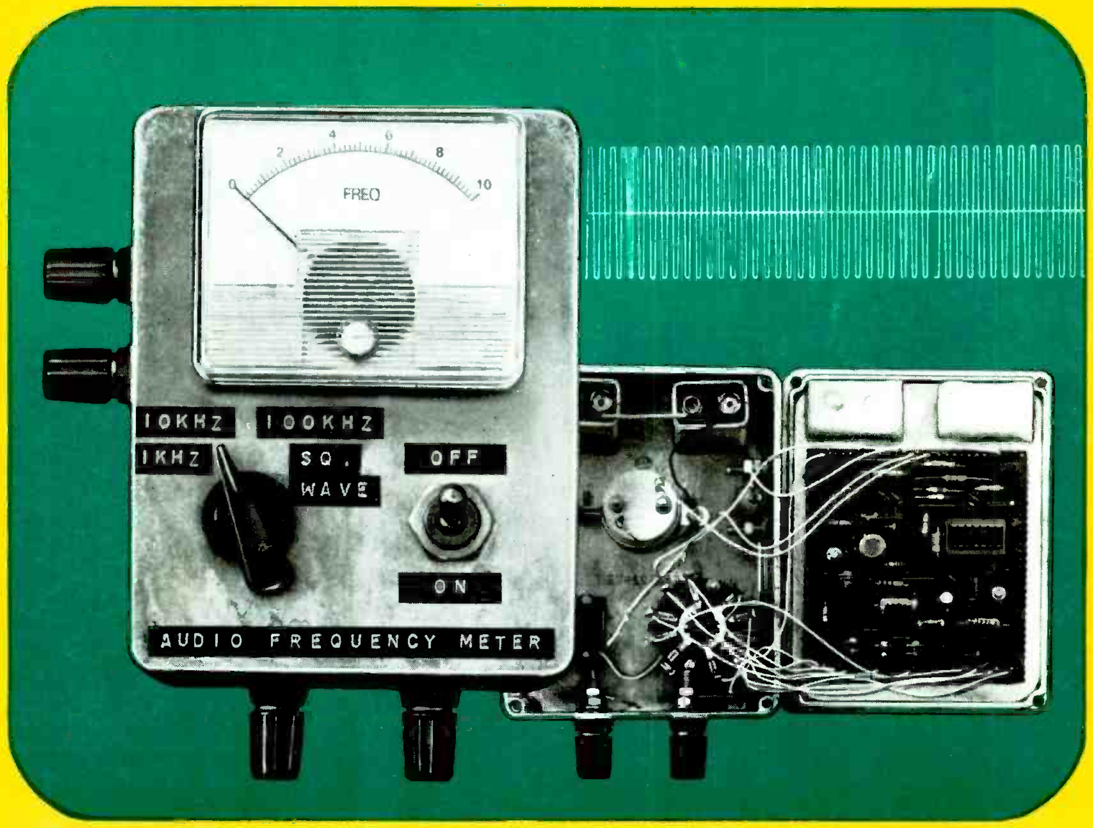
THE

RADIO CONSTRUCTOR

Vol. 25 No. 4 NOVEMBER 1971 20p



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PART 1

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Special IN THIS ISSUE

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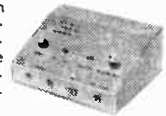

6 transistor reverberation chamber to which microphones, instruments, etc., may be connected for added dimensional effect. The output is suitable for most amplifiers and the unit is especially suitable for use with electronic organs. A ready-built spring and transducer assembly is used.
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U6	30 Silicon planar transistors NPN sim. BSY95A, 2N706	0.50
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U11	25 PNP silicon planar transistors TO-5 sim. 2N1132	0.50
U13	30 PNP-NPN sil. transistors OC200 & 2S104	0.50
U14	150 Mixed silicon and germanium diodes	0.50
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U28	Experimenters' assortment of integrated circuits, untested. Gates, flip-flops, registers, etc., 8 assorted pieces	1.00
U29	10 1-Amp SCR's TO-5 can up to 600 PIV CRS1/25-600	1.00
U31	20 Sil. Planar NPN trans. low noise amp 2N3707	0.50
U32	25 Zener diodes 400mW D07 case mixed volts, 3–18	0.50
U33	15 Plastic case 1 amp silicon rectifiers IN4000 series	0.50
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U40	10 Dual trans. 6 lead TO-5 2N2060	0.50
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SPECIFICATION
VCBO 80V VCEO 50V IC 10A PT 30 WATTS HFE 30-170.

PRICE	1–24	25–99	100 up
	43p each	40p each	36p each

GENERAL PURPOSE SILICON NPN POWER TRANSISTORS

Coded GP300. BRAND NEW TO-3 CASE. POSSIBLE REPLACEMENT FOR:—2N3055, BDY20, BDY11.
SPECIFICATION
VCBO 100V, VCEO 60V, IC 15AMPS, PT. 115 WATTS. Hfe 20–100. FTI MHZ.

PRICE	1–24	25–99	100+
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Q5	4 OC75 transistors	0.50
Q6	4 OC72 transistors	0.50
Q7	4 AC128 trans. PNP high gain	0.50
Q8	4 AC126 trans. PNP	0.50
Q9	7 OC81 type trans.	0.50
Q10	7 OC71 type trans.	0.50
Q11	2 AC127/128 comp. pairs PNP/NPN	0.50
Q12	3 AF116 type trans.	0.50
Q13	3 AF117 type trans.	0.50
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Q17	3 NPN 1 ST141 & 2 ST140	0.50
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Q19	3 Madt's 2 MAT 101 & 1 MAT 121	0.50
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Q31	6 Sil. switch trans. 2N708 NPN	0.50
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Q37	3 2N3053 NPN sil. trans.	0.50
Q38	7 PNP trans. 4× 2N3703, 3× 2N3702	0.50
Q39	7 NPN trans. 4× 2N3704, 3× 2N3705	0.50
Q40	7 NPN amp. 4× 2N3707, 2× 3N3708.	0.50
Q41	3 Plastic NPN TO-18 2N3904	0.50
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Q43	7 BC107 NPN trans.	0.50
Q44	7 NPN trans. 4× BC108, 3× BC109	0.50
Q45	3 BC113 NPN TO-18 trans.	0.50
Q46	3 BC115 NPN TO-5 trans.	0.50
Q47	6 NPN high gain 3× BC167, 3× BC168	0.50
Q48	4 BCY70 NPN trans. TO-18	0.50
Q49	4 NPN trans. 2× BFY51, 2× BFY52	0.50
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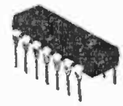

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BP10 – 7410	Triple 3-input positive NAND gates	0.15	0.14	0.12
BP13 – 7413	Dual 4-input Schmitt trigger	0.29	0.26	0.24
BP20 – 7420	Dual 4-input positive NAND gates	0.15	0.14	0.12
BP30 – 7430	8-input positive NAND gates	0.15	0.14	0.12
BP40 – 7440	Dual 4-input positive NAND buffers	0.15	0.14	0.12
BP41 – 7441	BCD to decimal nixie driver	0.67	0.64	0.58
BP42 – 7442	BCD to decimal decoder (4–10 lines, 1 of 10)	0.67	0.64	0.58
BP46 — 7446	BCD-to-Seven-Segment Decoder Driver	2.00	1.75	1.50
BP47 – 7447	BCD-seven-segment decoder/drivers (15V outputs)	0.97	0.94	0.88
BP48 – 7448	BCD-to-Seven-Segment decoder Driver	0.97	0.94	0.88
BP50 – 7450	Expandable dual 2-input AND-OR-INVERT	0.15	0.14	0.12
BP51 – 7451	Dual 2-wide 2-input NAND-OR-INVERT gates	0.15	0.14	0.12
BP53 – 7453	Quad 2-input expandable NAND-OR-INVERT	0.15	0.14	0.12
BP54 – 7454	4-wide 2-input NAND-OR-INVERT gates	0.15	0.14	0.12
BP60 – 7460	Dual 4-input expander	0.15	0.14	0.12
BP70 – 7470	Single-phase J-K flip-flop	0.29	0.26	0.24
BP72 – 7472	Master-slave J-K flip-flop	0.29	0.26	0.24
BP73 – 7473	Dual master slave J-K flip-flop	0.37	0.35	0.32
BP74 – 7474	Dual D type flip-flop	0.37	0.35	0.32
BP75 – 7475	Quad latch	0.47	0.45	0.42
BP76 – 7476	Dual J-K with pre-set and clear	0.43	0.40	0.38
BP80 – 7480	Gated full adders	0.67	0.64	0.58
BP81 – 7481	16-bit read/write memory	0.97	0.94	0.88
BP82 – 7482	2-bit binary full adders	0.97	0.94	0.88
BP83 – 7483	Quad full adder	1.10	1.05	0.95
BP86 – 7486	Quad 2-input exclusive NOR gates	0.32	0.30	0.28
BP90 – 7490	BCD decade counter	0.67	0.64	0.58
BP91 – 7491	8-bit shift registers	0.87	0.84	0.78
BP92 – 7492	Divide-by-twelve counters	0.67	0.64	0.58
BP93 – 7493	4-bit binary counters	0.67	0.64	0.58
BP94 – 7494	Dual entry 4-bit shift register	0.77	0.74	0.68
BP95 – 7495	4-bit up-down shift register	0.77	0.74	0.68
BP96 – 7496	5-bit parallel in parallel out shift-register	0.77	0.74	0.68
BP100 – 74100	8-bit bistable latches	1.75	1.65	1.55
BP104 – 74104	Single J-K Flip-Flop equiv. 9000. Series.	0.97	0.94	0.88
BP105 – 74105	Single J-K Flip-Flop equiv. 9001	0.97	0.94	0.88
BP107 – 74107	Dual Master Slave Flip-Flops	0.40	0.38	0.36
BP110 – 74110	Gates Master-Slave Flip-Flops	0.55	0.53	0.50
BP111 – 74111	Dual Data Lock-out Flip-Flop	1.25	1.15	1.00
BP118 – 74118	Hex set-reset latches	1.00	0.95	0.90
BP119 – 74119	Hex Set-Reset latches. 24 pin.	1.35	1.25	1.10
BP121 – 74121	Monostable multivibrators	0.67	0.64	0.58
BP141 – 74141	BCD-to-decimal decoder/driver	0.67	0.64	0.58
BP145 – 74145	BCD-to-decimal decoder/driver. O/C.	1.50	1.40	1.30
BP150 – 74150	16-Bit Data Selector	1.80	1.70	1.60
BP151 – 74151	8-bit data selectors (with strobe)	1.00	0.95	0.90
BP153 – 74153	Dual 4-line-to-1-line data	1.20	1.10	0.95
BP154 – 74154	4 to 16 Line Decoder	1.80	1.70	1.60

Devices may be mixed to qualify for quantity prices. Larger quantities—prices on application. (TTL 74 Series only.)

Data is available for the above series of I.C's in booklet form. price. 13p.

TTL INTEGRATED CIRCUITS

Manufacturers' "Fall outs"—out of spec. devices including functional units and part function but classed as out of spec. from the manufacturers' very rigid specifications. Ideal for learning about I.C's and experimental work.

PAK No.		PAK No.		PAK No.	
UIC00 – 12 × 7400N	50p	UIC42 – 5 × 7450N	50p	UIC80 – 5 × 7480N	50p
UIC01 – 12 × 7401N	50p	UIC50 – 12 × 7450N	50p	UIC82 – 5 × 7482N	50p
UIC02 – 12 × 7402N	50p	UIC51 – 12 × 7451N	50p	UIC83 – 5 × 7483N	50p
UIC03 – 12 × 7403N	50p	UIC60 – 12 × 7460N	50p	UIC86 – 5 × 7486N	50p
UIC04 – 12 × 7404N	50p	UIC70 – 8 × 7470N	50p	UIC90 – 5 × 7490N	50p
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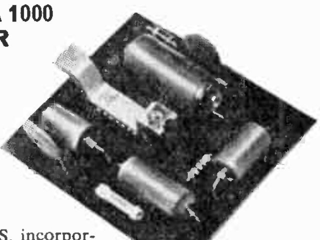

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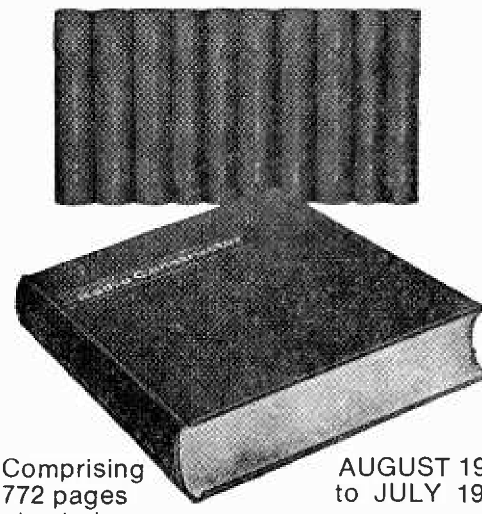

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CONTENTS

GENERAL PURPOSE TRANSISTOR SIGNAL GENERATOR 202
CAN ANYONE HELP? 207
NEWS AND COMMENT 208
TRIGGERED DOOR ALARM (Suggested Circuit No. 252) 210
ADDING REGENERATION 212
QSX 213
LOCAL RADIO TRANSMITTING STATIONS 214
THE 'DROITWICH' CAR RADIO 216
NOW HEAR THESE 223
AUDIO FREQUENCY METER (Part 1) 224
COIL-PACK COMMUNICATIONS RECEIVER (Part 2) 230
BENCH CURRENT MONITOR 232
CURRENT SCHEDULES 234
NEW PRODUCTS 235
IN YOUR WORKSHOP 236
TRADE NEWS 243
AN ENLARGER TIMER 244
RADIO TOPICS 247
LATE NEWS AND LAST LOOK ROUND 249
RADIO CONSTRUCTOR'S DATA SHEET No. 56 (Foreign Language Broadcasts) iii

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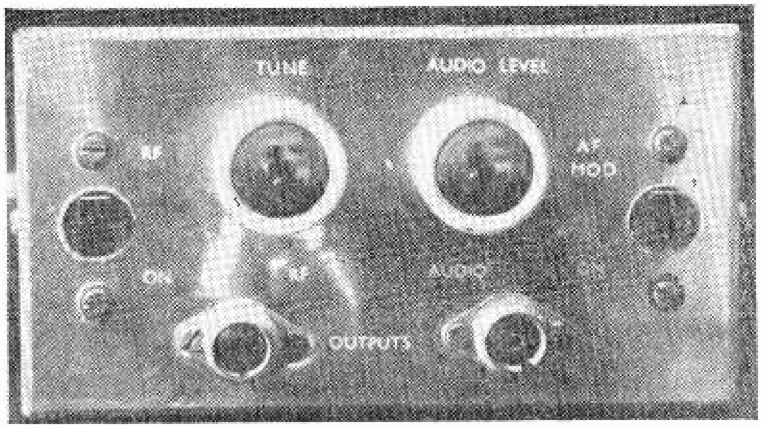
GENERAL PURPOSE TRANSISTOR SIGNAL GENERATOR



Front panel of the completed signal generator

by

R. A. PENFOLD

By means of a neat design approach this instrument may be used both for calibration marker frequency generation and for receiver r.f. and i.f. alignment. Completely self-contained, it is housed in a case measuring only $2\frac{3}{4}$ by $5\frac{1}{4}$ by $1\frac{1}{4}$in.

WHEN BUILDING AND SERvicing audio amplifiers, medium and long wave broadcast receivers, and more complex communications receivers, a signal generator was needed which would provide the following functions:

1. The accurate calibration of a receiver tuning dial.
2. The test and alignment of the r.f. stages of a receiver.
3. The test and alignment of the i.f. stages of a receiver.
4. The testing of audio amplifiers and the audio stages of a receiver.

It was also required that the unit be inexpensive, reasonably simple to construct, small and completely self-contained.

DESIGN CONSIDERATIONS

There are two types of signal generator which could be used. These may be referred to as 'the harmonic calibration oscillator' and 'the tunable wide range signal generator'. Both types often have an integral audio oscillator which may be used for either audio tests or to modulate the r.f. signal.

The harmonic calibration oscillator is the type which operates on fixed frequencies (usually 100kHz and 1MHz) and provides harmonics (multiples of the fundamental frequency) against which a receiver dial can be calibrated. It can also be used very effectively for testing and aligning the r.f. stages of a receiver, but it cannot do the same for the i.f. stages. This is because most i.f. stages operate at 455 to 470kHz, or at 1.62MHz, at which frequencies there is no harmonic output from the generator.

The wide range generator has a fully tunable oscillator, which usually has a coverage from about 100kHz to 30MHz. This could perform all the functions required, but to be really accurate a high quality slow motion dial would be needed. Such a dial would add to the size and the cost of the unit.

The answer to the problem seemed to be a combination of the two types of generator. This would be a tunable oscillator which can be set up against a standard frequency transmission when employed for calibration purposes, and which would have sufficient tuning range to cover the i.f. frequencies on its harmonics.

A tuning range of 200kHz to 235kHz is adequate for these requirements. The i.f. range of 455kHz to 470kHz is then covered by the second harmonic and 1.62MHz by the eighth harmonic, whilst the calibration fundamental frequency is given at 200kHz.

CIRCUIT CONSIDERATIONS

The r.f. oscillator needs to be extremely stable and crystals are often employed to control the frequency of oscillation. However, crystals are rather expensive, and it would be imposible for a variable crystal oscillator to be given the required frequency shift of over 15%. In consequence, a v.f.o. had to be used.

As with most v.f.o.'s, when the circuit employed in the present instrument was connected to a load, pulling in frequency resulted. To reduce this loading effect an untuned amplifier was included to isolate the oscillator from the output circuit. This amplifier stage also provides a convenient point at which to introduce the modulation from the a.f. oscillator.

The a.f. oscillator is required to give a sine wave on a single frequency, and the simplest method of obtaining this is to employ a single transistor phase-shift oscillator.

The output from this type of oscillator is rather small and was found to be insufficient for certain tests, and a stage of amplification was included to increase the output level. A potentiometer controls the amplitude of the output so that it may be reduced when testing low level stages.

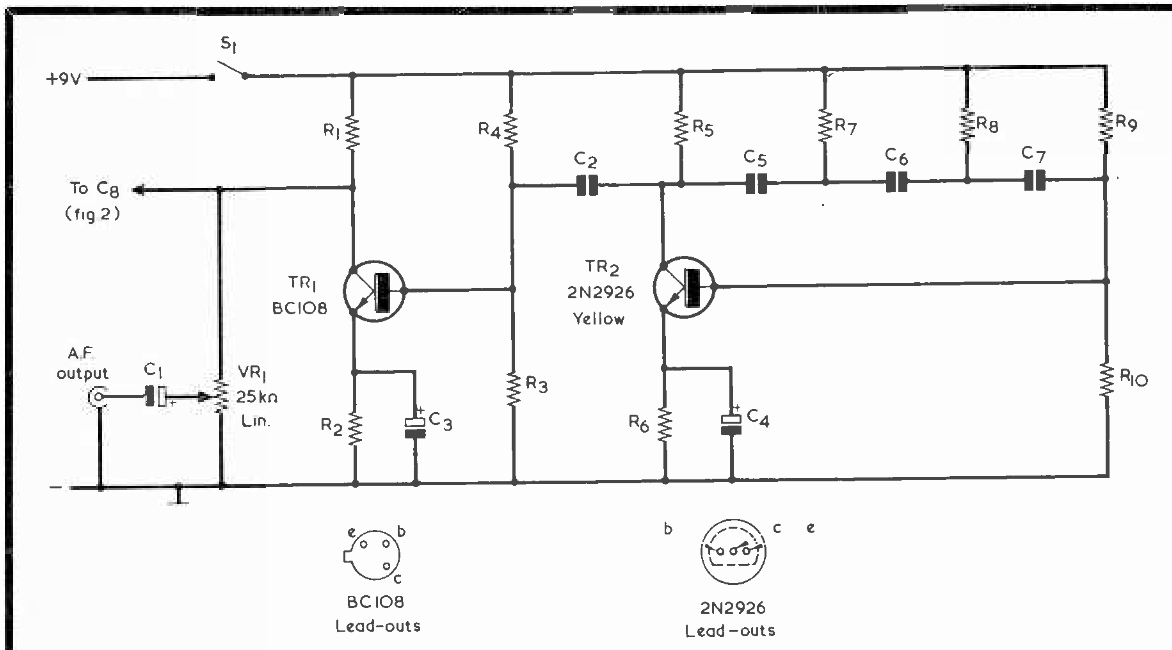


Fig. 1. Circuit of the a.f. section of the generator

The total current consumption of the completed instrument is quite low, with the a.f. section drawing approximately 4mA, and the r.f. section 5mA. These currents ensure many hours use from the PP4 battery used.

THE CIRCUIT

The a.f. circuit is shown in Fig. 1, and it will be seen that TR2 operates as the phase-shift oscillator and TR1 as the audio amplifier.

The oscillator works by applying positive feedback from the collector to the base of the transistor. As the transistor gives 180° phase shift between the base and the collector, the feedback also has to have a phase shift of 180° to bring it back in phase at the input. This is performed by the three-section resistance-capacitance network between the collector and the base.

The values of the components in the network decide the frequency at which the required phase shift occurs, and thus the frequency of oscillation. The circuit should oscillate at about 1kHz.

A high gain transistor needs to be used in this type of circuit to compensate for the losses in the phase shift network and to keep the overall gain at unity or above. The 2N2926 Yellow (available from LST Electronic Components, Ltd.) has an hfe spread from 150 to 300 and so no difficulty should be experienced in failure of oscillation due to lack of gain in the circuit.

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)

R1	220Ω
R2	100Ω
R3	6.8kΩ
R4	22kΩ
R5	8.2kΩ
R6	1kΩ
R7	8.2kΩ
R8	8.2kΩ
R9	39kΩ
R10	4.7kΩ
R11	2.2kΩ
R12	680Ω
R13	8.2kΩ
R14	1.8kΩ
R15	1kΩ
R16	15kΩ
R17	15kΩ
VR1	25kΩ potentiometer, linear

Capacitors

C1	10μF electrolytic, 50V wkg.
C2	0.1μF paper or plastic foil
C3	100μF electrolytic, 6V wkg.
C4	1μF electrolytic, 6V wkg.
C5	0.01μF paper or plastic foil
C6	0.01μF paper or plastic foil
C7	0.01μF paper or plastic foil
C8	0.1μF paper or plastic foil
C9	0.01μF paper or plastic foil
C10	0.04μF paper or plastic foil
C11	1,000pF silvered mica or polystyrene
C12	2,000pF silvered mica or polystyrene
C13	2,000pF silvered mica or polystyrene
C14	560pF silvered mica or polystyrene
VC1	500pF variable, solid dielectric

Inductor

L1 I.F. transformer type XT50/2 (Repanco), see text

Transistors

TR1	BC108
TR2	2N2926 Yellow
TR3	2N706A
TR4	2N2926 Yellow

Switches

S1 Slide switch
S2 Slide switch

Battery

9-volt battery type PP4 (Ever Ready), or equivalent

Miscellaneous

2 knobs
2 coaxial sockets
1 coaxial plug
1 test prod
1 crocodile clip
1 positive battery connector
1 aluminium case type AB7 (Electrovalue)
2½ x 3¾in. Veroboard. 0.15in. matrix (see Fig. 3)
Screened lead, wire, solder, etc.

The BC108, TR1, is a Class A amplifier and should provide an adequate output for most purposes. The output level control, VR1, is connected with the output to the slider of the potentiometer so that its setting does not alter the amount of modulation applied to the r.f. section.

The circuit of the r.f. section is given in Fig. 2. TR4 functions as a Colpitts oscillator. Coil L1 is the Green winding of a Repanco i.f. transformer type XT50/2, the other winding being unused. The internal capacitor across the coil remains in circuit. Some difficulty was experienced in making the circuit operate as low as 200kHz, and several types of transistor normally used in r.f. oscillators failed to work. It would seem that a high gain transistor is required for satisfactory operation at this frequency, and so another 2N2926 Yellow was employed.

The 2N706A, TR3, apart from isolating the oscillator from the output, acts as a mixer combining the r.f. and the a.f. signals. The a.f. is brought to the emitter through the coupling capacitor C8.

CONSTRUCTION

Most of the generator components are fitted on a piece of 0.15in. matrix Veroboard, 2½ by 3¾in. in size. It is housed in a commercially produced aluminium case type AB7 (available from Electrovalue, 28 St. Judes Road, Englefield Green, Egham, Surrey) measuring 2¼ by 5¼ by 1½in.

The layout of the components on the Veroboard panel is shown in Fig. 3. To prevent overcrowding of parts it is advisable to use physically small components wherever possible.

The board is held inside the case by two 6BA bolts. To ensure that the copper strips on the back of the board do not short-circuit to the aluminium case a piece of expanded polystyrene cut from a 1ft. square ceiling tile is placed between the two.

The negative supply to the Veroboard is obtained by a solder tag under the mounting bolt at hole 15–0. Take care to ensure that sufficient copper is cut away at hole 7–0 to ensure that the mounting bolt fitted at this position does not short-circuit the break or connect either of the strips at the break to chassis. The coil L1 is secured in place by a loop of wire passed through two adjacent holes in the board. It could alternatively be secured in position with adhesive. It has to be mounted on its side to enable it to fit into the case. Its screening can is earthed by connecting it to the tag which couples to hole 16–V.

Connections between the front panel and the Veroboard should be made using a fairly heavy gauge of single strand insulated wire. Multi-strand wire leads should not be used. The lead to the r.f. output socket is not screened.

The negative rail chassis connection to the moving vanes on tuning capacitor VC1 is provided, via the case and front panel, to the capacitor mounting bush. Similarly, the negative rail connection to the outer connectors of the output sockets is given via the chassis. Capacitor C1 is connected directly between the slider tag of the output control VR1 and the inner connector of the a.f. output socket.

Two strips of 22 s.w.g. alumini-

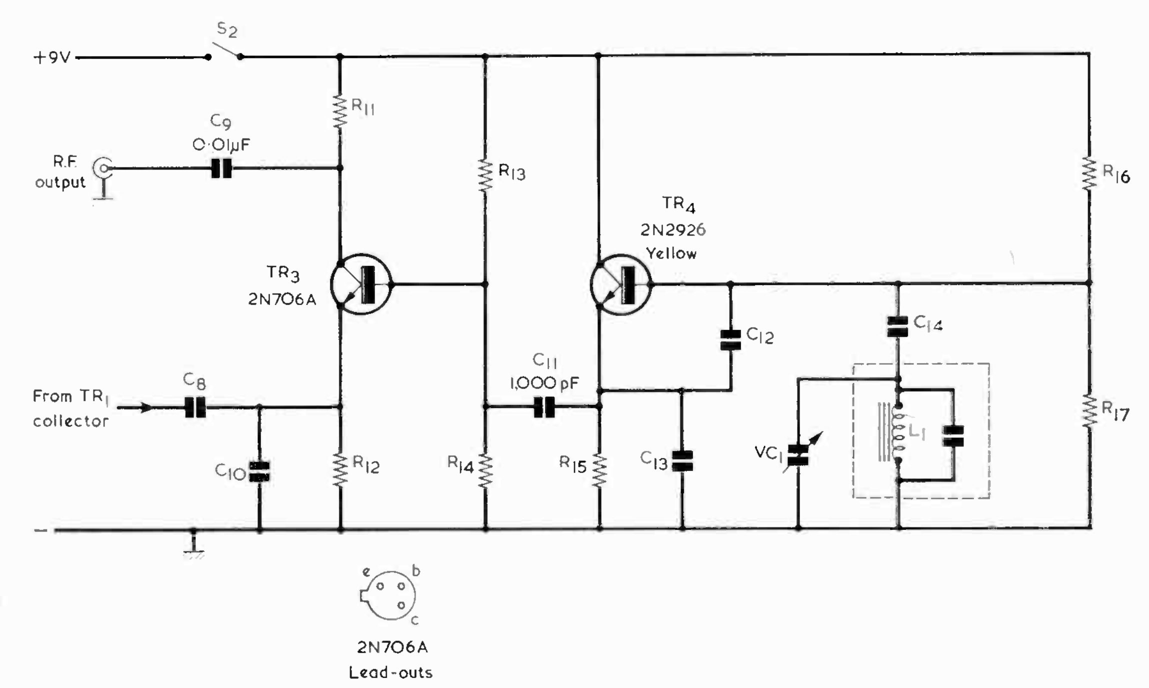
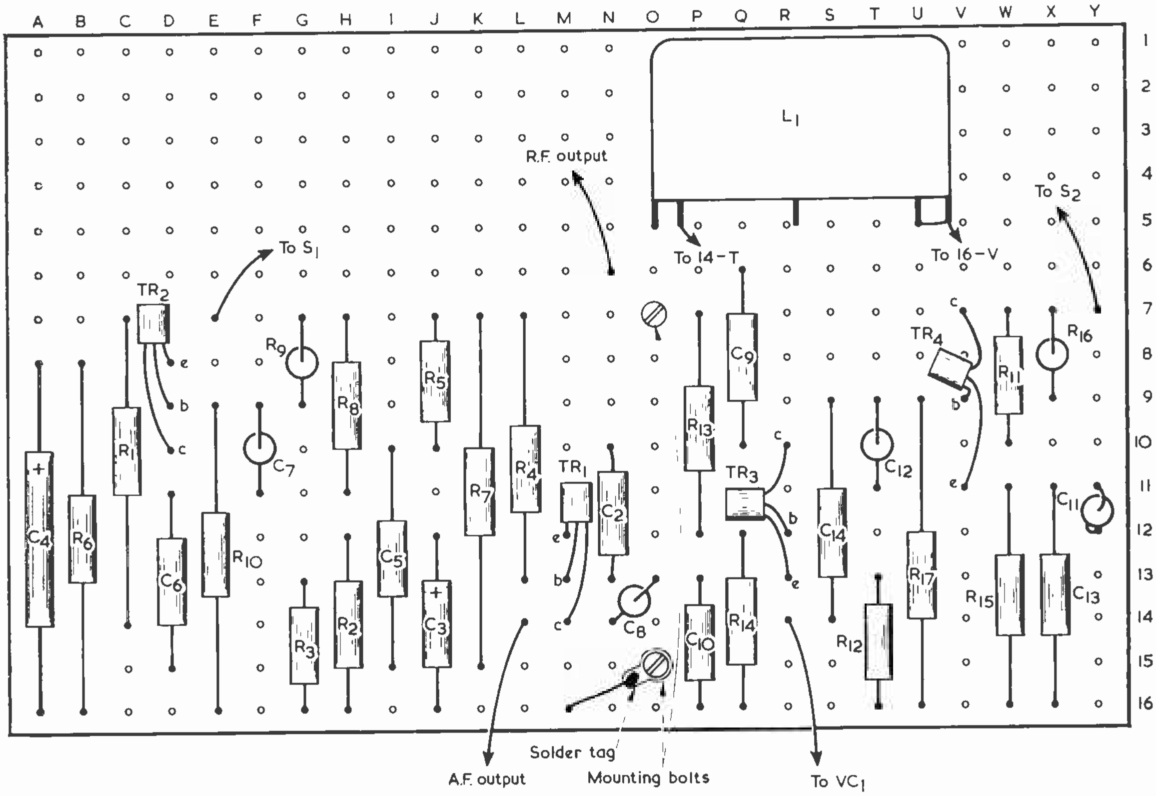


Fig. 2. The r.f. oscillator, TR4, and its buffer amplifier, TR3



Strips cut at : 7-O, 8-O, 9-O, 10-O, 11-O, 12-O, 14-O and 15-O

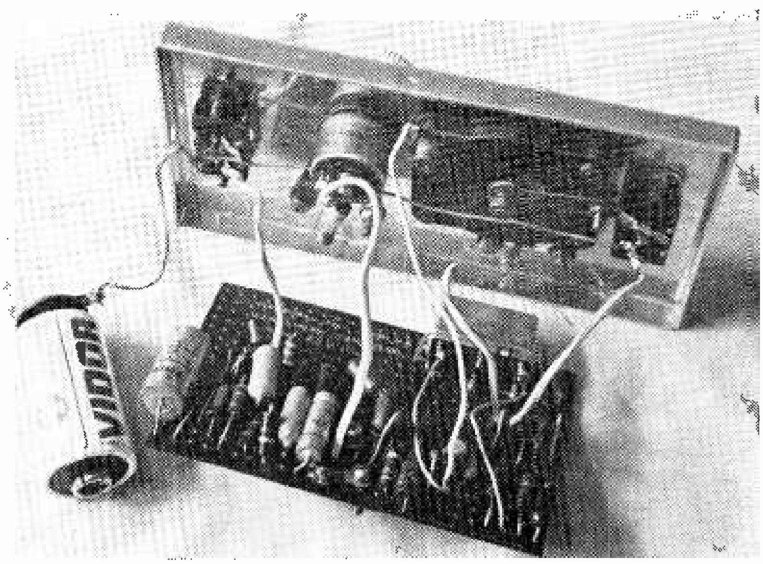
Strip cut between 13-N and 13-O

Mounting holes at 7-O and 15-O

Fig. 3. Component layout above the Veroboard. The copper strips are cut at the points indicated

um bent at 90° across the centre and then bolted into position form the battery holder. The positive end of the holder must be insulated with tape where the battery clip touches it or the battery will be short-circuited through the case. No battery clip is used on the negative terminal as this is connected directly to the case via the 22 s.w.g. aluminium strip at the negative end. The lead from the positive battery clip travels first to S1 and then to S2.

Drilling details of the front panel (which is the lid of the case) are given in Fig. 4. The panel has been given a symmetrical layout. Circular cut-outs were used for the two slide switches in the prototype, but rectangular holes could be provided instead, if desired. Fig. 5 gives details of the case and battery holder. The spacing between the two clips, shown as dimension 'X' in Fig. 5, can be found with the aid of the battery and the particular positive battery connector which is used.



The front panel components coupled to the Veroboard and battery

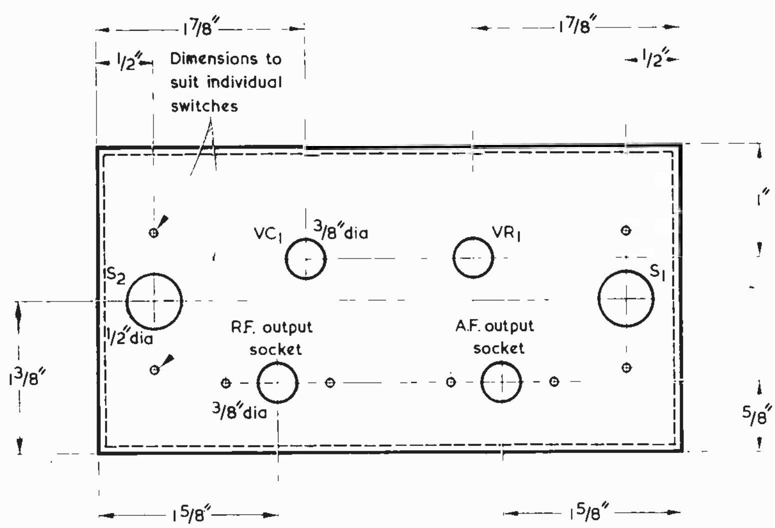


Fig. 4. Drilling details for the front panel

On final assembly the front panel is closed down over the veroboard and battery. The interconnecting leads can be approximately positioned before this is done so that they fold on themselves neatly.

A test lead is required. This can consist of a length of flexible insulated screened wire connected to a coaxial plug. The inner wire is terminated in a test prod and the outer braiding is terminated by a fly lead and crocodile clip. The latter is connected to the chassis of the equipment being checked.

USING THE GENERATOR

There are two controls for the a.f. section, these being on-off switch S1, and output level control VR1. The output from the generator is quite strong, and it must be remembered to keep VR1 well back when testing low level stages in an amplifier, in order to prevent overloading.

Before the r.f. section can be used, it must be given the correct frequency coverage. This entails adjusting the core of L1, for which purpose the unit should be removed from the case. Crocodile clip leads are employed to make temporary connections between the metal front panel and the battery negative terminal, and between the battery negative terminal and strip 16 on the Veroboard.

The r.f. output should now be coupled to a receiver tuned to B.B.C. Radio 2 on 1,500 metres. This is best achieved by placing a test prod and lead connected to the generator r.f. output near the set, being careful not to overload it.

When the r.f. section is in use S1 becomes the modulation on-off control, and this should now be set to the 'Off' position. The tuning control, VC1, should be turned fully clockwise to insert maximum capacitance.

The core of L1 is next adjusted until a whistle is heard from the receiver. Make certain that this corresponds to a true 200kHz signal and is not a whistle caused by a harmonic of the generator output being at the receiver intermediate frequency. This point may be checked by turning the receiver tuning dial slightly. If the whistle remains at a constant frequency the generator output is at the correct 200kHz, should the whistle change frequency it is caused by a generator harmonic at i.f.

The core of L1 should now be screwed as near to the centre of the coil as possible whilst still producing a whistle from the receiver.

To use the generator as a calibration oscillator, VC1 should be turned back until zero beat is obtained between the carrier of Radio 2 and the signal from the generator. At this setting the generator will be very accurately tuned to 200kHz.

Harmonics should be detectable well into the short wave spectrum on any reasonably sensitive receiver. Direct coupling between the generator output and the receiver aerial terminal may be needed at higher frequencies as the harmonics become weaker. In this respect it will be noted that no r.f. output level control has been provided. However, the desired level of coupling to any circuit will soon be found from experience, tight or loose couplings being easily arranged by having the output connect directly to the circuit under investigation or by coupling via a low value capacitor. Frequently, the requisite loose coupling may be given by merely positioning the r.f. output lead close to the wiring of the circuit being checked.

Harmonics from the generator can be identified by comparing them with transmissions of known frequency. For example, if a receiver is tuned to an amateur on Top Band, the station must be operating on a frequency between 1.8 and 2.0MHz. The receiver should now be tuned higher in frequency until a signal from the generator is received. This signal must be the 10th harmonic, at 2.0MHz. If the receiver is tuned still higher, then the 11th harmonic at 2.2MHz will be received. and then the 12th har-

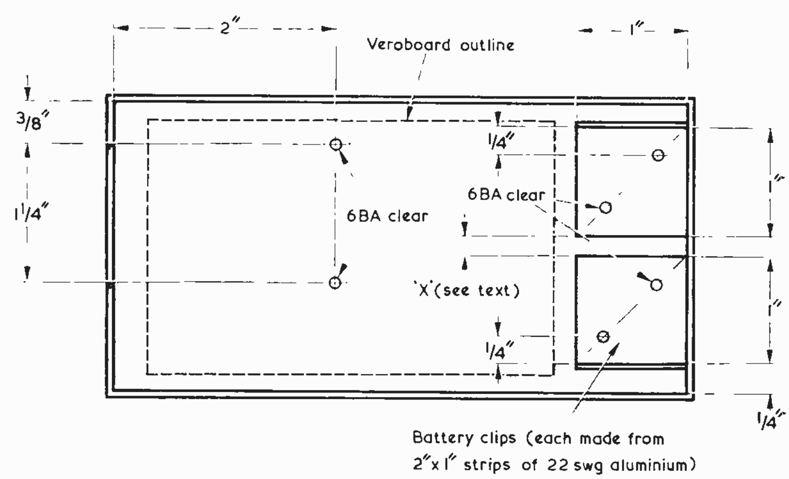


Fig. 5. Details of the case and battery holder

monic at 2.4MHz, and so on.

Other amateur bands, or broadcast stations, may be used for calibrating other wavebands on the receiver.

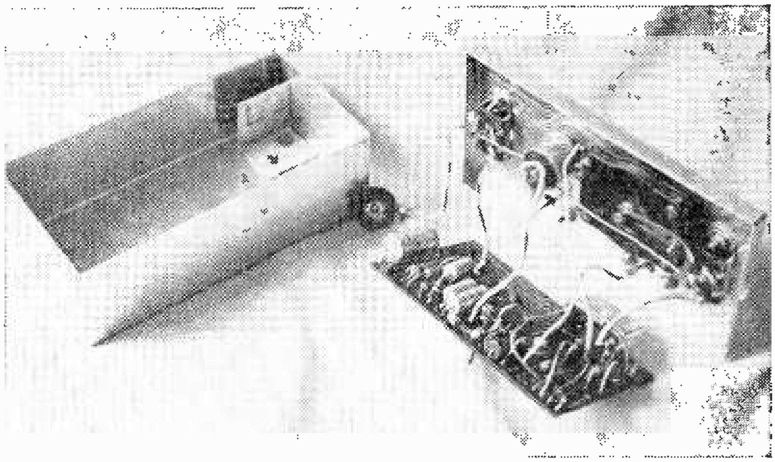
The harmonics from the generator can also be used very effectively for r.f. test and alignment.

When the generator is to be used for the i.f. alignment of a receiver which has just been constructed, there will probably be no way of tuning the required intermediate frequency on the generator accurately enough unless a frequency meter is available, or the following method is employed.

Most i.f. transformers are aligned at the factory to their approximate frequency, and it is only the final peaking adjustment that needs to be made. The i.f. amplifier can be aligned by coupling the generator output to the first i.f. transformer of the receiver, and tuning the generator for maximum output. The modulation should be switched on to make this process easier. The i.f. transformers are then peaked.

Even if the i.f. transformers are not pre-aligned, this method should still be accurate enough. Re-alignment can be achieved using the same method.

The a.f. output of the generator is isolated by capacitor C1, which has a working voltage of 50 and may be applied to any point in the equipment being checked where the standing direct voltage with respect to chassis is some 40 volts or less. This should cover all standard transistor equipment. If the standing direct voltage is in excess of 40 volts, as could occur in valve equipment, an external 0.02μF capacitor with an appropriate working voltage must be connected in series with the test prod.



Another view, including the case and one of the two battery holder strips

OPTIONAL BYPASS CAPACITOR

It will be seen that there is no bypass capacitor across the supply rails to the r.f section of the generator. If desired, such a capacitor can be added, a suitable value being 0.2μF. As there is no room on the Veroboard for the capacitor it may be wired between the appropriate tag on S2 and a solder tag under one of the securing nuts for this switch.

The capacitor gives a marginal improvement in performance and removes a slight quivering in frequency which may otherwise be evident on harmonics above about 10MHz. Since it could also guard against increasing battery internal resistance with age, some constructors may wish to add it to the unit. The capacitor was not included in the prototype and is not shown on the Components List. ■

CAN ANYONE HELP?

Requests for information are inserted in this feature free of charge, subject to space being available. Users of this service undertake to acknowledge all letters, etc., received and to reimburse all reasonable expenses incurred by correspondents. Circuits, manuals, service sheets, etc., lent by readers must be returned in good condition within a reasonable period of time.

Solatron Solarscope Type CD 1014.2 Double beam Oscilloscope. — J. H. Taylor, 12 West Drive, Cleadon, Sunderland, Co. Durham – circuit, service manual or any other details.

July 1961 issue The Radio Constructor. — A. Giles, 20 Fieldway, Dagenham, Essex RM8 2BH – would like to purchase.

BC 221 – AF Frequency Meter. — Alignment instructions, also circuit diagram and alignment details for the wavemeter D Mk II.

Avo Universal Bridge No. 408 – 151. 'Radar' C.R. Tester – Reactivator Model TT, Ser. No. 1310. — G. M. Keenan, 15 Tudor Drive, Belfast BT6 9LS – servicing information and operating instructions for either or both of these instruments.

Ex-Government Equipment. — Receiver type R1082. Ref. No. 10J/22, Training Sets W.T. Mk III H.E.C.L. Ref. No. 10D/8415, Controller Electric Type 4 Cat. No. Z.A.21137, Receiver Type R3003 Ref. No. 10DB/2, Wireless Remote Control Unit 'F' No. 1. Z.A.12642. — J. Hutcheon, The Manse, Borgue, Kirkcudbright, Kirkcudbrightshire – operational data and circuits required.

NEWS . . . AND .

DIGITAL VOLTMETER

Based on a new low cost DVM of advanced design, the new Jaquet range of digital instruments is intended to offer the systems designer a family of instruments based on the DIN module size of 72mm. x 144mm.

The digital voltmeter has a standard range of 0–200mV but other ranges are available at a small extra cost. Automatic zero point correction, AC rejection and accuracy are claimed to be superior to most existing instruments.

The DVM may be used as a digital ammeter by the addition of suitable shunts which may be built into the instrument itself.

The digital tachometer is claimed to be the lowest priced instrument of its type on the market, but retains most of the features of the existing Jaquet tachometer range. Measurements of speed or ratio are possible and the full range of existing Jaquet pick-ups are compatible.

The digital temperature indicators are available for platinum resistance thermometers but instruments for thermocouples will be added to the range shortly. Standard temperature ranges are 0–550°C and 0–200°C.

Remote indicators, printer outputs, digital comparators and a digital-to-analogue converter for driving Jaquet potentiometric recorders complete the range which supplements the existing Jaquet range of products.

BEST TYPE TAPE RECORDERS FOR SHORT WAVE LISTENERS

We are quite frequently asked by readers of our short wave columns the question 'What type of tape recorder should I purchase for use with my communications receiver?'

There are several types of recorder on the market today but that most favoured by the s.w. enthusiast is a 4-track, 3-speed mono machine, transistorised of course!

For short wave operation, stereo recorders are not required. In use, the recorder is used for taping station identifications, interval signals, etc., these being played back repeatedly in order to gain the correct identification – often at a later date.

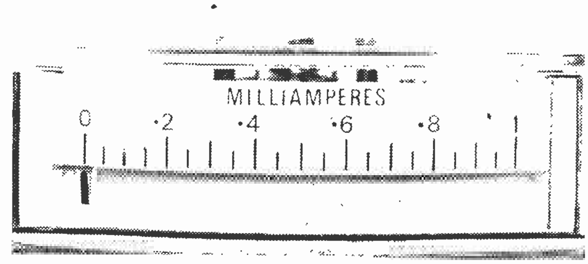
Most 'dyed-in-the-wool' broadcast enthusiasts are equipped with a tape recorder – indeed many regard it as the most essential item of equipment in the shack after the receiver!

TAYLOR EDGEWISE PANEL METER

Taylor Electrical Instruments of Archcliffe Road, Dover, announce a new model in their range of Edgewise panel mounting meters. The Model 330 offers a scale length of 2¼in. yet retains the same attractive styling of the smaller meters in the range.

This new model has been specially developed for use in today's complex yet crowded instrument panels where space is at a premium. The design is such that the Model 330 occupies a minimum of front panel area when compared with a conventional meter of equivalent scale length.

The well-proven Taylor centre pole movement is incorporated ensuring reliability and robustness. The Model 330 has a modern scale presentation and is offered with a choice of horizontal or vertical mounting.



... COMMENT

IN BRIEF

● Mr. A. J. Howarth, founder of Johnsons (Radio), St. Martin's Gate, Worcester, and a pioneer of construction kits, recently retired.

Johnsons, now part of the G-Ban Organisation, will shortly be introducing a new *Globe-King Skyranger* for the S.W. enthusiast.

● The Louis Tussaud's waxworks at Blackpool, situated in the golden mile, has a closed-circuit colour television system supplied by EMI which relays 'live' pictures of interesting tableaux in the exhibition.

● Would-be entrants for the Radio Amateurs Examination who live in the North East and who have not enrolled for an instruction course, may still do so at an evening class at the Gosforth Secondary School, Jubilee Road, Gosforth, Newcastle-upon-Tyne. Enquiries should be addressed c/o the Headmaster.

● Millbank Electronics, of Uckfield, Sussex, have won the approval of the Canadian Standards Association to supply their 30 watt, 50 watt and 100 watt professional amplifiers as CSA certified.

● A. Marshall & Son Ltd., 28 Cricklewood Broadway, London, N.W.2, are now offering a mailing service. The service will provide information and prices on their ranges of components including quantities too small in number to advertise.

The subscription fee is £1 per annum which entitles the subscriber to certain preferential discounts – a loose-leaf binder is provided to hold the information supplied.

● Professor J. F. Coales, Professor of Engineering (Control), Cambridge University, took office as President of The Institution of Electrical Engineers for 1971/72 on 1st October.

● The M-O Valve Co. Ltd. has received approval of its quality control organisation from the British Standards Institution as satisfying the requirements of the BS.9000 scheme for the manufacture of electronic parts of assessed quality.

● Radiotelevision Skopje have taken delivery of another Marconi transmitter, this time for installation on the summit of the 8,500ft. Mount Pellister in the Federal State of Macedonia, the most southern and mountainous of the six Yugoslavian republics.

● An order for a telex/telephone communications system has been placed with Marconi Marine by North Sea Sun Oil Co. Ltd., of London for the drilling rig *Transworld 61*, which will be sited 140 miles east of Aberdeen within an area designated as Block 22 in the North Sea.

● Europe's first fully-automatic unmanned navigational buoy, Hawker Siddeley Dynamics 84-ton 'Lanby', recently replaced the Shambles lightship off Portland Bill, Dorset.

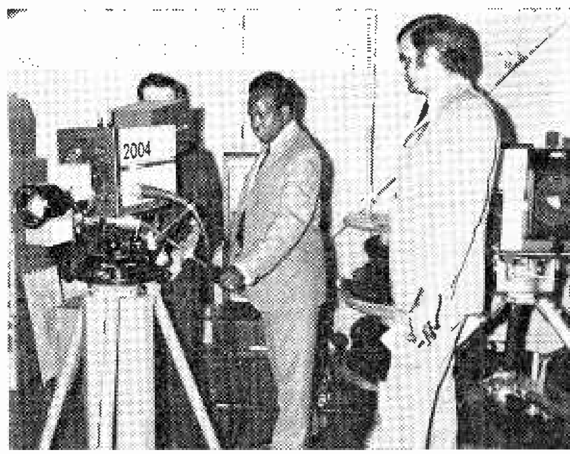
● Mr. C. J. W. Scott has retired from executive duties as a managing director of Crompton Parkinson Ltd., after more than 40 years with the company.

SMALL ADVERTISEMENTS

Extract from letter just received '. . . In closing may I thank you for your mag., the response to our small ad. has exceeded all expectations.'

Why not use this feature for your own benefit? The charge is only 4p per word, full details are give on page 251.

CHIEF ENGINEER OF EAST AFRICAN BROADCASTING AUTHORITY VISITS EMI



Voice of Kenya's chief engineer, Mr. Simeon Macharia, tries out EMI's latest monochrome type 2004 television camera during a recent visit to the Hayes, Middlesex, plant of EMI Electronics Ltd. Mr. Macharia, seen here with EMI export sales engineer Mr. Terence Bartlett (right), visited the company's Television Equipment Division during an eight-day fact-finding tour of major British television equipment manufacturers and broadcasting studios.

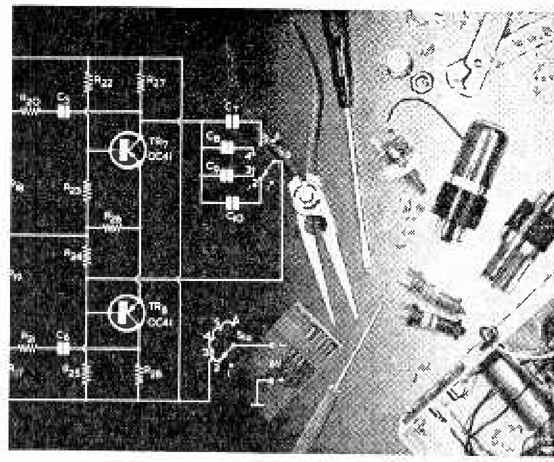
Voice of Kenya is to expand its existing television and radio broadcasting network in Kenya and future plans may include additional studio facilities.

Introduced in 1970, the EMI '2004' camera is designed for the smaller monochrome broadcasting station and for educational television work. It is a compact 625/525-line unit and its features include four-lens turret, tilting view-finder, variable aperture correction, built-in test signal facilities, cue circuits and camera talk-back.

". . . And I must apologise for loss of vision in Round Six."

TRIGGERED DOOR ALARM

by G. A. FRENCH



THE MULTIVIBRATOR IS AN oscillator which is very familiar to the experimenter. In its semiconductor form it has the advantage of considerable simplicity and it is also a circuit which is easy to put into operation. Furthermore, it can run at exceptionally low supply voltages and currents.

One factor of multivibrator operation which is not normally exploited is that it is capable of being 'triggered' in a manner reminiscent of the thyristor. It is possible to cause a multivibrator to start oscillation following the momentary closure of two contacts and then to continue oscillation until its power supply is disconnected. This mode of operation is quite reliable, and will now be discussed in this article.

TRIGGER OPERATION

Fig. 1 shows a standard transistor multivibrator circuit, with the familiar cross-coupling capacitors, C1 and C2, between each base and the opposite collector. We may assume that the component values are such that the multivibrator runs at an audio frequency.

Let us next reduce the value of Rx, the base resistor of TR2. If we reduce this value to a sufficiently low level we will have the case where, when the supply is applied, transistor TR2 is close to becoming fully bottomed and offers zero or negligible amplification at audio frequency. Under this condition the multivibrator will not start. If however, the base of TR2 is temporarily connected to the lower supply line the transistor becomes cut off and its collector voltage approaches that on the upper supply line. On removing the temporary connection the transistor collector voltage starts to fall to its previous low level but, in so doing, enters the range of voltages in which TR2 offers useful amplification. The multivibrator now commences to oscillate and continues in this state. This is because the process of oscillation causes C1 to take the voltage on the base of TR2 below that on the lower supply line during the half-cycles when TR2 is cut off, whereupon TR2 is capable of functioning in the manner required by the multivibrator.

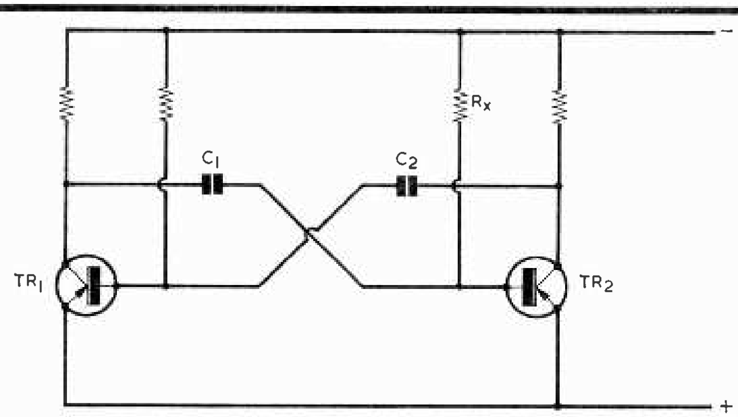


Fig. 1. The basic transistor multivibrator. For certain values of Rx the circuit can be 'triggered' by temporarily connecting the base of TR2 to the positive supply line

A triggered multivibrator operates reliably in practice but it is desirable, when switching on, to raise the power supply voltage gradually from zero to the final operating potential rather than to connect it abruptly to the multivibrator. If the supply is connected abruptly the multivibrator may start, since TR2 can momentarily pass through a condition at which it offers useful amplification. A gradual increase in supply voltage when switching on may be achieved very easily by connecting a large-value capacitor across the multivibrator supply rails and applying the supply to this capacitor via a resistor. A gradual increase in voltage is then given as the large-value capacitor charges.

PRACTICAL APPLICATIONS

Uses for the triggered multivibrator will suggest themselves to the experimenter, and Fig. 2 gives a simple application which shows typical component values in a practical working circuit. The circuit in Fig. 2 is for a novel door warning 'buzzer', which generates a continuous tone of around 500Hz from a loudspeaker as soon as a press-button is pressed and then released. The 'buzzer' can only be silenced

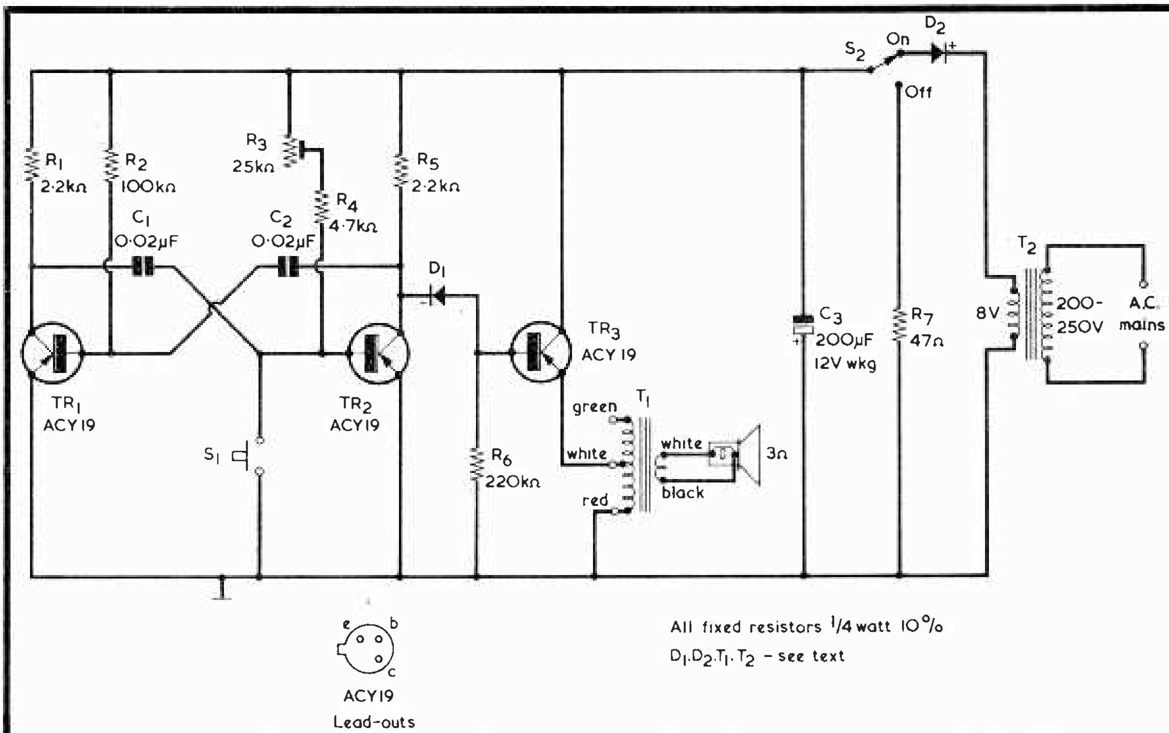


Fig. 2. A practical application of the triggered multivibrator. A tone is given at the loudspeaker after S1 has been pressed

by switching off the supply to the circuit and then switching it on again. The output level, from the simple amplifier incorporated, should be adequate for a small flat.

In Fig. 2, TR1 and TR2 are the two multivibrator transistors of Fig. 1. The base resistor Rx is now replaced by a preset variable resistor R3 in series with fixed resistor R4. The purpose of R4 is to set an upper limit to the base current that can be obtained by way of R3.

Switch S1 is the push-button that activates the multivibrator. When pressed, it connects the base of TR2 to the lower supply rail.

Additional components appear to the right of TR2. TR3 is an emitter follower which acts as a current amplifier and drives the loudspeaker by way of output transformer T1. D1 is a silicon diode and its function is to ensure that TR3 passes leakage current only during the time when the multivibrator is inoperative. Under this condition TR2 is nearly bottomed, and the voltage between its collector and emitter is less than the 0.5 volt which is needed for the flow of forward current in D1. When the multivibrator operates, after pressure and release at S1, the collector of TR2 swings above 0.5 volt on the half-cycles when this transistor is cut off, thereby enabling base current to flow in TR3 during these half-cycles.

The supply for the circuit is obtained from transformer T2, this being a mains bell transformer having a relatively high internal resistance. Its secondary voltage is rectified by silicon diode D2 and the resultant direct voltage appears across reservoir capacitor C3. C3 serves a secondary function also, since the transformer internal resistance and this capacitor provide the RC circuit, referred to earlier, which ensures that the supply voltage rises gradually on switching on.

S2 provides on-off switching. When it is desired to silence the 'buzzer' after S1 has been pressed and released, S2 is set to the 'Off' position. This removes the supply and also connects R7 across C3, causing the latter to discharge rapidly. S2 is then returned to 'On' whereupon the supply voltage reappears, building up gradually due to the presence of the transformer internal resistance and C3.

COMPONENTS

The three transistors are readily available germanium types. Diode D1 can be any silicon diode or rectifier. D2 should be a silicon rectifier capable of passing a forward current of 100mA or more, and having a p.i.v. in excess of 25 volts. The Lucas DD000 would be satisfactory in both diode positions.

Transformer T1 is an Eagle LT-700 transistor output transformer. Only half of its primary is connected into circuit. T2 is an inexpensive bell transformer of the type available from Woolworth's stores, and it offers a secondary voltage of eight volts with a tap at five volts. The tap is not used here. Any alternative type of mains transformer offering about eight volts may be employed instead. If, however, the alternative transformer has a low internal resistance it may be necessary to add a physical resistor between the secondary and D2 to provide the gradual increase in supply voltage when switching on. A 5Ω or 10Ω 1 watt resistor should be adequate.

The only remaining components which require comment are R3 and S2. R3 can be a skeleton preset variable resistor. S2 *must* be a type offering break-before-make switching and a suitable component would be a s.p.d.t. toggle switch.

SETTING UP

After the circuit has been completed, it has next to be set up.

R3 should initially be adjusted so that it inserts zero resistance into circuit. The primary of T2 is connected to the mains and S2 is switched to 'On'. If all is well, there should be no sound from the speaker. The slider of R3 is then adjusted to put increased resistance into circuit, and is turned until the multivibrator commences running and its tone is audible from the speaker. S2 is set to 'Off', the slider of R3 is returned a little way towards the zero resistance end of its track, and S2 is put to 'On' again. If the multivibrator commences to run again the procedure is repeated. Eventually, a setting in R3 will be found at which the multivibrator does not oscillate when S2 is returned to 'On'. This is the final setting and the multivibrator will now only run after S1 has been pressed and released.

The required setting in R3 was not at all critical with the prototype, and circuit operation was not affected when the supply voltage to the multivibrator was experimentally taken over the range 6 to 12 volts without any re-adjustment to R3. There is a slight possibility that spread in gain with transistors employed in the TR2 position may require that R4 be reduced in value with some specimens if R3 is to offer a useful range of adjustment. It will probably be found that the final setting of R3 will be such that its slider is near the zero resistance end of the track. ■

ADDING REGENERATION

by

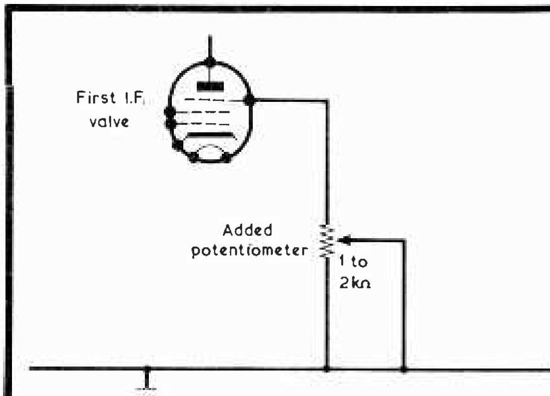
S. G. WOOD, G5UJ

This suggested method of adding regeneration to a valve broadcast receiver may not function with all sets, but its simplicity makes it worth trying out experimentally

PERHAPS NOT WIDELY APPRECIATED IS THE FACT that the modification of an ordinary valve long, medium and short wave superhet to facilitate the reception of c.w. signals can be simplicity itself. It is necessary for the first i.f. valve to have its suppressor grid brought out to a separate pin and not be connected internally to chassis.

ADDED POTENTIOMETER

As a glance at the accompanying diagram will show, all that is required in the way of additional components is a linear potentiometer, either carbon or wirewound, having a value of 1 to 2kΩ. This may be mounted in any convenient spot on the receiver chassis, it being wired into the suppressor grid circuit of the first i.f. valve as indicated. By virtue of the variable resistance inserted, a fair measure of regeneration can be obtained, thus enabling c.w. to be copied as would occur with the more orthodox b.f.o. used with proper communications receivers.



Normally, the suppressor grid of an i.f. amplifier valve is connected direct to chassis, or to cathode. Here, it is connected to chassis by way of a potentiometer

The modification need in no way interfere with the normal function of the receiver when used on the medium or long wave bands for broadcast reception. All that is necessary to render the receiver suitable for broadcast listening is to turn the potentiometer slider right to the end of its travel, thus reducing the resistance in circuit to almost zero, whereupon the i.f. stage will work normally.

In many i.f. valves the internal screen is internally connected to the suppressor grid, and the regeneration may be the result of the resistance which is inserted in series with the chassis connection to this screen rather than to any effect resulting from the suppressor grid itself. Before fitting the potentiometer first check that the receiver will allow regeneration to occur by temporarily inserting a 1kΩ or 2kΩ fixed resistor between the suppressor grid and chassis. If the receiver oscillates then the modification may be carried out and the potentiometer fitted. Should the valve have its internal screen brought out to a separate pin, try inserting the resistance between chassis and this screen as well as between chassis and the suppressor grid. ■

QSX

by **FRANK A. BALDWIN**

(All Times GMT)

Broadcast band listeners in this country are now engaged in logging those low powered Asian and Far Eastern stations occupying channels on the low frequency bands, the 'season' for reasonable reception of these transmitters now being upon us. For the summer months, however, most of their attention had been focused on the LA's (Latin Americans). The 'season' for LA's has not been a particularly good one as far as UK reception was concerned. In more years of Dx'ing than I care to remember, the writer considers that the prevailing high noise level, both man-made and natural, was the worst ever to be heard. However, be that as it may, some highlights inevitably occurred, making all those wasted LA sessions in which nothing of note was heard somewhat worthwhile.

Most Dx'ers retain memories of an outstanding Dx feat they have accomplished or of a transmission heard that had an unusual 'aura' about it – the writer recalling, for instance, reception of several low-powered field stations during the Spanish Civil War – complete with the sounds of battle in the background! All this leads into my latest 'unusual aura' logging.

On the 23rd of August, during an LA session, at 0319 the receiver was set at a measured frequency of **5055** when a programme of marching and patriotic tunes and songs was heard, interspersed with what one can only describe as political harangues in Spanish (shades of the Civil War!). The station identification, however, placed the transmitter far from the Iberian Peninsular, it was in fact CP87 San Rafael in Bolivia.

The programme content was strange to say the least from an LA station. Usually, their bubbling-effervescent, folksy and rhythmic music dominates almost every programme – there was obviously something very different about this one! Listening to the news on the BBC later that morning provided the answer – I had been eavesdropping on the latest (at the time of writing) LA revolution! One president had, apparently, rapidly replaced another!

Turning to another aspect of Dx'ing, that of identifying mysterious transmissions on unlisted channels, the writer located a station signing-off at 2200 with an anthem sounding very much like (but not quite) 'Auld Lang Syne' on a measured frequency of **4826**, this being heard on two later occasions. This station can only be heard (a) if conditions are good for Dx, and (b) after the USSR transmitter on **4825** closes-down at 2130.

The most likely answer is that provided by the British Association of Dx'ers (BADX). The station is situated in the Maldive Islands (400 miles S.W. of Ceylon) and is that of Radio Maldives, the anthem of this Independent Sultanate reminding one of the above-mentioned tune. R. Maldives is apt to appear on various channels without warning and just as suddenly to vanish elsewhere. In the past it has been reported on **3473, 6665, 9926** and **14310**, according to the World Radio Handbook.

● LATIN AMERICAN STATIONS

3365 0247 HIRL Radio Exitos, Santiago, Dominican Republic (1kW). Heard with station identification and LA songs.

3380 0300 OAX1O Radio Chiclayo, Chiclayo, Peru (1kW). Logged with plaintive songs of the Altiplano and identification.

4755 0100 ZYF23 Radio Dif Moranhao, Sao Luiz, Brazil (1kW). Commercials in Portuguese and station identification.

4830 0318 YVOA La Voz del Tachira, San Cristobal, Venezuela (1kW). Programme of typical Latin American songs and music.

4832 0323 TIHB Radio Capital, San Jose, Costa Rica (1kW). Station identification and LA music.

4865 0104 PRC5 Radio Club do Para. Belem, Brazil (2kW). Discussion in Portuguese on world affairs.

4875 0100 HCHE4 La Voz Esmeraldas, Ecuador (5kW). Latin American music and station identification.

4910 0036 YVPN Esc. Radiofonicas, San Fernando de Apure, Venezuela (10kW). Discussion in Spanish followed by LA music. QRM from HCMJ1 Emisora Gran Colombia in the background.

4923 0041 HCRQ1 Quito, Ecuador (5kW). Talk in Spanish with subsequent station identification at 0045 followed by LA music.

4990 0023 YVMQ Radio Barquisimeto, Barquisimeto, Venezuela (15kW). Discussion in Spanish, identification at 0030. LA music.

4995 0021 ZYX2 Radio Brazil Central, Goiania, Brazil (5 kW). LA songs and music, identification at 0030.

5010 0300 Radio Cristal, Santo Domingo, Dominican Republic (1kW). Typical LA songs and music, identification at 0300.

5030 0251 YVKM Radio Continente, Caracas, Venezuela (10 kW). LA songs and music with station identification at 0300.

6040 0115 HJLB La Voz del Tolima, Ibague, Colombia (10 kW). Station identification and commercials in Spanish.

6105 0110 ZYN6 Ceara Radio Club, Fortaleza, Brazil (5kW). Sports commentary in Portuguese – extended schedule, normally closes at 0100.

6175 0106 ZYV74 Radio Guarani, Belo Horizonte, Brazil (10kW). Sports commentary, very excitable, complete with roar of crowd in background!

6185 0104 ZYR77 Radio Bandeirantes, Sao Paulo, Brazil (10kW). Same programme as above.

6250 0145 OAX7A Radio Cuzco, Peru (1kW). Distinctive music of Peru interspersed with many identifications.

21460 2000 HCJB Voice of the Andes, Quito, Ecuador (50 kW). Programme in English with identification. A higher frequency at a reasonable(!) time.

21705 2115 XERMX Radio Mexico, Mexico City (100kW). Programme of music records after station identification in English.

● HERE AND THERE

From the British Association of Dx'ers journal, 'Bandspread', we learn that the full schedule of the Abu Dhabi Broadcasting Service is from 0230 to 0445 and from 1230 to 2000 on **4988.** An English programme is carried from 0930 to 1100 (except Friday) during the 0445 to 1230 period on **6124.** Present (at time of writing) power is 10kW but will shortly be increased to 500kW.

The writer wishes to acknowledge the assistance of the British Association of Dx'ers and also B. Walsh of Romford, Essex.

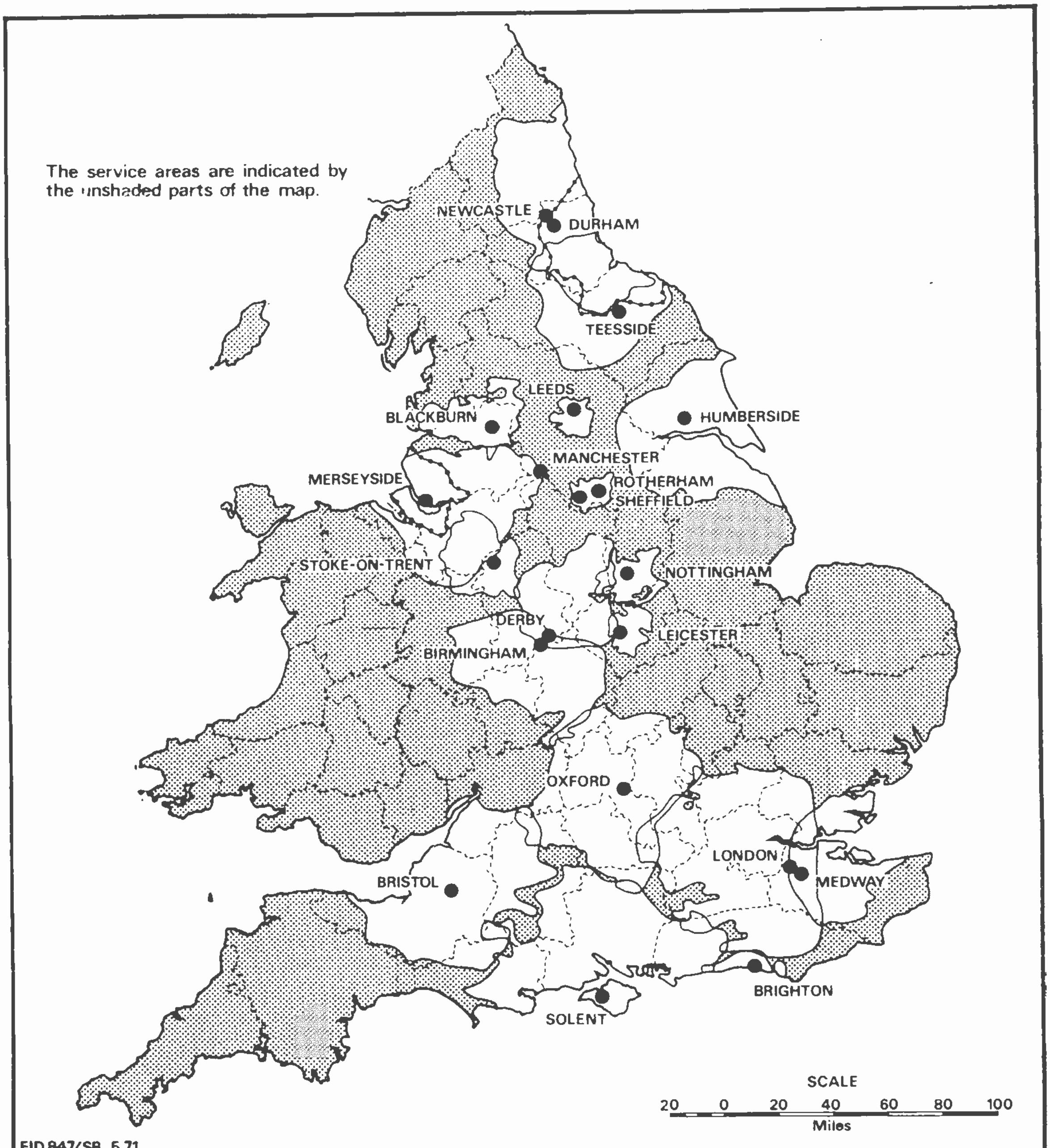
LOCAL RADIO

There are now no less than twenty local radio stations in service throughout England. These, together with their service areas are shown on the accompanying map, whilst frequency and power figures appear in the following list

	Frequency (MHz)	Max e.r.p. (kW)
BBC Radio London	95·3	16·5
BBC Radio Medway	97·0	5·5
BBC Radio Oxford	95·0	4·5
BBC Radio Birmingham	95·6	5·5
BBC Radio Derby	96.5*	5·5
BBC Radio Leicester	95·2	0·14
BBC Radio Nottingham	94.8*	0·2
BBC Radio Stoke-on-Trent	94·6	2·5
BBC Radio Brighton	95·8	0·5
BBC Radio Solent	96·1	5
BBC Radio Bristol	95·4	5
BBC Radio Humberside	95·3	4·5
BBC Radio Leeds	94·6	0·14
BBC Radio Sheffield (Rotherham)	88·6 95·05	0·03 0·01
BBC Radio Blackburn	96.4*	1·5
BBC Radio Manchester	95.1*	4
BBC Radio Merseyside	95·85	2·5
BBC Radio Durham	94·5	2·6
BBC Radio Newcastle	95·4	3·5
BBC Radio Teesside	96·6	5

*Slant polarization; all other transmissions use horizontal polarization.

TRANSMITTING STATIONS



THE 'DROITWICH' CAR RADIO

by

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

This receiver offers the ultimate in simplicity of car radio control since it is preset to the Radio 2 programme on 200kHz. Single station tuning also enables circuit simplicity to be achieved, as there is then no necessity for the use of a superhet design. The set functions from a 12 volt supply and can be wired for either a negative or a positive earth

NOW THAT RADIO 4 IS ALMOST confined to broadcasting speech, and while Radio 3 is still out of range in many parts of the country, there is a lot to be said for a fixed tuned Radio 2 car radio. A fixed tuned receiver is easy to make and set up, and can be operated without the driver taking his eyes from the road, since only a combined volume control and switch are required. Again, the comparative complication of a superhet becomes quite unnecessary. After all, a superhet is no more than a straight receiver tuned to about 465kHz, and preceded by a frequency changer which offers little amplification. The superhet is obviously of advantage when variable tuning is employed, or when the medium waveband is covered, but entirely without merit when the fixed frequency is lower than that normally used in the i.f. stages. A circuit tuned to 200kHz will give better sensitivity and selectivity

COMPONENTS

Resistors
(All fixed values ½ watt 10% unless otherwise stated)
R1 10kΩ
R2 3.9kΩ
R3 2.2MΩ
R4 22Ω 3 watt wirewound 5%
R5 470kΩ
R6 22kΩ
R7 4.7kΩ
R8 10kΩ
VR1 10kΩ potentiometer, skeleton preset
VR2 5kΩ potentiometer, log track, with switch S1 (see text)
VR3 1.5kΩ potentiometer, miniature preset

Capacitors
C1 0.01μF paper or plastic foil
C2 10μF electrolytic, 16V wkg, Mullard miniature
C3 180pF silver-mica, 2%
C4 220pF silver-mica
C5 1μF electrolytic, 40V wkg, Mullard miniature
C6 2,200pF, paper or plastic foil
C7 100pF silver-mica
C8 180pF silver-mica, 2%
C9 100μF electrolytic, 4V wkg, Mullard miniature
C10 220pF ceramic
C11 1,000μF electrolytic, 16V wkg, Mullard miniature
VC1 100pF trimmer, mica

Inductors
L1 2.5mH r.f. choke (Repanco)
L2 Miniature Dual-Purpose Coil, valve type, Blue, Range 1 (Denco)
L3, 4, 5 Miniature Dual-Purpose Coil, Valve type, Green, Range 1 (Denco)
T1 Interstage transformer type LT44 (Eagle)

Semiconductors
TR1 2N4289
TR2 BC169C for negative earth battery, 2N4289 for positive earth battery
TR3 AD162 for negative earth battery, AD161 for positive earth battery

Valve
V1 ECH83

Switch
S1(a) (b) d.p.d.t. (part of VR2)

Fuse
F1 2-amp fuse and holder

Speaker
25Ω speaker, 7in. by 4in.

Sockets, Plugs
3-off B9A valveholders
Car aerial socket
2-off 2-way socket (or terminal) strips

Case, Chassis
(All Home Radio)
2-off 4in. by 2in. sides (Cat. No. CU133)
2-off 7in. by 2in. sides (Cat. No. CU136)
2-off 4in. by 7in. plates (Cat. No. CU158)
1-off Hardware Kit (Cat. No. CU154A)

Miscellaneous
1 spindle extension (if needed – see text)
1 knob
Plywood
Nuts, bolts, connecting wire, etc.

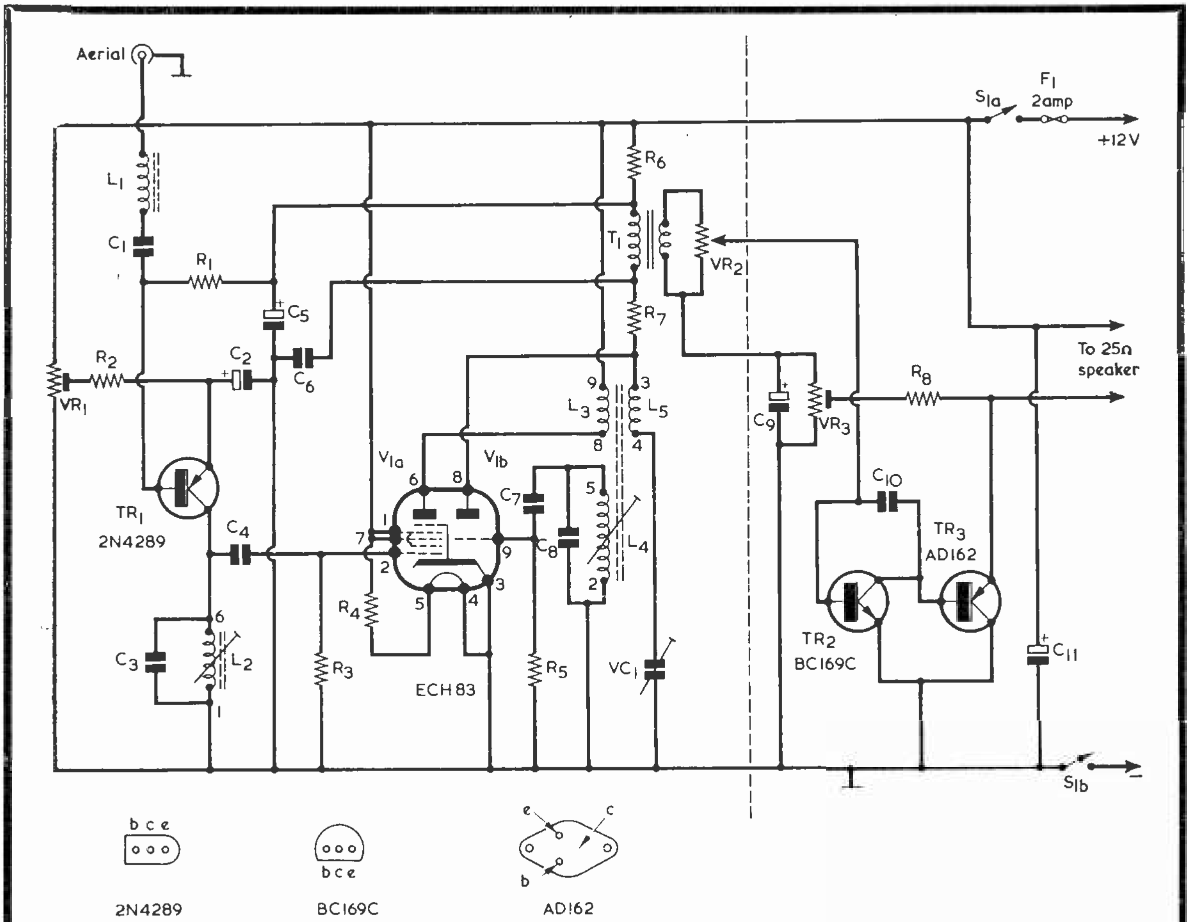


Fig. 1. The circuit of the 'Droitwich' Car Radio. The vertical dashed line is not a screen; the tuner section appears to the left of it and the a.f. amplifier section to the right. A negative battery earth is assumed

than one tuned to 465kHz, because of the better inductance-capacitance ratio.

The design adopted for this receiver uses the same basic principles as those employed in an earlier car radio design by the author for medium wavelengths, and described in this journal.* That is to say, it takes advantage of the stability of a valve and the high mutual conductance of a transistor to give a very good level of amplified a.g.c. The circuit has been considerably modified since the earlier design, and the present receiver uses fewer components but is more sensitive. Its construction can be safely undertaken by the comparative beginner who knows how to use simple tools and has made up two or three receivers.

*Sir Douglas Hall, 'Design For Universal Car Radio', *The Radio Constructor*, April 1969.

CIRCUIT OPERATION

The circuit is given in Fig. 1. The signal is picked up by a normal car aerial and applied to the base of a high amplification common emitter amplifier which has a tuned circuit in its output, this connecting to the input of V1(a). V1(a) is a valve r.f. amplifier, transformer coupled to V1(b), a leaky grid detector with reaction. The combination of two high efficiency amplifiers and a reaction circuit gives large overall signal frequency amplification. Because V1(b) is a leaky grid detector the bias at its grid will increase on the arrival of a signal. In consequence, the direct voltage drop across the decoupling resistor R6 will decrease, this voltage change having been amplified by the amplification factor of the valve. R6 is also in the bias feed circuit for the base of TR1. The emitter bias of TR1 is held fairly steady by the potentiometer VR1, only a small degree of negative feedback being given by R2, this being required to prevent too great a change in amplification being brought about by differences in car battery voltage due to its being on or off charge. Consequently, the base bias of TR1 will be decreased by a strong signal and TR1 will offer less amplification. In the earlier design, the input transistor was operated as a common base device. This arrangement worked well on medium waves, but on 200kHz the transistor continues to offer good amplification when nearly cut off. In the common emitter configuration, amplification falls off more rapidly with a drop in collector current, and the a.g.c. effect is therefore improved. A further advantage is the greater amplification available for weak signals owing to the greater efficiency of the common emitter arrangement, provided collector current is not too low.

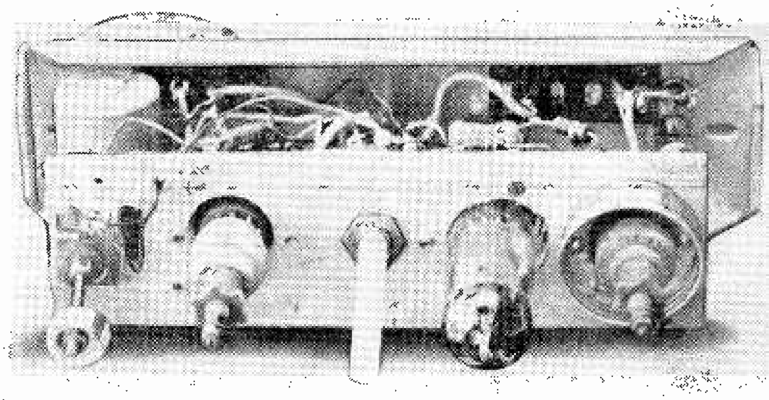
As regards circuit details in the tuner section it will be seen that C1 isolates the aerial from the battery. L1 prevents cross-modulation by powerful medium or short wave stations during the times when TR1 is passing very little collector current. V1(a) obtains its necessary grid bias by means of grid current flow in R3. The smaller value of grid resistor, R5, provided for V1(b), enables that valve to operate as a detector. The presence of R7 in the anode circuit of V1(b) allows reaction to be obtained. R4, which must have a rating not less than 3 watts, drops the heater voltage for the valve to a nominal 6.3 volts. C3 and C8 are close-tolerance capacitors which allow the variable cores of the two coils used to tune to 200kHz.

The tuner section ends at the dashed line and a pair of high resistance phones across the volume control VR2 will give good loud results.

The a.f. amplifier, to the right of the dashed line, could hardly be simpler. TR2 is a high amplification common emitter n.p.n. transmitter feeding direct into the output transistor, TR3, a p.n.p. emitter follower with a 25Ω speaker in its output circuit. Correct bias is set up by VR3, C9 acting as a bypass capacitor at audio frequencies. VR3 is adjusted so that half the battery voltage is dropped across the speech coil of the speaker, this giving conditions for maximum output by TR3 which, with the car running and the battery on charge, is about 1 watt. C10 provides a small degree of treble cut by negative feedback and keeps radio frequencies away from TR3. C11 is the usual high capacitance electrolytic component across the power supply.

A 35Ω speaker may alternatively be used, but this will reduce output to about 700mW.

The circuit, as so far described and as shown in Fig. 1, assumes a battery with negative earth. Circuit changes for a car with positive earth are described at the end of this article.



The receiver before fitting in its case. In this photograph the screening can for the aerial coil is removed. An extension threaded rod may be seen inserted in trimmer VC1

CONSTRUCTION

Construction should start with cutting a piece of plywood as in Fig. 2. The two coilholders and the valveholder (all identical components), VR2, T1 and VC1 are mounted as shown in Figs. 3 and 4. VR2 should have a body diameter of about 1in. or less, as it may otherwise foul the valveholder. This point should be checked before the valveholder hole is cut out; if necessary, the valveholder hole may be shifted very slightly to the left from the position indicated in Fig. 2. The two coilholders are fixed in position with wood screws behind the panel, but the valveholder is set back a little by means of two 6BA bolts, each with three nuts. It should take up a position such that, with the valve inserted, there is 2in. between the end of the valve pip and the outside surface of the panel. One of the coil can lids (i.e. the lid of one of the cans in which the coils are supplied) has a central portion cut away so that the coil can pass through it, and it is then bolted over the left hand coilholder, on the outside of the panel, the inner of the two bolts having a solder tag on it for earthing purposes. See Fig. 4. One of the coil cans has a $\frac{1}{4}$in. hole drilled through its bottom to allow the core to be adjusted and is then screwed to the lid. The other coil should not be screened. T1 should be cemented in position, its core fitting into the slot cut for it and its orientation being as indicated in Fig. 4. Cut a second piece of plywood, 6 by 1$\frac{3}{4}$in., to act as a baseboard and temporarily screw the components panel to this as indicated in Figs. 3 and 4.

Now examine the Home Radio 'Universal Chassis' parts specified in the Components List. It will be seen that there are two flanged sides 7in. by 2in., and two smaller sides 4in. by 2in. There will also be two plates, a little under 7in. by a little under 4in. Take one of the 7 by 2in. sides, and fit the aerial socket, battery socket, speaker socket and TR3 to it as illustrated in Figs. 3 and 4. Exact positions are not shown, since sockets vary a little in dimensions, but Fig. 4 shows how they should generally be placed. Small rectangular openings must be cut to allow the power and speaker plugs to be inserted into their sockets. Now, temporarily screw this metal side to the other side of the baseboard so that the assembly appears as in Fig. 3. Leave $\frac{1}{16}$in. between the underneath of the base-

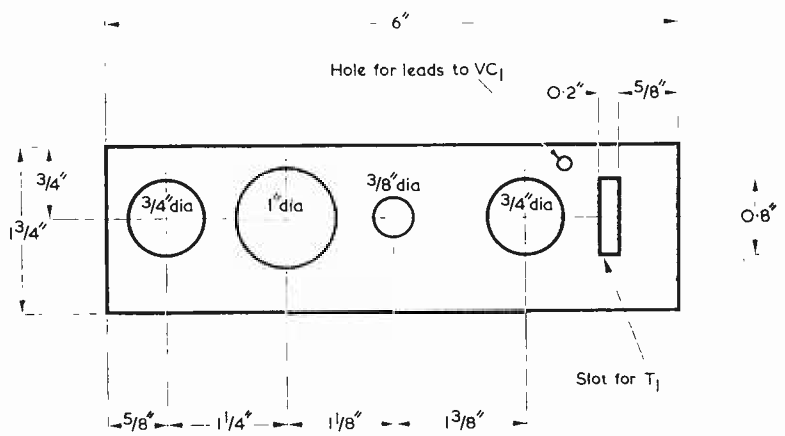


Fig. 2. Drilling details for the main component panel

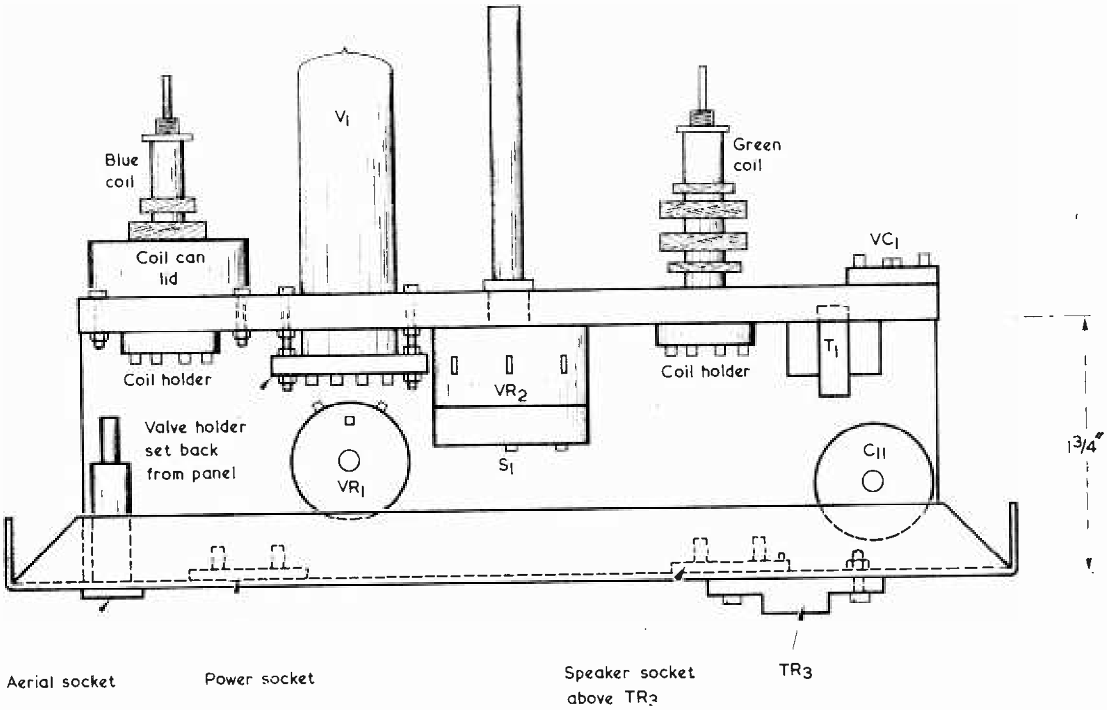
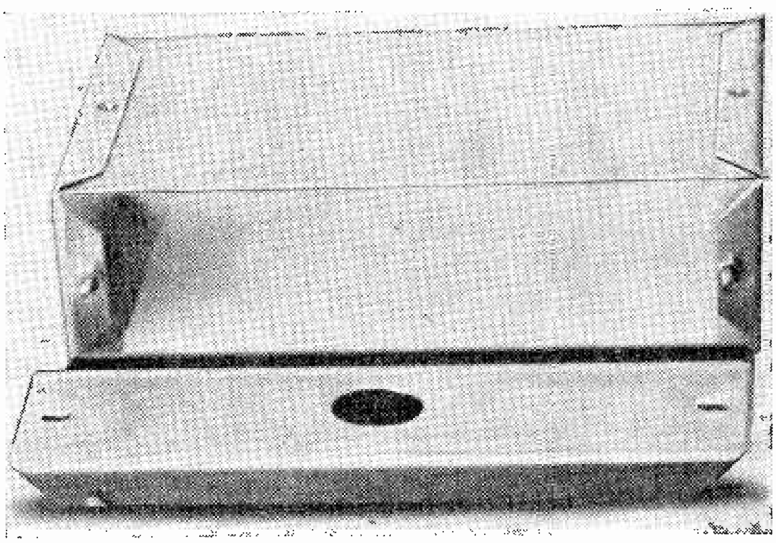


Fig. 3. Components on the main component panel, baseboard and rear metal panel assembly. Note that the body of TR3 is on the outside

board and the inside surface of the bottom flange of the metal side, so that one of the 7 by 4in. pieces may be later slid between the underneath of the baseboard and the flange.

Next, remove the main components panel and the metal side from the baseboard and wire up components as shown in Fig. 4, omitting the leads between the two sections. These leads are fitted when the components panel and metal side are, later, screwed to the baseboard once more. Points to note are that VR1 is, in fact, soldered direct to the appropriate tags of the valveholder, and not equipped with wires as is shown, for clarity, in the diagram. Also, VR1 and VR3 are turned through 90 degrees so that they are easy to adjust when the chassis is screwed together as in Fig. 3. It is important that the a.f. amplifier components shown in the lower part of Fig. 4 should not extend to the left further than the edge of VR2, or this component will foul them. The a.f. amplifier components should also lie fairly close to the metal side without being so close as to invite short-circuits. TR3 is bolted direct to the metal side – no insulating washer should be used, but care must be taken to see that neither the base pin nor the emitter pin is in contact with the metal side. It is as well to hold the main components panel and the metal side in place along the edges of the baseboard from time to time as wiring proceeds, to make sure that sufficient room is being left. There is room, but not much to spare. Do not use higher voltage electrolytic capacitors than those specified, or space will be at a premium. They are all standard Mullard components, easily available. VR3 can be obtained from Amatronix Ltd., 396 Selsdon Road, South Croydon, Surrey.

Further points are that the coupling winding fitted to L2 (and which connects to pins 8 and 9)



The metal case and front panel

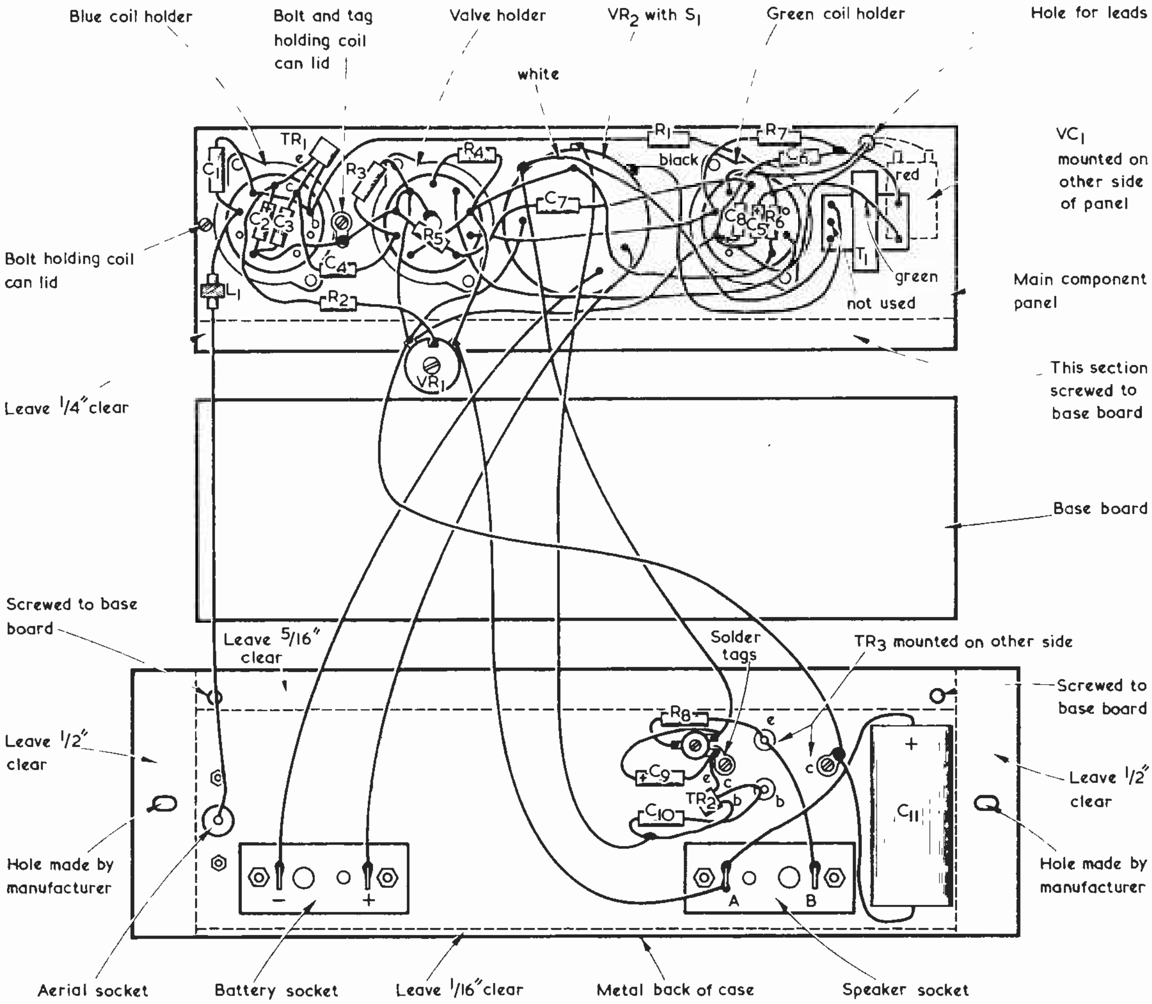


Fig. 4. Fitting and wiring of the components in the receiver

does not appear in the circuit and no connections are made to it. Some of the spare tags on both coilholders are used as anchoring tags. The tag layout of switch S1 may, with some components, vary from that shown in Fig. 4. Confirm the tags to be used with the aid of a continuity tester before wiring to them. If connections are made to incorrect tags the supply can become short-circuited when the switch is turned on.

When wiring on the main panel and the metal side has been completed, temporarily solder a 12in. length of red insulated wire to the end of R2 which joins to the slider of VR1, and a 12in. black lead to the other end of R2. Next, screw the component panel and metal side permanently back to the baseboard and complete the connections between the two sections. Useful refinements are to fit small compression springs over the core adjusters of the two coils, with nuts to compress them, and to replace the screw in VC1 with a short piece of threaded rod fitted with a knob. The first of these devices keeps the cores steady when the car is in motion, and the second makes adjustment a little easier.

Next, take the 4 by 7in. plates and cover one side of each with Fablon or Contact, leaving half an inch clear at each of the 4in. sides. With the covered sides inside, assemble with the two 4in. side pieces as shown in Figs. 5(a) and 5(b). It will be seen that the plates are bolted underneath the side flanges. This is in order to keep the overall depth down to 2in. and so ensure that the receiver will fit any slot provided in the car. 6BA countersunk nuts and bolts are used. Be careful when countersinking the holes in the flanges that the countersinker or drill used does not go right through the metal! Four holes will need to be drilled for these four 6BA bolts. In addition, four 4BA bolts and nuts are fitted to the existing holes in the side flanges as shown in Fig. 5. Bolts and nuts are provided, but slightly longer bolts will be required. These bolts will be used to lock the receiver into the case on the one side, and to fit the other 7in. by 4in. flanged side over the front when the receiver has been fitted.

When the case has been assembled as described, the receiver is slipped into it from one open side until the two 4BA bolts protrude through the holes already provided by the manufacturer in the 7in. by 4in. side which is the part of the receiver taking the amplifier components. Two nuts – dome nuts are neat here

– will lock the receiver into position. It will be seen that the edge of the bottom plate passes into the $\frac{1}{16}$in. space left between the baseboard and the metal side which is part of the receiver assembly. The two wires which have been soldered to R2 are passed round one end of the main components panel so that the ends pass through the front and are easily accessible.

SETTING UP

Setting up and testing can now take place.

Open VC1 fully, set the slider of VR1 to the negative end of its track (clockwise in Fig. 4) and set VR3 with its slider at the half way position. Clip a voltmeter, set to give a clear reading of 6 volts, across the speaker terminals with the positive lead to the speaker tag connected to the positive line. Connect up a battery in charged condition, but not actually on charge, switch on and adjust VR3 for a reading of 6.3 volts.

Now set the meter to a voltage range which offers at least 20kΩ meter resistance (e.g. a 20kΩ per volt meter on a 1 volt range, or a 10kΩ per volt meter on a 2 volt range, the former being preferable) and clip its leads across the red and black leads attached to R2. No aerial should be connected at this stage and the receiver is partly or wholly out of its case to provide access to VR1. Adjust VR1 to give a reading of 0.2 volt (200mV). Leave the meter in position, slide the receiver fully home in its case, plug in the aerial and adjust the cores of both coils for optimum results from Radio 2, which will be indicated by a minimum reading on the meter – down to near-zero in the case of a powerful signal. Now put the battery on charge, either by running the engine of the car or by means of a charger. Tighten VC1 a little, making any small adjustment to the core of the green coil as may be necessary. If VC1 is tightened too far there will be a loss of treble and, eventually oscillation. Adjusting VC1 will still further reduce the reading given by the voltmeter though it may cause little or no increase in volume level. Finally make sure that the core of the blue coil is at optimum, still using the meter as a guide. Tuning will be less sharp here than with the green coil. It should be pointed out that if VC1 is set for optimum when the battery is not on charge, there is likely to be distortion or instability when the engine is started.

COMPLETION

The receiver is now set up. Put a little adhesive on the coil core screws and the setting screw of VC1

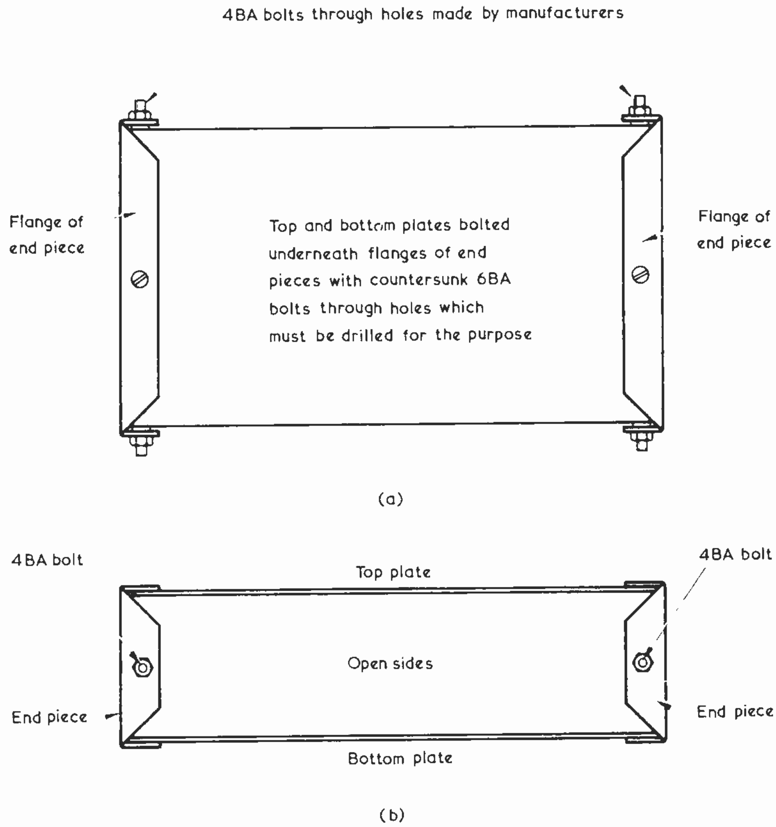
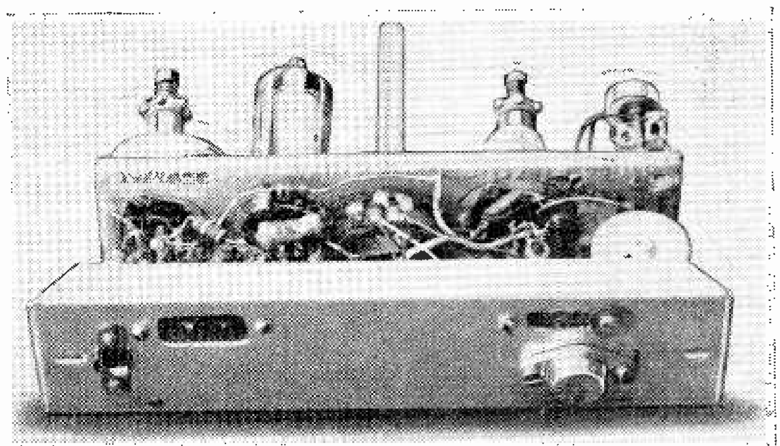


Fig. 5(a). Top view of the case in which the receiver is housed (b). Side view of the case



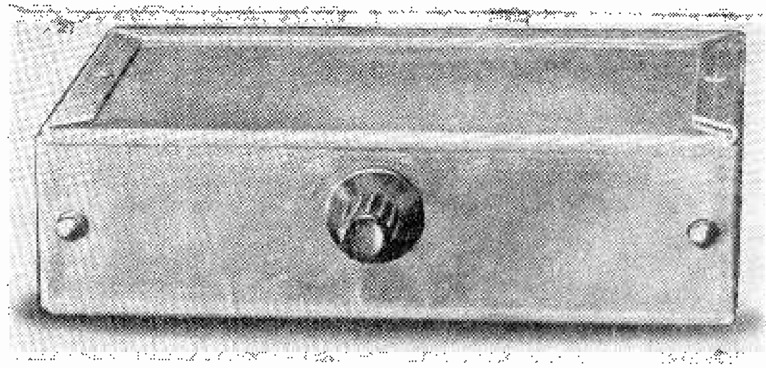
Rear view of the receiver. Note the output transistor on the rear panel

– this is especially important if an extension rod and small knob have been fitted as these encourage movement by vibration – remove the receiver from the case and unsolder the two leads from R2. These have served their purpose, and the receiver can now be finally bolted back into the case again.

Take the remaining 7in. by 4in. metal side and cut a hole in it for the spindle of VR2. This metal side is then pushed into place over the two 4BA bolts on the front of the case, and two dome nuts lock this into position. It may be necessary to use a spindle extension for VR2, or a long-necked self-locking type of knob.

Because of the presence of the four 4BA bolts, the two sides will be held a little away from the case, leaving small air gaps at each corner. These provide the ventilation necessary for V1 and R4. TR3, bolted direct to the side of the case, is in open air and keeps very cool.

The completed receiver may now be fitted to the car. A 2 amp fuse should be inserted in the positive lead to the battery (or in the negative lead if the receiver is to be wired up for a battery with positive earth) and should be removed whilst the receiver is being connected up since the positive plug could accidentally touch the case during this process. The fuse is external to the receiver and is positioned at a convenient point in the car.



The completed receiver. There is only one control, this being for on-off switching and volume

POSITIVE EARTH

So far, the description of the receiver has assumed a battery with negative earth. If a positive earth battery is used the amplifier circuit becomes as in Fig. 6, and the following changes are carried out. Transistors for TR2 and TR3 should be as indicated in the Components List for positive earth batteries. This enables TR3 still to be bolted direct to the metal side without the use of a washer. The connections from VR1 in Fig. 4 to speaker socket A and the securing bolt of TR3 are changed round. Speaker socket A now connects to the negative supply line and TR3 securing bolt to the positive line. Connections to C9 are reversed, and so are connections to C11. Also, C11 is physically turned round so that its positive lead appears at the bottom in Fig. 4. This is a precaution against possible short-circuits if the Fablon case lining becomes damaged. Apart from these changes, wiring is carried out as in Fig. 4.

Current drawn from the battery when the car is running will be about 600mA with a 25Ω speaker, or 500mA with a 35Ω speaker. Do not use a speaker with a lower impedance than 25Ω.

It may be pointed out that some constructors may prefer to use terminal strips rather than socket strips for the battery input connections at the receiver, since there is then less risk of a power plug working loose under vibration and short-circuiting to the receiver case or car earth. An important factor is that the battery must *always* be connected to the receiver with correct polarity, both in use and during setting-up. Battery connection with incorrect polarity can cause damage, particularly to the electrolytic capacitor C11.

As a final note it should be mentioned that radio frequency amplification is very high and all the normal suppression precautions should be taken. Otherwise, interference will be experienced in areas of low signal intensity where the a.g.c. action is minimal and amplification is at maximum. With some cars it may help to fit a low resistance choke in the non-earthy lead from the battery. This must not have a resistance of more than 1Ω and can be made by winding 16 yards of 24 s.w.g. enamelled wire in a pile on a short length of ⅜in. ferrite rod. The choke should be contained in an earthed screening can and should be fairly close to the receiver. It is also useful to use a fairly long aerial in the interests of good a.g.c. The author uses a 62in. Vanlan type AW300/4E available from Alpha Radio, 103 Leeds Terrace, Wintoun Street, Leeds. Mount the aerial as far from the engine as possible. ■

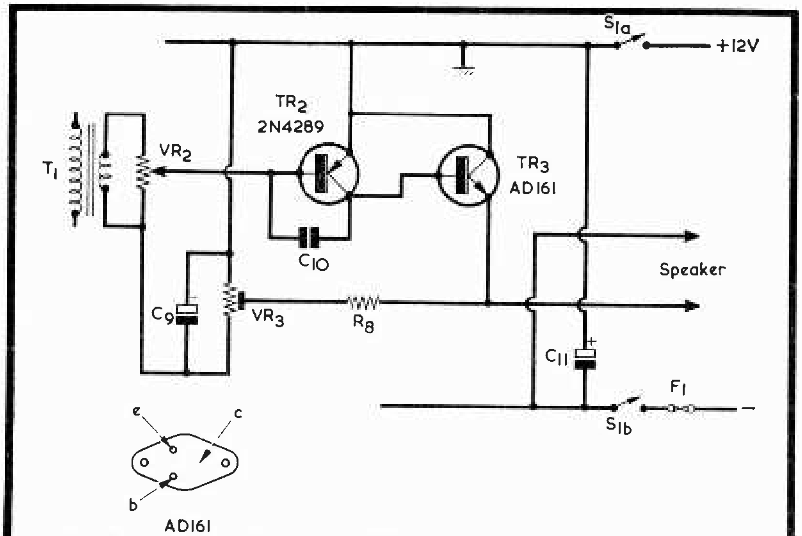


Fig. 6. The alternative a.f. amplifier circuit, for use if the car has a positive battery earth

NOW HEAR THESE

Tmes = GMT *Frequencies = kHz*

● **ANGOLA**
The correct frequency of CR6RE is **4966** (listed **4965**). All transmissions are experimental, the parallel channel being **3215**.

● **THAILAND**
The External Service of Radio Thailand, Bangkok, may be heard daily from 1155 on **11905** (listed **11910**). It is planned to provide a service to the Middle East and Europe from 0440 to 0615 on **17825** and on **17855**.

● **TAIWAN**
The North American Service of the Voice of Free China, Taipei, can be heard from 0200 on **15125** (50kW – 19.83 metres).

● **ARGENTINE**
It is reported that Radio Colon, a medium wave transmitter, uses **5514** as a standby channel for sports events on Sundays.

● **PAKISTAN**
Radio Pakistan may be heard with their regular transmission in English, beamed to the UK, from 1945 on **9460** (10/50kW – 31.76m).

● **NIGERIA**
NBC Kaduna may be heard with identification and newscast in English at 2200 on **9570** (10kW – 31.35m). Channel jammed from 2202. (BADX).

● **VATICAN**
Vatican Radio may be heard at 2230 with an English programme to the Philippines on **7250** (100kW – 41.38m).

● **INDIA**
News in English at dictation speed can be heard at 0900 from Delhi on **11910** (25.19m), **15185** (19.76m), **17840** (16.82m), **17780** (16.87m) and on **15333** (19.56m). (BADX).

● **ECUADOR**
HCJB Quito may be logged at 2000 with identification and English programme on **21460**.

● **GHANA**
Radio Ghana is to be heard with identification and a programme in Arabic at 1629 on **21545**.

● **N. KOREA**
Radio Pyongyang has been heard with programme announcements at 1958, identification after three short and one long 'pip' at 2000 and then news in Korean on **4275**. (BADX).

● **LIBERIA**
ELWA Monrovia may be logged – QRM permitting – around 2100 on **4770** (10kW).

● **MALAWI**
Blantyre can be heard at 2000 with identification in English followed by programme of records with English announcements on **3380** (20/100kW).

● **EGYPT**
Radio Cairo radiates a newscast in English at 1330 on **17920** (50/100kW – 16.74m).

Acknowledgements: Our Listening Post, SCDX.

Cover Feature

AUDIO FREQU

PAI

by

J. T. NEILL

A compact frequency meter, with frequencies and employing an integr square wave output is also available. tion, will be publ

ONE ITEM OF TEST EQUIPMENT THAT THE HOME constructor does not normally have at his disposal is a means of determining frequency.

In the radio frequency band, frequency measurement can often be carried out by comparison, in a receiver, of the unknown signal whose frequency it is required to determine with, for instance, the signal from a transmitter of known frequency. Comparison with the harmonics of a crystal oscillator is another system in common use.

At audio frequencies other methods have to be employed. Comparison with the output of a signal generator by means of a Lissajou figure on an oscilloscope is the most popular scheme, but of course an oscilloscope and, for that matter, an audio signal generator of good accuracy throughout its range, is not always to hand.

ANALOGUE DISPLAY

It was with these considerations in mind, and during the course of some audio experiments, that the author decided to construct an audio frequency meter. Commercial frequency meters invariably use a kind of digital display, but the circuits to drive them are complicated and correspondingly expensive; accordingly, the meter described here has an analogue display, using an ordinary 100μA meter for the purpose.

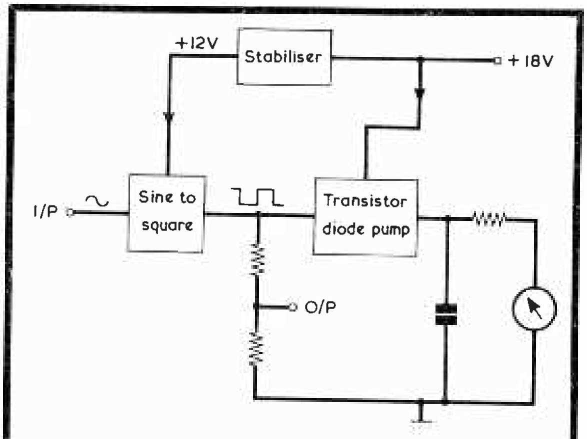


Fig. 1. Block diagram illustrating the basic operation of the audio frequency meter

This does reduce the accuracy somewhat, compared to the digital instrument, but when the cost and the fact that no frequency measuring equipment of any kind is normally available to amateurs are taken into account, it will be seen that this audio frequency meter will fill a large gap in the usual range of test equipment.

ENCY METER

Γ 1 ● ● ●

ılogue display, working at audio
ɨ circuit for ease of construction. A
ırt 2, giving constructional informa-
ed next month

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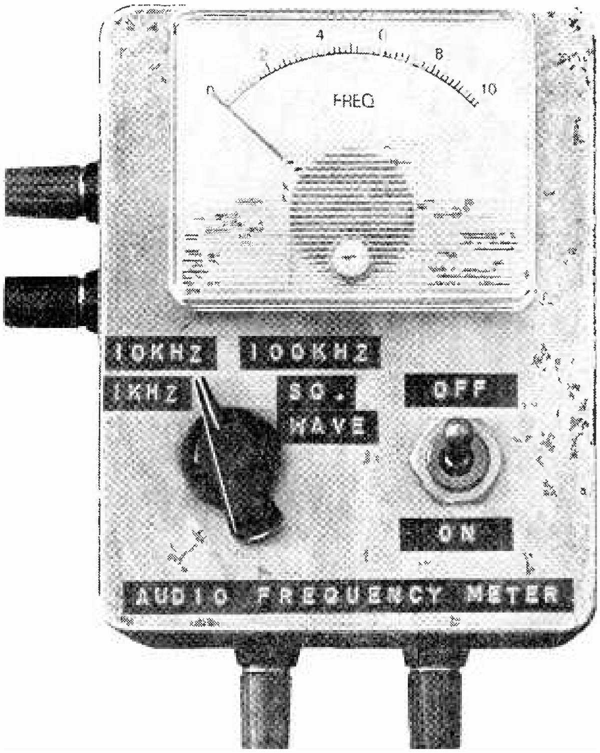


In its battery-powered form the meter can be built in a completely self-contained housing

In point of fact, the accuracy obtained here is as good as that of the moving coil meter incorporated, that is, about 2½%.

Frequency is displayed in a selected one of three ranges – up to 1kHz, up to 10kHz and up to 100kHz. The minimum level of input for reliable readings is 40mV, while the input impedance is 4.7kΩ. Power is derived either from the mains via an isolating transformer or from two 9 volt batteries which, as discussed later, can be either incorporated in the unit itself or used externally.

One feature which will be of particular interest to those enthusiasts who favour the use of square-wave testing of audio amplifiers is that a large amplitude square-wave of good rise time and of the same frequency as that of the input is made available. When this facility is in use the unit is not at the same time able to measure frequency, but can of course be returned to that mode when required. The square-wave output can also be used as a signal source in receiver fault finding, since it contains harmonics at least up to the 1MHz region.

CIRCUIT DIAGRAM

Fig. 1 gives the block diagram and Fig. 2 the circuit diagram, excluding the mains power supply.

In order to simplify the construction and setting up of the frequency meter, an integrated circuit operational amplifier is used to convert the input waveform to a square wave. The transistor diode pump responds in such a manner that the resultant reading on the meter is proportional to frequency. The RC time constant in the pump is selected by the range switch to give the ranges mentioned.

An operational amplifier (often referred to as an 'op. amp.') ideally has infinite gain and bandwidth, infinite input resistance and zero output impedance, but of course no actual amplifier can have these characteristics. However, in the case of the SN72709 amplifier used here, typically the gain is 45,000 and the input resistance is 250kΩ, according to the manufacturer's data sheet.

Since in the present circuit no negative feedback is applied, we have the full gain of the amplifier available, and it will readily be seen that it requires only a very small input signal to drive the amplifier to saturation in either direction. Consequently, at the output of the amplifier there appears a square-wave of good rise and fall times due to the high gain present and also because the upper frequency limit of the SN72709 is in the megahertz region.

It will be noted that there are two signal inputs to the SN72709, by convention labelled '–' and '+'. These are the inverting and the non-inverting inputs respectively, and are available for the application of feedback when the SN72709 is used with its gain reduced from the value given above. As stated

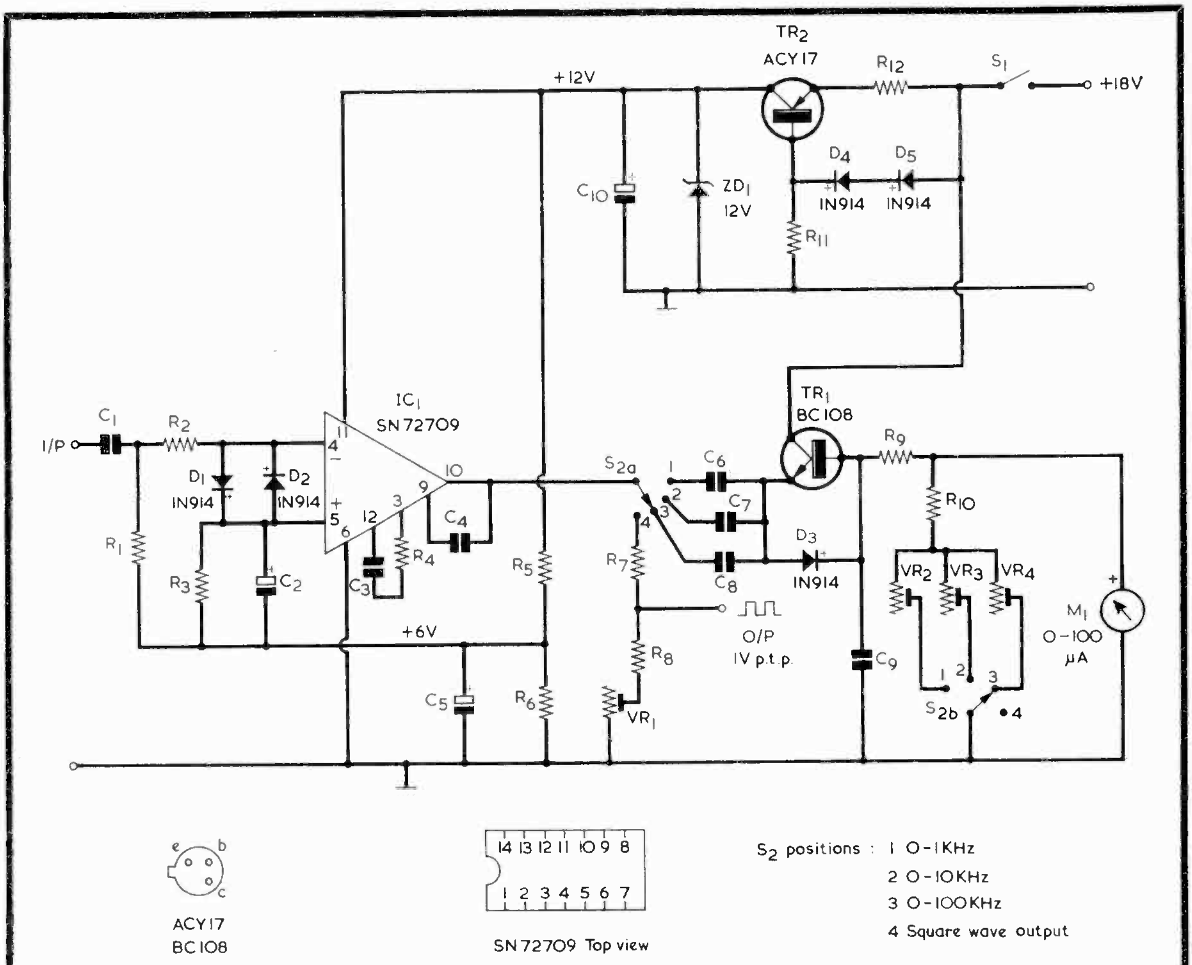


Fig. 2. Complete circuit diagram of the meter. The 18 volt supply may be obtained from batteries or a mains supply unit

previously, in this application no feedback is employed. However, since the SN72709 is d.c. coupled throughout means must be provided for keeping the two signal inputs at the same d.c. level, and this is done by returning both of them, through appropriate resistors, to half the supply voltage.

A brief outline of why this is necessary is as follows.

The SN72709, when used as a d.c. amplifier, is usually fed from equal positive and negative supply rails, with one signal input returned to earth, which of course lies mid-way between these two rails. The other signal input has the negative feedback, if any, applied to it, and so it also lies close to earth potential. When a.c. coupling is used, as here, there is no need to go to the trouble of voltages of both polarities, so long as the signal inputs are returned to a voltage roughly mid-way between the two supplies. The 'two supplies' are accordingly earth and the + 12 volt rail; as described later, this 12 volt supply rail is stabilised.

DIODE PUMP

As noted earlier, at the output of the SN72709 there exists a square wave, of the same frequency as the input signal, and of a constant amplitude, due to the use of the stabilised rail. The circuit that follows is the heart of the frequency meter, for it charges up a capacitor to a voltage dependent on the frequency of the input signal. It is possible to obtain more than one range of frequency measurement by switching in different values of capacitor.

Basically, the circuit used is a diode pump, shown in its basic form in Fig. 3, and it functions in the following manner.

Assume both capacitors are fully discharged, and then permit the first positive-going pulse to be applied to the input. Diode D2 will be non-conducting, but diode D1 will switch on and C1 and C2 in series will charge up to Vi, provided that the source impedance of the pulse generator is low. Since, in the frequency meter, the source impedance is the output impedance of the SN72709, which is of the order of a few hundred ohms, we will assume that the voltage across C1, and C2 in series will reach the input pulse voltage Vi.

From simple capacitor divider theory, if for example C2 is five times larger than C1, then the

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)

R1	4.7kΩ
R2	4.7kΩ
R3	10kΩ
R4	1.5kΩ
R5	10kΩ
R6	10kΩ
R7	8.2kΩ
R8	470Ω
R9	4.7kΩ
R10	680Ω*
R11	2.2kΩ
R12	270Ω
VR1	250Ω skeleton preset
VR2	500Ω skeleton preset*
VR3	500Ω skeleton preset*
VR4	500Ω skeleton preset*

*May require adjustment to suit meter resistance

Capacitors

C1	1μF miniature foil
C2	4.7μF electrolytic, 10V. wkg.
C3	100pF ceramic
C4	10pF ceramic
C5	4.7μF electrolytic, 10V. wkg.
C6	0.022μF plastic foil
C7	2,200pF plastic foil
C8	220pF silver-mica
C9	0.1μF plastic foil
C10	4.7μF electrolytic, 10V. wkg.

Semiconductors

TR1	BC108
TR2	ACY17
D1–D5	1N914
ZD1	zener diode, 12V 5% 250mW

Integrated Circuit
IC1 SN72709 or equivalent, 14 pin dual-in-line (see text)

Meter
M1 moving-coil meter, 0-100μA

Switches
S1 s.p.s.t., toggle
S2 2-pole 4-way, rotary

Power Supply
Either
T1 Mains transformer, sec. 9V 50mA (see text)
D6, D7 Rectifiers type DD000
C11, C12 22μF electrolytic, 25V. wkg.
Or
Batteries to provide 18V

Miscellaneous
Diecast box or similar (dimensions dependent on power supply and meter used)
Four terminals (two input, two output)
Veroboard (See Fig. 7 in Part 2)
Pointer knob
14 pin dual-in-line holder for integrated circuit

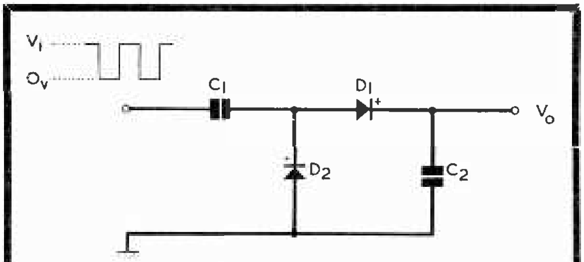


Fig. 3. A simple diode pump

voltage across C2 is 1/6 of Vi, and that across C1 is 5/6 of Vi.

As soon as the input falls to zero, D2 conducts and discharges C1; D1 is now reverse biased, for its cathode is held at 1/6 of Vi due to the charge on C2, so the charge on C2 is maintained.

The next input pulse is similarly divided between C1 and C2, but due to the existence of the voltage of 1/6 Vi already across C2 the division ratio is no longer the same as before, so that the voltage at the output rises by a rather smaller amount than with the first input pulse.

The effect is to give a staircase waveform across C2 as in Fig. 4, with each step in the staircase being smaller than the one preceding.

However, what is required is a voltage that rises in equal steps for each input pulse. This could be achieved by making the ratio C2/C1 much larger than the value of five considered above, and a value of C2/C1 of, say, 100, would indeed give a voltage rise that approaches linearity. A drawback of this scheme is that with C2 100 times larger than C1 a very low level output is obtained, although it is much more linear.

TRANSISTOR DIODE PUMP

Luckily, there is a way of using a C2/C1 ratio of low value, so giving a higher level of output, and at the same time ensuring that a linear staircase is available, and this makes use of the transistor diode pump shown in Fig. 5.

The diode D2 is replaced by an n.p.n. transistor with its collector taken to a high positive potential. This ensures that when the input goes to zero potential it returns the right hand side of C1 to the output

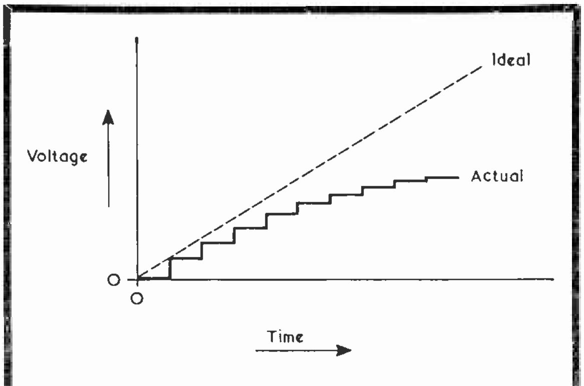


Fig. 4. Ideal and actual waveforms provided by the pump

voltage, so that each input pulse is added on top of the output.

With the output staircase now intrinsically linear, it is possible to use capacitors with lower C2/C1 ratio, so resulting in the required higher voltage at the output.

In practice, the transistor collector should be returned to a positive voltage higher than the peak value of Vi and in the frequency meter, the unstabilised supply is used. As the circuit operates with a considerable degree of negative feedback, it is not a disadvantage if this unstabilised supply varies.

One other point that should be mentioned here is that, so far, forward voltage drop in each diode (including the transistor base-emitter diode) is ignored. This is valid in the case of the transistor diode pump due to its inherent linearity, although the diode used should be of low leakage.

So far, we have only a staircase waveform across C2, so that after a number of pulses the output voltage will reach a value equal to the supply rail and then no further change can take place. Such a state of affairs is of no use in a frequency meter and and it is at this point that resistor R in Fig. 5 comes into the picture.

It partially discharges C2 between each input pulse, so that the average voltage across C2 is proportional to input frequency; for clearly the lower the frequency the longer the period of time between each pulse during which R can discharge C2.

The indication of frequency could be made on a high impedance voltmeter in parallel with R, but the easiest way is to put a suitable current meter in series with R, where, of course, the current is proportional to frequency.

In fact, to allow the reading to be set up using a known input frequency, component values have been chosen to give somewhat greater current in R than that required by the 100μA meter used; the meter is shunted by a fixed and a pre-set variable resistor, so permitting calibration, either overall or separately on each range, to be provided. Further details concerning calibration are given later.

POWER SUPPLY

In connection with the d.c. arrangements for the SN72709 it was mentioned that there was a requirement for the +12 volt supply to be stabilised, and this is done by means of a constant current stabiliser. In Fig. 2 the transistor TR2, by virtue of its constant base potential and fixed emitter resistor, passes a constant current to the zener diode and load in parallel. Since the load current is almost unchanged during operation – it does change with meter deflection slightly – this means an almost constant current in the zener diode, so contributing to voltage stability.

Other, more conventional, series stabilisers were tried but where, as here, input voltage varies due to either mains variations or battery exhaustion, and where there is (almost) constant load current, the constant current circuit has the advantage in terms of output voltage stability. Further, due to the high impedance of the constant current transistor and the low impedance of the zener diode, good rejection of power supply ripple is achieved. This is important if a poorly smoothed mains supply is used.

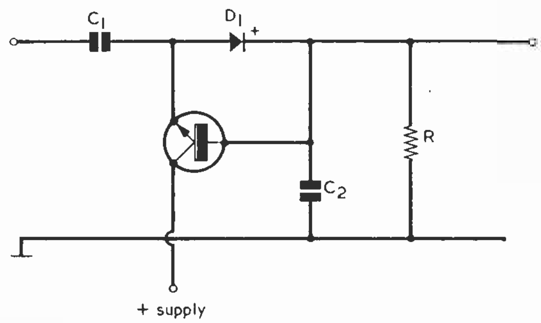


Fig. 5. An improved waveform is given by the transistor diode pump shown here

An output voltage of about 12 volts is required – the actual value is not so important as its stability – so two 5.6 volt zener diodes could be used in series to give best temperature stability. (It is with zener diodes of around 6 volts that the smallest voltage change occurs as the temperature changes.) Should the best accuracy not be required, then a single 12 volt zener can be used instead.

The input to the regulator can be either from two 9 volt batteries in series or from the mains via a midget transformer and voltage doubler, as shown in Fig. 6. (Should difficulty be experienced in obtaining a 9 volt 50mA transformer, a suitable alternative is the MT9, offering 9-0-9 volts at 80mA, available

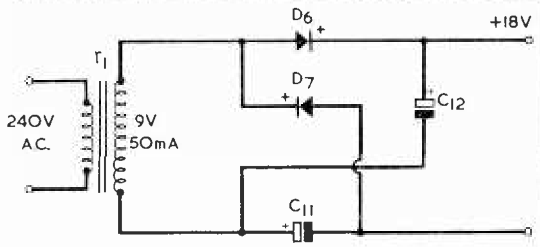
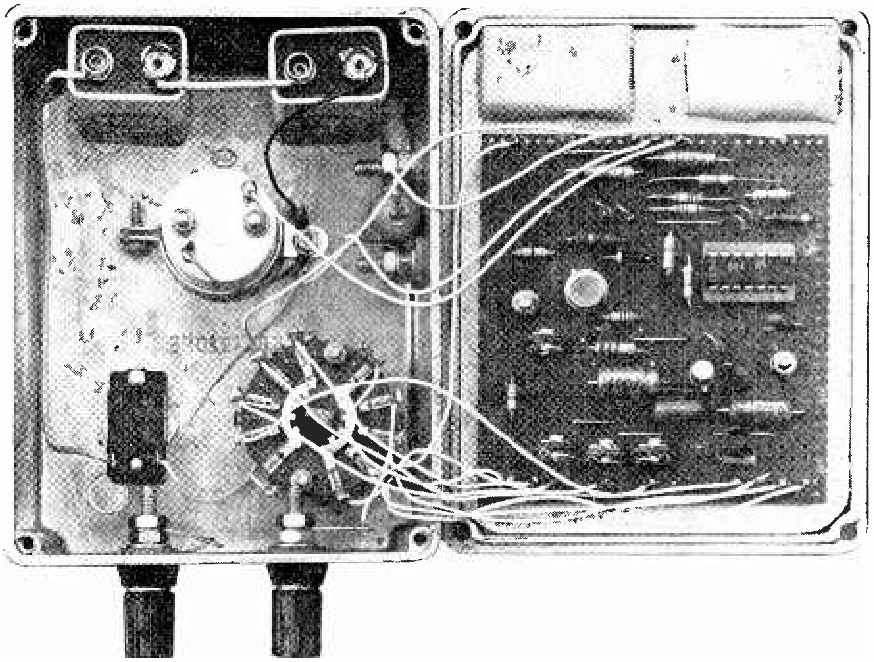


Fig. 6. Circuit of a suitable mains supply



A view inside the author's frequency meter with the lid, on which the Veroboard holding the components is mounted, removed

from Amatronix Ltd., 396 Selsdon Road, South Croydon, Surrey. The full secondary of this transformer can be coupled to a single diode half-wave rectifier and a 22μF reservoir capacitor.) If battery operation is decided upon, then two small batteries could be built into the unit, occupying about the same space as the transformer etc.; alternatively, two larger 9 volt batteries used externally would give greater economy.

The decision as to which form of power supply to use will depend on a number of factors. Very frequent use of the frequency meter would point to a mains supply, while batteries connected externally reduce the cost to a minimum by enabling the smallest size of housing to be employed.

Total current drain, at full scale deflection on the meter, is 14mA.

PRACTICAL DETAILS

That concludes the description of the basic principles of the frequency meter; now for some practical details.

The SN72709 op. amp. in the required dual-in-line package is available from a number of advertisers in *The Radio Constructor*, as is the 14 pin holder. Alternative type numbers for the same basic amplifier are BP709, MIC709 and μA709, but care must be taken to purchase the dual-in-line configuration if the layout given is to be followed. The circuit will function as well with type 709 amplifiers in T05 encapsulation, but since the pin layout is different, an alternative layout will need to be evolved.

In order to stabilise the operation of the SN72709 it is necessary to include R4, C3 and C4; these ensure that no high frequency instability occurs. The input resistance is determined by R1; a higher value of input resistance, say 10kΩ, can be achieved by increasing R1 to this value, in which case R3 should also be increased, to 15kΩ, to keep the resistance seen by the two inputs of the SN72709 to the same value.

Two silicon diodes are connected back to back across the two inputs of the SN72709, they ensure that, should a large signal be applied to the input, it will be limited to about 1 volt peak-to-peak amplitude. The frequency of the signal will not, of course, be changed.

This precaution is necessary since a very large signal (greater than 5 volts peak-to-peak) applied to the inputs of the SN72709 could cause damage to it.

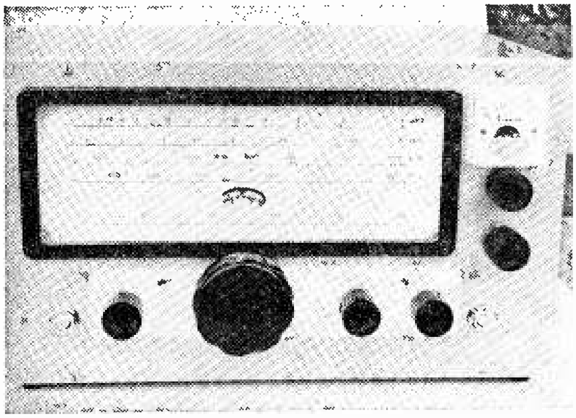
In order to provide the three ranges mentioned, switch S2(a) selects series capacitors in the pump circuit. Normally, care would have to be taken that the ratios of these capacitors were such as to preserve the calibration on all three ranges. That is, C6 should be ten times C7 and C7 ten times C8. However it was thought that the selection of such capacitors might be difficult for the home constructor, so an alternative scheme is used. A second pole on the range switch brings in a meter shunt resistor, which is adjusted, on calibration, to give the required meter deflection on each range. In this way, only nominal valve capacitors are required.

A single meter shunt could be employed but then the accuracy obtained by using non-selected capacitors will have to be accepted – this may suit those constructors who do not require a highly accurate measurement of frequency.

The values shown for the meter shunts, consisting of a fixed resistor and a small carbon pre-set variable resistor in series, were chosen to suit the meter used in the prototype. This meter was quoted as having a resistance of 1,050Ω. Should a meter of some other resistance be employed, then the values of the resistances in the shunts will require modification accordingly.

(To be concluded)

COIL PACK COMMUNICATIONS RECEIVER



PART 2

by

F. G. RAYER, Assoc.I.E.R.E., G3OGR

In this concluding article, our contributor discusses calibration, i.f. alignment and coil-pack setting-up

I.F. ALIGNMENT

A CORRECTLY SHAPED TRIMMING TOOL, WHICH should not be metal, is advised, to avoid any danger of breaking the i.f. transformer cores. Each i.f. transformer has two cores one reached from the top and one from the bottom. The i.f. transformers are supplied pre-aligned, so the cores should be left as they are until the receiver is working. They may then be given the small adjustment required to take up the stray capacitances presented by the receiver circuits and wiring.

Use a short piece of wire as an indoor aerial, then obtain a meter reading of about S4 to S7 with a local B.B.C. station correctly tuned in on the medium wave band. Carefully rotate each i.f. transformer core for the best meter reading. Each core has a definite peak or tuning point. Once the cores are peaked up, they need no further adjustment.

B.F.O. COIL

A value of 140pF is specified by the manufacturer of the b.f.o. coil for its fixed tuning capacitor (C25 in the present receiver) but it was found that a 150pF 1% capacitor was suitable. Set VC3 half closed, its knob being fitted such that this corresponds to its pointer being vertical. Again, correctly tune in a B.B.C. transmission on the medium wave band. Turn switch S1 to the 'S.S.B.–C.W.' position. Rotate the core of the b.f.o. coil until a whistle is heard. This falls in pitch as the correct position is reached, then starts again and rises in pitch as this point is passed. Adjust the core to the central or zero-beat position. Rotating VC3 either way from its central position will now produce an audio tone, which rises in pitch as the control is turned.

The 'S.S.B.–C.W.' position is used only for the reception of single-sideband and c.w. (Morse) transmissions. Working can be checked by finding an s.s.b. transmission on 80 metres. Tune this for the best meter reading, which will fluctuate with speech. With the switch in the 'S.S.B.–C.W.' position, adjust VC3 slightly, as necessary, to produce intelligible speech.

The same method is used to receive c.w. signals, except that in this case VC3 is adjusted, one way or the other, to produce an audible tone.

AERIAL AND OSCILLATOR TUNING

Coverage is approximately as follows:–

Long Wave:	800-2,000 metres. 375-150kHz.
Medium Wave:	194-550 metres. 1546-545kHz.
S.W.1:	50-160 metres. 6-1.85MHz.
S.W.2:	16-50 metres. 18.75-6MHz.

The SW1 range is readily adjusted to give coverage to 1.8MHz, for Top Band.

Trimmers can be adjusted with a small screwdriver. Fig. 2, published last month, gives their locations. The cores can be reached with a suitable tool, or plastic knitting needle filed to a screwdriver shape. The trimming or alignment of one range is completely separate from that of the other ranges, so deal with one range at a time.

Coverage should be approximately correct. However, the frequency reached with VC1 and 2 *fully closed* can be altered by rotating the oscillator coil core of the band in question. The coil-pack data supplied with the pack shows the cores, though they can easily be identified. If necessary, the frequency reached with VC1 and 2 *fully open* can be modified by adjusting the appropriate oscillator trimmer, Fig. 2.

Band coverage can be checked with a signal generator, if wished, or by tuning in known transmissions.

When band coverage is suitable, adjust the aerial cores and trimmers for best reception. Again, deal with each band separately, adjusting the core at a low frequency, and the trimmer at a high frequency. As an example, switch to the medium wave range. Tune in a signal with VC1 and 2 nearly open, and adjust the medium wave aerial trimmer for best tuning meter reading. Then tune in a signal with VC1 and 2 nearly fully closed, and adjust the aerial coil core for best meter reading. Repeat the adjustments until there is no further improvement.

With the higher frequency short wave range it is possible in some cases to tune the aerial circuit to the second channel. That is, to a signal two times 465kHz too high in frequency. This will be avoided if the SW2 aerial trimmer is adjusted to the lower frequency position of its two settings which peak up signals. That is, the position where it is more nearly screwed down.

CALIBRATION

The dial has a vernier 0-100 scale which rotates five times for one traverse of the pointer, which moves against a hundreds scale, thus giving a total of 500 divisions. If no other means of calibration are available, a graph of known transmissions could be drawn for each band. The readings for round figures may then be taken from the graph and marked on the tuning scale.

The simplest method of calibration is to use an accurate signal generator, or a harmonic crystal marker. The latter will give harmonic pips at 100kHz and 1MHz or other intervals, which are tuned in one by one, and marked on the scales.

A piece of thin Perspex, 8in. by 1½in., was drilled to fit over the lower control bushes, and this covers a thin card marked with control functions.

CABINET

The cabinet requires some ventilation holes at the back, and these can be made with a valveholder chassis-cutter. Cut-outs are also needed for the aerial.

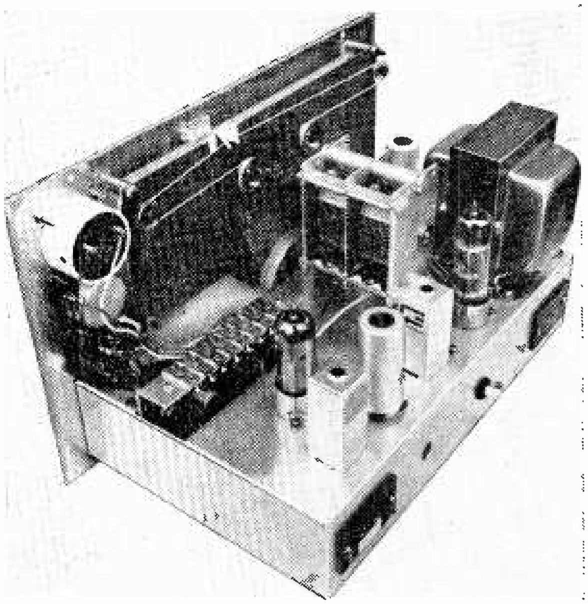
TABLE
Logging Scale Readings

The Table lists logging scale readings obtained with the prototype receiver.

SW2 Freq.	SW2 Scale	SW1 Freq.	SW1 Scale	MW Freq.	MW Scale
6MHz	492	1.8MHz	488	550kHz	482
7MHz	397	2.0MHz	419	600kHz	408
8MHz	332	2.5MHz	308	700kHz	321
9MHz	278	3.0MHz	232	800kHz	260
10MHz	233	3.5MHz	176	900kHz	211
11MHz	194	4.0MHz	128	1,000kHz	168
12MHz	164	5.0MHz	65	1,100kHz	131
13MHz	134	6.0MHz	14	1,200kHz	100
14MHz	109			1,300kHz	72
15MHz	85			1,400kHz	53
16MHz	65			1,500kHz	32
17MHz	48				
18MHz	31				

LW

Freq.	Scale
150kHz	475
200kHz	290
250kHz	183
300kHz	110
350kHz	53



This rear view of the receiver illustrates its neat and compact layout

earth and speaker sockets. It was felt most convenient to remove a piece about 10in. by 2in. from the back, this being done by punching valveholder holes to give rounded corners to the aperture, and then cutting between these with a metal saw. Afterwards a file was used to smooth and level the edges.

For adequate ventilation, six or eight similar holes are punched in the bottom of the cabinet, which is then raised on four plastic feet.

SPEAKER

A reasonably large 2 to 3Ω unit is required, and it should be fitted in a cabinet, or attached to a baffle board.

AERIAL AND EARTH

Many transmissions will be received well with no earth and quite a short indoor aerial wire. Such an aerial can also give good signal strength from many short wave broadcast stations.

A more efficient aerial will, however, bring about a very substantial improvement, particularly with weak signals. Remote Amateur and other signals which can be received with a properly designed outdoor aerial may completely disappear with a short random wire, or an indoor aerial.

For medium wave reception and for broadcast stations around the 4 to 18MHz range, a large aerial is by no means likely to prove best. When such an aerial is used, loading on the receiver input circuit can be reduced by placing a small pre-set or variable capacitor of around 100pF maximum in series with the aerial lead, at the receiver. This capacitor is then adjusted for best results.

Finally, a set of logging scale readings, as obtained with the prototype, is given in the accompanying Table. Exact agreement with these readings should not be expected, but they should nevertheless prove of help in calibration. ■

BENCH CURRENT MONITOR

by

D. L. SIMPSON

This monitor gives a visual indication when any power, from 5 to 750 watts, is drawn from a mains supply. Of particular interest is the technique employed for stepping down the mains current to a level suitable for application to small transistors

MOST HOME CONSTRUCTORS INSTALL A COMMON mains supply for all the equipment which is employed on a bench for experiments or servicing. If a large quantity of mains-driven equipment is used it is quite possible for one or more items to be left accidentally switched on after a session of work has been completed.

The device described in this article gives a visual indication whenever current is drawn from the mains, and therefore provides a reminder that equipment has been left switched on. Indication is by means of two small pilot lamps. For power consumption from 5 to around 20 watts, one of the bulbs is illuminated whilst at higher powers both bulbs are illuminated. The circuit is intended for mains loads up to 750 watts maximum.

A previous device incorporating a similar method of operation appeared in the 'Suggested Circuit' published in the September 1970 issue of this journal.* The present device is a development from that 'Suggested Circuit'.

OPERATION

The circuit of the bench current monitor appears in Fig. 1. Here, a 6.3 volt winding on mains transformer T1 is inserted in series with the live mains input lead to the supplied equipment on the bench, with the result that when any item of mains-driven equipment is switched on current flows in this transformer winding.

A 240 volt winding on the same transformer couples to diode D1 and to the base-emitter junctions of TR1 and TR2 in series. On half-cycles when the right-hand end of the 240 volt winding is positive diode D1 conducts, whilst when the right-hand end of the winding is negative the base-emitter junctions of TR1 and TR2 in series conduct. Thus, no voltage in excess of about 0.5 volt can appear across the 240 volt winding. Because of this, a considerably lower voltage appears across the 6.3 volt winding and there is negligible loss of mains voltage due to its insertion in the circuit.

Working from its 6.3 volt to its 240 volt winding, the transformer produces a step-up in voltage. At the the same time it produces a step-*down* in current. It is the step-down in current which enables relatively small transistors, such as the ACY19's specified, to be employed in the circuit. The current step-down ratio is the opposite of the voltage step-up ratio and in the present instance is 240:6.3, or approximately 40:1. If the maximum recommended r.m.s. current of 3 amps (corresponding to 750 watts) flows in the 6.3 volt winding, the r.m.s. current in the 240 volt winding becomes 3/40 amps, i.e. 75mA. The peak value flowing in the base-emitter junctions of TR1 and TR2 from the 240 volt winding is thus 75 times 1.4, or 105mA, which is comfortably within the maximum base current rating for the ACY19.

When the mains current in the 6.3 volt winding of T1 is low, a proportionately low current flows from the 240 volt winding in the base-emitter junctions of TR1 and TR2. TR1 functions as an emitter follower, causing an amplified current to flow in the base-emitter junction of TR2. TR2 then conducts and pilot lamp PL2 becomes illuminated. As the mains current increases so also does that in the base-emitter junction of TR1, with the result that its collector current increases and PL1 commences to become illuminated in addition to PL2. At higher mains currents again, both transistors become bottomed on the half-cycles when they conduct and both lamps are fully lit.

Power for the lamps is obtained, via rectifier D2, from the 8 volt winding on transformer T2, this being phased such that negative half-cycles are passed to D2 when negative half-cycles are present at TR1 base. Rectifier D2 is necessary for correct circuit operation. If it were omitted, both bulbs would

*G. A. French, Suggested Circuit No. 238, 'Switch-Off Reminder', *The Radio Constructor*, September 1970.

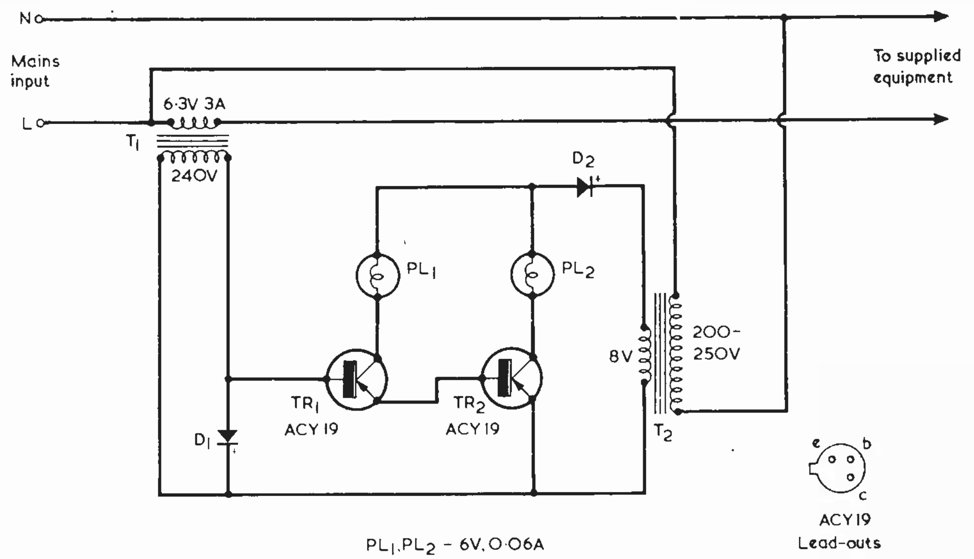


Fig. 1. The circuit of the bench current monitor. The design approach offers a considerable economy in components

become continuously illuminated on the opposite half-cycles due to the conducting path offered by the collector-base junctions of the transistors and by D1.

COMPONENTS

Many constructors may already have some of the components on hand. Transformer T1 is any mains transformer having a 6.3 volt winding rated at 3 amps or more and a 240 volt primary. The latter is the 240 volt winding shown in Fig. 1. Any other windings on the transformer are simply ignored. Transformer T2 in the author's version was a small bell transformer purchased at a Woolworth's store. The primary is rated 200-250 volts at 40 to 60Hz, and the secondary is nominally 8 volts with a tapping at 5 volts. It will be seen that the primary is connected permanently across the mains supply, as would occur when the transformer is employed for its normal application. The current drawn by this primary will be negligibly low. Any other small transformer offering about 8 volts can, of course, be employed instead of the particular bell transformer used by the author.

D1 and D2 are both silicon rectifiers. The author used BY100's, which happened to be available, but any small silicon rectifier with a forward current rating of 200mA or more should be satisfactory. In use, the peak inverse voltage applied to D1 is only about 0.4 volt. That applied to D2 is 11.2 volts.

TR1 and TR2 are standard ACY19's. At mains currents approaching the maximum, TR2 tends to become a little warm since its base current includes that needed to illuminate PL1 in addition to the current from the 240 volt winding of T1. In consequence, it is desirable to fit a heat sink to TR2, and this can be any small sink intended for a TO-5 can. A suitable heat sink is the type H2 available from Henry's Radio. It should be remembered that the can of an ACY19 is connected internally to its base.

The two pilot lamps are m.e.s. 6 volt 0.06 amp types, and are available from Home Radio under Cat. No. PL7. On no account should 6 volt bulbs rated at currents higher than 0.06 amp be employed.

CONSTRUCTION

There need be few difficulties in construction as layout is not critical. It will probably be found most convenient to mount all the components with the exception of PL1 and PL2 at some point at the side or back of the bench, taking care to allow access of air to the two transistors for cooling purposes. PL1 and PL2 can then be mounted at a conspicuous point on the front of the bench.

Great care must be taken to ensure that D1 is connected into circuit with correct polarity. If it is connected incorrectly both transistors will be damaged as soon as a mains current flows in the 6.3 volt winding of T1. Since it is easy to make mistakes here, it is advisable to wire in the diode and the base and emitter connections of TR1 and TR2 first, as illustrated in Fig. 2. A voltmeter in series with a 6 volt battery is then connected to the circuit incorporating D1, TR1 and TR2 as shown, whereupon it should give a reading slightly less than 6 volts. The test leads are then changed over and re-applied, whereupon a reading of slightly less than 6 volts should again be given. The purpose of the 1kΩ resistor across the voltmeter is to prevent the latter giving misleading readings due to leakage current in the diode or transistors if either are connected wrong way round. When this test has proved satisfactory, the diode and transistors can be connected up to the 240 volt winding of T1 and the remainder of the wiring carried out.

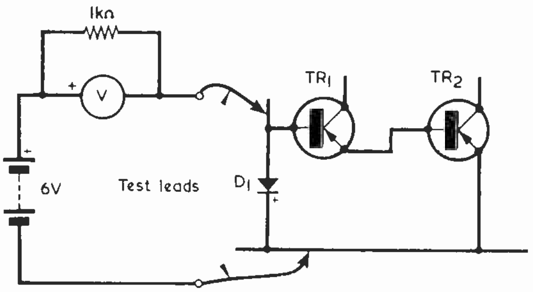


Fig. 2. A voltmeter test, described in the text, ensures that there are no errors in the wiring of D1, TR1 and TR2

The correct method of connecting T2 has to be found experimentally. If the lamps do not light up when current is drawn from the supply, reverse the connections to T2 primary.

Results with the prototype were satisfactory. Pilot lamp PL2 commenced to glow when a 20kΩ resistor (representing a power load of 3 watts) was connected across the supply leads. The circuit was, also, temporarily overloaded by coupling a 1kW fire element to it. This overload was comfortably withstood without any failures or overheating in the transistors or other components. With the 1kW fire element, the voltage dropped across the 6.3 volt winding of T1 was 0.4 volt r.m.s. only. ■

CURRENT SCHEDULES

Times = GMT *Frequencies = kHz*

★ JAPAN

The morning transmission to Europe, from Tokyo, is now on **17825** (100kW) with the **21570** (200kW) transmitter in parallel. The **21535** channel is discontinued. The address for reports is – Nippon Hoso Kyokai, No. 2, 2-chome, Uchisaiwa-cho, Chiyoda-ku, Tokyo.

★ SEYCHELLES

Transmissions to the Middle East are now on **11935** from 1700 to 1900. To India and Pakistan on **11920** from 0100 to 0130 in Sinhala and from 0130 to 0300 in English. The **15270** channel is used from 1230 to 1645 with various language programmes, English being from 1500 to 1545.

★ SOLOMON ISLANDS

The schedule of the Solomon Islands Broadcasting Service is now from 0655 to 1140 and from 1855 to 0030 on VQO4 **3995** (5kW) and on VQO7 **7235** (5kW).

★ SOUTH AFRICA

A new transmission in English, beamed to Europe by RSA, may be heard from 2215 to 2315 on **5980** (100/250kW – 50.17 metres) and on **9575** (100/250 kW – 31.33m). To N. America in English from 2215 to 2315 on **9695** (250kW – 30.94m) and on **11970** (100/250kW – 25.06m). In German to Europe from 1800 to 1850 on **15175** (250kW – 19.77m) and on **17825** (250kW – 16.83m).

★ SWEDEN

Programmes are beamed to South Asia from 1400 to 1530 on **15240** (100kW – 19.69m); to the Middle East from 1600 to 1700 on **11930** (100kW – 25.15m); to Australia and New Zealand from 0515 to 0615 on **9590** (100kW – 31.28m) and to East and North USA from 0000 to 0230 on **11825** (100kW – 25.37m).

★ CANADA

The English daily schedule of Radio Canada is now as follows – To Africa from 0715 to 0745 on **15390** (19.49m) and on **17820** (16.84m); to Europe from 0715 to 0745 on **5990** (50.08m) and **9625** (31.17m); to the South Pacific from 0830 to 0930 on **5970** (50.25m) and **9625**; to Europe, Caribbean Area and USA from 1217 to 1313 on **9625, 11720** (25.60m), **15315** (19.59m) and on **15325** (19.58m). To Europe (News) from 1515 to 1522 on **15320** (19.58m), **17820** (16.84m) and on **21595** (13.89m). To Africa from 1831 to 1914 on **15325, 17820** and **21595**; to Europe from 2115 to 2152 (on Saturdays and Sundays from 2100 to 2152) on **11720, 15325** and on **17820**; to Caribbean Area, USA and Latin America from 2300 to 2330 on **9625, 11945** (25.12m) and on **15190**.

★ TRUCIAL STATES

Schedule of the Abu Dhabi Broadcasting Service is as follows – from 0230 to 0445 and from 1230 to 2000 on **4988**. From 0445 to 1230 on **6124** (English programme from 0930 to 1100 except Friday). Present transmitter has output power of 10kW but this will shortly be increased to 500kW. (BADX).

Acknowledgements: Our Listening Post, SCDX.

HERE AND THERE

INDONESIA

Radio Angkatan Udara (Air Force Radio) was logged by several Dx'ers last 'season' on the 'out of band' channel of **11321**. BADX reports that the station can also be heard on a measured frequency of **3408**. Those living nearer Indonesia can also hear the station on **2475**, a parallel channel to the former mentioned two frequencies.

NEW GUINEA

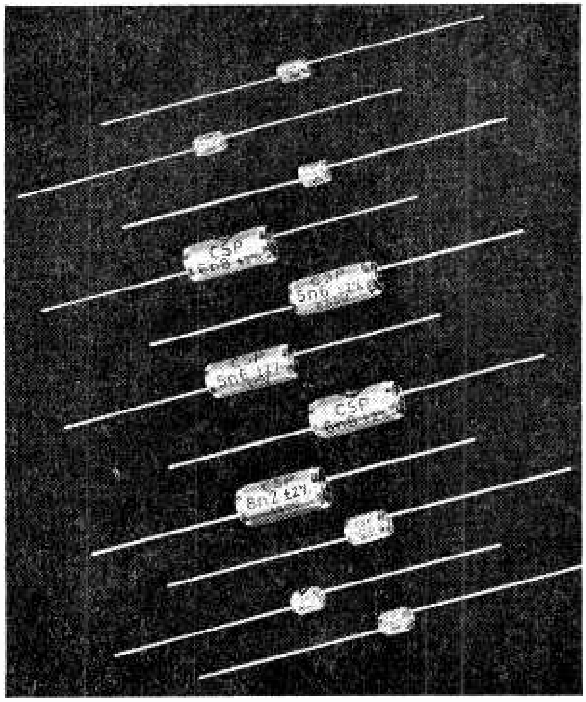
BADX also provides the information that Radio Morobe, a new station, has been logged on **3220** from 0845 to 0900 sign-off. Programme consisted of western-type music, identification in English and Pidgin. Another new one reported is Radio Madang, now on a regular schedule from around 0800 to sign-off at 1100 with identification and National Anthem. A further new one is Port Moresby on **3290**, noted from around 0800 to past 1100, with taped announcement advising it is on the air for propagation tests with 2kW.

PERU

OAX8X Radio Amazonas, Iquitos, transmits from 1100 to 0500 on **4815** (1kW). BADX report logging this station at 0451 with identification in Spanish.

NEW PRODUCTS

POLYSTYRENE CAPACITORS

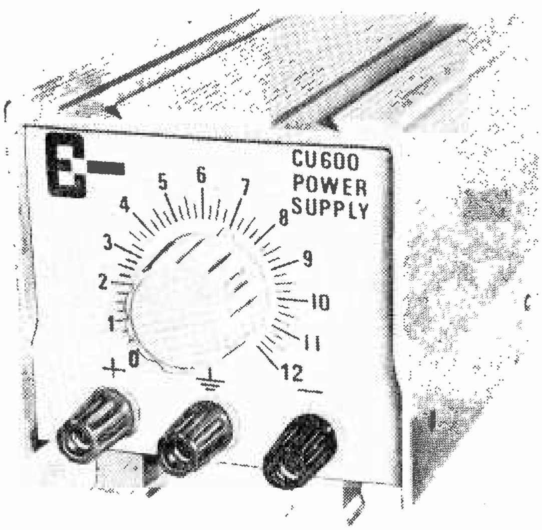


A range of polystyrene capacitors (Type CSP) has been introduced by Seatronics (UK) Ltd. The capacitors, which are produced in Seatronic's Singapore factory, are of extended foil construction with welded terminations to the aluminium foil resulting in low self-inductance and low high-frequency losses.

With a low temperature coefficient, the capacitors are suitable for computing circuits, coupling, filters, tuned circuits, etc. Voltage ratings are 160V and 630V; capacitance range 4.7pF to 100,000pF; capacitance tolerance ±10%, ±5%, ±2%; operating temperature range −40°C to +85°C; and tan delta = 0.001 max.

For comprehensive data and prices please contact Seatronics (UK) Ltd., 22–25 Finsbury Square, London EC2A 1DT.

LOW COST POWER SUPPLY UNITS



Circuit Integration Ltd., of Runcorn, Cheshire, have announced the introduction of a new range of Power Supply Units, known as the CU600 series. The outstanding feature of these units is the prices, which are extremely low for units of this specification.

It is believed that the CU600 series will fill a long felt need for power supply units which combine simplicity of operation, reliability and rugged construction with a low price.

The initial range consists of six units which offer a range of currents and voltages particularly suitable for all Integrated Circuit and Transistor operations.

The units are all fully stabilised, using Integrated Circuit techniques and silicon semiconductors throughout. Output ranges from 0–60 volts, according to type, with output impedance less than 0.05 ohm. All the units are provided with short-circuit protection.

The CU600 units are of rugged, compact case design, with provision for slide-in stacking, and may be used in series or in parallel.

Prices start at £10.00 per unit, subject to quantity and educational discounts.

Further details on specific units available from Circuit Integration Ltd., Canal Street, Runcorn, Cheshire.

In your workshop

This month Smithy's able assistant, Dick, returns to one of his old haunts. As so often occurs, however, this does not prevent him from obtaining his usual quota of information from the sagacious Serviceman. In the present episode the pair discuss microphones

A GUST OF CHILLY NOVEMBER air blew into the workshop as Smithy opened the door and let himself in. Hurriedly, he closed the door behind him, then switched on the lights. Their cheerful blaze intensified the gloominess of the murky early morning air lapping at the windows. Smithy rubbed his hands together briskly, then proceeded to divest himself of his overcoat. At that instant the door opened once more, to admit Dick in his usual state of post-breakfast dishevelment. He slammed the door behind him and took off his raincoat.

Smithy looked on with intense disfavour as Dick walked to his bench, produced a small mirror from a drawer, propped it up against his signal generator, then proceeded to comb his unruly hair.

P.A. SYSTEM

"Corblimey," snorted Smithy in disgust. "You'll be *shaving* in here next."

"Why, that's a good idea," said Dick cheerfully. "I could easily plug my shaver in on the bench, and that would mean a few extra minutes in the old pit each morning."

"And a few extra minutes," growled Smithy, "of working time wasted here as well. Why on earth can't you get up early in the mornings?"

"Because," replied Dick simply, "I go to bed so late on the previous nights."

"I hope," pronounced Smithy sternly, "that you're not presuming to take the Michael."

"No, I'm serious, Smithy. Things have been pretty hectic on the social scene lately, and I've got myself rather heavily involved."

"Involved?"

"I'm involved in looking after the electronics," explained Dick. "Down at Joe's Caff."

Smithy's hand, poised to take his overall jacket from its hook, faltered in mid-air.

"Joe's Caff? Why, I thought you'd given that place up ages ago."

"Well," admitted Dick, "my crowd does tend to drift away from time to time but, somehow, we still find ourselves going back there again for the evenings."

"If I remember correctly," said Smithy thoughtfully, "Joe's Caff is the place where he's always having it done up differently and keeps changing its name each time."

"That's right," confirmed Dick. "At the moment he's making it all Continental with the accent on the French."

"What on earth for?"

"Because," explained Dick, "of the Common Market. He reckons that when we enter the Common Market we've got to change our ways so that we're more Continental in outlook. He's starting off by giving his place a real French atmosphere."

Smithy absorbed this information in silence.

"What I'm doing," carried on Dick enthusiastically, "is installing a microphone and loudspeaker system for a cabaret he's thinking of starting. He's got a beat-up old amplifier which I've fixed up for him, and I spent last night coupling up a mike to it."

"What sort of mike?"

"One of those stick moving-coil jobs."

"That should be all right, then," commented Smithy approvingly. "Moving-coil microphones are much the best for knock-about jobs like that. They normally give a good frequency response and they're robust enough to stand up to rough handling. Also, there's no particular restriction on the length of lead between the microphone and the amplifier."

"I had a lot of trouble last night," commented Dick, "with feedback howl. Is there any special way of overcoming it, by speaker positioning or something like that?"

"Are you having the microphone on a stage at the end of the room?"

"Oh no," replied Dick. "Joe's Caff is quite a smallish place and there's no room for a stage. The chap who's performing just moves around the centre of the room carrying the mike in his hand on the end of a long flexible lead."

"Then, in that case," said Smithy, "all you need do is to have the speakers ranged around the walls at about eight feet off the floor and simply keep the whole system just below feedback level." (Fig. 1).

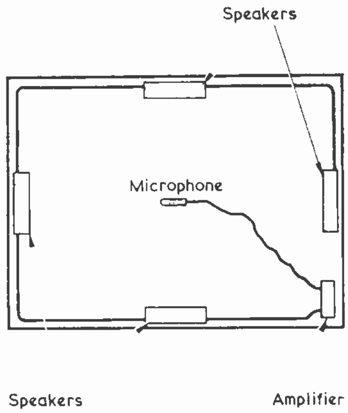


Fig. 1. For light entertainment sound reinforcement involving solo artistes in surroundings that are too small to merit a stage, it is in order to employ a hand-held moving-coil microphone which is fully in the field of the speakers. To be successful, the system must have a reasonably flat overall frequency response. The number of speakers used need not necessarily be the four shown here

"What d'you mean, just below feedback level?"

"Dear, oh dear," grumbled Smithy. "With you I always have to go back to first principles. Now, the feedback you get with a microphone and amplifier normally consists of a howl, and it's caused by the microphone picking up the sound from the loudspeaker or loudspeakers. The whole chain, microphone, amplifier and loudspeaker or loudspeakers, then forms an oscillator which oscillates at the frequency at which the amplification is greatest.

In the system I've just described, where you have the speakers round the walls, you deliberately allow the microphone to pick up sound from the speakers but you keep the amplifier gain at a level which is just too low to allow the system to oscillate."

"But," protested Dick, "doesn't that mean that the microphone will be insensitive and you won't be able to use the full power of the amplifier?"

"Of course it doesn't. The performer holds the microphone fairly close to his mouth so that the sound intensity it receives from him is much greater than the sound intensity it picks up from the speakers. And the amplifier output stage is still going to deliver its rated number of watts if enough signal is fed to it, regardless of the position of the amplifier volume control."

"Oh, I see what you mean," said Dick. "I can still visualise some snags, though. Quite a few other people will be playing around with the amplifier controls when I'm away and they're quite liable to take the volume up beyond feedback level and then think there's a fault in the amplifier."

"There's an old dodge to cover situations like that," said Smithy. "What you do is to craftily secrete a little preset potentiometer into the amplifier chassis. This has the same value as the volume control and immediately follows it." (Figs. 2(a) and (b)).

"What's it for?"

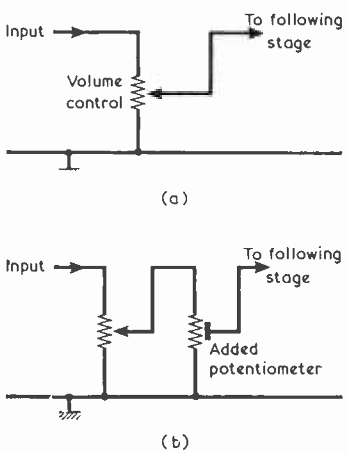


Fig. 2. To guard against feedback howl when the system of Fig. 1. is used by lay persons a preset potentiometer may be added after the amplifier volume control. The volume control circuit before and after the addition of the preset potentiometer is shown in (a) and (b) respectively

"It's for limiting the gain of the amplifier," replied Smithy. "The best way to adjust it is to choose a time when the place in which the amplifier is to be used is nearly empty of people. You put the mike on a table in the centre of the room, turn up the main volume control to maximum then adjust the preset control so that the whole system is just below the feedback oscillation point. You then pick up the microphone, walk around over the area in which it is to be used, hold it in all the positions it's likely to take up, and make sure that the feedback doesn't reappear at any point. If it does, then you back off the preset potentiometer a wee bit more, as required. After that, everything is set. Non-technical people will use the normal volume control, and they cannot, even when this is set to maximum, cause feedback to occur. After a while you'll probably find that they just leave the volume control at maximum all the time and the only other amplifier control they'll touch will be its on-off switch."

CRYSTAL MICROPHONE

"Why," asked Dick, "do you do the adjustment when the place is nearly empty of people?"

"There are two reasons," replied Smithy. "First of all it's obviously going to be much easier walking around with the mike when there's nobody to get in the way. Also, people can be a positive menace when there's a mike around. They always want to blow into the darned thing or make silly comments into it. Secondly, the worst conditions for promoting feedback are given when the place is nearly empty, and you can then be sure that you've got a really reliable setting on the added preset volume control. When the place is full of people they will absorb some of the sound from the speakers and will help to kill reflections from the walls, and so the risk of going into feedback will then be even less."

"You said just now," commented Dick, as he suddenly thought of an earlier point, "that the people using the amplifier will probably, after a period, just leave its volume control at maximum all the time. Won't they want to vary the volume to suit a particular act?"

"Not very often," said Smithy. "As the system uses a hand-held mike, this will mainly be used by comedians and singers. A performer will be able to hear the sound of his own voice from the speakers and so, if he is anything approaching professional, he'll automatically hold the microphone at the correct distance for best sound output from those speakers. But there's one important point I haven't mentioned yet."

"What's that?"

"There mustn't be any pronounced peak in the frequency response of either the microphone, the amplifier or the speaker or speakers. They must all have a reasonably smooth response. If there *is* a peak in the system at any frequency, feedback is likely to occur at that frequency, and you'll have to keep the amplifier gain for all frequencies limited to the low level dictated by the peaky frequency."

"I think," said Dick, "we're all right so far as frequency response is concerned. It looks as though I've got a nice little job to do at Joe's tonight. I'll put in a preset pot in that amplifier of his and get the whole system finally set up."

"I'd almost forgotten," said Smithy, "that this sound system is to be used in Joe's Caff, of all places. I must confess that my mind still boggles at the thought of it going all French. Has he got any plans about the menu?"

"What he's going to do, so far as food is concerned," replied Dick, "is to keep all his English dishes and add French ones. For instance, he's thinking of introducing snails and beans, snails and chips, and snails on toast."

"Dear me," said Smithy. "I don't think I'd like any of those."

"None of us are very keen, either," admitted Dick. "He's also started putting up some signs in French, and that hasn't gone down too well, either. For instance, he put up a sign in the 'Gents' which was supposed to read 'Hommes' but he left out an 'm'. Then someone changed the 'e' to 'o'. There was nearly a riot that night."

"Well, well," remarked Smithy. "Dear me."

His hand once more went out to pick up his overall coat.

"Why," asked Dick, "did you say that a moving-coil mike was the best type to use for a job like that down at Joe's Caff? Why couldn't I use, say, a crystal mike?"

Again, Smithy's hand was arrested. He considered Dick's question.

"There's no compelling reason," he said eventually, "why you shouldn't employ a crystal microphone for p.a. work; but its use is liable to raise several difficulties. The first of these is that, to obtain a good bass response, a crystal microphone has to work into a load resistance of about 2 to 5MΩ. Secondly, the lead connecting a crystal microphone to the amplifier has to be restricted to some ten feet or so. On the other hand, an advantage with the crystal microphone is that it gives a high output and has a reasonably good frequency response although, with the cheaper crystal microphones, this may not be as flat as is offered by a moving-coil microphone. However, it doesn't do to be too dogmatic about microphone responses since, with the large number of microphones available these days, responses can vary quite a bit from make to make or model to model."

"Why does the crystal microphone have to work into such a high load resistance? And why is its lead length restricted?"

"To answer those questions fully," said Smithy, "it would be helpful first to take a look at the construction of the crystal microphone itself. In its more common form the crystal microphone comprises a diaphragm whose centre couples mechanically to a crystal bimorph which may be either a bender or a twister."

"You're joking, of course."

"Indeed, I'm not joking," retorted Smithy indignantly. "A bender or twister crystal bimorph is the basic voltage-producing element in any crystal microphone."

"I do wish," complained Dick, "that you wouldn't spring terms like that on me when I'm not prepared for them. I've never ever heard of bimorphs, and that's before we even *get* to this bending and twisting bit!"

"Take it easy," said Smithy soothingly. "You'll find out in a few minutes that this business of crystal bimorphs is quite simple. As you know, a thin slice cut from a crystal of piezo-electric material such as Rochelle salt changes in dimension when a voltage is applied across its two surfaces. This is, of course, the result of the piezo-electric effect itself. The directions in which the dimensional changes occur depend upon the angle of cut in the original crystal from which the slices are taken. One angle of cut can give you a slice which, if it were in the shape of a square, gets longer from top to bottom and narrower from side to side when the voltage is applied. If you take two slices of this nature, turn one of them through 90 degrees and then cement them together with suitably applied electrodes, you get what is called a crystal bimorph. The electrodes, incidentally, can consist of metallising deposited on the slice surfaces. I might add also that the expression 'morph' comes from a similar Greek word meaning 'form'." (Figs. 3(a) and (b)).

"So far as I'm concerned," grumbled Dick, "it's *all* Greek to me. What does this bimorph thing *do*?"

"When it's clamped at one edge," explained Smithy, "it bends when the voltage is applied across it. One of the slices gets longer and the other, because it's been turned through 90 degrees, gets shorter. So the combination of the two

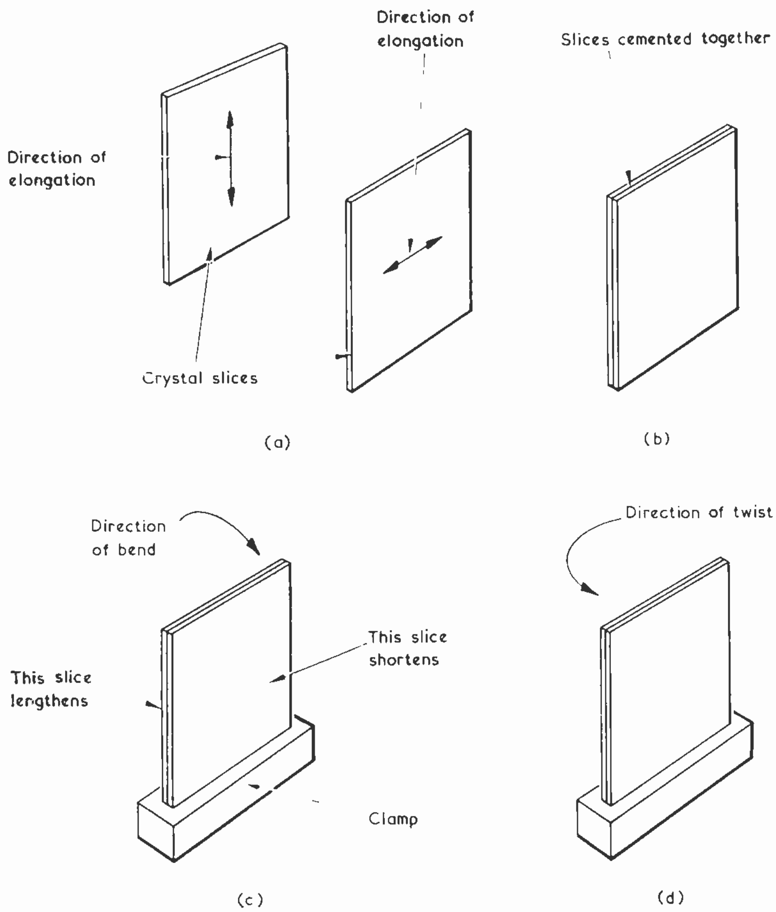


Fig. 3 (a). Two square slices cut from a crystal of piezo-electric material. The arrows show the dimension which increases when a potential is applied. (b). The two slices cemented together to form a bimorph unit. (c). When a potential is applied across the bimorph its free edge bends. The direction of bend reverses when the polarity of the potential is reversed. (d). Alternative cuts from the parent crystal can result in a bimorph whose free edge twists

bends. It bends in one direction for an applied voltage of one polarity and in the other direction for an applied voltage of the opposite polarity." (Fig. 3(c)).

"Blimey," exclaimed Dick, "I can see it all now! Why, it's rather like those bimetal strips which bend when you heat them."

"It is, rather," agreed Smithy. "Now, I referred to square slices of crystal to make things easier to explain, but the two slices making up the bimorph could also be rectangular, if desired. One of the slices would be cut from the parent crystal so that its length was 90 degrees removed from the length of the other slice. Now, since we are using piezo-electric material we can reverse the effect. Thus, if we bend the bimorph physically, a corresponding voltage appears across the outside electrodes."

"What about the twister bimorph?"

"The twister bimorph," said Smithy, "consists of two strips cut at a different angle from the parent crystal. If one edge is clamped securely, the opposite edge of the bimorph twists when the voltage is applied. Or, in the reverse sense, a voltage is produced across the electrodes if the unclamped end is physically twisted." (Fig. 3(d)).

"I see," said Dick slowly. "In the crystal microphone, then, you have the centre of a diaphragm mechanically coupled to a bimorph which can be of either the bender or the twister type."

"That's right," confirmed Smithy. "Sound picked up by the diaphragm causes it to move in sympathy and either bend or twist the bimorph according to whichever type the latter is. The bender type is used more frequently than the twister type. In practice, the diaphragm will have some form of cloth or perforated material in front of it to damp down mechanical resonances." (Fig. 4).

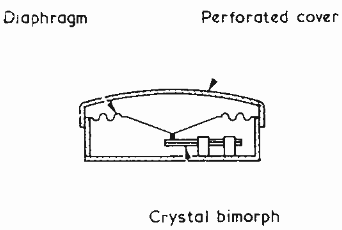


Fig. 4. Sectional view showing the basic construction of a diaphragm crystal microphone. A layer of cloth (not shown) is usually fitted between the perforated cover and the diaphragm to damp down resonances

SOUND CELL MICROPHONE

"Is that the only type of crystal microphone that's made?"

"There's an alternative and more expensive type," said Smithy, "and it's known as the 'sound cell' microphone. In this, the crystal bimorphs themselves act as diaphragms. A typical construction comprises two bender bimorphs fixed in a rectangular frame with a small air gap between them. The bimorphs bend in and out according to the pressure of the outside air and this produces a voltage corresponding to any sound that falls on them. A sound cell microphone can have about half-a-dozen of these assemblies all connected in series-parallel and stacked one above the other. The sound reaches them from the side." (Fig. 5).

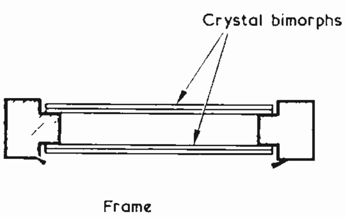


Fig. 5. Sectional view showing two crystal bimorphs in a sound cell microphone

"Right," said Dick briskly. "Now, let's get back to those questions of mine. First of all, why does the crystal microphone have to couple into such a high value of load resistance?"

"Because of its self-capacitance," replied Smithy, "which is the capacitance between the two outside electrodes on the bimorph surfaces. At a first approximation, the equivalent electrical circuit for a crystal microphone consists of a voltage generator in series with a capacitor whose value is equal to the self-capacitance of the microphone. Typically, this capacitance is between 1,000 and 2,000pF. Let's say it's 1,000pF and that it's connected to a load resistance of half a megohm. The load resistance is the input resistance of the amplifier to which the microphone is connected." (Fig. 6).

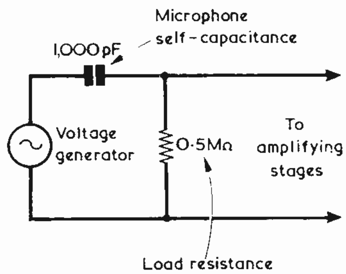


Fig. 6. The crystal microphone behaves as a voltage generator in series with a capacitance equal to its own self-capacitance. Here, a crystal microphone is applied, incorrectly, to a load resistance of 0.5MΩ

Smithy walked over to his bench and returned with a small file of papers.

"Now let's have a look through our collection of Radio Constructor's Data Sheets," he continued as he opened the file. "Ah, here's the one I want: 'Capacitive Reactance – Audio Frequencies'. This Data Sheet tells me that a 1,000pF capacitor has a reactance of 398kΩ at 400Hz, so we can assume, rough check, that it will have a reactance of half a megohm at about 300Hz. In consequence, if we use the microphone with a load resistance of half a megohm all frequencies below 300Hz will be seriously attenuated, the attenuation increasing at 6dB per octave as frequency goes down."

"Ah," said Dick, a glint of sudden understanding gleaming in his eye. "This is beginning to make sense now."

He looked over at Smithy's Data Sheet.

"At 100Hz," he went on, "the reactance of 1,000pF is 1,590kΩ, which is a little more than three times the value of the half-megohm load resistance. The result of using that load resistor is that at 100Hz about three times more signal voltage appears across the self-capacitance of the microphone than appears across the load resistance."

"You've got the idea," said Smithy, "and you can now see why we've got to use a high value load resistor with a crystal microphone. If you use a low value resistor you lose bass response. A value of about 2 to 5MΩ is usual, the higher the value the better. The reactance of the 1,000pF self-capacitance we used as an example is 5MΩ at about 32Hz, so you would get negligible fall-off in bass response if you used a 5MΩ load resistor. Now, let's turn to your other question, which was concerned with the length of the microphone lead. This lead will, of course, be screened wire, and it has to be limited in length because of its self-capacitance. You have the situation where the capacitance in the microphone is in series with the capacitance in the lead, whereupon there is a loss in signal voltage from the microphone. If the lead is too long, its self-capacitance will be so high as to cause the loss to become serious." (Fig. 7).

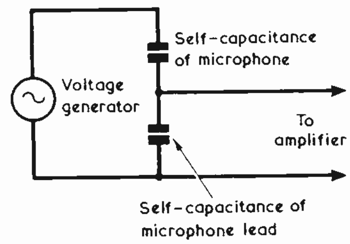


Fig. 7. The self-capacitance of the microphone and the self-capacitance of the lead coupling it to the amplifier form a capacitive potentiometer

"Wouldn't the capacitance in the lead also cause a reduction in high frequency response?"

"Theoretically, no," said Smithy. "What you've got is a capacitor potentiometer in which all frequencies are attenuated by an equal amount. In practice, you might get a little top-cut. Looking upon the microphone as a generator in series with a capacitor represents rather a simplified picture of things, and a long microphone lead could, perhaps, slightly alter the frequency characteristics also."

"I can certainly see now," said Dick, "that a crystal microphone wouldn't be much good for that installation at Joe's Caff. Apart from anything else, there'd be the difficulty of restricted microphone lead length."

Smithy's interest was aroused yet again.

"I'm still highly intrigued over the changes that are going on at that place," he remarked. "Tell me what else he's done to make it French in character."

"Well," replied Dick, turning his thoughts back again towards his evening rendezvous, "one thing he did was to try using those long French loaves instead of the usual sliced bread he gets. They weren't too bad around ham and cheese, but they were a dead loss for fried egg sandwiches."

"Has he given the place a new name?"

"Oh yes," replied Dick. "Joe always changes the name whenever he carries out alterations, and in this case he wanted a name which would carry associations with both France and with England. So he asked some of the students who come in what was the everyday French term for England, and that's the name he's now using."

"Yes, but what *is* it?"

"He calls the place 'Le Perfidious Albion'."

Smithy looked impressed.

"That's a jolly good name," he stated approvingly. "It has a certain ring about it."

"It's not bad, is it? Anyway, let's get back to microphones again. I was reading about ribbon microphones recently. Could a ribbon microphone be used for general p.a. work?"

RIBBON MICROPHONE

"I wouldn't recommend it," replied Smithy. "Ribbon microphones are delicate instruments which are intended for professional or semi-professional studio work and they won't stand up to physical abuse. On the other hand, they give excellent quality. They were used extensively by the B.B.C. in the past, and you may recall seeing them in pictures showing B.B.C. artistes performing in sound radio broadcasts. The B.B.C. ribbon microphone was housed in a large oblong metal case, the top part of which was perforated."

"I remember seeing them, now you mention it," said Dick. "How do ribbon microphones work?"

"They're a variation on the moving-coil microphone," replied Smithy. "As you know, the moving-coil microphone is basically a scaled-down moving-coil loudspeaker with the exception that the diaphragm is usually just a little wider than the diameter of the voice coil that's secured to it. Sound impinging on the diaphragm causes it to move in and out, whereupon the turns of the voice coil are similarly moved in the field of the microphone magnet. Current is induced in the coil and a signal voltage appears across its ends." (Fig. 8).

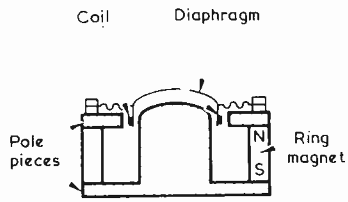


Fig. 8. The basic construction of a moving-coil microphone

Smithy paused for a moment to collect his thoughts.

"Now, a ribbon microphone," he resumed, "doesn't have a *coil* moving in the magnetic field. Instead it has a single conductor, which is the ribbon itself. This is a strip of extremely thin aluminium foil, and it is usually corrugated along its length to bring its low frequency resonance below the audio spectrum. It is mounted between two vertical pole-pieces coupled to a powerful magnet. When sound reaches the ribbon it moves back and forth in sympathy, whereupon current is induced in it due to the magnetic field between the pole-pieces. The ribbon is, in effect, a single-turn coil, with the result that the impedance it presents and the voltage it produces are both very low. Because of this, a step-up transformer is built into the microphone case, this providing an output at an impedance suitable for connection to the cable which runs to the amplifier. The impedance provided by the transformer secondary depends upon the application for which the microphone is required. A common figure is 600Ω, but lower impedances are also provided. If the ribbon microphone is a velocity type, as most models are, it is necessary for the pole-pieces to be thin, or to have large holes in them, so that the air displacement due to the sound appears on both the front and back surfaces of the ribbon." (Fig. 9).

"Stap me," groaned Dick. "You've done it again."

"Done what?"

"Introduced another of your way-out terms," complained Dick. "What's this 'velocity' business?"

"The word 'velocity' defines the mode of operation of the microphone," explained Smithy patiently. "The moving-coil and crystal microphones we have been considering up to now are described as 'pressure' types because the sound reaches their diaphragms from one side only. As a result, diaphragm movement is proportional to the changes in air pressure resulting from the sounds. With the ribbon microphone, on the other hand, the idea is that the ribbon movement is proportional to the *velocity* of the air particles as they move back and forth with the successive rarefactions and compressions caused by the sound. If the ribbon is to be correctly affected by particle velocity both its surfaces have to be open to the air carrying the sound, and so the pole-piece assembly mustn't get in the way too much."

"Does that mean, then," asked Dick, "that you can speak into either surface of the ribbon?"

"Yes, it does," confirmed Smithy. "And this fact results in an important feature of the velocity ribbon microphone, which is that it has a figure-of-eight polar diaphragm so far as its sensitivity to sound is concerned. It has maximum sensitivity for sounds which come from points at 90 degrees to the surfaces of the ribbon, and

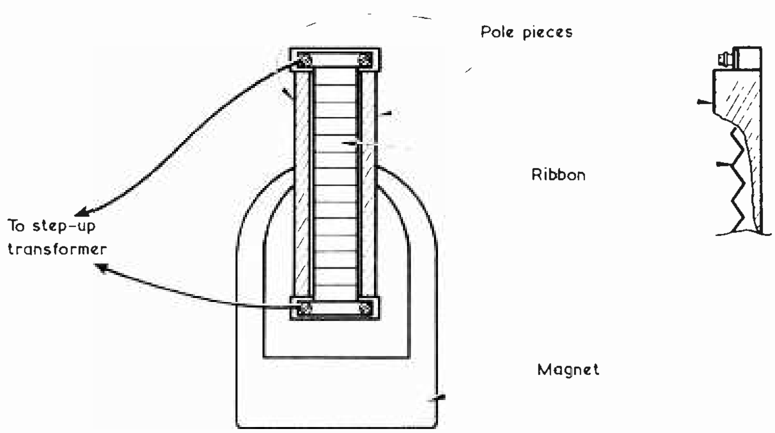


Fig. 9. Essential features of a ribbon microphone. The step-up transformer is housed, with the ribbon in the microphone case

minimum sensitivity for sounds which reach it from either side. This is to be expected, of course, since sound coming from the side will affect both surfaces of the ribbon equally." (Fig. 10).

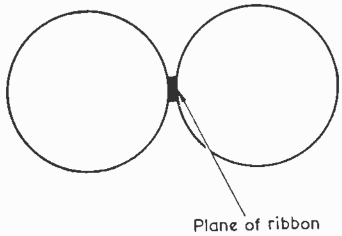


Fig. 10. The polar response of the velocity ribbon microphone. It has minimum sensitivity to sounds arriving from the sound side

"You keep referring to velocity ribbon microphones," remarked Dick. "It sounds as though there are pressure ribbon microphones as well."

"There are," agreed Smithy, "but just let me finish on the velocity ones first. Now, the word 'velocity' is not a very accurate one because even the exceptionally light ribbon of a ribbon microphone is still too heavy to faithfully follow air velocity changes, and the term 'pressure-gradient' is sometimes used for these microphones instead. They have one peculiarity, incidentally, which results from the velocity mode of operation. This is that they accentuate bass frequencies when the sound source is very close to them. If you speak too near to a velocity ribbon microphone, the lower frequencies are emphasised. This is because the microphone works best with a plane sound wave, which is one having a flat wave front and which is given when the sound source is some distance away. If the sound source approaches the microphone the wave front becomes more and more spherical and the bass accentuation takes place. A rather simplified way of explaining the effect is to say that the higher frequency sound waves in the spherical wave front do not all reach the ribbon at the same instant and tend to cancel out, allowing the bass boost effect to take place. Now, let's turn to the pressure ribbon microphone. This employs the same basic construction as the velocity microphone but the ribbon is open to the air on one side only. The back of the ribbon is enclosed by the microphone case, some form of material having acoustic resistance being positioned behind the ribbon to prevent resonances."

"I suppose," remarked Dick, "that ribbon microphones are delicate items because of the thinness of the ribbon itself."

"That is one of the reasons," agreed Smithy. "Another is that the spacing between the ribbon edges and the pole-pieces is usually quite small, and physical maltreatment of the microphone could cause the ribbon to become distorted in shape and touch one or other of the pole-pieces. Another point is that you must never blow into a ribbon microphone to check whether it's in circuit and working, or you'll simply blow the ribbon clean out of the gap and it might not come back in again. Ye gods!"

TIME TO GO

"Blow me," said Dick, startled by Smithy's sudden exclamation. "What's up?"

"Have you seen the time, lad? Blimey. I must be going out of my mind. I've been talking with you all this time, and we should have started work *ages* ago."

"Well," said Dick comfortingly, "the time hasn't been wasted so far as I'm concerned. You've certainly given me some useful information on microphones."

"We've only brushed the surface of the subject," replied Smithy. "There are a lot of other types of microphone in addition to the ones we've talked about today."

"Could we have a session on them at some time in the future?"

"Very well," promised Smithy. "But for the present we've got to get some work done, Dick."

Whereupon the pair, Dick temporarily sated with information and Smithy fretting at the complementary loss of working time, settled down to their noble and dedicated task of setting to rights the receivers which the lay public entrusted to their care. As they bustle briskly about the workshop we must now take our leave of them. Or rather, bearing in mind the machinations of the francophilic Joe, we should say our French leave.

EDITOR'S NOTE

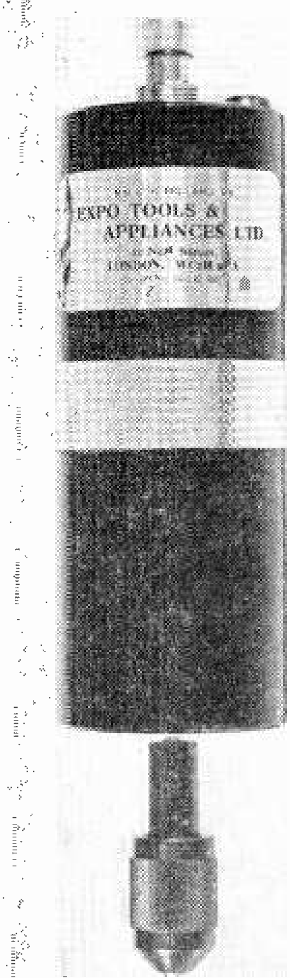
The Radio Constructor's Data Sheet consulted by Smithy is No. 5 in the series, and appeared in the April 1968 issue. ■

THE 'MINIFLEX' MARK IV PORTABLE RECEIVER

Intending constructors of the Miniflex Mark IV Portable Receiver, which was described in last month's issue, may note that an alternative supplier for the 40468A f.e.t. is Henry's Radio Ltd.

Trade News . . .

MINIATURE ELECTRIC TOOLS



This battery-operated miniature tool is one of a range made by Expo (Drills) Ltd., 62 Neal Street, London W.C.2. They can be used with drills, cleaning brushes, abrasive stones, cutting burrs, polishing mops and other tools, and are completely independent of a mains electricity supply

A range of battery-operated miniature tools capable of operating drills, cleaning brushes, abrasive stones, cutting burrs, polishing mops and other tools for precision work has been introduced by Expo (Drills) Ltd., 62 Neal Street, London W.C.2.

Exceptionally compact for tools of this type, they are designed for easy handling and for use in any situation independent of a mains electricity supply. There are several alternative power sources – 12V dry batteries, a transformer-rectifier, or a 12V car or boat battery. Low-voltage operation makes them completely safe to handle in all circumstances, and being portable they can be used in confined situations where standard mains-powered tools are impractical.

Two basic models are available. The 'Reliant' is designed for lighter work such as model making, and has a full load current of 1.5A. Its rated torque is 1.38oz. in. (100 gm. cm.). For jobs requiring a more powerful tool and for professional applications the 'Titan Super' is rated at 3.5A on full load. It has a rated torque of 350 cmp operating at 4,000–9,000 rpm. It is capable of undertaking a wide range of industrial work and is also recommended by the makers for use by lapidarists.

An extremely large range of accessories is also available for both models. These include a diamond bonded drill for gem stones up to 7MOHS and many types of abrasives, cutters and saws. Various collets and accessories are supplied with the different models, which range in price from £3.00 to £5.50.

PRINTED CIRCUIT CARDS

Roxburgh Electronics Ltd., Sandy, Bedfordshire, announce the introduction of a new package-deal range of printed circuit cards designed to enable systems varying in complexity from small instruments to large installations to be economically assembled.

The first series of cards are digital functions using T.T.L. integrated circuits. These cards are designed to enable independent connection of all inputs and outputs of the devices on the card.

Each card is provided with lever type card ejectors, a supply decoupling capacitor, and strategically placed test points. The cards fit standard edge connectors and card racks.

A wall chart showing full details of these cards is available on request from the Company at 22 Bedford Road, Sandy, Bedfordshire. Future cards in the series will provide analogue and subsystem functions.

SOLID TANTALUM CAPACITORS

A range of resin end-sealed solid tantalum capacitors codenamed TAR and giving a high capacity in a small can size has been introduced by ITT Components Group Europe.

This new series of metal-cased axial capacitors offers capacitances in the range 0.1μF to 680μF with a $\pm$20% (standard) or $\pm$10% (special) tolerance. Working voltages of 6, 10, 15, 20 and 35V d.c. are available and the rated temperature range is -40°C to $+85$°C.

The encapsulation provides a 21-day humidity rating and a high resistance to damage from mechanical vibration and shock.

For further information contact ITT Components Group Europe, Capacitor Product Division, Brixham Road, Paignton, Devon.

TRANSFORMER SUPPLIES

Gardners Transformers Ltd. of Christchurch, Hampshire, announce the appointment of W. S. McMillan & Co. Ltd. of 29 Waterloo Street, Glasgow C2, as sole selling agents for Scotland and Northumberland for all of Gardners' transformer products.

AN ENLARGER TIMER

by

B. E. HUNTER

This interesting circuit takes advantage of a semiconductor device which may be new to some readers — the programmable unijunction transistor

THIS ARTICLE DESCRIBES A SIMPLE TIMER WHICH was designed to be used with an enlarger, enabling the exposure to be automatically controlled whilst the user is otherwise engaged. Using the timer, repeat exposures can also be made from one negative with accuracy, enabling a number of prints to be made in the minimum amount of time. The timer also has a focus switch which overrides the timing circuit and allows for focusing the enlarger.

In use, the negative is put into the enlarger, the focusing switch is operated and the lamp comes on. The negative is focused, the exposure determined and the time set on the dial. The lamp is then switched off again using the focusing switch, the bromide paper placed on the baseboard and the start button is then pressed momentarily. This starts the timing period and the lamp comes on for the pre-set period.

P.U.T. OPERATION

The circuit of the timer is shown in Fig. 1. The only unusual component is TR2 which is a programmable unijunction transistor, or p.u.t. The equivalent circuit of a programmable unijunction transistor and its symbol are shown in Fig. 2(a) and those of a conventional unijunction transistor (or u.j.t.) in Fig. 2(b).

It will be seen from the equivalent circuit that the u.j.t. can be considered as a potential divider with a diode tap. With a voltage applied across the potential divider, the tapping point is set to a fixed potential, and until the voltage on the diode exceeds that on the tap, the diode is reverse biased. When the diode voltage does exceed that on the tap the diode becomes forward biased, and R1 becomes low resistance and generates a negative resistance characteristic.

The disadvantage of the simple u.j.t. is that the tapping point varies quite a lot due to manufacturing difficulties and so the voltage at which the device will switch varies correspondingly.

This disadvantage is not present with the p.u.t. as the potential divider is formed by two external re-

COMPONENTS

Resistors
(All fixed values ¼ watt)
- R1 27kΩ 10%
- R2 56Ω 10%
- R3 1MΩ 5%
- R4 820kΩ 5%
- R5 4.7Ω 20%
- R6 100Ω 10%
- VR1 2MΩ potentiometer, linear
- VR2 250kΩ potentiometer, pre-set

Capacitors
- C1 20μF electrolytic, 25V wkg
- C2 250μF electrolytic, 25V wkg
- C3 100μF electrolytic, 25V wkg

Transformer
- T1 Mains transformer, secondary 12–0–12V 50mA, Cat. No. TMM13 (Home Radio)

Semiconductors
- TR1 BFY51
- TR2 D13T1 (L.S.T. Electronic Components Ltd.)
- D1 DD000
- D2 DD000

Fuse
- FS1 100mA cartridge fuse with panel-mounting fuse-holder

Relay
- RLA See text

Switches
- S1 push-button
- S2 s.p.s.t. toggle

Socket
Bulgin 3-way plug and socket, Cat. No. P340 (Home Radio)

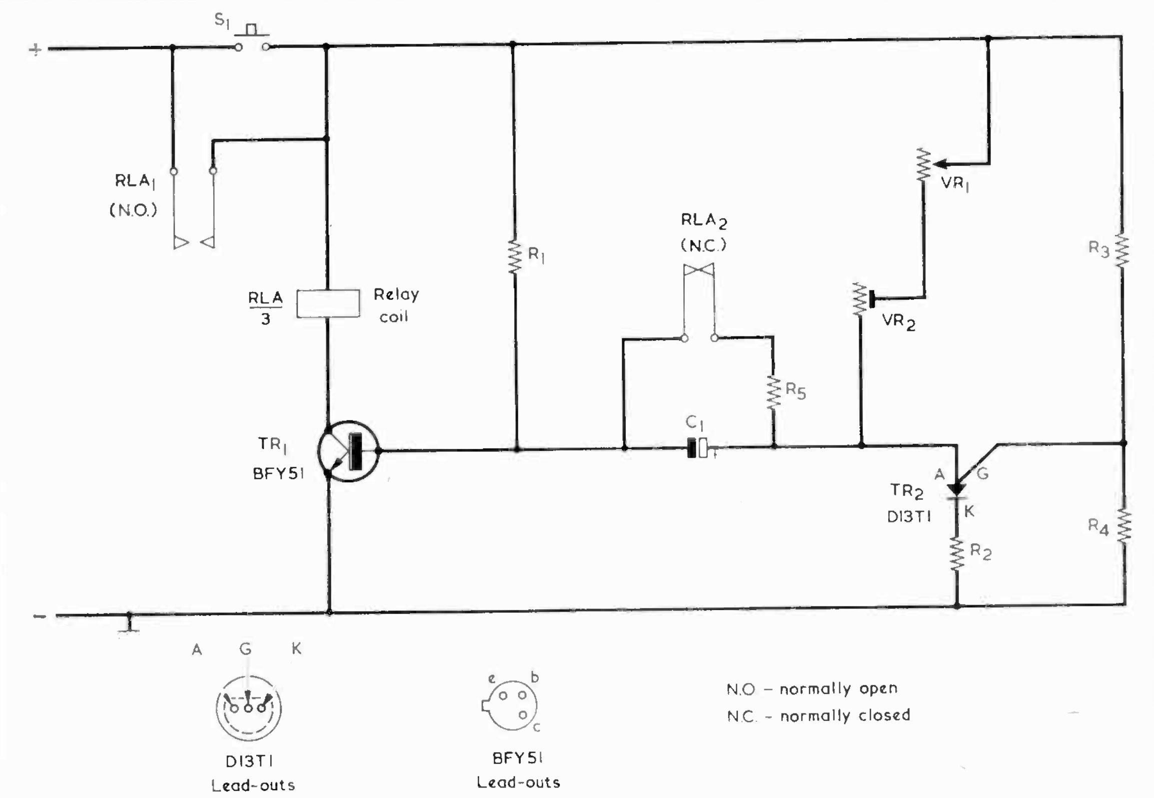
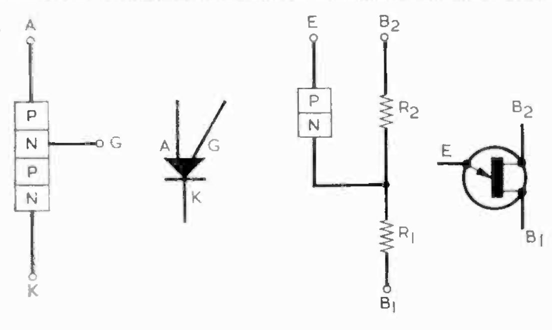


Fig. 1. The circuit of the timer section. TR2 is the programmable unijunction transistor

sistors, as in Fig 3, which can be of as close a tolerance as required. When the voltage on the anode exceeds that on the gate the diode conducts and regeneration in the p.n.p.n. device causes it to switch on.

TIMER CIRCUIT

In the timer circuit of Fig. 1, the resistors R3 and R4 set the gate potential to a little below half supply voltage. When push-button S1 is pressed, the supply is applied to the circuit and TR1 is biased on via R1. The relay operates, maintaining the supply when the push-button is released and removing the short-circuit from across C1. C1 now begins to charge via VR1 and VR2 and TR1 base-emitter junction. When the voltage across the capacitor reaches the triggering point of the p.u.t., the p.u.t. turns on and takes the positive plate of C1 negative. This causes the base of TR1 to go negative which, in turn, turns the transistor off. The relay de-energises and the supply is disconnected from the circuit, so



(a) (b)

Fig. 2(a). Equivalent circuit and circuit symbol for a p.u.t. (b). Equivalent circuit and circuit symbol for a unijunction transistor

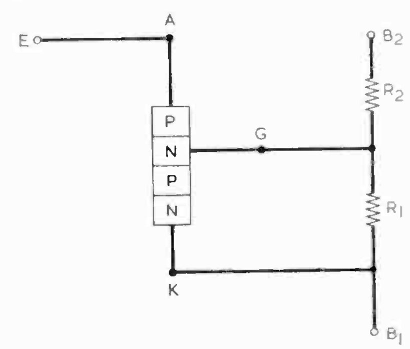


Fig. 3. The p.u.t. triggering level is set up by the values of R1 and R2

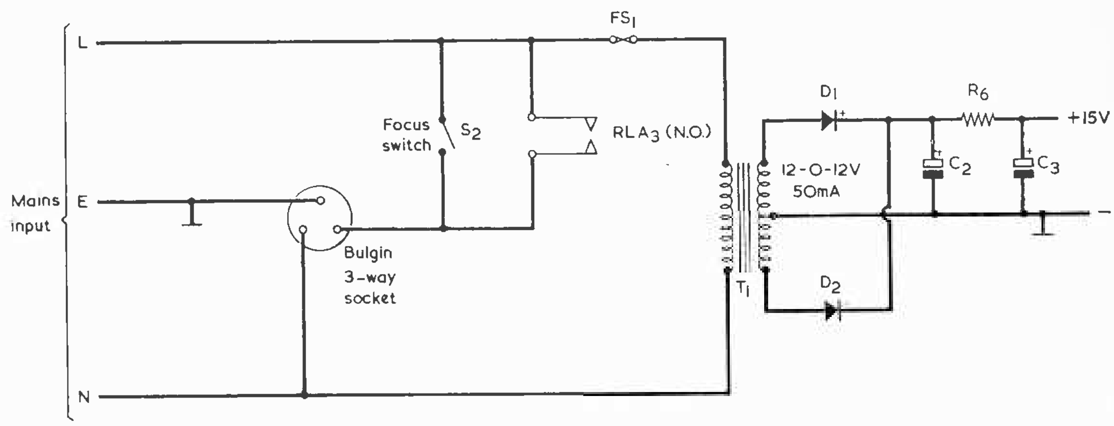


Fig. 4. The power supply section. Contacts RLA3 switch on the enlarger lamp when the relay energises

leaving it ready for the next operation. The relay also puts a short-circuit on C1 via limiter resistor R5, thereby ensuring that it is fully discharged between operations. Without this short-circuit it was found that, if the timer was operated twice in rapid succession, the second timing period was shorter due to the capacitor remaining slightly charged.

POWER SUPPLY

The power supply is shown in Fig. 4. It is simply a full-wave rectifying circuit supplying the 15 volts required by the timer at about 20mA. The timer was built on one piece of Veroboard and the power supply and mains transformer on another. The timer board also supports the relay which, in the prototype, is a miniature plug-in type.

The whole circuit is built into a case measuring 6 by 4 by 4in., with the three controls on the front panel. These are the focus switch, S2, the start button, S1, and the timing period adjustment, VR1. The output to the enlarger appears at a 3-way Bulgin socket mounted on the back panel, along with the fuse, FS1, for the timer. It will be seen from the circuit of the power supply that the fuse is inserted after the enlarger socket; this is done so that the fuse can be made small enough to protect the timer. The mains plug should be fused if possible to protect the enlarger circuit.

The timer covers a range from about one second to 50 seconds. The value given for C1 should be correct but, due to tolerances in this component, it may be found that the range cannot be covered, even by adjustment of VR2. If this is so C1 should be made smaller or larger as required. Its value can be effectively increased by adding one or more small value capacitors in parallel.

To calibrate the scale of the timer, control VR1 was first set to maximum and VR2 adjusted until the timing period was exactly 50 seconds. The tens of seconds points were then found by trial and error, after which the smaller divisions were marked in by judgement. ■

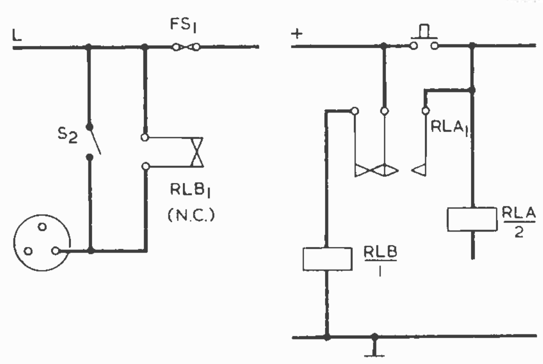


Fig. 5. A circuit modification which allows a second relay to switch the controlled mains circuit

EDITOR'S NOTE

The relay employed by the author was the Radiospares relay Type 45. This is not available to readers direct from Radiospares, although a retailer could be asked to order the component. Any other relay, capable of energising at 12 volts, with a coil resistance of 600Ω or more and two make (normally open) contact sets and one break (normally closed) contact set can be used, provided that the make contact set in the RLA3 position can handle 1 amp at mains voltage. Should difficulty in obtaining a suitable relay be encountered, the circuit may be modified in the manner shown in Fig. 5, in which a second relay, RLB, is included. Contact set RLA1 is now changeover and causes the second relay to be de-energised when RLA is energised and vice-versa. RLA now only requires two contact sets and a suitable type would be Home Radio Cat. No. WS162. Relay RLB could be Home Radio Cat. No. WS163, whose s.p.d.t. contacts are rated at 5 amps at 250 volts a.c.

Radio Topics

By Recorder

NATURE, IT IS SAID, ALWAYS steps in to maintain the balance. Thus if, in our somewhat turbulent atmosphere, a rarefaction appears in one place, then sooner or later air from outside rushes in to rebuild the pressure.

Perhaps Nature's nicest balance of all is exemplified in the water content of our planet. Most of it is present in its familiar liquid form on our lakes and seas, but sufficient of it still manages to become vaporised so that it can subsequently be distributed in the form of rain.

THE DANGER

Nature can also, to keep the balance, put a curb on a species if it gets too far out of hand. She allows the species to evolve into a form in which one or other of its characteristics becomes too advanced to be sustained by the whole. Witness the dinosaurs and pterodactyls of prehistoric times, which just evolved themselves out of existence.

If we aren't careful Nature is going to teach mankind a rather unpleasant lesson, too. As a species we have evolved to the state where we can change the mineral sources of our earth to complex materials which have vastly different properties and which are virtually indestructible. This in itself is no particular sin: indeed we are deserving of praise for our ingenuity and skill. But we can earn nothing but pitying wonder when it is seen that after learning these skills we apply them to producing great quantities of the new materials and do nothing whatsoever to ensure that they are broken down again to their harmless constituents after they have been used. Worse, when some of the processes involved in the manufacture of the new materials result in the appearance of byproducts which are, without any question, toxic to the human body, we have no compunction whatsoever in simply dumping them in the most convenient and economic spot available.

All this, of course, refers to our present gigantic problem of pollution. Above a certain level pollution tends to spiral. When a river choked with industry's rubbish, approaches total deoxidation, its life, which would have helped to fight that deoxidation, dies out and the battle is lost.

Perhaps Nature has allowed us to over-develop our mechanical and chemical skills so that, like the blundering dinosaur, we have become directly aimed towards extinction. In this instance, though, extinction will not follow from the fact that we have become unsuited to our environment but that we have knowingly wrecked the environment ourselves. We have certainly bashed our old globe around, and it is a little frightening to realise that most of the damage we have created has occurred within the last hundred years or so.

It is difficult to say what electronics – which represents our own special interest – has done either in the cause or in the prevention of pollution. In terms of worn-out items, some parts of our countryside do tend to have their complement of old radio and TV sets in addition to the usual depressing old mattresses and junked motor cars, but the proportion of discarded electronic gear is low. There are other less serious forms of pollution, of course, including the sound pollution resulting from the use outdoors of distorted and over-run transistor radios. Turning to another facet, nobody yet knows whether the myriad electromagnetic waves which currently travel through the ether, and presumably through us, cause any prolonged physiological damage. It would appear safe to assume that the general effect, if it exists, is minimal. Obviously, one does not stand in the path of a high intensity microwave beam, and curious phenomena are liable to happen close to exceptionally high power transmitters, but such happenings hardly fall into the category of lasting pollution.

It looks, therefore, that the science and practice of electronics has not contributed grossly to our present pollution problems and that instead – admittedly more by luck than judgement – electronics could almost be described as presenting an example for others to follow. Let us hope that those others can, in future, try to be equally blameless and that a halt will be called to the processes which will eventually make our earth uninhabitable.

ARTERY FORCEPS

Do you remember that reader's hint in 'In Your Workshop' in the last July issue where it was suggested that $4\frac{1}{2}$in. artery forceps be employed as a heat shunt when soldering transistors into circuit? To recap, these forceps have interlocking notches on the handles which engage with each other and keep the forceps closed. The forceps are ideal for the heat shunt application as they can be readily applied to the transistor lead-out being soldered and they leave both hands free for the soldering operation.

The only apparent snag which was evident when the hint appeared was that readers might have difficulty in obtaining the forceps through normal retail channels. We are now indebted to Mr. R. Weaver of

"Don't look now, but here comes – Mister Big'ead"

Rochester, Kent, who tells us that the forceps can be purchased from fishing tackle dealers, as they are used extensively by anglers for the purpose of removing hooks from fishes' mouths. Indeed, Mr. Weaver purchased his own pair for this very purpose some ten years ago, then subsequently started to use them as a heat shunt in the manner described in 'In Your Workshop'.

BRITISH RAIL REGRETS

There is something comforting in observing the signs of bureaucracy at work, since one then acquires the feeling that someone, somewhere, maintains the system. Even the tools of bureaucracy – forms and notices – are themselves regulated by being given numbers so that they may be correctly stored, requisitioned and issued with full and proper regard for orderliness.

Whilst inspecting a drink-vending machine on a railway station platform recently I was pleased to note that British Rail are no mean hands at the business of keeping strictly to the routine, and that station staff may, when required, obtain British Rail stick-on notice No. B.R.29100. This reads: 'Out Of Order'.

SPEAKING BUTTONS

A letter from Philip Abd El Malik of 214A Ramsis St., Cairo, U.A.R., has been passed on to me. It describes an invention which is described as 'The Speaking Buttons', and which is certainly of interest.

'The Speaking Buttons' is stated to comprise three inventions under one title, the first of these being called 'The Dumb Speaks'. This is a small portable apparatus with 200 or more buttons, each of which is inscribed with a single word. On pressing any button, the apparatus, by means of pre-recorded tape, *speaks* the word on the key.

The second invention is claimed to solve the problems of translation. Two persons of different language, each being completely ignorant of the other's language, can hold a conversation by way of another small portable apparatus having a series of buttons on either side. In one series the buttons are inscribed with words of the first language but the sounds given when they are pressed are in the second language. In the other series the buttons have words in the second language and the sound output is in the first language.

The third invention is referred to as a 'Universal Sound Library'. The operator first presses a button corresponding to the language he wishes to hear, then presses a word key to hear its sound in the selected language.

The apparatus has been patented and further details may be obtained from Philip Abd El Malik at the address at the start of this section.

LAMPHOLDERS

One of the busiest counters at any Woolworth's store is that on which the electrical goods are displayed. Apart from the usual array of mains plugs and sockets, you will nearly always find a line that has remained virtually unaltered since well before the war. This consists of a small Bakelite batten-mounting lampholder intended for m.e.s bulbs of the flash-lamp variety. You are almost certain to know the type I mean: there are two mounting holes in the circular base and two small nickel-plated screw terminals for connections. Over the years I have bought quite a few of these lampholders for various projects and I should imagine that quite a few other experimenters have done so as well.

Recently the design has been slightly changed. The tip of the bulb used to make contact with the head of a bolt in the lampholder, the bolt being screwed into a tapped hole in the metal terminal-connecting strip in the bottom of the moulding. Nowadays, however, the bolt has been replaced by a copper rivet which, alas, does not make as reliable a connection to the metal strip. I had quite some difficulty with one of these lampholders until I realised the cause, and the intermittent connection it gave cleared completely after I had soldered the bottom of the rivet over to the metal strip.

I mention this little tip because these lampholders are a popular line, and it could well be of value to other constructors who use them.

COLOUR CODE

I know it's a bit late in the day, but even so I think it's worthwhile passing on the latest mnemonic going the rounds for remembering the new mains lead colour coding.

Yellow-green for 'earth' is simple enough because it carries over the old green earth colour, and the first syllable of 'neutral' and blue rhyme with each other. But how about brown and 'live'?

That's easy. Just remember that 'George Brown is a live-wire'!

SWITCH ABBREVIATIONS

Finally, let me pass on some brief details about switch abbreviations which appear in some of our Components Lists and which, apparently, tend to confuse newcomers to our ranks.

The abbreviations concerned are 's.p.s.t.', 's.p.d.t.', 'd.p.s.t.' and 'd.p.d.t.' and they all apply to toggle switches or two-way rotary switches. The term 's.p.s.t' stands for 'single-pole single-throw' and defines the simplest switch of all, this having one arm and one contact. In one position the switch is closed and in the other position it is open. The letters 's.p.d.t' indicate 'single-pole double-throw'. In this case there is still one arm but there are now two contacts. The arm connects to one contact in one position and to the second contact in the other position. The switch may alternatively be referred to as a 'changeover' switch.

The letters 'd.p.s.t.' stand for 'double-pole single-throw'. This time there are two separate arms which move together in unison. The two arms connect to two separate contacts in one position, and the two sections of the switch are open in the other position. A 'd.p.d.t.' switch is a 'double-pole double-throw' type and this, again, has two separate arms which move together in unison. In one position they connect to two separate contacts and in the other position they connect to a second set of two separate contacts.

And that's all there is to it! ■

BACK NUMBERS

For the benefit of new readers we would draw attention to our back number service.
We retain past issues for a period of two years and we can, occasionally, supply copies more than two years old.
The cost is the cover price stated on the issue, plus 4p postage.
Before underaking any constructional project described in a back issue, it must be borne in mind that components readily available at the time of publication may have gone off the market.
We regret that we are unable to supply photo copies of articles where an issue is not available.
Libraries and members of local radio clubs can often be very helpful where an issue is not available for sale.

LATE NEWS

Times = GMT *Frequencies = kHz*

★ AMATEUR BANDS

● **MARTINIQUE**
Often heard these days is FM7WF using CW on, or near, **14060** around 1900 to 2000.

● **MOZAMBIQUE**
A regular user of the CW mode from this part of the world is CR7FM, usually around **14095** in the early evenings.

● **SOUTH AFRICA**
ZS6ME puts a very strong CW signal into the UK and may often be heard working all and sundry on **14055** around 1900 to 2000.

● **KENYA**
Zone 37 is often represented at the CW end of 14MHz by 5Z5KL. A favourite spot is near the band edge on **14005** around 2000.

● **PUERTO RICO**
For those brave enough to ward off the QRM on 'forty', try around 0030 for the CW signals of KP4CBI on **7040**, often working into the USA.

● **LIBERIA**
EL2CB often uses CW on, or near, **21040** in the early afternoons around 1430 busily working into Europe. EL2CJ favours the SSB mode and can be heard during the same period higher up the band.

★ BROADCAST BANDS

● **NETHERLANDS**
The weekday schedule of Radio Nederland, in English to Europe, is now as follows – 0930 to 1050 on **6020, 17810** and on **21480.** From 1400 to 1520 on **6020, 15330, 17810** and on **21480.** From 1830 to 1950 on **6020, 6085** and on **17830.**

● **AUSTRIA**
A station not often reported has been heard by B. Walsh of Romford, who informs us that a QSL card has been obtained from OYE21 Vienna on **6255.** Schulungssender Des Osterreichischen Bundesheeres (Austrian Army Radio) has a daily programme in German (Mondays to Fridays) from 1100 to 1230 and from 1630 to 1900. After the opening announcements, a course of Morse classes are held of approximately one half hour duration, this being followed by music, news and slogans. The address for reports is – Gussriegelstrasse 45, A–1100 Vienna.

● **IRAN**
This country can fairly easily be logged on **3778** around 1930 with transmissions from Tehran. The power is 100kW, programmes in Farsi (Persian) and the address – Ministry of Information, Meidan Ark, Tehran.

● **CAPE VERDE ISLANDS**
Radio Barlavento operates on **3930** (1kW) weekdays from 1500 to 1600 and from 2200 to 0100. Saturdays from 1600 to 1900 and from 2200 to 0100. Sundays from 1100 to 1300, 1600 to 1900 and from 2200 to 0100. The address of CR4AC is – C.P.29, S. Vicente. Programmes are in Portuguese.

Acknowledgements: BADX, Our Listening Post, SCDX.

120 METRE BAND

Did you know that the reception of stations operating in this, the lowest (in frequency terms) Broadcast band is perfectly possible here in the UK? You didn't? Let us assure you that in fact it can be done. Needless to say, endless patience is required, an ability to brave the QRM and fish-fone, with the equipment and aerial system at the highest peak of efficiency for this band, then with some luck one may hear the following – as did Alan B. Thompson of Neath, one of our ablest operators.

2326 1937 SABC Johannesburg, S. Africa (20kW). English Service heard through the surrounding fish-fone.
2346 1935 SABC Johannesburg, S. Africa (20kW). Afrikaans Service, again heard through the fish-fone.
2376 0020 SABC Johannesburg, S. Africa (20kW). Logged with musical programme in the All-Night Service.
2442 1932 Galei Tsahal, Tel Aviv, Israel (1kW). Light music and songs, Hebrew announcements.

That lot should be enough Dx of the highest order for anyone – why not have a try at the 120 metre band and see?

LAST LOOK ROUND

BRITISH ASSOCIATION OF DX'ERS

On page 91 of our issue dated September 1971, in our feature QSX, an account was given of the work of the British Association of Dx'ers (BADX) which resulted in the eventual identification of several transmitters operating from the Arabic-speaking world.

As a direct result of this article, a large number of membership enquiries were received at the BADX Headquarters, 16 Ena Avenue, Neath, Glamorgan. It would considerably assist the Association if those making membership enquiries would kindly enclose a stamped (3p), addressed envelope (preferably 9 x 4in.).

BADX is a non-profit making organisation having a limited membership devoted to Broadcast band Dx'ing. Their journal 'Bandspread' is posted first class to members on a fortnightly basis (monthly during July and August), normally eight foolscap pages, it is a veritable mine of information.

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(Continued on page 253)

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6BH6	.43	DF91	.14	ECL84	.54	PCF86	.44	UC92	.35	BY100	.18
6BJ6	.39	DF96	.34	ECL86	.35	PCF801	.29	UCC84	.33	BY126	.15
6BR7	.79	DK91	.26	EF22	.63	PCF802	.40	UCC85	.34	BY127	.18
6BW6	.72	DK92	.35	EF41	.58	PCF806	.57	UCF80	.33	OA81	.09
6BW7	.54	DK96	.35	EF80	.22	PCL82	.32	UCH42	.60	OA91	.09
6BZ6	.31	DL92	.25	EF85	.26	PCL83	.58	UCH81	.30	OA95	.09
6C4	.28	DL94	.32	EF86	.29	PCL84	.34	UCL82	.33	OC23	.38
6CU5	.30	DL96	.35	EF89	.23	PCL805		UCL83	.48	OC24	.38
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6F23	.68	E88CC	.60	EF183	.26	PD500	1.44	UF85	.34	OC28	.60
6F28	.60	E92CC	.40	EF184	.29	PFL200	.52	UF86	.63	OC35	.32
6K7G	.10	E180F	.90	EH90	.36	PL36	.47	UF89	.27	OC36	.43
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9D7	.78	EB34	.20	EL91	.23	PL84	.30	UY85	.25	OC46	.15
10F18	.35	EB91	.10	EL95	.32	PL504	.62	AC113	.25	OC70	.13
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30C17	.77		1.50	EY83	.54	PY83	.26	AD161	.45	OC81D	.11
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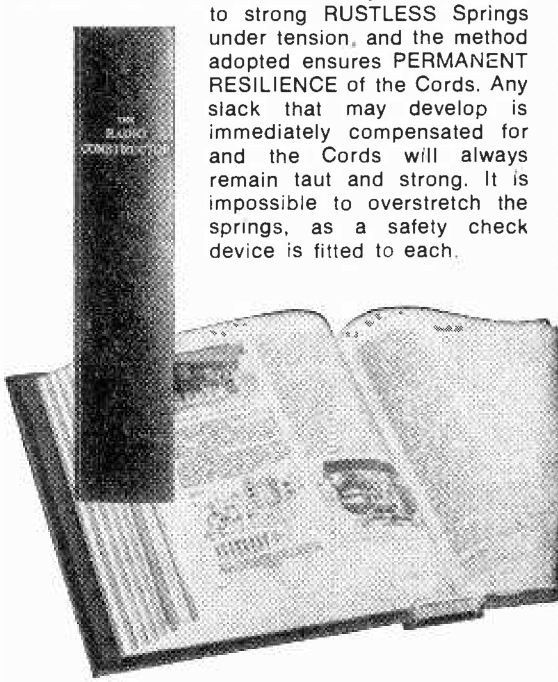

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SMALL ADVERTISEMENTS

Continued from page 251

WORLD DX CLUB covers all aspects of SWLing on Amateur and Broadcast Bands through its monthly bulletin *"Contact"*. Membership costs £1.38 a year. Enquiries to Secretary, WDXC, 11 Wesley Grove, Portsmouth, Hants., PO3 5ER.

AERIAL AMPLIFIERS, Bands 1, 2 and 3. Secondhand but in excellent condition, reputable maker Teleng, 25, 40 or 60dB. S.a.e. for further details. Fraction of original price. Webster, 15 Lindsay Road, Sprowston, Norwich, Norfolk NOR 92P.

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JOIN THE INTERNATIONAL S.W. LEAGUE. Free services to members including Q.S.L. Bureau, Amateur and Broadcast Translation, Technical and Identification Dept. – both Broadcast and Fixed Stations, DX Certificates, contests and activities for the SWL and transmitting members. Monthly magazine, *Monitor,* containing articles of general interest to Broadcast and Amateur SWLs, Transmitter Section and League affairs, etc. League supplies such as badges, headed notepaper and envelopes, QSL cards, etc., are available at reasonable cost. Send for League particulars. Membership including monthly magazines, etc., £1.75 per annum. Secretary ISWL, 1 Grove Road, Lydney, Glos., GL15 5JE.

FOR SALE: Creed Teletax transceiver type TR 105, £15. Ex-R.A.F. tuning fork drive unit type 114, £12. Box No. G167.

FOR SALE: 50 OC71 type transistors 50p. OC83 transistors 5p each. 1000pF polyester capacitors 2p each. P. & p. 8p. E.C.B., 45 Brockhurst Street, Fullbrook, Walsall, Staffs.

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WANTED: 9.5mm cine equipment. Cameras, projectors, editors, splicers, film reels, etc. Details to: Box No. G169.

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(Continued on page 255)

SMALL ADVERTISEMENTS

(Continued from page 253)

FOR SALE: Electronic Devices (Cheltenham) Ltd. electric "bug" morse key. £10. Box No. G170.

WANTED: Bound volumes of *The Radio Constructor* for years 1962 to 1967. State price to: A. Wilcock, 23 Irving Street, Hollinwood, Oldham, Lancs.

WANTED: Marconi AD 8882B receiver manual circuit diagram, p.s.u. details, etc., for loan or purchase. Postage refunded on all corespondence. Pring, 89A High Street, Chard, Somerset.

ARE YOU A MOTORING ENTHUSIAST? The Seven-Fifty Motor Club caters for all types of motor sport–racing, rallies, hill climbs, etc. Monthly Bulletin free to members. For full details write to: The General Secretary, Colin Peck, "Dancers' End", St. Winifred's Road, Biggin Hill, Kent.

FOR SALE: Small stamp collection £5. Box No. G.171.

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FREE GIFT when you request our quality stamps, supplied on approval. Generous discounts. Details from: Watson's Philatelic Service, 6 Beech Avenue, Brentwood, Essex.

FOR SALE: Raven radio control Tx & Rx. Multichannel reed. £25. S.A.E. for details. Box No. G172.

"GOVERNMENT SURPLUS WIRELESS EQUIPMENT HANDBOOK". Contains circuits, data, illustrations, components lists for British/U.S.A. receivers, transmitters, trans/receivers; includes modifications to sets and test equipment. Surplus/commercial cross-referenced transistor and valve guide. A gold mine of valuable information. Price £2.84. P. & P. 16p. Myers, 112 Stainburn Crescent, Leeds 17, Yorks.

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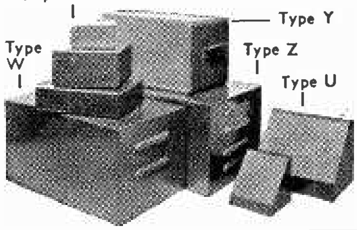

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FOREIGN LANGUAGE BROADCASTS

The Table lists B.B.C. transmissions in the languages shown. Two-figure numbers indicate Metre Bands and three-figure numbers indicate Metres. Times are in G.M.T. and, where applicable, days are quoted in brackets. The list started in Data Sheet 55 and will be completed in Data Sheet 57

GREEK
0545–0600 16, 19, 25, 31, 41
1300–1315 16, 19, 25
1545–1600 13, 16, 19 (Su, M, W, F)
1900–1930 19, 25, 31
2230–2300 25, 31, 41

HAUSA
0545–0600 19, 25, 31, 41
1345–1415 13, 16
1930–1945 13, 16, 19, 31
1945–2000 19, 31

HINDI
0050–0110 31, 41, 49 and 213, 428m.
0140–0200 31, 41, 49 and 213m.
1430–1515 13, 16, 19, 25 and 213m.
1600–1615 13, 16, 25 and 213m.

HUNGARIAN
0530–0545 25, 31, 41, 49
0630–0645 25, 31, 41, 49
1000–1030 19, 25 (Su)
1215–1230 19, 25, 31
1345–1400 19, 25, 31 (M, W, F)
1515–1530 19, 25, 31
1900–1945 19, 25, 31, 41, 49
2200–2245 25, 31, 41, 49 and 232m. from 2215

INDONESIAN
1030–1100 13, 16, 25, 31, 41
2315–2330 25, 31, 41, 49, 75

ITALIAN
0915–0930 13, 16, 19 (Su)
1430–1445 16, 19, 25 (ex Su)
2100–2130 31, 41, 49, 75 and 232m.

JAPANESE
1100–1130 13, 16, 19, 25
2200–2215 19, 25, 31, 41, 49

MALAY
1300–1315 13, 16

MALTESE
1650–1655 25, 31

MAURITIUS (English and French)
1000–1015 13 (alt M)

NEPALI
0930–1000 13, 16 (Sa)
1615–1645 25 (Sa)

PERSIAN
0200–0230 31, 41, 49
0315–0345 31, 41, 49 and 213, 417, 428m.
1615–1700 13, 16, 31, 41 and 213, 417m.

POLISH
0400–0415 31, 41, 49 and 232, 464m.
0500–0515 25, 31, 41, 49, 75 and 232, 464m.
0600–0615 25, 31, 41, 49
1315–1330 19, 25, 31
1330–1345 19, 25, 31 (Su, W, Sa)
1500–1515 19, 25, 31
1545–1600 19, 25, 31 (M, Th)
1800–1845 19, 25, 31, 41
2015–2045 19, 25, 31, 41, 49 and 232m.
2115–2145 25, 31, 41, 49

PORTUGUESE
Europe
1230–1245 19, 25
2200–2230 41, 49
Brazil
2200–0015 16, 19, 25, 31