)	BSX60 (S)	C426 (S)	2N388A (G)	2N1507 (S)	2N2219A (S)
BF259 (S)	BFX98 (S)	BFY77 (S)	BSX61 (S)	C428 (S)	2N696 (S)	2N1613 (S)	2N2220 (S)
BCW34 (S)	BFY10 (S)	BFY78 (S)	BSX76 (S)	C441 (S)	2N697 (S)	2N1711 (S)	2N2221 (S)
BCY42 (S)	BFY11 (S)	BLY33 (S)	BSX77 (S)	C442 (S)	2N698 (S)	2N1714 (S)	2N2221A (S)

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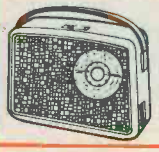

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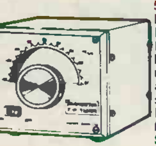

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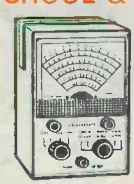

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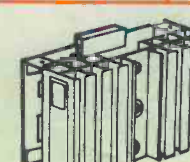

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