THE
RADIO CONSTRUCTOR

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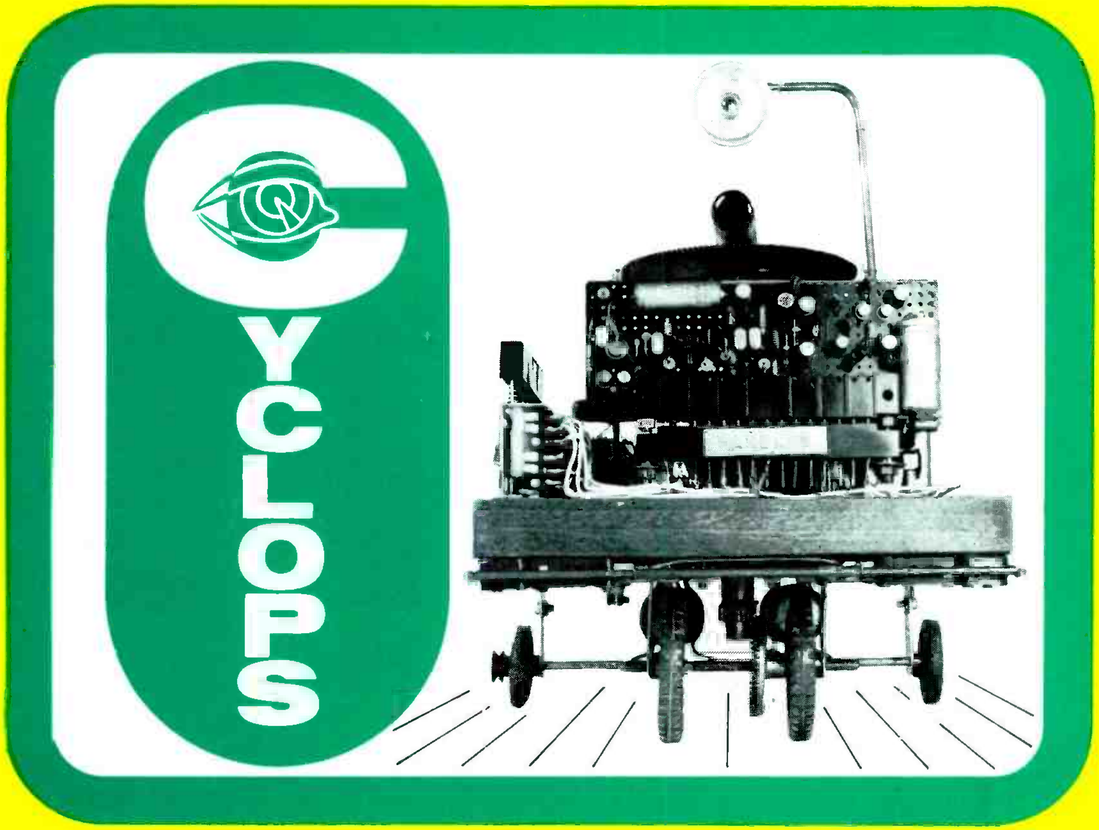

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Index Volume 25, Aug. 1971 - July 1972

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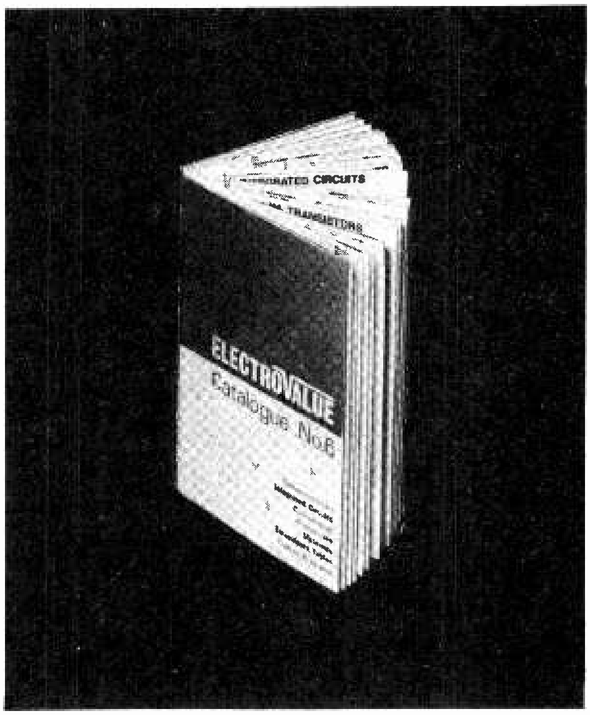

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400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
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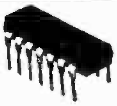

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BP44 = SN7444	1·95	1·85	1·75
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BP46 = SN7446	0·97	0·94	0·88
BP47 = SN7447	0·97	0·94	0·88
BP48 = SN7448	0·97	0·94	0·88
BP50 = SN7450	0·15	0·14	0·12
BP51 = SN7451	0·15	0·14	0·12
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BP54 = SN7454	0·15	0·14	0·12
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BP70 = SN7470	0·29	0·26	0·24
BP72 = SN7472	0·29	0·26	0·24
BP73 = SN7473	0·37	0·35	0·32
BP74 = SN7474	0·37	0·35	0·32
BP75 = SN7475	0·47	0·45	0·42
BP76 = SN7476	0·43	0·40	0·38
BP80 = SN7480	0·67	0·64	0·58
BP81 = SN7481	0·97	0·94	0·88
BP82 = SN7482	0·97	0·94	0·88
BP83 = SN7483	1·10	1·05	0·95
BP86 = SN7486	0·32	0·30	0·28
BP90 = SN7490	0·67	0·64	0·58
BP91 = SN7491AN	0·87	0·84	0·78
BP92 = SN7492	0·67	0·64	0·58
BP93 = SN7493	0·67	0·64	0·58
BP94 = SN7494	0·77	0·74	0·68
BP95 = SN7495	0·77	0·74	0·68
BP96 = SN7496	0·77	0·74	0·68
BP100 = SN74100	1·75	1·65	1·55
BP104 = SN74104	0·97	0·94	0·88
BP105 = SN74105	0·97	0·94	0·88
BP107 = SN74107	0·40	0·38	0·36
BP110 = SN74110	0·55	0·53	0·50
BP111 = SN74111	1·25	1·15	1·00
BP118 = SN74118	1·00	0·95	0·90
BP119 = SN74119	1·35	1·25	1·10
BP121 = SN74121	0·67	0·64	0·58
BP141 = SN74141	0·67	0·64	0·58
BP145 = SN74145	1·50	1·40	1·30
BP150 = SN74150	1·80	1·70	1·60
BP151 = SN74151	1·00	0·95	0·90
BP153 = SN74153	1·20	1·10	0·95
BP154 = SN74154	1·80	1·70	1·60
BP155 = SN74155	1·40	1·30	1·20
BP156 = SN74156	1·40	1·30	1·20
BP160 = SN74160	1·80	1·70	1·60
BP161 = SN74161	1·80	1·70	1·60
BP164 = SN74164	2·00	1·90	1·80
BP165 = SN74165	2·00	1·90	1·80
BP181 = SN74181	2·75	2·60	2·40
BP182 = SN74182	0·97	0·94	0·88
BP190 = SN74190	3·50	3·25	3·00
BP191 = SN74191	3·50	3·25	3·00
BP192 = SN74192	2·10	1·95	1·75
BP193 = SN74193	2·10	1·95	1·75
BP195 = SN74195	1·10	1·05	0·95
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BP198 = SN74198	5·50	5·00	4·00
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PRICE-MIX. Devices may be mixed to qualify for quantity prices. **PRICES** for quantities in excess of 500 pieces mixed, on application. Owing to the ever increasing range of TTL 74 Series, please check with us for supplies of any devices not listed above, as it is probably now in stock. WARE 3442.

LINEAR I.C's— FULL SPEC.

Type No.	Price 1-24	25-99	100 up
BP 201C—SL201C	63p	53p	45p
BP 701C—SL701C	63p	50p	45p
BP 702C—SL702C	63p	60p	45p
BP 702—72702	53p	45p	40p
BP 709—72709	53p	45p	40p
BP 709P—µA709C	53p	45p	40p
BP 710—72710	53p	45p	40p
BP 711—µA711	68p	50p	45p
BP 741—72741	75p	60p	50p
µA 703C—µA703C	43p	35p	27p
TAA 263—	70p	60p	55p
TAA 293—	90p	75p	70p
TAA 350	170p	158p	150p

LOGIC DTL 930 SERIES I.C's
ROCK BOTTOM PRICES

Type No.	Price 1-24	25-99	100 up
BP930	12p	11p	10p
BP932	13p	12p	11p
BP933	13p	12p	11p
BP935	13p	12p	11p
BP936	13p	12p	11p
BP944	13p	12p	11p
BP945	25p	24p	22p
BP946	12p	11p	10p
BP948	25p	24p	22p
BP951	65p	60p	55p
BP962	12p	11p	10p
BP9093	40p	38p	35p
BP9094	40p	38p	35p
BP9097	40p	38p	35p
BP9099	40p	38p	35p

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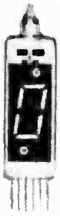

MODEL	CD66	GR 116	3015F
Anode voltage (Vdc)	170 min	175 min	5
Cathode cur'nt (mA)	2.3	14	
Numeral h'ght (mm)	16	13	9
Tube height (mm)	47	32	22
Tube diameter (mm)	19	13	12
I.C. driver rec.	BP41 or 141	BP41 or 141	BP47
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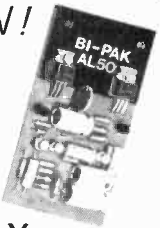

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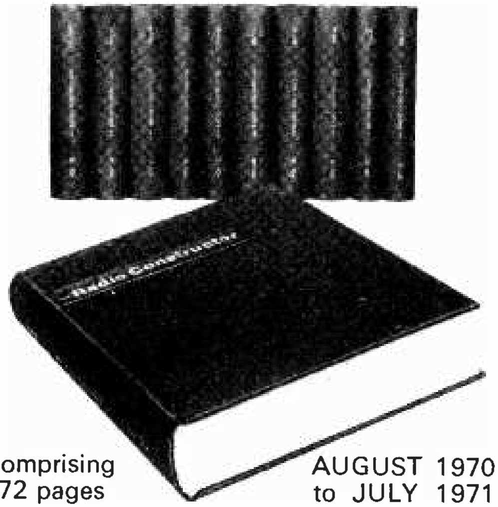

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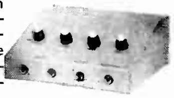

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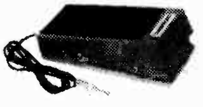

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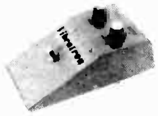

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AF186	0·20	2N1302-3	0·15
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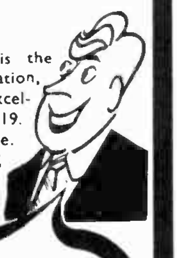

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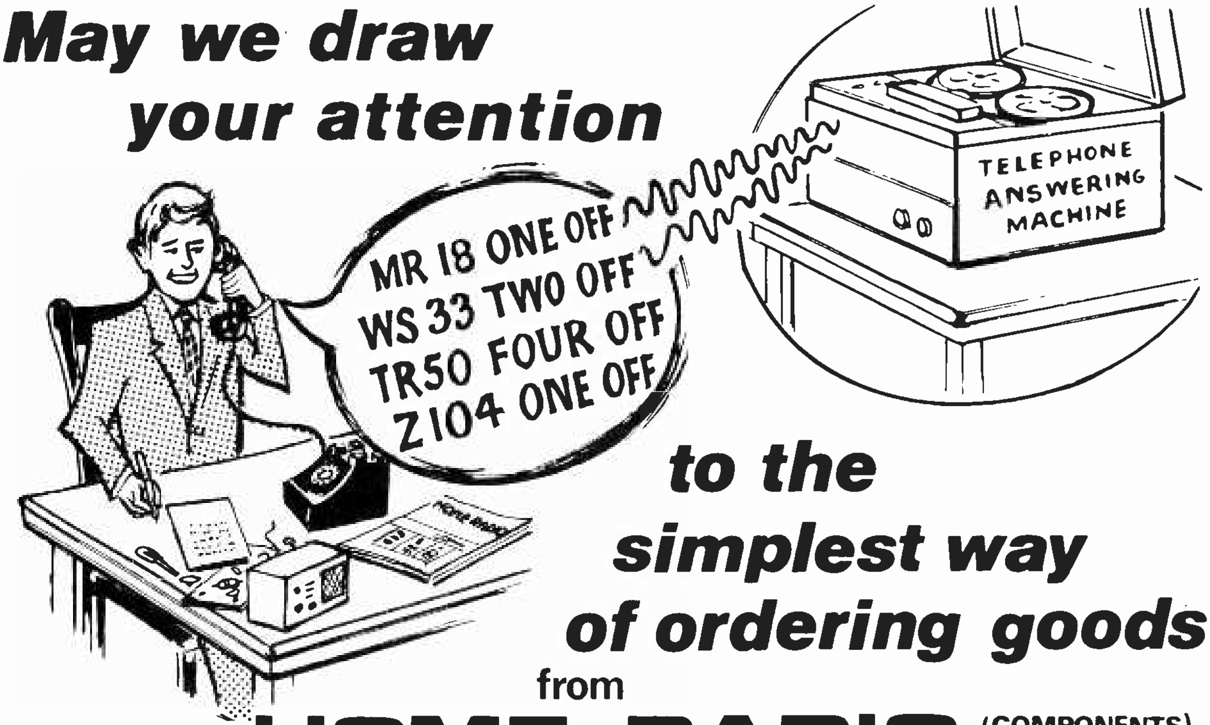

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AUGUST ISSUE WILL BE PUBLISHED ON AUGUST 1st

Bedside Reflex Receiver

by

A. Sapciyan

Circuit design for a low-cost 3-transistor medium-wave receiver

SIMPLE RECEIVERS ARE AMONG THE MOST INTERESTING projects for the home constructor. Receivers of this type frequently use the reflex principle, which provides a high gain with the minimum of components. The reflex receiver to be described in this article is capable of giving adequate loudspeaker volume for bedside listening without the need for an external aerial or earth. The sensitivity and selectivity are sufficient to enable several foreign stations to be tuned in after dark.

CIRCUIT DETAILS

The circuit is shown in Fig. 1. This has a variable resistor, VR1, which enables the set to be brought just below the oscillation level, thereby offering best sensitivity and selectivity for the reception of local and foreign transmissions. L1 is a ferrite aerial coil and is tuned by VC1. The signals picked up are passed to TR1 for r.f. amplification, the amplified signals being largely prevented by r.f. choke L2 from passing to the later stages. These r.f. signals then pass through C2 and are detected by D1, the resultant a.f. being reapplied to the base of TR1 via the electrolytic capacitor C9 and the lower end of L1. TR1 now functions as an a.f. amplifier and the amplified a.f. signals at its collector pass readily through the r.f. choke for application to TR2. C4 functions as a bypass capacitor for any r.f. signals that may still be present after the r.f. choke.

The a.f. signals next pass via C5 to TR2 and then via C7 to TR3. In the prototype, TR3 feeds a high impedance speaker directly but, as will be explained shortly, it may also couple into a 3Ω speaker via a step-down transformer.

The transistor in the first stage is an AF117 or AF127. The shield connection for either type is left open-circuit as this assists in providing regeneration. The current consumption of the first stage should be about 1.5mA.

The second stage uses an AC126 whilst the output stage employs an AC128. In the prototype, the output transistor coupled directly into a 150Ω speaker. However, speakers of this impedance are not widely available, and an alternative arrangement consists of coupling the collector of TR3 to the primary of a 9.2:1 step-down transformer (R.S. Components type T/T4), the secondary of which connects to a 3Ω speaker. The circuit incorporating the transformer is given in Fig. 2.

The total consumption of all three stages should not exceed 15mA, which is quite reasonable.

Sensitivity depends on the first stage providing a high gain. This stage can be checked for gain, if necessary, by connecting a pair of high impedance headphones in parallel with the load resistor, R2. R1, in series with VR1, controls the setting of the latter which allows oscillation to occur, and it may require adjustment in some cases for best results. R4 and C3 are decoupling components, and prevent motor-boating as the battery ages.

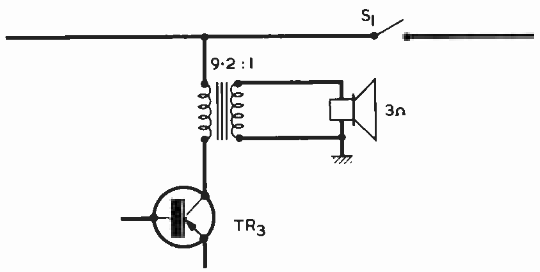


Fig. 2. Alternative output circuit employing a step-down transformer

AERIAL COIL

The aerial coil is wound on a ferrite rod 4 in. long by ⅜ in. in diameter, and consists of 75 turns close-wound on a paper sleeve that is free to slide along the rod. See Fig. 3. A tap is made at the 9th turn for the connection to the base of TR1, and the wire is 30 s.w.g. enamelled. Different grades of ferrite may give slightly varying values of inductance to the coil, and the constructor is advised to commence with 85 turns overall, still keeping the tap at the 9th turn. After the set has been completed and brought into working order, turns can then be

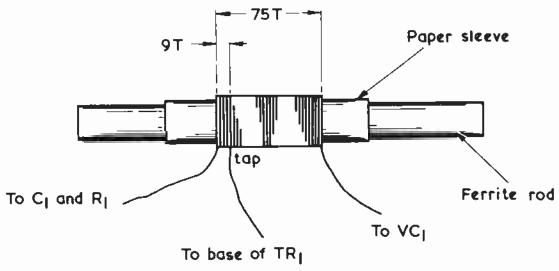


Fig. 3. Details of the ferrite rod aerial

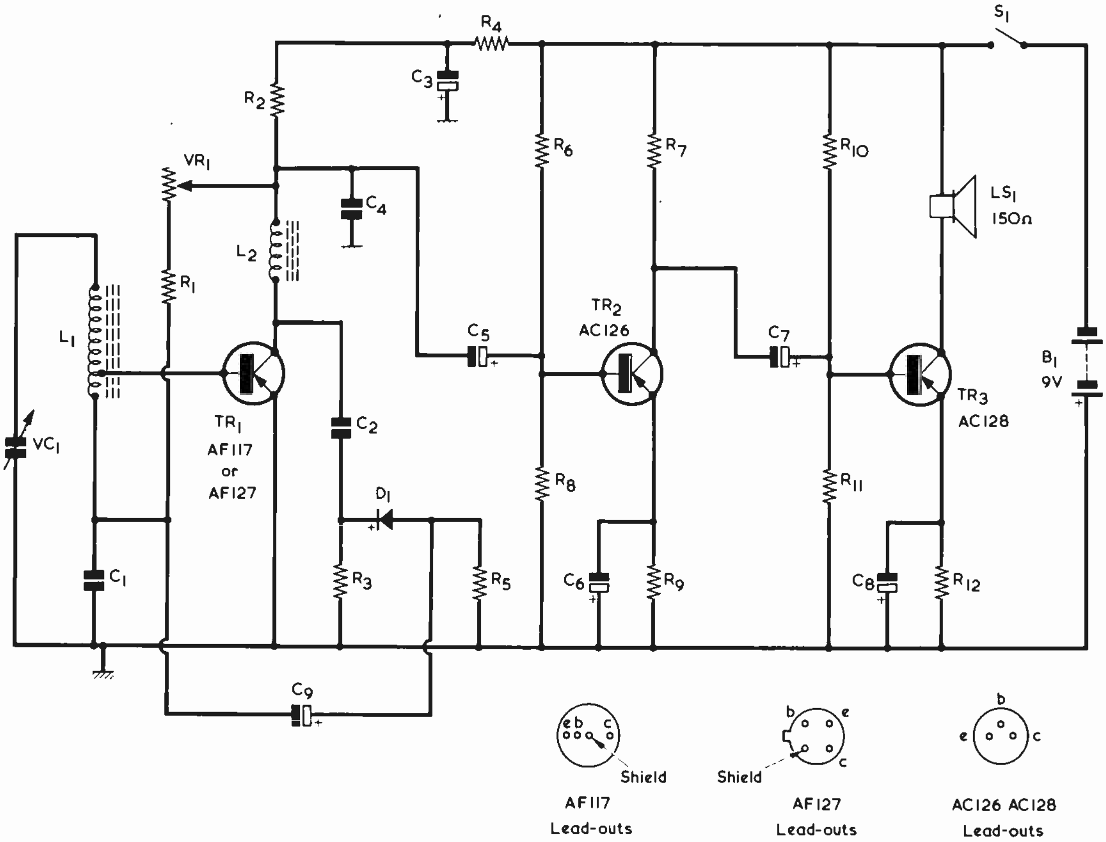


Fig. 1. The circuit of the reflex receiver

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)

R1	68kΩ (see text)
R2	1kΩ
R3	4.7kΩ
R4	1kΩ
R5	10kΩ
R6	68kΩ
R7	5.6kΩ
R8	10kΩ
R9	680Ω
R10	33kΩ
R11	5.6kΩ
R12	150Ω
VR1	100kΩ potentiometer, linear

Capacitors

C1	0.01μF paper or plastic foil
C2	330pF ceramic or silvered mica
C3	50μF electrolytic, 10 V.Wkg.
C4	0.01μF paper or plastic foil
C5	5μF electrolytic, 10 V.Wkg.
C6	50μF electrolytic, 6 V.Wkg.
C7	5μF electrolytic, 10 V.Wkg.
C8	100μF electrolytic, 6 V.Wkg.
C9	10μF electrolytic, 2.5 V.Wkg.
VC1	300pF variable, solid dielectric

Inductors

L1	Ferrite aerial coil (see text)
L2	2.5mH r.f. choke type CH1 (Repanco)

Semiconductors

TR1	AF117 or AF127
TR2	AC126
TR3	AC128
D1	OA85

Switch

S1	s.p.s.t., toggle or rotary

Speaker

LS1	Miniature speaker, 150Ω, or 3Ω with R.S. Components transformer type T/T4

Battery

B1	9-volt battery

Miscellaneous
Slow-motion drive and knob
Chassis, as required
Tagstrips or tagboard.

taken off at the end remote from the tap until the desired medium-wave coverage is obtained.

The receiver may be constructed on tagstrips or a tagboard mounted on a small metal chassis having a front panel for VC1, VR1 and, if desired, the speaker. VC1 should be provided with a simple slow-motion drive, such as is given by an epicyclic drive. VR1 is wired such that the resistance it inserts into circuit reduces as it is turned clockwise. The components should be laid out in roughly the same order as they appear in the circuit diagram, keeping the circuitry around TR3 well-spaced from that around TR1. The ferrite rod must be kept well away from the metal chassis or panel. The r.f. choke should not be connected permanently at this stage, as it may be necessary to alter its position with respect to the ferrite rod. It should be positioned about 2 in. from the rod.

When construction is complete, a battery may be connected and the receiver performance checked. After switching on, it should be possible to receive local stations by adjustment of VC1. VR1 functions as a reaction control and sensitivity is increased as it is turned clockwise, maximum sensitivity being given when it is set just below the oscillation point. VR1 will require different settings as the tuning is adjusted across the range. It may be found that the position of L2 relative to the ferrite rod affects the reaction and L2 should be rotated, if necessary through 180°, for best reaction performance.

As already mentioned, the value of R1 affects the setting of VR1 at which oscillation occurs, and R1 should have a resistance which enables VR1 to offer adequate control both with a new battery and with one whose voltage has fallen to some 7 volts or so. The value of 68kΩ employed in the prototype should be satisfactory in general, but it may need to be varied in some instances.

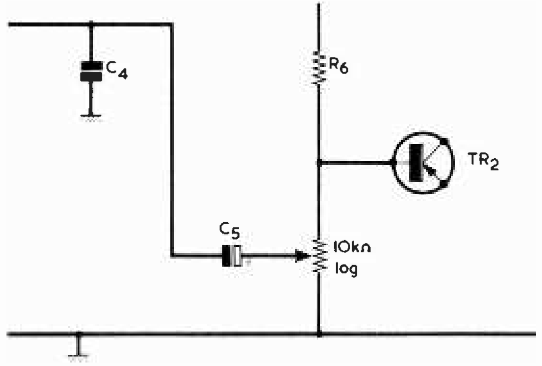


Fig. 4. In areas of very high signal strength R8 may be changed to an a.f. volume control, as illustrated here

No overloading problems were evident with the author's receiver, but they are feasible if the set should be employed close to a powerful station. Should overloading occur, resistor R8 may be replaced by a 10kΩ log potentiometer, connected as shown in Fig. 4. This will function as an a.f. gain control. It should be remembered that VR1 is a reaction control and is not a gain control, as such. VR1 should always be kept at a setting which provides adequate selectivity and sensitivity. ■

* AUDIO

by

R. A. Penfold

THIS FILTER UNIT IS DESIGNED FOR USE WITH transistor short wave receivers, where it is used to greatly reduce the bandwidth of the receiver and thus reject unwanted transmissions together with atmospheric and other electrical interference. The bandwidth of the filter unit is very small and is far too limited for the reception of speech, but it is ideal for the reception of c.w. (morse code). The unit is inserted in the a.f. stages of the receiver after the detector and offers a high level of gain to audio frequencies at, or very near to, the frequency of the filter, and low gain to all other audio frequencies.

CIRCUIT DETAILS

Only a dozen components are used, and the cost of the unit is low. A single transistor is incorporated, this being a high-gain silicon type. Any extra noise introduced by the addition of the unit to the receiver is very small, and appears only at frequencies that lie within its passband. This small addition in noise should be more than compensated for by the reduction it provides in the noise from the earlier stages as well as by the increase in a.f. gain it gives at the filter frequency.

The circuit of the unit is given in Fig. 1, and it will be

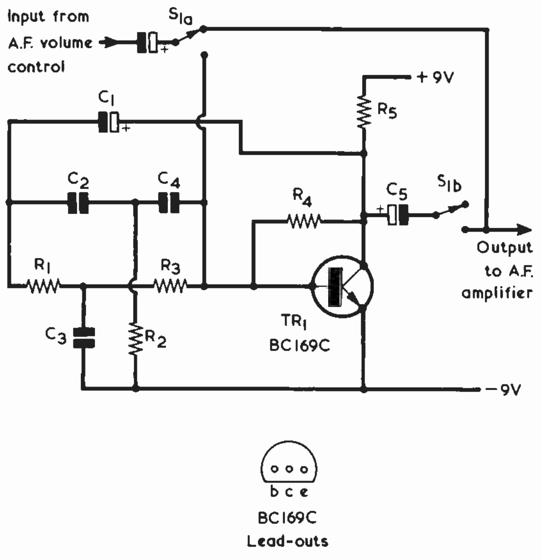


Fig. 1. The circuit of the filter unit. This offers a high level of amplification for frequencies at, or very close to, the filter frequency

FILTER FOR C.W. *

A simple but effective filter unit which may be inserted in the a.f. stages of a transistor short wave receiver

seen that it consists of a simple transistor amplifier employing TR1, R4 and R5, together with a parallel-T filter given by C2, C3, C4, R1, R2 and R3. This filter appears in a negative feedback path from the transistor collector to the base, and it offers very high attenuation to negative feedback signals at its operating frequency. Thus, signals at this frequency are not returned to the base of the transistor at any significant level, and the transistor is capable of offering the full gain of which it is capable. Full negative feedback is given to frequencies removed by any significant amount from the filter frequency and these are amplified at very much lower level by the transistor.

The filter unit is best inserted immediately after the slider of the a.f. volume control of the receiver. The electrolytic input capacitor shown in Fig. 1 without a component designation will normally be that already installed in the receiver which previously coupled to the base circuit of the following a.f. transistor. When the unit is installed, the output via C5 is passed to that base circuit. It will be noted that S1 (a) (b) enables the filter unit to be switched in or out, as desired.

It may be possible to add the parallel-T filter to the first audio stage of the receiver itself by coupling the network given by C2 to C4 and R1 to R3 between its collector and base circuits. This would make TR1, R4, R5 and C5 unnecessary. However, the addition of the filter would cause a loss in the gain of the set, and in most cases it would be preferable to use the filter in an additional unit, as described here.

The operating frequency of the filter is about 4kHz. If this is thought to be rather high it can be reduced by altering the values of C2 and C4 to 0.02µF and that of C3 to 0.04µF. These changes will reduce the operating frequency to just over 2kHz.

Ideally, C2, C3 and C4 should have a tolerance of 5% or better, but it will be difficult to obtain the values specified with a tolerance as close as this. In practice, good quality plastic foil components will work adequately. Avoid the use of ceramic capacitors, which may have very wide tolerances.

The power supply may be obtained from the receiver circuits, and it is left permanently connected to the filter unit. Since the current consumption of the unit will normally be less than 1mA, there is little point in providing it with an on-off supply switch.

COMPONENTS

Resistors

(All resistors ¼ watt or ⅛ watt)

R1	3.6kΩ 5%
R2	1.8kΩ 5%
R3	3.6kΩ 5%
R4	1.2MΩ 10%
R5	4.7kΩ 10%

Capacitors

C1	25µF electrolytic, 6.4V.wkg.
C2	0.01µF plastic foil
C3	0.02µF plastic foil
C4	0.01µF plastic foil
C5	25µF electrolytic, 6.4 V.wkg.

Transistor

TR1 BC169C

Switch

S1 (a) (b) d.p.d.t. toggle

Miscellaneous

Veroboard, 0.1 in. or 0.15 in. matrix, as required.

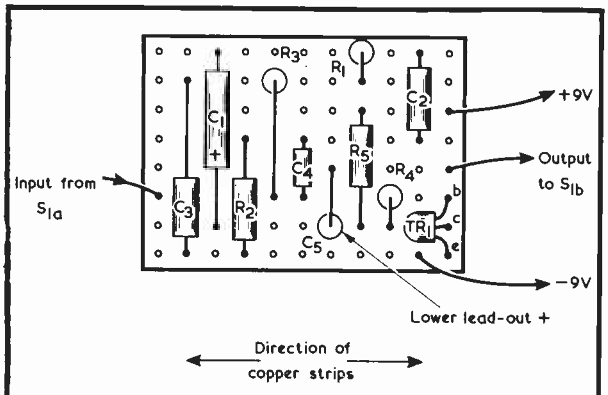
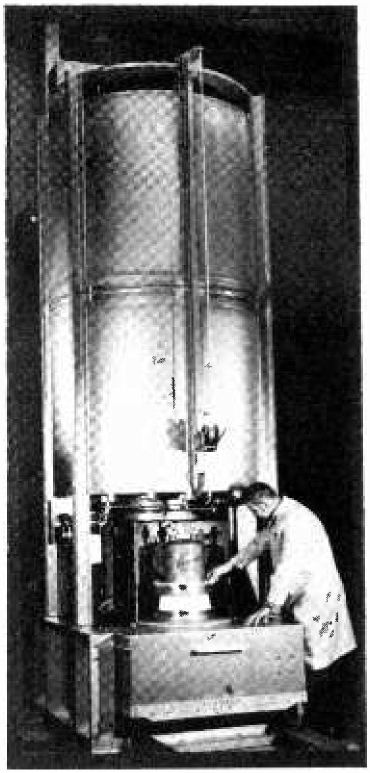


Fig. 2. A suitable veroboard layout for the unit

There will not be much space in most transistor receivers to accomodate the unit and, because of this, it must be made fairly small. Fig. 2 shows a suitable layout on a piece of Veroboard. In this layout, R1, R3 and C5 are mounted vertically. Veroboard with a matrix of 0.1 in. can be used if the physical size of the components allows this, otherwise a board of 0.15 in. matrix should be used. The switch S1 (a) (b) is external to the board and may be mounted at any convenient point in the receiver. It may be necessary to use screened wire for the input and output connections to the Veroboard and to the switch, the braiding of the wire being connected to the receiver chassis. ■

WORLD'S MOST POWERFUL VALVE



The world's most powerful radio transmitting valve is this two million-watt output super power tetrode pictured here in a test amplifier at the EIMAC Division of Varian Associates (San Carlos, Calif.). Generacting more than two times the power of all the AM, FM and television stations in New York City, the 175-pound valve was developed for use in high-power transmitters in medium- and high-frequency broadcast service and for industrial and scientific uses as a 1,000-ampere, 60-kV switch. Costing $20,000 each, the new two-megawatt valves permit a single stage amplifier to reach an output power level of 2,500 kW, 100 percent modulated – five times more powerful than any previous single amplifier ever built.

25 YEARS OLD AND STILL GOING STRONG

Observant readers will already probably have noticed that this issue of THE RADIO CONSTRUCTOR is Volume 25 No. 12. This means that the magazine has completed 25 years of publication.

Looking back over the years to our first issue, 28 small pages, we recall the hopes, fears and excitement that went into its production. Today, one of the few national magazines in this country published independently of the large publishing groups, we draw considerable satisfaction from our progress in this highly competitive field.

This progress has largely been due to the loyalty of our readers, many of whom look upon the "Constructor" with an almost proprietorial interest. We feel that this loyalty, which we greatly value, is in no small measure due to our policy of publishing, to the best of our ability, sound worthwhile articles of practical interest and giving good value for money.

As time goes on interests change, and a far greater proportion of our subject matter now deals with electronics over a broader field, but radio has not, nor will it be, neglected.

To commence our 26th year of publication, our Technical Editor, J. R. Davies, has especially designed the "Jubilee" 8 watt amplifier, to feature in our August and September issues; to be followed by a special October issue.

We have many exciting plans for the future, and the magazine will continue to evolve in the same practical friendly manner as it has done in the past.

If you are an established reader thank you for your support, and if our magazine is new to you we hope that you too will find pleasure and satisfaction in our pages and join the ranks of our regular readers.

NEW ELECTRONICS INSTRUMENT PLANT

Venner have just announced the opening, at their New Malden Works, of a new 5,000 sq.ft. Assembly and Test Unit for their range of electronic measuring instruments. This unit has been specially built and equipped to cater for a significant increase in instrument production, an increase which has become necessary in order to meet the ever growing demand for existing types and to handle the widening range of instruments now being developed.

Already recognised as one of the leading manufacturers of digital counting and timing instruments, Venner are now breaking into the communications test gear markets with their new ranges of p.c.m. and data line test instruments.

Commenting on this expansion, Mr. Derek Ashby, Venner's General Sales Manager, said "Our instrument sales in 1971 was an all-time record despite the apparent recession in the electronic industry, and our new assembly and test facilities are capable of producing over £1,000,000 worth of equipment each year".

. . . COMMENT

ANOTHER NEW BRANCH FOR HENRY'S RADIO LTD

Ready for opening early July will be the new Electronics Centre for Henry's Radio Ltd. at 404-406, Edgware Road, London, W.2.

This large 32ft. frontage shop is the latest Henry's branch to be opened and will contain a comprehensive range of every conceivable item of electronic components – plus audio and test gear all offered at highly competitive prices.

In addition to the new branch Henry's Radio Ltd. have centres at 354/356 Edgware Road for Hi Fi and Tape Equipment, 309 Edgware Road for Disco, PA and Lighting equipment and 303 Edgware Road, London, W.2. deals with all mail orders, industrial sales and also stocks many clearance bargains at specially reduced prices.

IN BRIEF

● The English Electric Valve Co. Ltd., as well as THE RADIO CONSTRUCTOR, has also recently completed 25 years existence. Formed when The English Electric Co. Ltd., bought the controlling interest in Marconi's Wireless Telegraph Co. Ltd., the Company has expanded from 150 employees to more than 2,000. More than half the annual turnover of £10 million is exported.

● A group for the furtherance of FM operation in the VHF/UHF spectrum, and having the orderly growth of FM in the UK as one of its objectives, has recently been formed.

The group is known as U.K. FM Group, details from the Hon. Secretary, K. H. Kanalz G5AGX, Flat 6, Marzena Court, Whitton Dene, Hounslow, Middlesex.

● Advance warning of potentially dangerous rolling conditions, which could lead to a vessel's capsize, can be given by a roll period indicator a new electronic instrument introduced by Recording Designs (EMI) Ltd., of Camberley, Surrey.

● The Barking Radio Society will be operating an Exhibition Station at the Dagenham Town Show on Saturday and Sunday 8th and 9th July. All bands from Top Band through to 70 Centimetres.

Also on Sunday 9th July, the Cornish Radio Amateur Club is holding its annual mobile rally at the Truro Rugby Club.

● Lonsdale Technical's Printed Circuit company at Waterlooville, Hampshire, has been reconstituted as a separate company trading as Lonsdale Technical (Circuits) Ltd. They produce conventional and PTH circuit boards by modern plating techniques.

● An Honorary Fellowship of the Royal Television Society has been awarded to Dr. Gerhard Lubszynski. He was an original member of Sir Isaac Schonberg's pioneering team at E.M.I., and is a world authority on camera tubes and the author of 94 Patents in that field.

● Readers in South London who wish to purchase components locally, can do so from The Radio Shack, 161 St. John's Hill, Battersea. Shop hours are from 9am to 8pm Monday to Saturday.

● Vero Electronics announce what must be one of the largest export orders for printed circuit boards ever received by a U.K. company. The order, worth $150,000 and won in fierce competition with American companies, is for the supply of standard universal wiring boards of their D.I.P. Board and Finger Board types.

● A new Vidor 14.74 volt mercury-zinc battery designed for radio microphone use has been developed by Crompton Parkinson Ltd., of Northampton. The battery consists of eleven KRK42 mercury-zinc round cells connected in series.

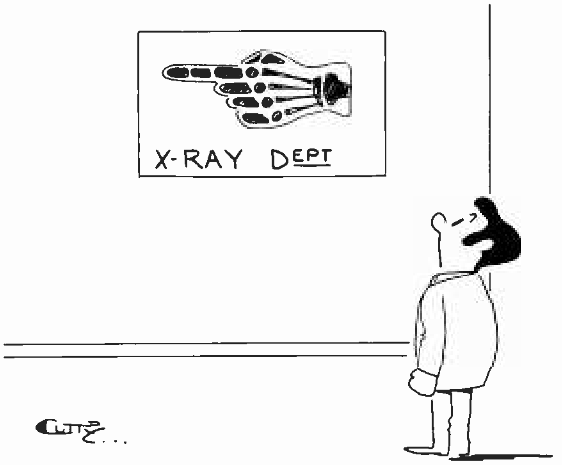
ITA TRANSMITTERS – A POCKET GUIDE

A new edition of the fold-out publication "ITA Transmitters – A Pocket Guide" has just been published by the ITA to assist television suppliers, aerial erectors and others concerned with television.

The Pocket Guide provides essential technical details of the ITA network of 47 VHF (Band III) transmitting stations and 149 existing or planned UHF (Bands IV and V) stations.

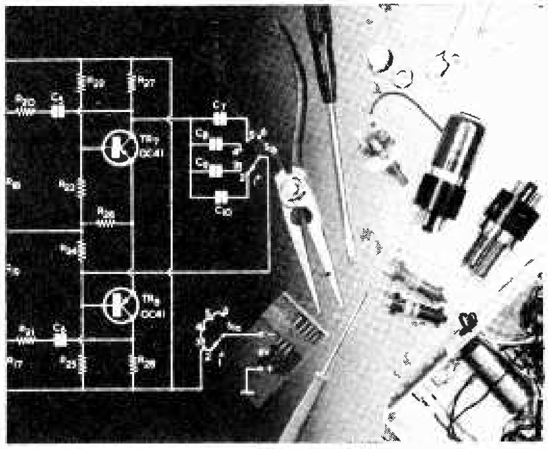
It includes details of channels, aerial polarization and recommended UHF aerial group, effective radiated power, aerial height above sea level, national grid references for 171 sites, programme company using each transmitter, reference information on channel frequencies, and a useful map. Where available, target dates are provided for those UHF stations not already in service, and an index to all stations is included.

Copies of the new Pocket Guide, which measures approximately 8in. by 3½in. when folded, are available on request from: ITA Engineering Information Service, 70 Brompton Road, London, S.W.3. 1EY.



ELECTRONIC EGG–TIMER

by G. A. FRENCH



WHAT CAN ALMOST BE REFERRED to as the 'classical' type of egg-timer consists of a scaled-down version of the hour-glass in which the passage of sand from one section to the other indicates the time required for the boiling of an egg. This type of timer is set up by turning it through 180° so that the lower section, full with sand, becomes uppermost. The timing period is at an end when all the sand has flown through from this uppermost section.

The egg-timer concept offers an interesting challenge to electronic design. Obviously, an electronic 'egg-timer' has applications other than that of timing the boiling of an egg, and it could be employed for any operation where it is desired to indicate the timing of a process. If the egg-timer analogue is to be followed through in its entirety, the electronic version should be capable of being set in operation at any time and should require no attention other than that of being initially started.

The device to be described in this article meets both these requirements. It employs a battery-operated circuit which is normally in the 'off' condition and the only control is a push-button, this being pressed to start the timing period. At the end of the period an electric bell sounds, after which the unit automatically turns itself off again.

THE CIRCUIT

If complete switching-off at the end of a timing period is to be achieved with certainty, it is necessary to employ mechanically operated switching contacts. A semiconductor device could be cut off to prevent a circuit from operating but it would still allow a small leakage current, even if only of the order of a few microamps, to flow. For a definite and positive switching-off action mechanically operated contacts are essential, and this argues the use of relays. Two simple relays are employed in the timing unit to be discussed. Their specifications are not particularly critical and a fairly wide variety of relay types can be used.

In the accompanying circuit diagram for the timing unit the two relays are depicted in the so-called 'detached' method of presentation. Each relay coil is shown as a rectangle, alongside which is a letter over a number. The letter is the identifying letter for the relay, whilst the number indicates the number of contact sets that the relay possesses. The contact sets may appear anywhere in the diagram and are shown in the position they take up when the relay is de-energised. As an example, the coil of relay X can be seen in the collector circuit of transistor TR2. The legend alongside the rectangle indicates that this relay has 2 contact sets. These contact sets, X1 and X2, appear elsewhere in the diagram, in the de-energised position.

As the circuit stands, no positive connection is made to battery B1, and no current is drawn from it. To start the timing cycle, push-button S1 is pressed. This causes capacitor C1 to be almost immediately charged to about 8.2 volts, this voltage being controlled by zener diode D1. At the same time, the positive supply potential is made available to the upper terminal of the coil of relay X by way of diode D2. As soon as C1 becomes charged, forward current flows from its positive plate via R4, D3 and D4 to the base of transistor TR1. This transistor becomes fully conductive and, in turn, makes TR2 similarly conductive. The voltage across the emitter and collector of TR2 is negligibly low and relay X energises. Its contact set X1 closes, causing the relay coil positive supply to be independent of the circuit provided by S1 and D2. This contact set also causes pilot lamp PL1 to be illuminated, thereby indicating that the circuit is ready to commence the timing cycle. At the same time, contact set X2 connects capacitor C2 across the 12 volt supply rails,causing C2 to become charged to the supply voltage.

The timing period commences when S1 is released. As soon as this occurs, capacitor C1 starts to discharge into R2 and R3 and the circuit given by R4, D3, D4 and the base-emitter junctions of TR1 and TR2. Diode D2 is now reverse-biased and plays no further part in circuit operation. After a period, the voltage across C1 falls below the level required to maintain forward current flow in D3, D4 and the base-emitter junctions of TR1 and TR2, with the result that TR2 becomes non-conductive. Relay X de-energises and its contact set X1 opens, extinguishing pilot lamp PL1. Contact set X2 changes over, connecting the coil of relay Y to the fully charged capacitor, C2. Current flows from C2 into the coil of relay Y, whereupon it energises and its contact set Y1 causes the electric bell to be connected to battery B2. The bell sounds until the charge remaining in C2 is insufficient to maintain relay Y energised. Relay Y de-energises and the circuit reverts to its original condition, with no connection made to battery B1.

A further timing period may be initiated at any time by pressing push-button S1 again. This will cause C1 to be charged once more and the cycle of operation to be repeated, terminating in the ringing of the electric bell.

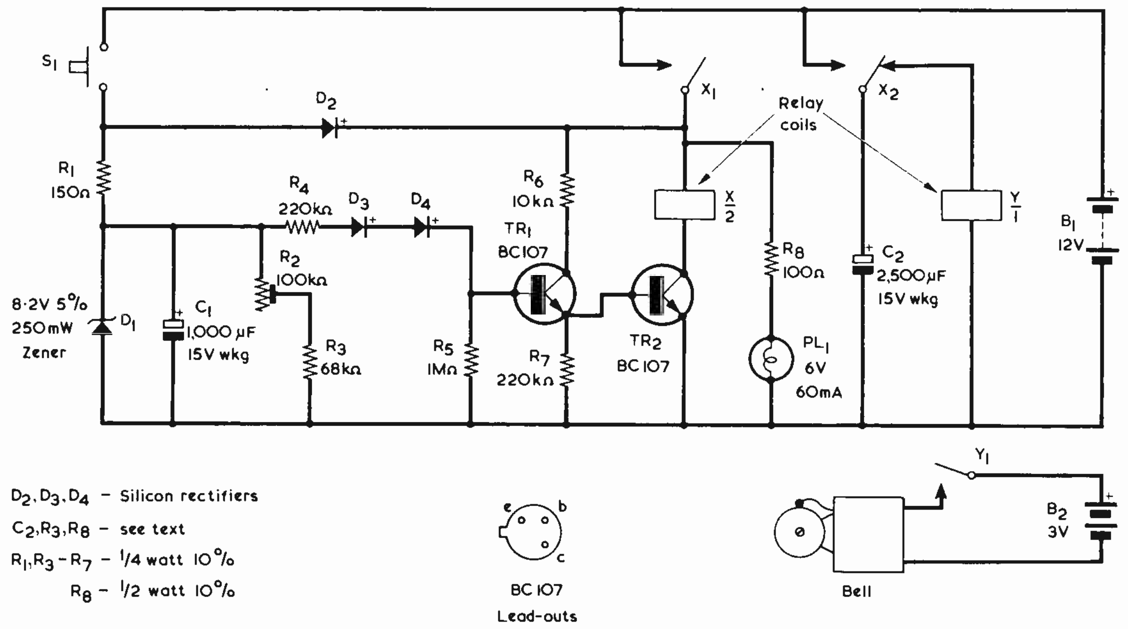
FURTHER POINTS

A few points concerned with circuit operation need to be discussed in more detail. Two transistors in tandem are employed to operate relay X, since the consequent high gain they provide enables the relay to energise with a relatively low current from capacitor C1. The use of two transistors also ensures that the fall in relay coil current before de-energising takes place is relatively swift, whereupon the length of the timing period is less dependent upon any changes in de-energising current in relay X which may take place. Mechanical performance is liable to cause the current at which relay de-energising takes place to vary with time, whereupon such variations could significantly affect the accuracy of the timing period if they were not taken into consideration. Silicon diodes D3 and D4 are included in the forward current supply to the base of TR1 to enable relay de-energising to occur when the voltage across C1 is equal to about 2.4 volts, this being the total forward voltage drop across the diodes and the base-emitter junctions of the transistors. Relay de-energising thus takes place when the decrease in voltage across C1 is still proceeding at a reasonably steep region in the exponential voltage-time discharge curve, a factor which further ensures that a relatively swift fall in relay coil energising current takes place. In practice, coil current commences to fall after 95% of the timing period, which would seem reasonable in a simple timing circuit of this nature. The reduction in coil energising current is not so abrupt as to necessitate the usual diode across the relay coil to prevent the formation of back-e.m.f. voltages on de-energising, and such a diode is not employed in the present circuit.

The length of the timing period depends upon the gain of the particular transistors employed in the TR1 and TR2 positions and the coil resistance and de-energising current of relay X. Because of these factors it may be necessary to vary the value of R3 to suit the particular transistors and relay employed. This procedure is carried out experimentally after the timer has been constructed. In the prototype circuit (in which the relays employed are discussed later) a value of 68kΩ in R3 provided a timing period of about 2¼ minutes when R2 inserted minimum resistance into circuit and a timing period of about 4¾ minutes when R2 inserted maximum resistance.

Zener diode D1 ensures that the voltage appearing across C1 is reasonably constant when S1 is pressed, and it prevents falling battery voltage from seriously affecting the length of the timing period. The 12 volt battery should, preferably, be discarded when its voltage falls below 10 volts.

The current drawn from the 12 volt battery when S1 is pressed consists of the initial charging currents for C1 and C2, plus some 27mA in R1, 1.2mA in R6, the current flowing in the coil of relay X, and 60mA in R8 and PL1. When the button is released, the current drawn is that flowing through R6, the relay coil and the pilot lamp circuit. The current falls to zero when the timing period ends. Relay Y draws no current directly from the battery since it is energised by the charge in C2. It is desirable to use a separate 3 volt battery for the bell circuit. Electric bells tend to draw a relatively heavy current and it would probably be necessary to insert series resistance if the bell were operated



The circuit of the electronic 'egg-timer'. By adjustments to the value of R3, this can be made to cover any period from less than 20 seconds to 10 minutes

from the 12 volt battery, with a consequent uneconomic demand on that battery.

It is necessary to have pilot lamp PL1 in circuit because this indicates that relay X has 'latched on' after S1 has been pressed. Should S1 be pressed and very quickly released the charge across C1 may not be sufficient to allow relay X to energise. If, however, S1 is held pressed until PL1 lights up, not only is the energising of the relay ensured but so also is the full charging of C1. Since the cold resistance of PL1 is much lower than its resistance when illuminated, the presence of series resistor R8 results in a very small but significant delay before the lamp becomes fully illuminated after contact set X1 closes. Thus, the operator of the timer presses S1 for the short period needed for PL1 to light up, and is then assured that the timer is in the correct condition for a timing period. To minimise battery drain PL1 needs to be a low-current type and the author employed a 6 volt 60mA m.e.s. type here, this being available from Home Radio under Cat. No. PL7. The Home Radio catalogue also lists a 6 volt 40mA m.e.s. bulb under Cat. No. PL5A. This could be used instead of the 60mA type if desired, with a consequent reduction in current consumption from the battery. With the 40mA bulb, R8 should be increased to 150Ω.

COMPONENTS

No great difficulties should be experienced in obtaining the components for the timer. The two transistors are a readily available standard silicon n.p.n. type. Diodes D2, D3 and D4 can be any small silicon rectifiers, such as the Lucas DD000. Zener diodes rated at 8.2 volts 5%, 250mW, are available in various constructions and makes, including the Mullard OAZ206. The resistors are standard components. Preset variable resistor R2 may be a skeleton potentiometer. Both the capacitors should be good quality modern types.

The relays used by the author were P.O. 3000 types having 500Ω coils and the contact sets indicated. P.O. 3000 relays having 500Ω coils and 3 changeover contact sets are available from G. W. Smith & Co. (Radio) Ltd., 3 Lisle Street, London W.C.2, and these could be employed with no connections made to the unused contacts. G. W. Smith & Co. will also make up relays to customer's specification as, similarly, will L. Wilkinson (Croydon) Ltd., Longley House, Longley Road, West Croydon, Surrey. As was mentioned earlier, however, the relays are not at all critical and any relays having the requisite contact sets, a coil resistance of 400Ω or more and the ability to energise reliably at 9 volts may be used in the circuit.

In the prototype, the 500Ω relay employed for relay Y energised for about 4 seconds after the completion of the timing period, this being more than adequate for the ringing of the electric bell to attract attention. The bell-ringing period will be increased if a relay having a coil resistance higher than 500Ω and the same energising voltage is employed. Alternatively, the value of C2 could be reduced for the same bell-ringing period with such a relay.

The 12 volt battery, B1, can be made up with two 6 volt batteries, or four 3 volt batteries, in series as desired. If extensive use is to be made of the timer, four 3 volt cycle lamp batteries (Ever Ready type 800) could be used. A 3 volt cycle lamp battery would be a good choice, also, for B2.

CONSTRUCTION

The method of construction is left to individual choice. Probably the best approach would consist of housing all the parts in a small wooden case with S1 and PL1 on the front panel. The bell could be mounted on the side of the box. Component layout is in no way critical.

When wiring up, R3 and C2 should be connected into circuit temporarily only, as they may need to be changed. When wiring is completed the circuit should be given several test runs to ensure that it functions correctly. If C1 has been in store for a considerable period these test runs will also enable it to 'form' and settle down to its final value.

The length of the timing periods given with R2 first inserting zero resistance and then inserting full resistance should next be measured. If the circuit is to be employed as an egg-timer, the final timing period required will probably be, say, 3½ minutes. If the extreme settings of R2 result in periods on either side of 3½ minutes then R2 may be adjusted until this period is provided. Should it be found that the extreme settings of R2 result in periods that are both shorter than 3½ minutes the value of R3 should be increased, as required; whilst if the test periods are both longer than 3½ minutes the value of R3 should be reduced.

The timer can be used for other applications, and by suitable adjustments in the value of R3 may be made to cover any period from less than 20 seconds to 10 minutes.

The final process consists of checking the length of time during which relay Y energises at the end of the timing period. If this length of time is too long the value of C2 may be reduced. An insensitive relay may result in too short a length of time during which the bell rings, whereupon the value of C2 needs to be increased. Judging from the writer's experience with the prototype, however, it is doubtful whether an increase in the value of this capacitor will be required. ■

NOTES ON SEMICONDUCTORS

Further Notes-8 by P. WILLIAMS

KEEP IT SIMPLE

The current gain of silicon transistors can be determined with the aid of a circuit comprising two fixed resistors, a variable resistor and a voltmeter

THE CIRCUIT TO BE DESCRIBED THIS MONTH IS ALMOST sinful in its simplicity. It allows the measurement of current gain for a silicon transistor though under a somewhat restricted range of operating conditions.

EQUIPMENT NEEDED

The equipment needed for this transistor tester is:

(i) a voltage supply capable of supplying a few mA, voltage not critical though 5 to 6V is quite convenient.
(ii) a fixed resistor, typically 1kΩ.
(iii) a resistor variable from about 10kΩ to 500kΩ
(iv) a sensitive voltmeter, calibration unimportant.

Thus the cost can be very low if there is such a meter available – such a one as might be used for detecting unbalance of a bridge circuit.

The procedure is as follows. Start with R1 of Fig. 1 at its maximum value and then reduce until the meter *just* reads zero. At this point the collector voltage must have fallen to equal the base voltage. This condition for the large majority of silicon transistors still leaves the transistor with a current gain almost equal to its value at the more usual voltages of, say, 2 to 20V. This is illustrated in Fig. 2 with typical output characteristics where the spacing between the characteristics has barely started to narrow at Vce = 0.5V, i.e. where Vce = Vbe.

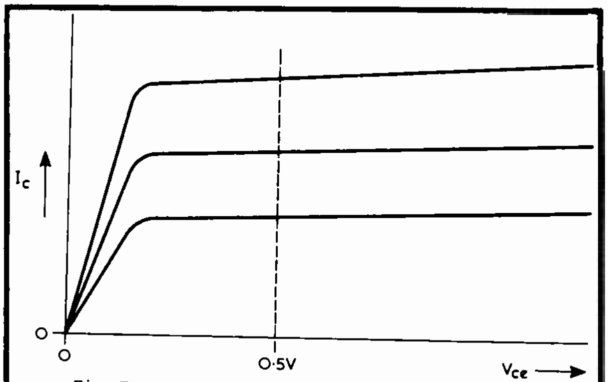


Fig. 2. A family of collector current – collector voltage curves. Each corresponds to a different base current

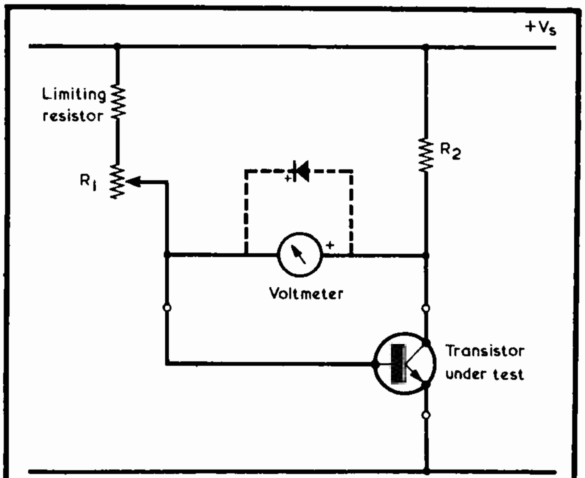


Fig. 1. The transistor gain tester. R1 is calibrated in terms of current gain

To protect the meter against excessive current under fault conditions or where the collector current falls to zero for some reason, the meter should be switched to a higher voltage range until balance is almost reached. Alternatively any diode, either silicon or germanium, may be placed in parallel with the meter as shown dotted in Fig. 1. This limits the meter p.d. to a few hundred millivolts even under fault conditions.

The variable resistor R1 may be a calibrated potentiometer, preferably with a logarithmic law to prevent cramping of the scale by allowing a change of current gain of a given percentage to be as clear at low gains as at high gains. A limiting series resistor of say 1kΩ in the base prevents excessive current. An interesting modification is to replace R1 by a set of switched resistors of preferred values between say 10kΩ and 470kΩ. This covers the gain range from 10 to 470, since at the balance point the voltages across R1 and R2 must be equal, i.e. Ib R1 = Ic R2.

But Ic/Ib = hFE = R1/R2. Hence (ignoring the base current limiting resistor) the current gain equals the value of R1 in kΩ at which balance is achieved – provided R2 = 1kΩ. (The calibration of R1 at low gain settings should take up the value of the series limiting resistor). If switched fixed resistors are used, no particular resistor will give exact balance but switching between one resistor and the next will cause the meter reading to change from positive to negative as balance is passed. Then the appropriate current gain can be estimated from these two values.

It must be noted that the current gain is measured at a fixed current of about 5mA. Other values of resistance and/or supply voltage may be used if testing at other currents is required. One snag of the switching method is that the meter reading jumps between switch positions. It remains the only method if the experimenter has no means of calibrating the variable resistor. While readings can only be made at 20% intervals using standard value resistors, this is good enough for most purposes. It may be worth while noting that the current gain at collector voltages up to 10V is likely to increase by less than this amount. ■

Trade News . . .

BOURNS POTENTIOMETERS NOW ALSO MADE IN SCOTLAND

The Bourns Model 3700 and 3707 wirewound precision potentiometers are now made at their plant in Scotland which backed up by their extensive production facilities in the U.S.A. supports their claim to be able to provide customers with two sources of supply for every popular model in their range. These 10-turn potentiometers are ½in. in diameter, bushing mount with a 3/32in. shaft.

Brief Specifications:

	3700	**3707**
Resistance Range:	50Ω to 100KΩ	100Ω to 100KΩ
Resistance Tolerance:	± 5%	± 5%
Independent Linearity:	± 0.5% max.	± 1.0%
Effective Electrical Angle:	3600°(+20°–0°)	3600°(+10° –5°)
Power ratings:	1.0 watt @ 70°C 0 watt @ 125°C	1.0 watt @ 40°C 0 watt @ 105°C

HIGH QUALITY MINIATURE LOUDSPEAKERS

A high quality miniature moving coil loudspeaker with a frequency range of up to 5KHz is now available on the U.K. market from B. & Y. (Gates) Electronic Developments Limited, 26 Uxbridge Road, London W5 2BP.

The Company, members of the Interby Group, has already received full approval for the unit which is in use in Government Departments.

Mr. Anthony Young, Managing Director of B. & Y. (Gates) said that the loudpseaker had been designed and developed for all-purpose uses and was ideally suited for pocket pageing systems.

It has a power output of 0.1 watt and an impedance of 15 ohms. Measuring 1.5in. diameter × 0.65in. depth, the speaker can be supplied ex stock. Full technical specifications together with a typical frequency response graph may be obtained from the Company on request.

NEW FEATURES FOR AVO'S MULTIMINOR

Avo introduce the new pocket-size Multiminor Mark 5 which is designed to replace the popular Avo Multiminor Mark 4. It is similar in appearance and identical in size, but in this new model modern technology provides new improved features. Serviceability is simplified and reliability is increased by the use of thick film techniques.

The front panel and case of the Multiminor Mark 5 are black mouldings and the new range selector switch is in contrasting silver grey, with the ranges clearly marked with both conventional and international symbols.

The specification is unchanged, the sensitivity of 10,000Ω/V and the accuracy of 2.25% on d.c. voltage and current and 2.75% on a.c. voltage ranges ensure that this compact, lightweight instrument is ideal for use by the radio and television service engineer.

Provision is made for the measurement of d.c. voltage between 100mV and 1000V, a.c. voltage between 10V and 1000V, and d.c. current between 0.1mA and 1A. Two basic scales are provided each approximately 70mm (2¾in.) in length. The inner is used for resistance measurements up to 20mΩ and scaled 0 – 2kΩ, the outer scale, calibrated 0 – 25 and 0 – 100, is used for all a.c./d.c. voltage and d.c. current measurements.

The Mark 5 is supplied in an attractive black carrying case.

USING THE U.J.T.

By

M. HARDING

This article discusses the basic operation of the unijunction transistor and its employment as a relaxation oscillator. It then describes a practical square wave generator which incorporates a unijunction transistor, and which has a wide frequency range and excellent output waveform.

THE UNIJUNCTION TRANSISTOR (U.J.T.) HAS BEEN around now for quite some time, but not a great deal has been said about it. It is an interesting device with a primary application in relaxation oscillator and timing circuits. In order to become intelligent users of any semiconductor device it is necessary to acquire at least a brief insight into the way in which the device functions. Therefore the next section outlines the way in which the unijunction transistor works, and this is followed by a practical application in which a unijunction transistor is employed in a wide range square wave generator.

BASIC CHARACTERISTICS

The symbol for the U.J.T. is shown in Fig. 1(a) and the basic internal structure of the early devices is shown in Fig. 1(b).

Essentially, the device consists of a bar of n type silicon with non-rectifying, or ohmic contacts, attached to each end. These contacts are called 'base 1' and 'base 2'. Normally base 2 is made positive with respect to base 1 and a current flows through the base material, which forms a linear resistance. Typically, this resistance lies between 5 and 10kΩ. In addition to the two base contacts a third contact is made on the bar near the base 1 contact. This time, however, the contact is a rectifying contact and is in the form of a small piece of p type silicon. The contact is called the emitter and it will be fairly clear to see that if a potential of some 9 or 10 volts is applied between base 2 and base 1, then the bar will behave as a potential divider with respect to this emitter connection. Indeed, the proportion of interbase voltage which appears between base 1 and the emitter junction effectively reverse biases the emitter diode. It is this proportion which represents one of the most important device characteristics and it is called the 'intrinsic stand-off ratio'.

The most interesting characteristic of the U.J.T. is seen if we explore its behaviour when the emitter is made positive with respect to base 1. This can best be visualised by plotting a graph of emitter voltage against emitter current as seen in Fig. 2.

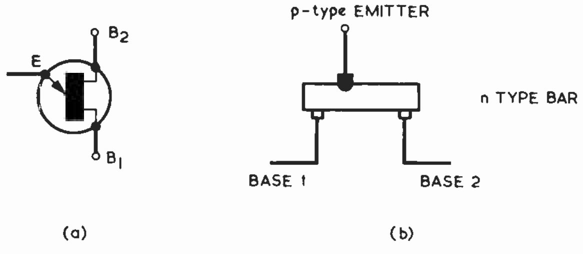


Fig. 1 (a). Circuit symbol for the unijunction transistor

(b). The basic construction of the transistor

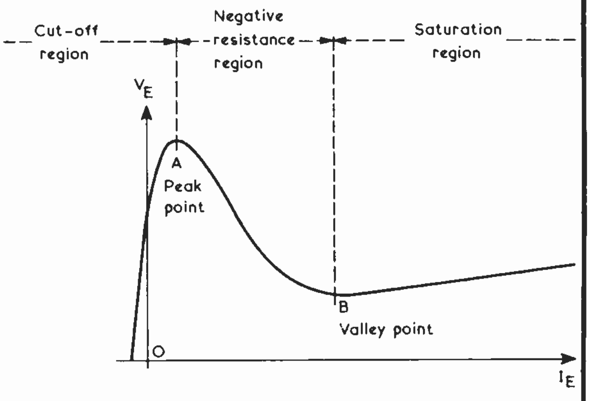


Fig. 2. Emitter voltage – emitter current characteristic of the unijunction transistor

Initially, as the emitter voltage rises the emitter current is very small indeed, usually just a few microamps. When the emitter voltage exceeds the reverse bias, point A is reached and the emitter injects current into the base. The point A is another important device parameter: it is called the 'peak point emitter voltage' and is denoted by Vp. The current flows in the direction of the applied electric field towards base 1 and thereby causes a decrease in the resistivity of that region. The consequence of this is that as the emitter current rises the emitter voltage drops and a region of negative resistance results. Eventually at point B, called the 'valley point', saturation sets in and a positive resistance characteristic exists once again.

It should be noted that in present-day devices a cube structure has been adopted in the manufacture of the device instead of the bar configuration, but the basic principle of operation remains unchanged.

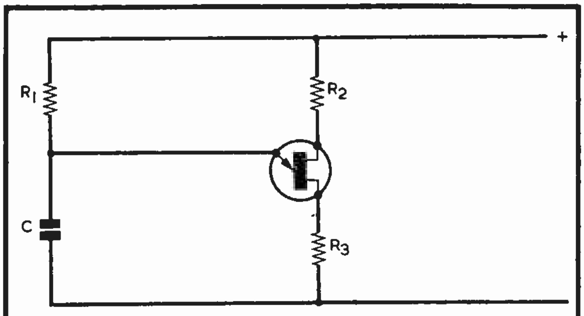


Fig. 3. A unijunction transistor relaxation oscillator. This produces short duration positive-going pulses at the upper end of R3

RELAXATION OSCILLATOR

The simplest circuit using a U.J.T. is shown in Fig. 3. This basic circuit produces an exponential sawtooth across the capacitor and a short duration positive-going pulse across the base 1 resistor R3. The way in which the circuit functions is quite simple to see. The U.J.T. is initially cut off and so the capacitor C charges through R1 until the emitter potential reaches the peak point value. The U.J.T. then fires, discharging the capacitor through the emitter diode. The current is limited by R3 and the discharge continues until the capacitor current reaches the valley point emitter current value. At this point the U.J.T. abruptly cuts off and the whole cycle repeats.

With regard to practical component values, R2 is usually 680Ω with a 9V supply and is included to help stabilize the emitter peak point voltage against temperature effects. R3 is not critical and a value of 120Ω is common. The period of oscillation is, of course, fixed by the combination of R1 and C. A lower limit to the value of R1 is set by the fact that the load line drawn on the Ve-Ie characteristic must intersect the region of negative resistance. A minimum value of 10kΩ is typical. The maximum value of R1 is determined by the emitter drive requirements and 250kΩ would be a safe maximum for devices in common use. An upper limit for the capacitor value would typically be 10μF in order to limit the amount of energy dissipated in the emitter diode during the discharge phase of the cycle.

Using the maximum values of R1 and C just indicated and by employing the popular U.J.T. type 2N2646, one will obtain a short positive pulse, produced across R3, about every 3 seconds. With a capacitor value of 1000pF and R1 around 10kΩ, an output pulse repetition frequency of some 100kHz would be produced.

It will be clear from the above discussion that this simple circuit could form the basis of a number of interesting designs. If R1 is made a variable resistor in series with a fixed resistor, and various values of C are switched into circuit, then we have a variable wide frequency range source of positive trigger pulses. We will now consider how this circuit may be used as the basis of a wide frequency range square wave generator.

PRACTICAL CIRCUIT

As many readers will know, square waves are very useful for checking the performance of an audio amplifier in conjunction with an oscilloscope. Indeed a square wave generator which can have its frequency continuously adjusted constitutes a useful addition to any home laboratory.

Fig. 4 shows the basic U.J.T. relaxation oscillator of Fig. 3 used to trigger a conventional divide-by-two bistable via an inverting stage. It will be seen at once that the fixed resistance of Fig. 3 has been replaced by a variable resistor in series with a fixed resistor. Four capacitor values may be switched into circuit by S1(a) which, together with VR1, enables the frequency to be continuously adjusted between upper limits determined by the value of the fixed resistor and lower limits determined by the maximum value of the potentiometer.

The positive-going pulse from R3 is coupled via C5 to the base of TR1 which is biased into its active region by R4. On each positive pulse TR1 conducts sharply and passes a negative-going pulse into the steering diodes D1 and D2. Initially the bistable, which is made up of transistors TR2 and TR3, takes up some arbitrary state. Either TR2 will be on and TR3 off or vice versa. The steering diodes D1 and D2 effectively route the negative-going pulse from TR1 to the base of the transistor that is on and flips the bistable into its complementary state, in which it remains until the next negative-going pulse arrives from TR1. The result is that the bistable changes state once for every pulse produced by the U.J.T. and in consequence anti-phase square wave outputs are available from the collectors of TR2 and TR3.

The table shows the frequency ranges obtained with the prototype. It should be noted that the frequencies listed refer to the output from the bistable which is, of course, dividing the pulse repetition frequency of the U.J.T. relaxation oscillator by 2.

In Fig. 4 the collector of TR3 is shown as being directly coupled to the output socket. This arrangement was used in the prototype in order to maintain a good

TABLE

Square wave generator frequency ranges for different values of C (C1 – C4 in Fig. 4)

Capacitor	*Frequency Range*
1μF	2Hz – 55Hz
0.1μF	20Hz – 550Hz
0.01μF	200Hz – 5.5kHz
0.001μF	2kHz – 55kHz

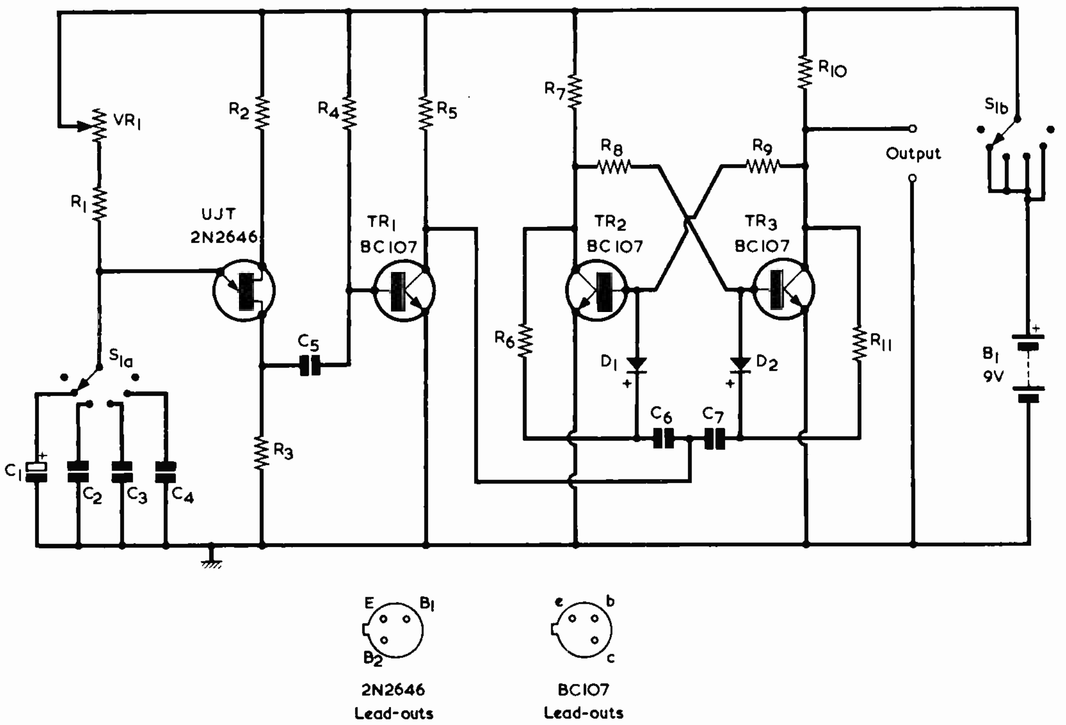


Fig. 4. A practical square wave generator incoporating a unijunction transistor relaxation oscillator for frequency control

COMPONENTS

Resistors
(All fixed values ⅛ watt 10%)

R1	10kΩ
R2	680Ω
R3	220Ω
R4	1MΩ
R5	5.6kΩ
R6	15kΩ
R7	1kΩ
R8	5.6kΩ
R9	5.6kΩ
R10	1kΩ
R11	15kΩ
VR1	250kΩ potentiometer, linear

Capacitors

C1	1μF electrolytic, 40 V. Wkg., Mullard miniature
C2	0.1μF polyester
C3	0.01μF polyester
C4	0.001μF polyester
C5	0.001μF plastic foil
C6	0.001μF plastic foil
C7	0.001μF plastic foil

Semiconductors

U.J.T.	2N2646
TR1	BC107
TR2	BC107
TR3	BC107
D1	OA91
D2	OA91

Switch

S1	2-pole 6-way, miniature rotary

Battery

B1	9-volt battery type PP3 (Ever Ready)

Miscellaneous
2 pointer knobs
2 wander plug sockets
Connectors for B1
Veroboard, 0.1in. matrix (see Fig. 5)
18 s.w.g. aluminium sheet (see Fig. 6)
4 small grommets

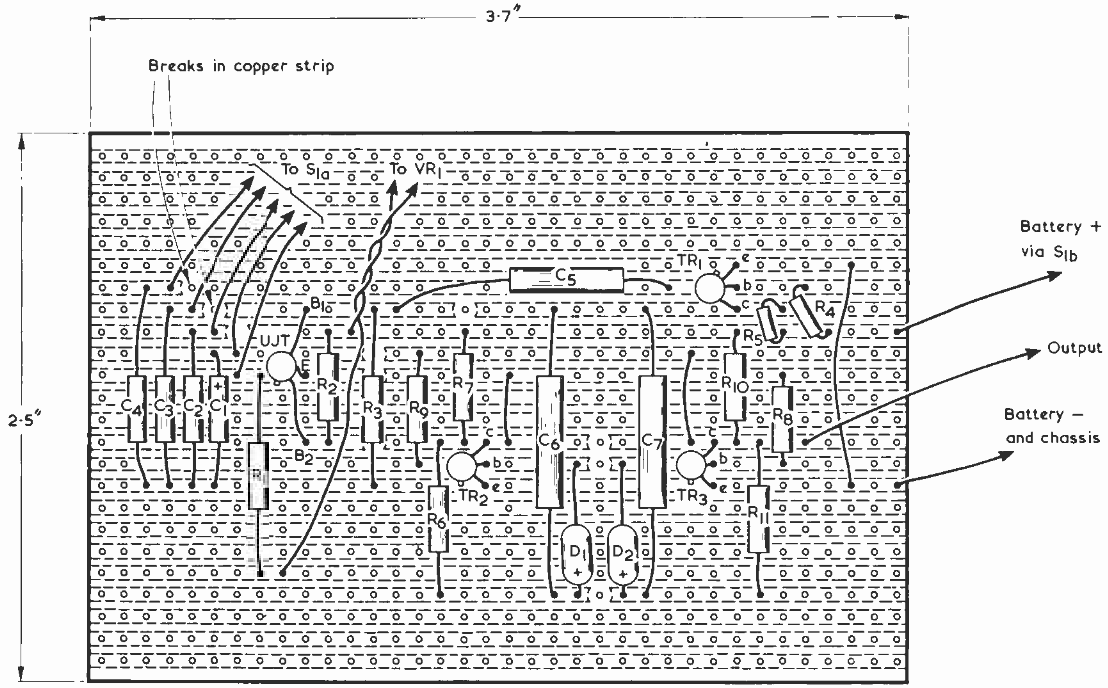


Fig. 5. Wiring up the components on the Veroboard. This view is of the component side of the board, the copper strips being underneath. Breaks in the strips are made where indicated

response down to the lowest frequencies. However, for many purposes d.c. isolation from the collector of TR3 would be desirable and an output coupling capacitor of 100μF would give acceptable results in most applications.

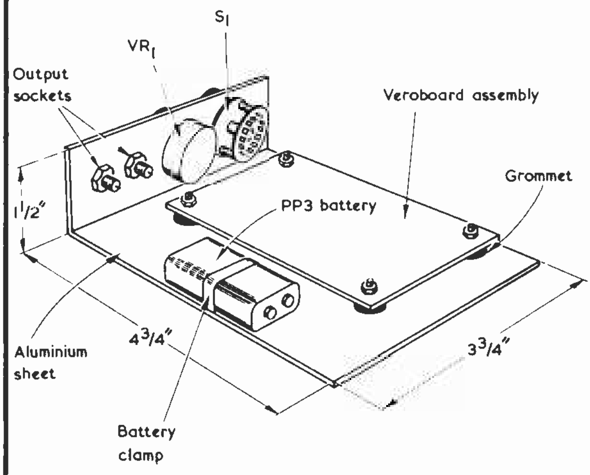


Fig. 6. The Veroboard and the panel components for the square wave generator are fitted on a small aluminium chassis as shown here

Although not employed in the prototype, a 250μF 10 V.Wkg. electrolytic capacitor could be added across the supply lines. This capacitor could improve performance when the internal impedance of the battery increases with age.

It will be seen that S1(a)(b) is a 6-way component. The four central positions select the frequency ranges by way of S1(a), whilst the two outside positions cause the generator to be switched off at S1(b).

The current consumption from the 9V battery is a nominal 12mA.

CONSTRUCTION

The layout of the generator is in no way critical and the original was wired up on a piece of Veroboard, with copper strips, measuring 3.7 by 2.5in. The Veroboard had a 0.1in. matrix. The layout details of the original are shown in Fig. 5.

Great care has to be taken when soldering on this fine matrix to ensure that the solder does not run across adjacent copper strips. The use of 22 s.w.g. solder and a soldering iron with a 2mm. bit has a lot to commend it.

The board was mounted on an aluminium plate using 0.5in. 6 B.A. bolts. The board was spaced away from the aluminium plate by small grommets as shown in Fig. 6. A small aluminium front panel carried the frequency controls together with the output sockets.

The unit as a whole forms a useful wide frequency range square wave generator module. ■

Q S X

By
FRANK A. BALDWIN

(All Times GMT)

In the last QSX (May issue, page 607) mention was made of Radio Curom, Netherlands Antilles, broadcasting on a measured frequency of **20778**, reception here in the U.K. In this issue, we report reception of Radio Curom on **17513** by a BADX (British Association of Dx'ers) operator from 1500 through to 0400 on various days and times within the GMT limits mentioned. The frequency stated is subject to some variation from day to day.

However, there is some doubt about these transmissions and the theory has been put forward in 'Bandspread', the journal of BADX, that these programmes were those of Radio Curom and that they did, in fact, originate in Willemstad – their transmission on PTP frequencies being due to the whim of an engineer prefering such programmes instead of a marker or test tape when keeping the channel open – I am inclined to agree with this conclusion.

● UNID.

In dyed-in-the-wool S.W.L. language, this sub-head simply signifies 'unidentified', its appearance usually causing many operators to tune to the particular frequency mentioned, switch in the preselector, and to sharpen up the selectivity, the pencil and the ears. What are the top-flight operators trying to identify this time? Well, at the time of writing, attention is centred on two channels in the 60 metre band – details herewith.

On a measured frequency of **4968** we have logged a weak transmission in the Arabic language on several occasions during the time period 1930 to 2100. Now **4968** is an old channel of Radio Kuwait and the question is – is this Kuwait back on the channel as of yore? It seems the most likely answer.

The second unid. is on **4985** where we heard a weak signal in an unknown language from 1930 through to 2030, the signal being heard on several different occasions. After a landline contact, two top-flight SWL's, Alan B. Thompson of Neath, and Glyn H. Morgan of Tredegar, brought themselves into action and suggested the possible answers after having logged these transmissions.

In the second case, the probable answer is that the unknown language is Malgache and that, after hearing the news in French at 2030, the transmission emanates from Radio Tananarive, this being a channel once used by this station in the past.

Can you, the reader, confirm or deny?

● MYSTERY SOLVED – AGAIN

In the last QSX, under the Mystery Solved sub-head, information was given on the **9020** transmission of Radio Teheran reported by B. Walsh of Romford and also heard by us. It would appear that we have to solve the mystery once more, for it appears that Radio Teheran is a confirmed wanderer, being logged by us on a measured **9004** around 2025 recently. According to BADX, this station has sojourned briefly on **7038**, **9020V** (V = varies) **12165** and **12176**. Just where it will be by the time these lines appear in print is anyone's guess!

● LATIN AMERICA

The LA's have been coming through quite well of late, two short sessions providing the following results:

4790	**0240**	HCVP2 Sistema de Emisora Atalaya, Guayaquil, Ecuador, with prolonged discussion in Spanish, YVON in the background with sports commentary. Schedule from 0100 to 0455, 10kW (62.63m).
4832	**0530**	TIHB Radio Capital, San Jose, Costa Rica, with LA music and several identifications, terrific signal. Schedule is 24 hours, 1kW listed (62.09m).
4880	**0235**	Radio Universo, Barquisimeto, Venezuela, with typical Latin American music and songs. Schedule 1000 to 0400, 10kW (61.48m).
4980	**0228**	Ecos del Torbes, San Cristobal, Venezuela, LA songs and music. Schedule not published, 10kW (60.25m).
5010	**0545**	HIMI Radio Cristal, Santo Domingo, Dominican Republic with music and songs of Hispanic America. Schedule 24 hours, 1kW (59.88m).
5040	**0225**	YVQH Radio Maturin, Maturin, Venezuela, with identification followed by the inevitable LA music. Schedule 1000 to 0400, 1kW (59.55m)

● MOZAMBIQUE

Radio Clube Mozambique, in addition to being heard on **4762** (63.00m) as reported in "Short Wave News" this issue, has also been logged recently on **4855** (61.79m) with full station identification in Portuguese at 2100 and followed by a programme of dance music. The address is – P.O. Box 594, Lourenco Marques.

● YEMEN

Radio Sana'a has been reported on **5804** (51.68m) at 1930 with a talk in Arabic.

● SAUDI ARABIA

The Saudi Arabian Broadcasting Service is reported by BADX on **5987** (50.11m) at 2300 with identification in Arabic after a reading of the Koran, sign-off with National Anthem followed. Formerly on **6000**.

● CHINA

BADX reports Radio Peking on **9390** (31.93m) escaping the usual jamming when transmitting the Russian Service. Nothing unusual about the frequency or the programme content, the interest lies in the absence of jamming and more so in the fact that the tape was played forward and not backward – yes, backward – it is one of the mysteries of the short wave world. Why are the Russian programme tapes often run through in reverse?

● GAMBIA

Radio Gambia may be heard on **4820** (62.24m) at 2256 with identification and the news headlines in English and Madinka, sign-off at 2300 with the National Anthem.

● GUINEA

Radio Conakry can be heard on **4910** (61.48m) where it was logged by us at 1935 with a drama in an African dialect.

● CLANDESTINE

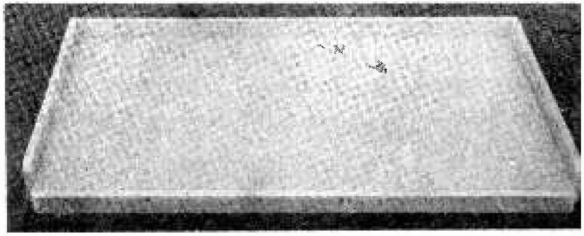
Radio Free Portugal is reported on **12010** (24.98m) at 1205 and also in parallel on **15480** (19.38m), both signals being jammed (as usual!).

A
Table-Top
Work
Bench

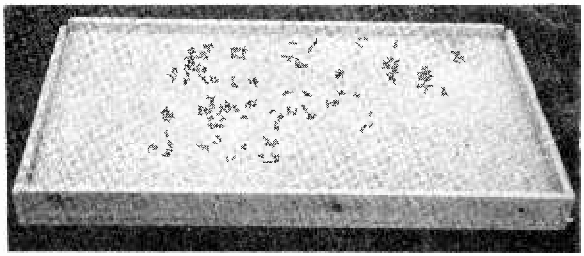
By

Arthur C. Gee, G2 UK

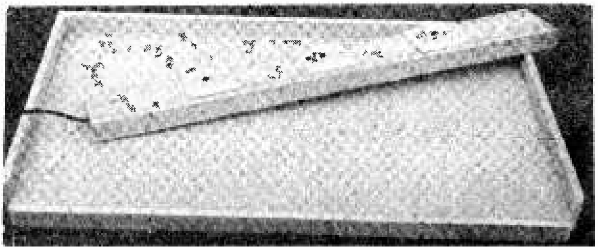
* * *



Chipboard working surface, with strip wood each side and along the rear edge

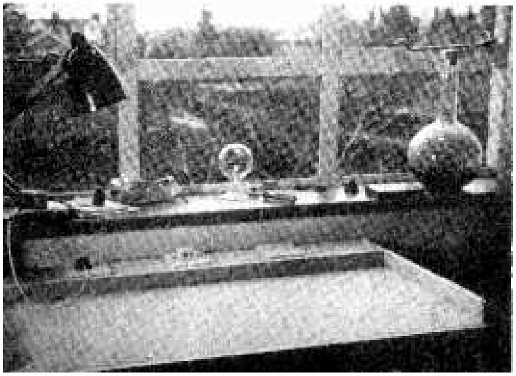


Under-surface of the bench. Strip wood side pieces are taken down all round to make a 'lip' to fit bench firmly on top of table, etc



The mains power supply points ready to be fitted to the bench

Completed work bench in position on top of a "Z" bed

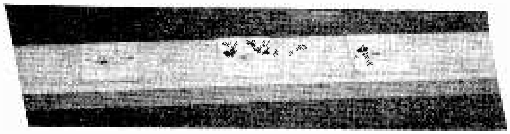


WITH THE MINIATURISATION OF RADIO AND electronic equipment these days, what with printed circuit boards, transistors and integrated circuits, the large 'shack-size' work bench is hardly necessary for the hobbyist radio constructor now.

The writer recently made up a small work bench to fit on top of a 'Z' bed, and this has served its purpose so well that he felt other readers might be interested in the idea. Made to fit an occasional table, or even to go over one end of the proverbial kitchen table, with this table-top bench one can leave everything out on the bench without having to clear it away and simply stow it away under the bed or on top of the wardrobe until one has time to do a bit more to the project under construction.

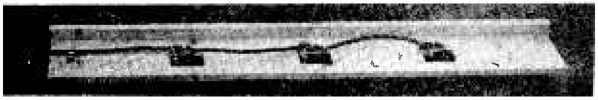
The work bench with power supply points fitted

A piece of chipboard, half an inch or so thick and cut to just cover the top of the table, has three side pieces of ¼ inch thick wood strip screwed to it as shown in the photos; one along the back and two down each side. These are wide enough to extend down around the edges of the table to just make a snug fit, so as to stop the work bench sliding off the top of the table. A fourth piece is fitted to the front edge of the work bench, but is only wide enough to complete the work bench edging in a downward direction. It prevents the work bench sliding backwards off the table top. In other words, do not have the back and sides type of 'edging' on the front of your work bench as well, as it will interfere considerably with easy working on the bench. The photographs make this point clear.



Wiring completed on the power point sockets

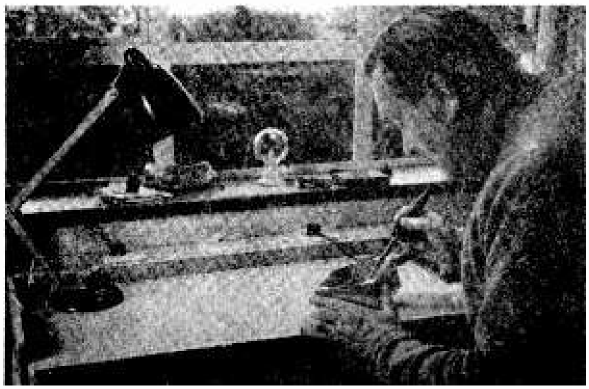
Along the back of the bench, three switched, three-pin mains sockets are fitted. These can be of the skirting board type as shown in the photos. This is a well worthwhile feature to incorporate, so that soldering iron, test equipment and the gear under construction can be easily plugged into the mains supply. These plugs are wired up in parallel with heavy duty flexible three-core electric cable, of sufficient length to go to the nearest power socket in the work room.



Three switched sockets are fitted to a batten cut to fit the rear edge of the bench

It had been intended to make an Anglepoise electric reading lamp a permanently fitted fixture to the work bench, but it was realised that to do so would make the bench much less easy to stow away when not in use. By keeping all tall items movable, it can more easily be stored away under the bed, chest of drawers, or other convenient out-of-the-way place, thereby pleasing the 'lady-of-the-house'!

The table-top work bench in use



There is little need to describe the construction of the bench further, since the photos illustrate well the various stages in its assembly. Since making up this little work bench, the writer has found that the old adage of 'building it on the kitchen table' to be a far less awkward procedure than hitherto. The new table-top work bench, which can be stowed away when not in use, is a far more acceptable item with the domestic side of the household than were his previous requests for a 'corner-of-the-kitchen-table-for-an-hour-or-so, please!'

WINDING TOROIDAL COILS

By

C. DICKSON

The unusual approach described here can ease the problem of winding these difficult coils.

OCCASIONALLY, THE HOME-CONSTRUCTOR FINDS IT necessary to wind a toroidal coil; that is, a coil which is wound on a core shaped like an American doughnut. Alternatively, he may find it necessary to wind a coil on a former which is so positioned on a chassis that it is impossible to wind the wire on directly. In either instance it is necessary to poke the wire through the centre of the toroidal core, or through the accessible section of the awkwardly placed former, and pull the whole length of the wire through for each turn until the coil is completed.

EASIER METHOD

If high coil voltages are not involved and a scramble-winding can be permitted, the process of winding a toroidal coil can be made considerably easier by taking advantage of the method to be described.

The explanation of this technique is best illustrated by a typical example. Let us say that we wish to scramble-wind 60 turns of wire on a toroidal core (or on a difficult-to-reach former). We first of all work out approximately the length of wire required for the coil by putting one turn on the core (or former) and measuring the length of wire involved. If the single turn requires 2in, then the total length of wire needed will, at a first approximation, be 60 times 2in., which works out at 120in. or 10ft. However, as the coil will be a scramble-winding some of the turns will rest on top of others and will require more than 2in. of wire. It would be best to allow a reasonable amount for this effect and, also, for the provision of lead-outs, and so it would be advisable to assume we will require an additional 25%, which means that we should allot 12½ft. of wire for the coil.

We next cut off 12½ft. of the wire to be used and double it back on itself, as in Fig. 1(a). This gives us a 6¼ft. length of double wire. We anchor the two 'open' ends of this double length of wire to the core and proceed to wind 30 turns of the double wire on to the core. There will be no greater difficulty in pulling the 'closed' end of the double wire through the core centre than there would be in putting a single wire through. Once the 30 turns have been wound on, the double wire at the end of the coil is secured to the core, and the coil has the appearance shown in Fig. 1(b).

Next, we cut the wire at the 'closed' end of the coil

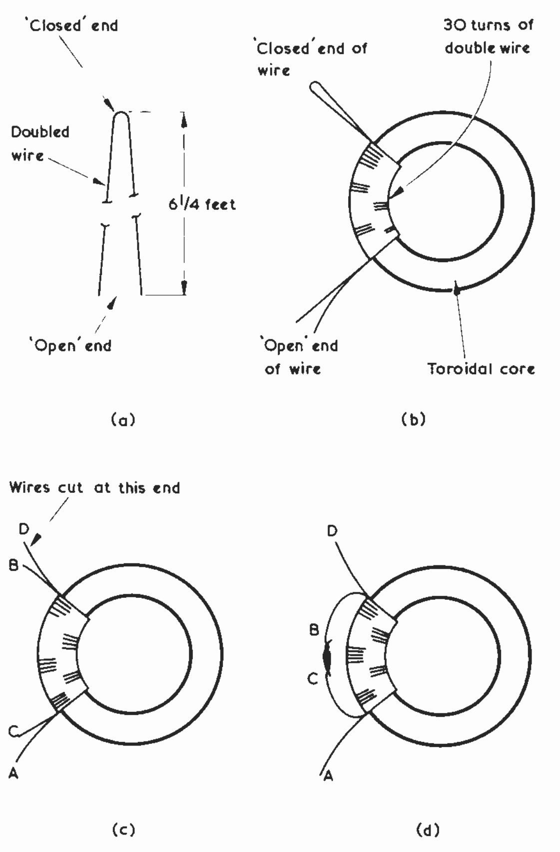


Fig. 1 (a). Folding the wire in two before winding it on the toroidal core

(b). The completed winding with the double wire

(c). The wires at the finish are cut and one of the wires is checked through for continuity

(d). When the correct wire ends are soldered together, a 60-turn coil results

whereupon there are two free wires at this end as well as two free wires at the start of the winding. We now have two 30-turn coils on the core and all we have to do, to obtain a 60-turn coil, is to connect them in series! Take up a continuity tester, such as a multi-testmeter switched to an ohms range, and connect it to one of the coil wires at the start of the winding. Then find the corresponding wire at the finish of the winding, and connect this to the other wire at the start. The two remaining free ends are now the connections to the 60-turn coil. The idea is illustrated in Figs. 1(c) and (d). In Fig. 1(c) the two wire ends with continuity between them are shown as A and B, the other two ends being C and D. Wire B is joined to wire C and the coil terminations are provided by A and D.

FURTHER DOUBLING

The approach can be taken a stage further by folding the original wire 4 times or 6 times. Fig. 2(a) shows the wire folded 4 times. Working from the previous example we now need to put only 15 turns of this 4-fold wire on the core to obtain an eventual 60-turn coil. The folded ends which are pushed through the core need to be twisted or soldered together to ensure that they can be handled easily.

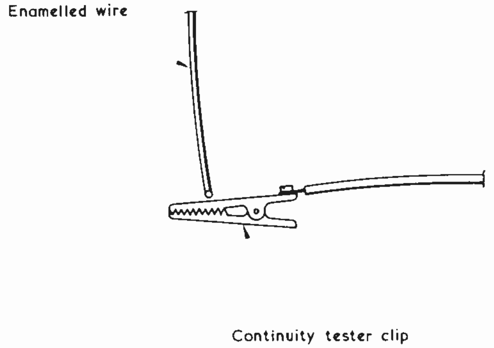


Fig. 3. It is usually possible to check an enamelled wire for continuity, without removing the enamel, in the manner shown here

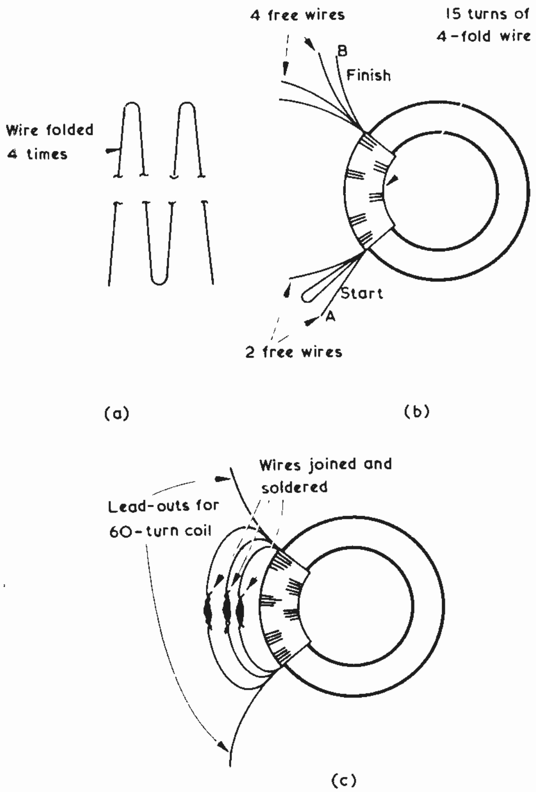


Fig. 2 (a). Folding the winding wire 4 times
(b). The finished winding, ready for continuity checks
(c). The final 60-turn coil

When the 15 turns of the 4-fold wire have been wound on, the final coil is produced in the following manner. First, as in Fig. 2(b), cut the wires at the finish of the winding so that there are now 4 free wires here. Connect the continuity tester to one of the free wires at the start of the winding and find the corresponding wire at the finish of the winding. See Fig. 2(b), where the wire ends are shown as A and B. Next, cut the joined wires at the start of the winding and connect end B to either of these. Leaving the continuity tester still connected to wire end A, find the next free wire at the finish of the winding which indicates continuity. Connect this wire to any of the remaining free wires at the start of the winding, and repeat the process until the winding connections are complete, as shown in Fig. 2(c.)

The same procedure is followed with a 6-fold wire and, working to our example, only 10 turns of such wire would be required.

As may be gathered, there is an optimum number of folds in the wire for any particular coil, since the saving in coil winding time is offset by the time taken in tracing through the wire ends and suitably connecting them together afterwards. Usually, a 2-fold or 4-fold approach affords the best results. A further possible disadvantage is that a 4-fold or 6-fold winding could look a little more untidy than a winding made with single wire or with a 2-fold wire. However, a competent constructor should be able to make a neat job of any of the versions.

A few final tips may be of assistance. The solder joints between wire ends can be insulated by passing a length of sleeving over one of the wires before soldering. The sleeving is then pulled back along the wire to cover the joint. Another dodge is that it is often possible to trace out an enamelled wire by a continuity test without removing any of its enamel, this being especially true of the thicker wires. If the cut end of the enamelled wire is held against the clip of the tester, keeping the wire perpendicular as in Fig. 3, at least a momentary indication of continuity should be given. ■

Balanced Distribution Boxes

by
L. Simpson

How to calculate the resistor values needed in 75Ω distribution boxes

DISTRIBUTION BOXES FOR DOMESTIC AND RETAIL SHOP TV aerial installations are easy to make up, the main components needed being a small resistor for each input or output socket. The important point to remember is that the input and output impedance at any socket on the box must always be 75Ω. Otherwise, there is likely to be trouble and possible ghosting due to incorrectly matched runs of coaxial cable. Also, a poorly matched aerial feeder can give rise to changes in TV receiver performance if it is brought close to large metal objects or other cables. Most of us have seen the instance where a very badly matched cable is so 'hot' that the picture given by the TV set it feeds changes noticeably as people approach the aerial lead.

BASIC CIRCUIT

The conventional form of distribution box has a circuit of the nature shown in Fig. 1, which illustrates a box with 4 coaxial sockets. These sockets are positioned close together on the front panel of a small enclosed metal case, as in Fig. 2, their centre contacts being coupled together by equal-value resistors mounted inside the box. The outer connections of the sockets are all commoned via the metal of the box itself. In Fig. 1, an aerial may connect to any one of the sockets, whereupon three outlets are available at the other three sockets. all with impedances at 75Ω. Alternatively, two separate aerials may connect to two of the sockets, with the result that two outlets are available, these carrying the combined signals from the two aerials. Provided that all sockets are loaded by 75Ω, any socket can accept a 75Ω input or provide a 75Ω output.

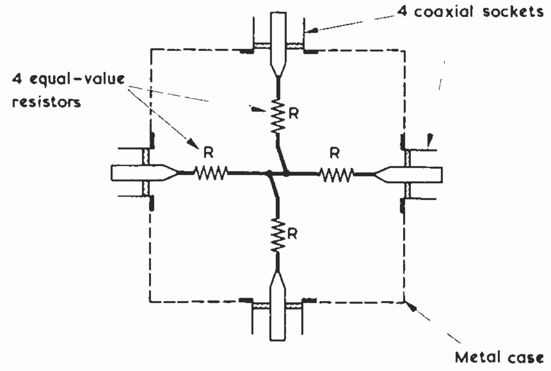


Fig. 1 Circuit of a distribution box having four coaxial sockets

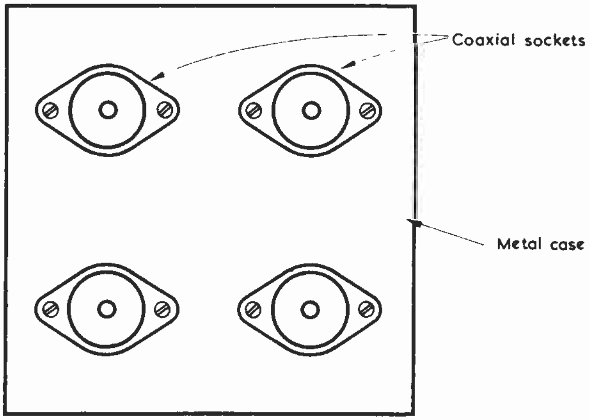


Fig. 2 In practice, the sockets of Fig. 1 are mounted on the front panel of a small metal box, the equal-value resistors being fitted inside. The wiring inside the box should be kept short

If it is required to make up a box with 5 sockets, then 5 equal-value resistors are employed, one end of each resistor connecting to the centre contact of each socket.

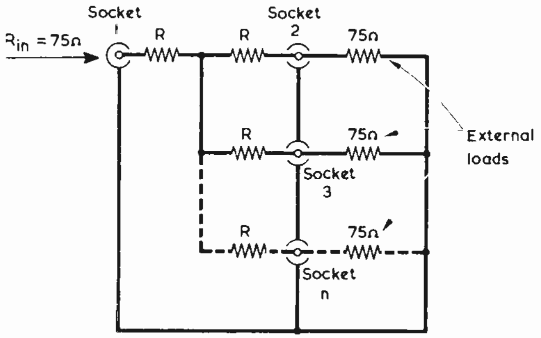


Fig. 3 Investigating the general instance where there is a total of n sockets

The other ends of all the resistors are joined together. With a box having 6 sockets, 6 equal-value resistors, similarly connected, are needed, and so on.

The value required in the equal-value resistors depends upon the number of sockets, and can be calculated by considering the instance where there are n sockets overall, as in Fig. 3. The distribution box shown here functions correctly if an external circuit 'looking into' socket No. 1 'sees' a resistance of 75Ω.

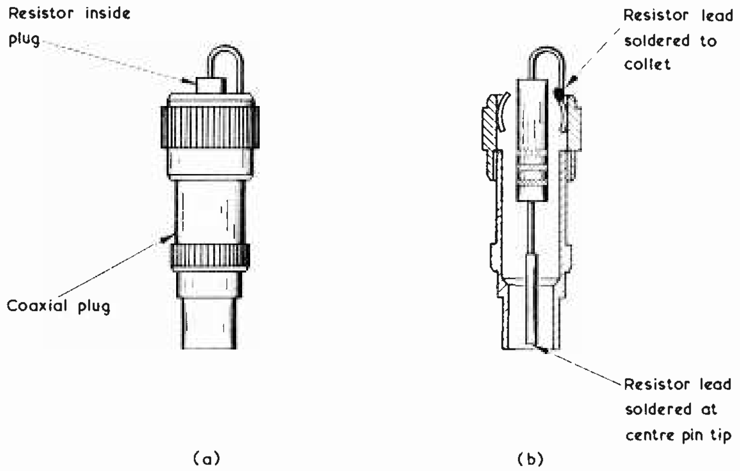


Fig. 4 (a) A dummy load may be made up by fitting a 75Ω resistor in a standard coaxial plug
(b) Cross - sectional view showing how the resistor is connected inside the plug

This resistance will be given by the resistance inserted by the resistor R connecting to the centre contact of socket No. 1 plus the parallel resistance of the (n – 1) remaining branches, each of which offers R + 75Ω.

Thus:

$$75 = R + \frac{1}{n-1}(R+75).$$

This calculates out, for R in ohms, as

$$R = \frac{75(n-2).}{n}$$

To check the equation, let us take an example of an actual circuit, choosing as a start the 4-socket box of Fig. 1. Here, n is equal to 4, whereupon R is equal to 75 multiplied by ½, or 37½Ω. If we consider three branches as being externally loaded by 75Ω, their resistance, in parallel, is ⅓ of (75+37½)Ω, which works out at 37½Ω. This value will also be that of the resistor coupling to the remaining socket, with the consequence that the resistance 'seen' at this socket is 37½ + 37½Ω, or 75Ω.

Using the equation for a box with 6 sockets gives us a value, in R, of 75 multiplied by ⅔, or 50Ω. Five branches, each of 50+75Ω, gives a total parallel resistance of ⅕(50+75), or 25Ω. A circuit connected to the sixth socket will then 'see' a resistance of 50+25Ω, which is the required 75Ω.

In practice it will be sufficient to use the 5% preferred value which is nearest to the calculated value, and the accompanying table lists values of R for distribution boxes having from 3 to 8 sockets. Where there is a choice of nearest preferred values, the resistors in the box should all be of the value chosen. Thus, in a box with 5 sockets, all the resistors may be 43Ω or 47Ω. They should not be a mixture of 43Ω and 47Ω. The resistors may be ½ watt carbon or high-stability, but *not* wire-wound.

TABLE

Total number of sockets	*Value of R (calculated)*	*Nearest 5% preferred value*
3	25Ω	24Ω
4	37.5Ω	36Ω or 39Ω
5	45Ω	43Ω or 47Ω
6	50Ω	51Ω
7	53.6Ω	56Ω
8	56.3Ω	56Ω

Remember that the box introduces an inevitable loss in signal strength between any input and any output socket. With a box carrying one input and two outputs, each output receives half the input voltage. For one input and three outputs, each output receives one third of the input voltage, and so on.

Finally, any socket to which a connection is not made should still have a 75Ω load, as the distribution system will otherwise become unbalanced. If it is likely that sockets will be occasionally unloaded, an appropriate number of 75Ω dummy loads should be made up, these being fitted, when required, to unoccupied sockets. Each dummy load consists of a normal coaxial plug with a 75Ω resistor fitted internally, as shown in Figs. 4(a) and (b). A ½ watt resistor will fit comfortably inside a standard metal coaxial plug such as the Belling-Lee type L.734/P. ■

Cover Feature

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This article is the first of a sho
cybernetic devices. One cyberne
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P A R T O N E

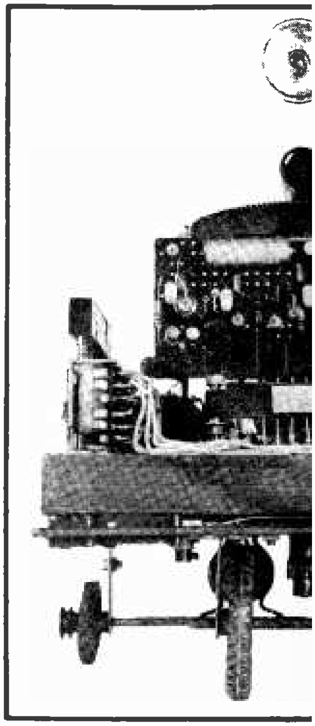
EXAMPLES OF THE USE OF CYBERNETICS WHICH IS the science of feedback control, have become proliferous in recent years. In general, the wide field of Cybernetics may be divided into two main regions. The first is where a device is built to perform a number of specific pre-determined tasks, and devices of this nature are known as servo-robots. The other region encompasses devices which are built with a much more diversified approach, and have no specific purpose but to exist. They are ususally much less specialised, and are known as auto-robots.

Examples of the former device are to be found everywhere. Computers, industrial control systems, traffic light systems and even common devices such as the motor car, the refrigerator and the washing machine are all servo-robots relying on feedback control.

The most common form of auto-robot is Homo Sapiens, a very generalised machine apparently having no specific purpose but to exist and better his environment. As mentioned in the author's earlier articles concerning 'Cynthia'[1], Man has had for a long time a compulsion to build something emulating himself. At present, his attempts in building various types of auto-robots have been fairly successful, the ultimate development to date having taken place in America with the programme at The Stanford Research Institute for developing a mobile automaton. Details of this device will be appearing in a later article. However, there is at present one limitation to the complexity of the systems that can be built, and that limitation is the finite speed of light.

The reason for this situation is as follows. When one compares the human brain to a computer, the latter, in certain aspects, is far superior. For instance, the rate of transfer of information, storage rate, and reset time of individual elements in a computer are all very much faster than the corresponding rates in the human brain. On the other hand, the human brain excels in storage capacity, and also in the fact that each element in the brain is connected to many more other elements than occurs in a computer. This rich interconnection in the human brain means that it can process information parallel with other information, as opposed to serially. The brain also has a very good filtering capability and, unlike the computer, can receive general information as opposed to pre-digested information. In the event of a component breakdown the brain appears to be 'holographic' in nature, in that it still gives the correct answer to a problem although sometimes to a lesser accuracy. In the event of a computer breakdown, a 'nonsense' answer usually results. Also, the brain can deal with general problems, whilst the computer is rather more limited.

The reason why the computer cannot at present have richer interconnection between elements is that, at the speeds computers operate, light (and therefore electricity) travels but a few feet per computer operation.



A general view of Cyc
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[1] L. C. Galitz, 'Cybernetic Cynthia', *The Radio Constructor*, June, July, 1970.

CLOPS

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**series devoted to robots and
device, called Cyclops, will be
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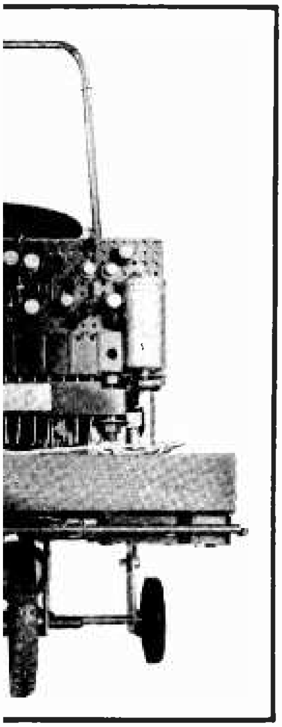
ot, and introduces Cyclops**



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by L.C. GALITZ

Therefore, in order that computer processing should operate in step, no two units in the central processing unit may be connected by a wire of more than two feet or so, otherwise pulses will arrive too late for any particular operation. At present, it is impossible for a machine to be built with all the relevant electronics in a sphere of radius less than about a foot, and with sufficient complexity to even approach that of the human brain. Nevertheless, we have still come a long way since Babbage's Analytical Engine.

CYCLOPS

One very useful way of finding out about something unknown is to build a model of it, and see how closely it imitates the real thing. In many cases this is the only way, and in some cases, such as solving the mystery of the human brain, it is the most practical way. Many auto-robots nowadays are mechanical equivalents of real animals, and such is the case with Cyclops, which is an approximate electro-mechanical equivalent of an animal in the amoeba family. Although most of Cyclop's behaviour is predetermined in the circuitry, one of the earlier prototypes surprised the author in imitating something which, although beneficial to both animal and machine, had not been intentionally put in!

Cyclops was designed with several criteria in mind. One of the most important of these was that he should explore his environment looking for things to happen, rather than passively wait for them to occur. Cyclops was to be positively tropic[2] towards light, and negatively tropic towards touch and bright lights. In other words, Cyclops is attracted by lights of a moderate intensity, and repelled by lights of dazzling intensity and also by obstacles into which it bumps. An advantage of using light as the sole attractive stimulus is that light, by way of solar cells, can mean food, i.e. electricity. In a perfect machine, the robot would be equipped with a bank of solar cells and, on finding a light, would pause to recharge its batteries. After its 'meal' it would then move off to explore further its environment. Thus, the perfect machine would show internal stability, and by reason of its positive tropism be self-perpetuating. Unfortunately, due to the prohibitive cost of a bank of solar cells providing sufficient power to recharge the machine's batteries within a reasonable length of time, another approach is needed for a practical device. A cheaper alternative would be for every light source to be equipped with a low tension supply, so that the machine would be capable of locating the light, homing into it, and plugging itself into the power source in order to recharge its batteries. Once these were recharged, the machine could move off again.

Returning to Cyclops in particular, other design requirements were that he should be able to recognise his reflection in a mirror, and that he should be able to recognise other members of his species.

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[2] Derived from 'tropism', the response of protoplasm to stimulus.—Editor.

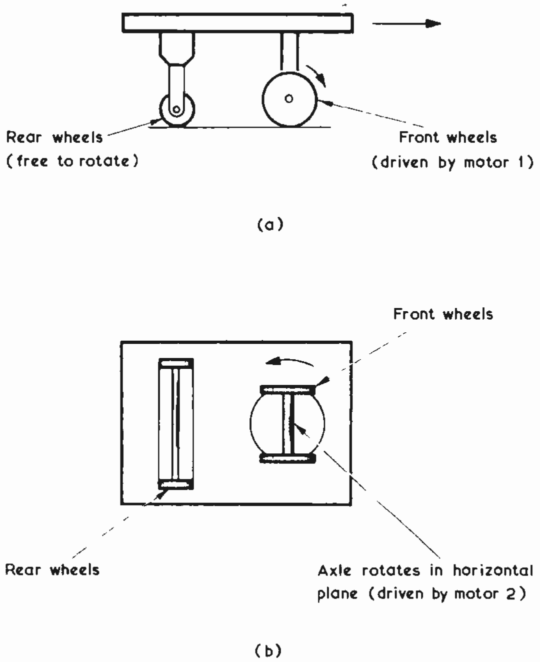


Fig. 1. Side view (a) and bottom view (b), illustrating the drives to the front wheels and their axle

To sum up, Cyclops will explore his terrain looking for light and, upon finding some will approach it and when sufficiently close, stop as if to recharge his batteries. Should he be dazzled, he will move off, and he will also avoid obstacles. This is sufficient to make him self-perpetuating. In order to be more realistic, a learning circuit was introduced, which enables Cyclops to make decisions concerning himself and his actions in relation to his environment.

BASIC DETAILS

The basis by which Cyclops works is by having the electronics control two motors. One motor drives the front wheels round to make Cyclops move. The other motor rotates the front wheels' *axis* through 360° and so changes the direction in which Cyclops moves. The drive from this second motor is in one direction only and cannot be reversed. The arrangement is shown in the side view of Fig. 1 (a) and the bottom view of Fig. 1 (b). The front wheels are caused to rotate by Motor 1, and their axis is rotated by Motor 2. The rear wheels are free to rotate and are not driven. Figs. 2 (a) to (d) illustrate how the rotating front axle changes the direction in which Cyclops moves.

With both motors running, Cyclops follows the path shown in Fig. 3. With the gear ratios incorporated the diameter of this pattern is approximately 6ft. Thus, quite a large area is traced out. The area would be larger if Motor 2 ran more slowly, but if this motor is geared down too much the robot will not home into light sources effectively. Hence, a compromise has to be reached.

Motor 2 not only rotates the front wheel unit but also a unit upon which the 'eye', which senses the presence of light, is mounted. The eye rotates at the same speed and in the same direction as the front wheel and thus always 'looks' in the direction in which Cyclops is moving. This rotation of the eye is referred to as 'scanning'.

When Cyclops sees a faint light, the electronics operate a relay which cuts the power to the scanning motor (i.e. Motor 2), causing Cyclops to move in the direction of the light. It will be appreciated that, unless the eye happens to be pointing straight ahead at the time Cyclops will tend to veer away from the light source, and the scanning motor will cut on. If the scanning stopped at an eye position such that, when the scan restarts, the eye turns in the direction which will bring it to the straight ahead direction sooner, the eye will be brought in line with the light source almost immediately after scanning starts again. Thus Cyclops will once more start heading for the light. He will then veer again for a shorter distance, after which the

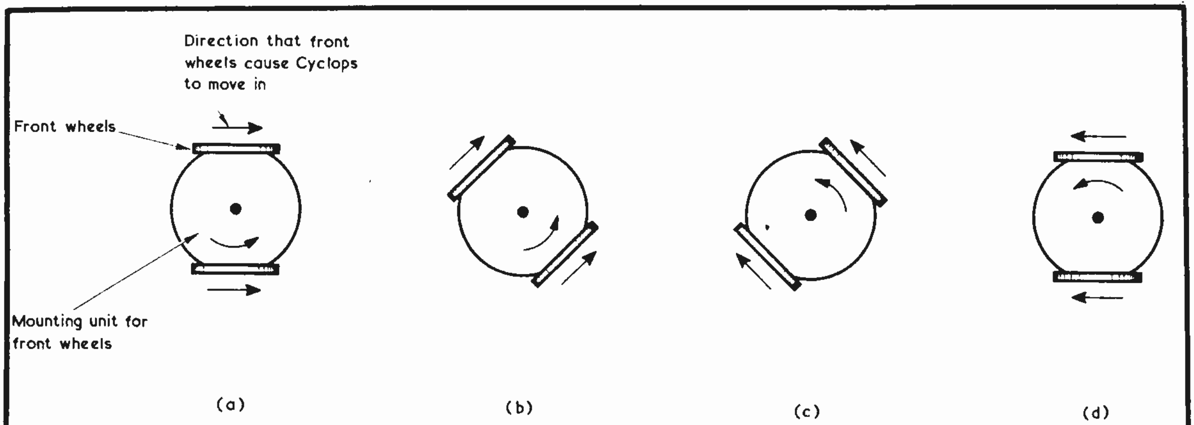


Fig. 2. Showing, in successive steps, the different directions in which Cyclops is caused to move as the front wheel unit is rotated

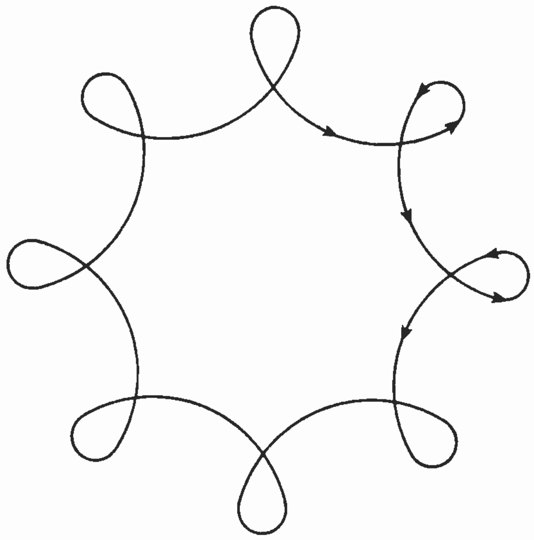


Fig. 3. The pattern traced out by Cyclops when not subjected to external stimuli

scanning motor will once more cut on. This process repeats in quick succession until the eye is pointing straight ahead, and Cyclops will then move straight towards the light. If the eye had stopped rotating in such a position that, on resumption of scanning, it moved in the opposite direction to that just described, then the eye will come to point straight ahead the longer way round. That is to say, it will perform almost a complete rotation before it sees the light again. The process previously described will then take place, ending with Cyclops moving straight towards the light.

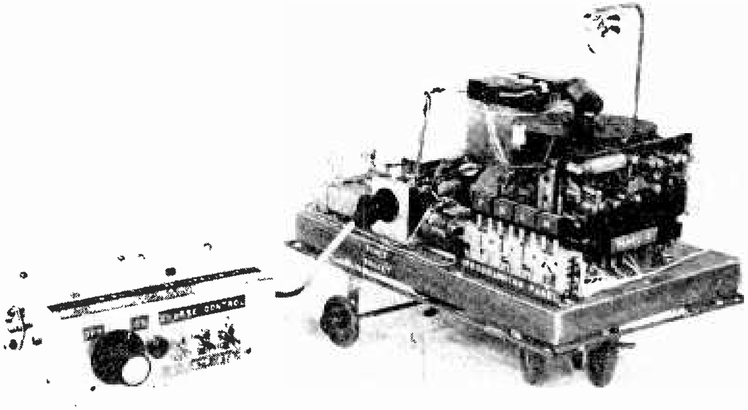
When Cyclops is sufficiently close, and the light has reached a sufficiently intense level, the electronics switch both motors off, and the robot waits in front of the light. In the perfect machine, either there would be a bank of solar cells to collect the light and recharge the batteries, or there would be a low tension supply associated with each light source so that the robot could plug itself in to recharge its batteries. Unfortunately, due to the excessively high cost of the former scheme, and due to the mechanical difficulties involved in arranging a reliable form of plug and socket suitable for the latter, it has to be assumed that, whilst waiting in front of the light source, Cyclops is recharging his batteries.

The electronics also arrange an 'ignore' mechanism for very bright lights, or for normal lights should Cyclops happen to approach too closely. Thus Cyclops avoids the 'moth in the candle flame' problem. Due to the fact that Cyclops will only start homing into a light source when he is pointing towards it, he will also avoid the dilemma of Dante's free man, or of Buridan's ass, which starved to death because two exactly equal piles of hay were equidistant from it. If placed precisely the same distance away from two equi-brilliant light sources, Cyclops will visit one, and then the other.

When Cyclops bumps into an obstacle, his touch sensor activates a circuit which causes his drive motor to operate in the reverse mode for a period equal to that required for the scanning motor to rotate the front wheels' direction through 180°. The circuit turns on the scanning motor irrespective of whether the eye sees a light or not. Thus it will be seen that when Cyclops bumps into an obstacle, he moves away from it due to the fact that his drive motor, and therefore his direction, is reversed. At the same time, his scan motor is changing his direction. Then, just as he is about to head back into the obstacle due to the scan motor now causing the front wheels to point in the opposite direction, the drive motor reverts back to normal, reversing the drive again, and therefore causing Cyclops to continue to move away from the obstacle. Due to the fact that the obstacle-avoiding circuitry overrides all the other positively tropic responses, Cyclops will always get himself out of trouble before trying to feed on an otherwise attractive light source. If he were to try and force his way through an immovable object in order to get to a light, it would not be too difficult for him to initially damage his touch sensors, and even for his motors to stall and overheat. Thus touch may also be regarded as being a stimulus of pain, and this fact is used when he is being taught to use his learning circuits.

RECOGNITION

The method by which self- and mutual-recognition is achieved, although apparently difficult, is really very simple to engineer. A lamp with a reflector is fitted to the machine so that it shines in the forward direction.



Cyclops at rest as the batteries are charged

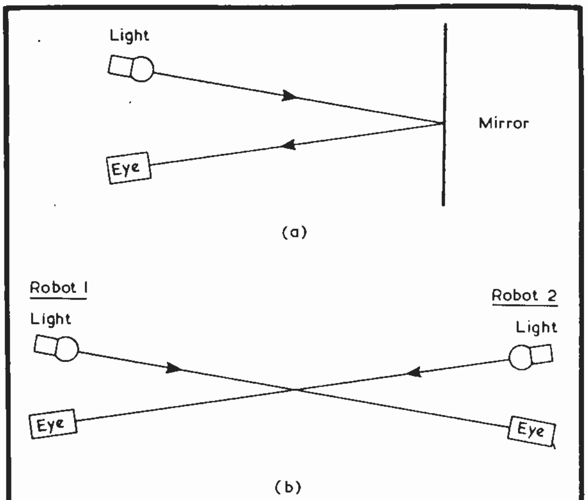


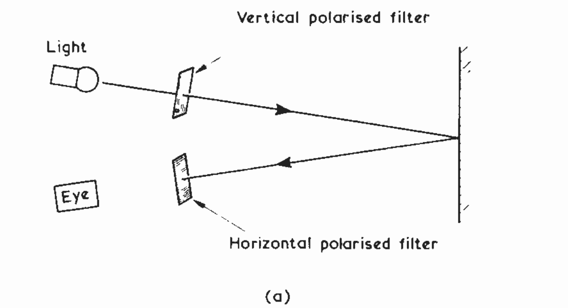
Fig. 4 (a). Cyclops can achieve self-recognition when confronted with a mirror

(b). Mutual recognition between two robots is also possible

t is wired across the main drive motor with the result that, when the machine moves the lamp is illuminated, and when the machine stops the lamp extinguishes. If now a mirror is held up to Cyclops' eye such that he sees the lamp's image through the mirror, he will stop, the light being of sufficient brilliance to activate his 'stop to feed' circuitry. However, the action of this circuit is to cut the power to the motors, and this will extinguish the lamp. As Cyclops can now no longer see the lamp, his 'stop to feed' circuitry will revert to its normal state, and the power to his motors will be restored, and hence the lamp will light up again. This cycle of events will continue for as long as the mirror is held in front of Cyclops' eye, and he will linger in front of the mirror flickering, twittering, and jigging like a clumsy Narcissus. This highly specific behaviour towards his own reflection may be accepted as evidence that Cyclops has some degree of self-awareness. See Fig. 4 (a).

If we consider the result when two 'animals' of the same species as Cyclops encounter one another, we find that they home into one another owing to the attraction of the light. However, as this happens, the lamp and therefore the stimulus is cut off, but the removal of the stimulus restores the light which then becomes a stimulus again. Thus, the two animals dance about one another. See Fig. 4 (b).

With a colony of such creatures, the very fact that each animal extinguishes its own source of attraction in the act of seeking it in others means that the colony, when no other attraction is presented, must stick together. Such a colony will also attract other creatures of the same species due to the fact that the colony is giving off light. Unfortunately, the very gregariousness of creatures of the species of Cyclops is that species' downfall, because even though an external light source will attract several members of the colony, a good many will remain behind. It is not difficult to realise that the light source of the colony (the animals themselves) can never be sufficient to recharge the batteries of the animals therein, and eventually all the animals forming the colony must eventually die unless an external light source is available. An interesting point which arises here is that when an animal is reaching the end of its life its batteries will be low, and therefore the light it



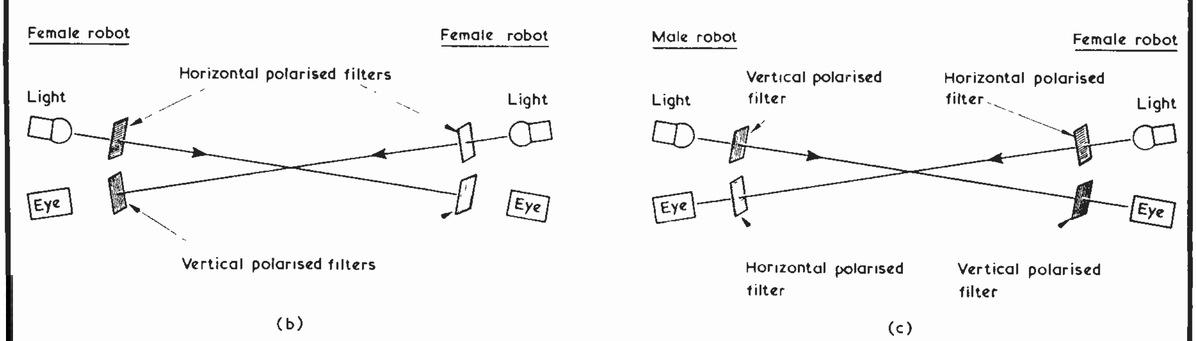


Fig. 5 (a). Although not incorporated in the present model, polaroid filters may be added to modify robot reactions. Here, a male robot is confronted by a mirror but the vertically polarised light cannot pass through the horizontally polarised filter and there is no reaction

(b). The filters ensure that one female robot is not recognised by another female robot

(c). Recognition is only achieved between a male and a female robot

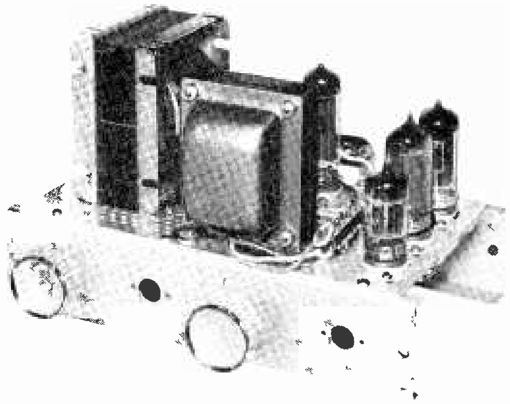
emits will be dim. Therefore, there will be less likelihood of the animal going through the self-recognition response, and also the mutual recognition response, which would certainly be its downfall. The animal would rather look for light to replenish its waning power source than to participate in games with itself or with other animals of its own species.

One can be pedantic about this feature of mutual recognition and, at the expense of the self-recognition feature (which may be regarded as undesirable anyway) one could incorporate polaroid filters in front of the light source on each animal, and in front of the eye. These filters could create arbitrary males and females of the species. With this arrangement, a male will not react to itself or to another male; similarly, a female will not react to her reflection or to another female. However, males and females will react with the mutual recognition response upon encountering one another.

This feature can be accomplished by having a horizontally polarised filter in front of the light of a female and the eye of a male robot; and a vertically polarised filter in front of the eye of a female robot and in front of the light of a male robot. Thus, when encountering a mirror, neither variety of animal is able to see its own light due to the fact that there are opposing filters on the light and eye. The same thing occurs when a male robot meets another male robot, or when a female robot meets another female robot. It is only when a female and a male robot meet that the filters are of the correct orientation for the female eye to see the light from the male's light, and for the male eye to see the light from the female's light. Naturally, the filter does not interfere with the light from unpolarised light sources, to which the animals are normally sensitive. Figs. 5 (a), (b) and (c) show the various situations.

Details of the construction of the mechanics of Cyclops will be given in the next article, which will appear in next month's issue.

(To be continued)



DIGITAL FREQUENCY MONITOR

PART 2

by

S. A. Money, M.B.C.S., G3FZX

This concluding article in our 2-part series completes the description of circuit operation and describes the process of setting up and final use.

THE CONTROL LOGIC

THE FUNCTION OF THE CONTROL LOGIC IS TO GOVERN the sequence of events required to carry out a single cycle of frequency measurement. Fig. 6 shows the circuit of this part of the system.

A four stage shift register circuit using two 7474 modules controls the timing sequence. This shift register is driven by the 250 Hz clock produced by the crystal controlled reference generator. At the start of the cycle the shift register is in a dormant state with the first three stages set at 'zero' and the fourth at 'one'. The clock is fed in via gates G1 and G2 which are controlled by the inverted output NQ of the fourth stage of the register. At the start of the cycle the clock gate is held closed because the fourth stage is at the 'one' level and hence its NQ output is at 'zero'.

To start a new cycle of operations a trigger pulse is applied to the preset and clear inputs of the four flip-flops so that the first stage is set at 'one' and the other stages are all set at 'zero'. Gate G1 will now open and allow clock pulses to be applied to the shift register.

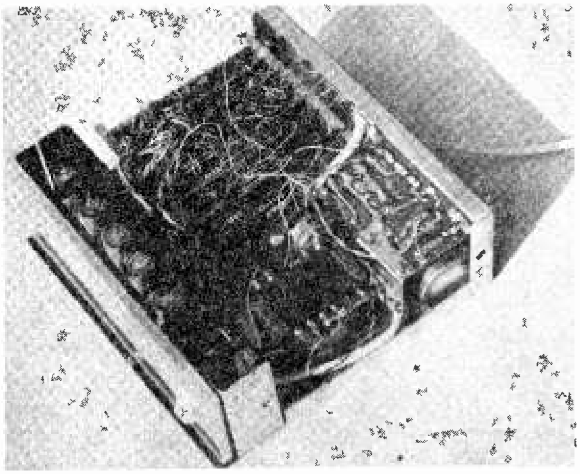
At the first clock pulse after the gate has been opened the 'one' state will move along the register from stage 1 to stage 2. Stage 1 will reset to 'zero' again because its D input is permanently held at the 'zero' level. The output from stage 2 of the shift register is gated with the clock pulse in gate G3 to produce the presetting pulse for the main decade counter chain. Transistor TR2 inverts this pulse and also provides sufficient current drive to operate all of the decade stage reset lines in parallel.

When the next clock pulse occurs the 'one' state moves along to stage 3 of the register and stage 2 returns to 'zero'. The Q output of stage 3 is used to open the input gate circuit for exactly one period of the 250 Hz reference clock. The fourth clock pulse returns the shift register to its starting condition at which point gate G1 closes and cuts off the clock pulses. The control logic will now remain in this state until a new trigger pulse is applied to start another cycle.

In order to produce a continuously updated output display the trigger pulses which start the sequence need to be applied regularly. A convenient source of pulses is the 50 Hz power supply frequency. A half-wave rectified signal is applied via a resistor to the base of transistor TR3 which acts as a limiter and pulse shaper. The collector output drives the divide-by-five section of a 7490 and this in turn drives a short pulse monostable circuit made up from a 7400. The output from this stage is used to provide the trigger pulse which starts a new sequence in the control logic.

DISPLAY TUBE BLANKING

During the period where the input frequency is being counted the display will change in sympathy with the count total since the indicators are connected to the counter output. This causes an objectionable flicker effect unless some form of blanking is applied to the indicator tubes.



Side view of the prototype

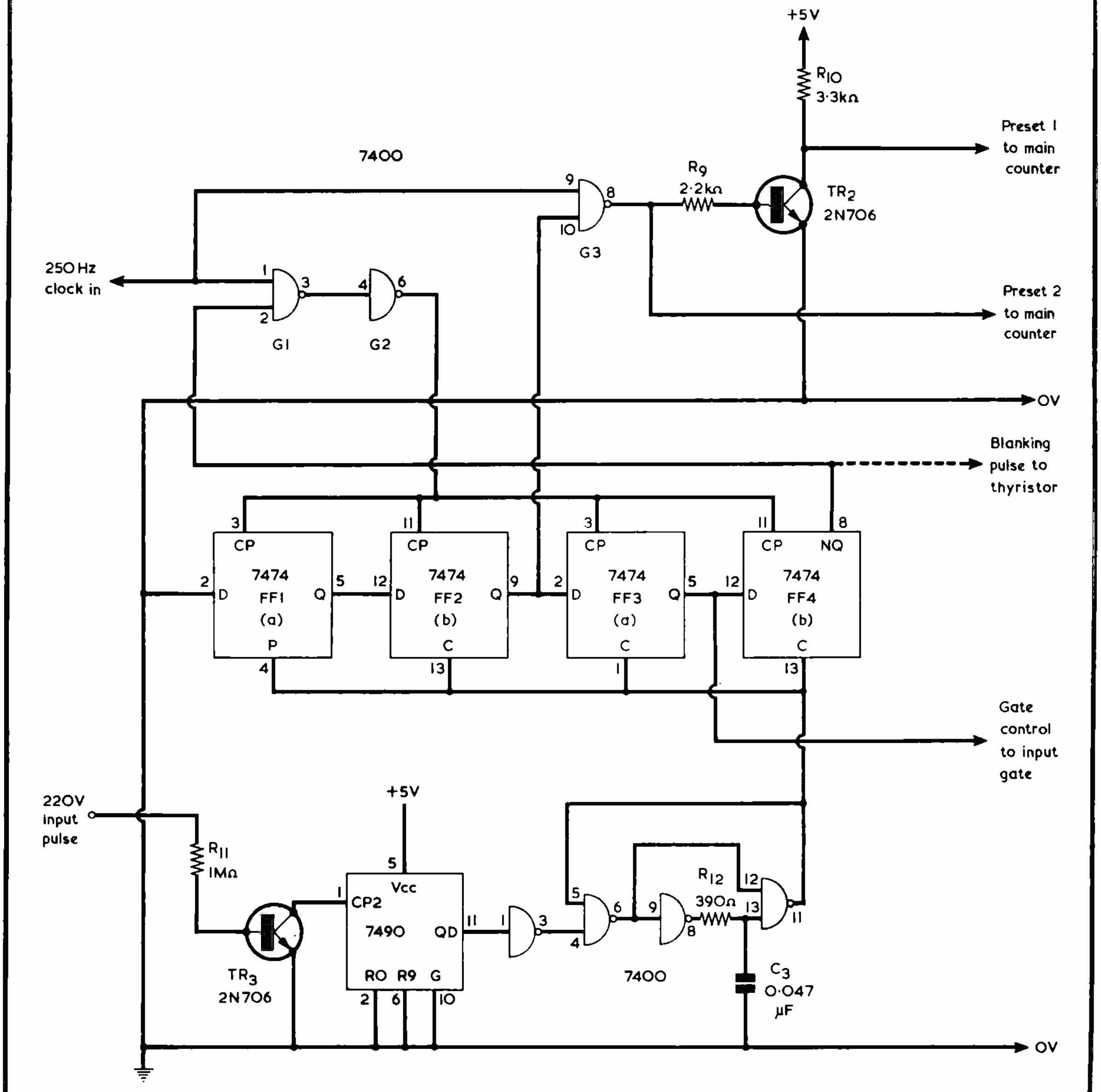
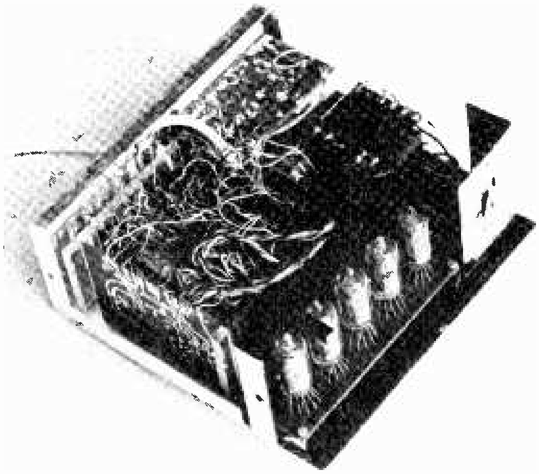


Fig. 6. The circuit of the frequency monitor control logic

The simplest method of achieving this is to feed the anodes of the indicators from a half-wave rectified supply and then to synchronise the control sequence to this same supply. If the control sequence is started as the anode voltage falls to zero the indicator tubes will be effectively switched off during the preset and count periods of the control sequence. During the half-cycle when the anode voltage is positive the counter output will be static and the indicators will display the current value of the frequency being measured. In fact the anode supply of the indicators may be used to drive transistor TR3 in the control logic.

Although this simple method of blanking works when the frequency is measured in units of 1 kHz it will be necessary to use a more complex arrangement if hundreds of Hz are to be displayed. In this case the period for which the tubes must be blanked out is more than one half-cycle of the supply mains. A suitable circuit for this purpose is shown in Fig 10. In this arrangement a thyristor is used to provide the control of the anode voltage of the indicators. This thyristor is driven by the signal from the NQ output of the fourth stage of the shift register in the control logic. The thyristor will be turned on during the whole of the measurement sequence and effectively holds the anode voltage of the indicators below the striking level, thus blanking the display. To prevent excessive loading of the flip-flop stage a transistor emitter follower is included



Another side view, illustrating the manner in which printed circuit boards were employed in the author's unit

to drive the gate of the thyristor. A resistor in the anode circuit of the thyristor limits the current when the thyristor is turned on.

THE POWER SUPPLY

A power supply is required to provide a d.c. supply stabilised at 5 volts for the logic circuits and a half wave rectified 220 volt supply for the indicator tubes. A small transformer was used which had 220 volt 50mA, and 6.3 volt 1 amp secondaries, and a 240 volt primary. A 1N4005 rectifier supplies the 220 volt line for the indicator anodes and a bridge using four 1N4001 diodes is employed to provide the low voltage supply at about 750 mA. Using a 16,000 µF reservoir capacitor, this circuit gives about 7 volts output at full load. A simple series stabiliser circuit is used to derive the 5 volt supply for the logic.

An OC28 germanium transistor was used as the series regulator because the voltage drop in silicon types did not permit the required 5 volts output to be maintained at full load current. Using an OC28 the output was stable up to 800mA load current. A 2 in. square heat sink of 16 s.w.g. aluminium will be required for this transistor.

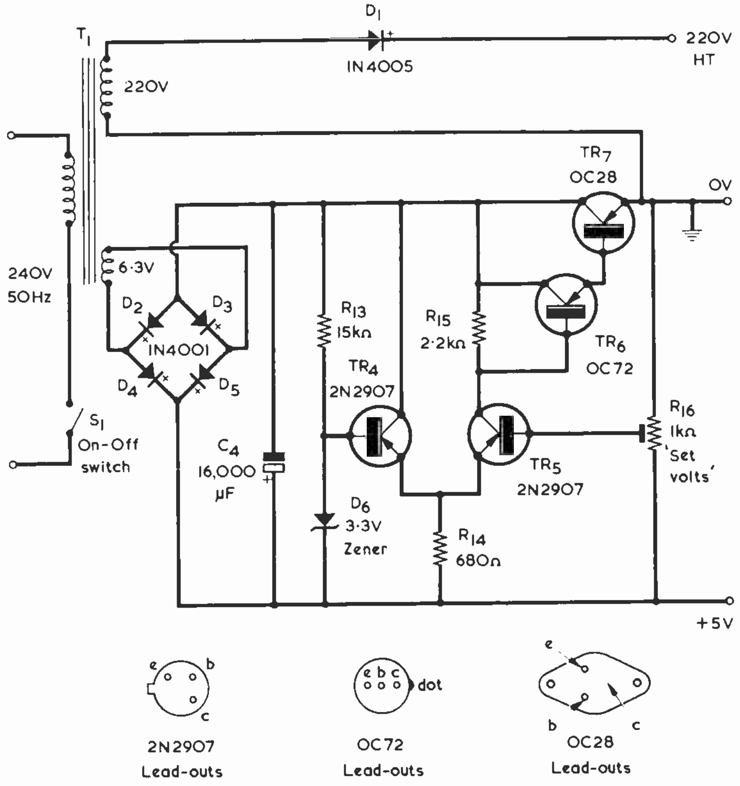
Fig. 7 shows the circuit diagram of the power supply unit for the monitor unit.

DISPLAY INDICATOR TUBES

In the original unit Hivac type XN13 indicator tubes were used since these are readily available to the amateur constructor. The base connection arrangement is shown in Fig. 8. It should be noted that this type of tube has wire terminations instead of pins and the tube itself is about the size of an average B9A valve.

Each indicator tube has an 82kΩ anode resistor to limit the anode current to the recommended value. If other types of tube are used their data sheets should be consulted since they may require a different value limiting resistor. When thyristor blanking is used the value of the anode resistors may be reduced to 68kΩ to allow for the effect of the common series resistor in

Fig. 7. The power supply circuit



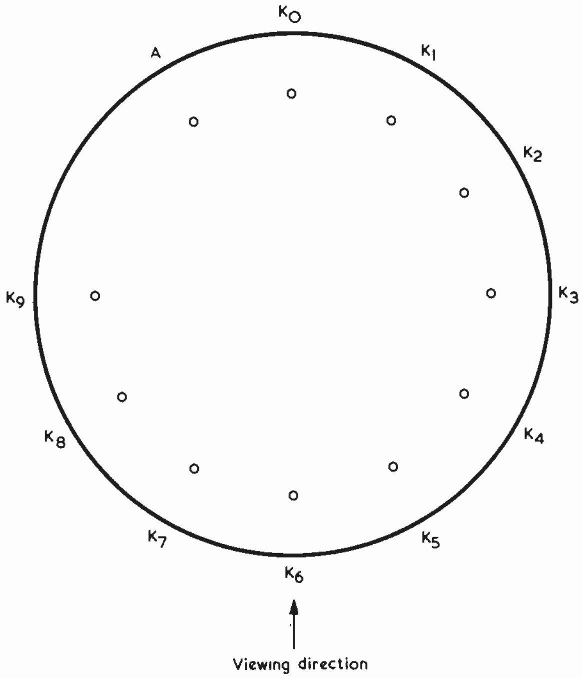


Fig. 8. Connections to the XN13 indicator tube

the anode circuit of the thyristor. The ten cathodes of the tube are connected directly to the ten outputs of the 7441 decoder module used to drive it.

RECEIVER MODIFICATIONS

A signal must be extracted from the receiver local oscillator in order to provide the input signal for the frequency monitor unit. A buffer amplifier and pulse shaper will be needed to provide the correct signal level. Since the frequencies involved are relatively high this circuit is best mounted in the receiver near the oscillator and must be capable of driving a short length of coaxial cable.

The author's receiver is a Lafayette HE30 which uses a Hartley type oscillator. The most convenient pick-off point for this circuit was found to be at the cathode of the oscillator valve. For other receivers it will be necessary to find a pick-off point which causes least disturbance to the oscillator operation.

A buffer amplifier and limiter circuit as shown in Fig. 9 is used and should be mounted as close as is practicable to the oscillator circuit of the receiver. The transistor provides a buffering action and the two 7400 gates act as a limiter and cable driver. It should be possible to drive a coaxial cable of up to 3 ft. in length with this circuit.

The circuit requires a 5 volt supply which can be derived from the receiver heater supply in a valve type receiver by using a rectifier and zener stabilizer as shown in Fig. 9. If there is no convenient source of low voltage available in the receiver it will become necessary to feed 5 volts to the buffer unit from the frequency monitor itself.

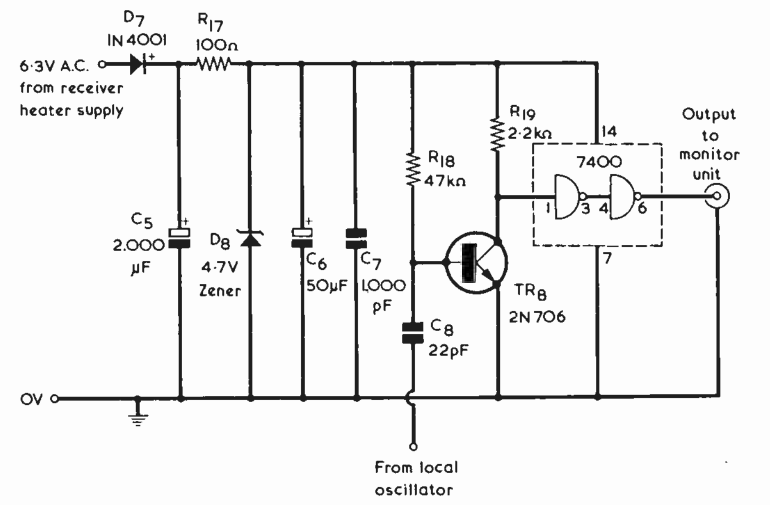
CONSTRUCTION NOTES

It is not proposed to give detailed instructions on how the unit should be built since the majority of readers attempting this project will already be quite experienced in construction and will no doubt have their own ideas on the method of construction they intend to use. Some notes on the techniques used in building the prototype unit may however be of interest.

Home-made printed circuit cards were used with a separate card for each decade module and two further cards for the reference and control circuits. In making these cards the tracks were marked out on clean copper clad board using a cellulose enamel paint. For the etch a 50% solution of ferric chloride was used. After the etching stage the paint mask was removed with paint stripper such as Polystrippa. An alternative method of card construction would be to use 0.1 in. grid Veroboard.

The XN13 tubes are mounted on a single card and spaced at 1 in. intervals with the connection leads soldered directly to the card. The anode resistors may be mounted directly under the tubes they feed. A mask

Fig. 9. The receiver pick-off circuit



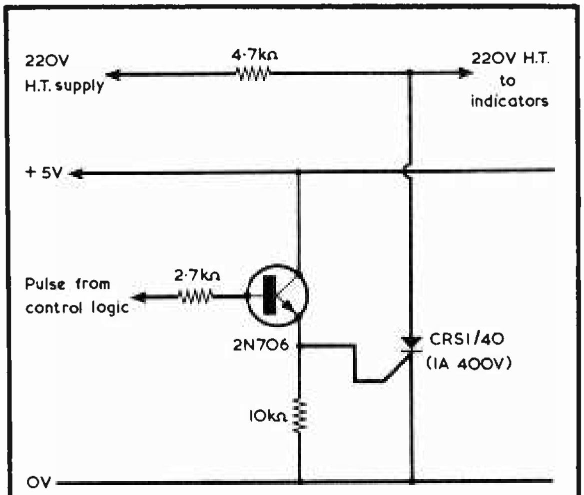


Fig. 10. A thyristor blanking circuit for the indicator tubes which may be employed when measuring frequency in units lower than 1kHz

plate of 22 s.w.g. aluminium with a suitable viewing aperture is mounted in front of the indicators and to give a reasonable finish to the unit a ¼ in. thick clear Perspex front panel is mounted in front of the masking plate. It is a good idea to mount the indicator tubes in a screened compartment as they tend to produce a certain amount of radio frequency interference. The surface behind the tubes and the front mask plate should be painted matt black to reduce reflections.

The whole unit should be mounted in a metal case which provides reasonably good r.f. screening. For the original unit a case of size 8 in. by 8 in. by 5 in. high was used. Since power dissipation is small no arrangements for ventilation are likely to be required.

The writer did not find it necessary in his unit (and in a subsequent monitor built up to the same circuit) to use bypass capacitors on the supply lines. It may, however, be worth-while to include a 0.1µF ceramic capacitor across the 5 volt lines, preferably on the card carrying the input divider stages, and also on the reference generator.

TESTING AND ADJUSTMENT

Although not essential, an oscilloscope will be very helpful in finding faults in the operation of the logic system. For most purposes, however, the only test instrument needed will be a multimeter.

For a start the power supply should be checked by itself using a 7Ω 2 watt resistor as a dummy load in place of the logic. Adjust the preset voltage control potentiometer to give an output of 5 volts. Check that when the dummy load resistor is removed the output stays at 5 volts. The logic circuits may next be connected and any final adjustment to the output voltage made. The indicators should now be illuminated and will probably be showing some random number at this stage.

With the power supply operating it is now possible to check the operation of the crystal oscillator and the reference divider chain. At this stage the series capacitor (Cs) in the crystal oscillator circuit should be 0.1µF and there should be no shunt capacitor (Cp).

With the case removed from the unit it should be possible to pick up the harmonics of the crystal oscillator on a receiver. The operation of the reference divider can readily be checked using an oscilloscope. If there is no oscilloscope available the output can be fed to a pair of high impedance headphones or an audio amplifier and loudspeaker. The 250 Hz tone is very nearly at Middle C in the musical scale and the earlier stages of the divider will give higher notes when they are operating correctly.

At this point the frequency of the crystal oscillator must be set up accurately. Tune in a standard or other known frequency station such as MSF on 2,500 or 5,000 kHz. The station chosen must have a frequency which is an exact harmonic of the crystal frequency. Adjust the receiver b.f.o. to zero-beat with the station. Switch on the monitor unit and check whether the harmonic of the crystal oscillator is also at zero beat with the b.f.o. If the resultant beat note is lower than about 50 Hz then no adjustment is needed.

In most cases it will be found that the beat note will be fairly high and it will be necessary to tune the crystal oscillator circuit to the precise frequency of 500kHz. Retune the receiver to bring the crystal harmonic to zero beat with the b.f.o. and note whether it was necessary to move higher or lower in frequency to achieve this. If the receiver had to be tuned higher then it will be necessary to add a small capacitor (Cp) across the crystal. This will need to be a few pF in value and should be increased until the crystal signal is as near as possible to zero beat with the signal from the standard frequency station. If the receiver has to be tuned lower in frequency the value of the series capacitor (Cs) will need to be reduced until the same result is achieved. The value of Cs may have to be reduced to the order of only a few picofarads. In both cases a variable trimmer capacitor may be helpful in setting the frequency accurately.

Once the crystal frequency has been adjusted to its correct value the presetting links in the decade counter may be set up to give the offset correction. Subtract the receiver i.f. frequency from 40 MHz to get the value to which the counter must be preset at the start of each measurement cycle. In the case of an i.f. of 465 kHz the counter must be preset to 39535.

The four links in each decade are set to Preset or Clear as shown in the Table in order to set the decade

TABLE

Link connections for presetting decade counters. (P = Preset, C = Clear).

Required State	Link Connections			
	S1	S2	S3	S4
0	C	C	C	C
1	P	C	C	C
2	C	P	C	C
3	P	P	C	C
4	C	C	P	C
5	P	C	P	C
6	C	P	P	C
7	P	P	P	C
8	C	C	C	P
9	P	C	C	P

to its required starting point. When all decades have been set up the readout should read 39535 for a 465 kHz i.f.

At this point the crystal oscillator signal may be fed in as a test input and the frequency readout should be 00035 for a 500kHz crystal and a 465 kHz i.f. offset. If this test works the receiver may be connected and a known frequency station on say the medium wave band tuned in. Check the frequency readout against the known frequency of the station. It may be necessary to do some experimenting with the pick-off circuit from the local oscillator in order to ensure that the monitor unit gets a clean signal and operates properly on all bands. Due to the added stray capacitance of the buffer amplifier it may be necessary to slightly realign the oscillator circuits in the receiver. It may also be necessary to adjust the offset of the kHz decade if the receiver i.f. is not aligned exactly to the stated frequency.

Once the unit has been set up and is operating correctly it will be found that logging station frequencies and setting the receiver to given frequencies in the bands will be very easy, and the receiver main tuning dial may then be ignored. ■

BOOK REVIEWS

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RADIO AND LINE TRANSMISSION, Vol. 2, Second Edition. By G. L. Danielson, M.Sc.Tech., B.Sc., C.Eng., M.I.E.E. and R. S. Walker, C.Eng., M.I.E.R.E.
301 pages, 5¼ x 8½ in. Published by Iliffe Books. Price £1.60.

The first edition of this book appeared in 1963 and was intended to cover the syllabus of the City and Guilds of London Technician's Certificate examination in 'Radio and Line Transmission B'. This new edition is published with the same intention, and takes up changes in the syllabus which have occurred over the intervening period. Additions include details of transistor h-parameters, v.h.f. propagation and rectangular pulse waveforms. Also, the sections dealing with electronic voltmeters have been up-dated, a section dealing with Q-meters added and further material on transistor circuits incorporated. Finally, all units have been amended to S.I. and any traces of non-metric units removed.

The book commences with the subject of propagation, then carries on to lines and cables, communication channels, aerials, components, and logarithmic scales and units. Further sections deal with noise in communication systems, a.f. amplification, tuned circuits, r.f. amplification, oscillators, modulation and detection, and superhet reception. The final section discusses r.f. measurements, and there is an extensive index. Each of the sections ends with a number of test questions, many of which are taken from earlier City and Guilds examinations

The book deals effectively with its subject-matter and offers a very useful text-book for the students for whom it has been primarily written. There are a large number of diagrams and the approach is at all times clear and concise.

INTRODUCTION TO VIDEO RECORDING. By W. Oliver, G3XT.
109 pages, 5½ x 8½ in. Published by W. Foulsham & Co. Ltd. Price £1.50.

This interesting book, on a subject which has not, perhaps, had as much information published about it as is due, is written for the layman and not for the technical expert. It introduces the reader to the various modes of video recording at present in use, dealing with these at elementary level so far as technicalities are concerned, but at the same time giving full details of operation and use, as offered by the commercial systems currently available. The manufacturers whose products are referred to include Ampex, E.M.I., Sony, Decca, Philips, EVR Rank-Bush-Murphy, National, R.C.A. and Akai. Also given is a list of agencies in the U.K. which handle video recording equipment, closed-circuit TV and allied apparatus.

After a preliminary outline the book compares sound and video recording, then carries on to video cameras, the choice of systems, video tape recorders, the EVR system, video disc systems, the laser and hologram in video recording, and video tape. Further chapters discuss closed-circuit TV systems, portable video recording systems, recording and playback transducers, applications and the cost of equipment. A final chapter deals with supplies and suppliers.

The book is well illustrated with photographs and will be of value to any reader contemplating the purchase of video recording equipment either for his own use or for commercial, entertainment or educational purposes.

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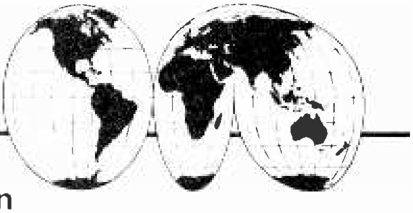
SHORT WAVE NEWS



FOR DX LISTENERS

By Frank A. Baldwin

Times=GMT *Frequencies*=kHz

The newly formed nation of Bangladesh (formerly East Pakistan) has a transmitter at the capital Dacca and has been operating a service in English from 1230 to 1300 daily on **11620** (25.82 metres) and **17925** (16.73m) although readers should be warned that the frequencies quoted are nominal – Bangladesh engineers are not noted for accuracy where frequencies are concerned. A transmission from Dacca recently logged by the writer was on a measured frequency of **17930**, the listed **11620** channel was, for some unknown reason, silent.

Another broadcast in English in the General Overseas Service of Radio Bangladesh is from 1715 to 1800 on **11650** (25.75m) according to recent station announcements heard here.

The most recent schedule of Radio Bangladesh is as follows – 0230 to 0300 in-English on **9690** (30.96m) and on **15520** (19.33m); from 1000 to 1030 on **11620** and **17925**; from 1230 to 1300 in English as listed above; from 1320 to 1350 in Nepalese on **7260** (41.32m) and on **9690**; from 1430 to 1530 in Bengali on **9680** (30.99m); from 1600 to 1630 in Hindi on **9680** and **11650** and in English from 1715 as listed above, according to the BBC Monitoring Service (BBCMS).

The programme from Radio Bangladesh usually consists of station identification and news about Bangladesh at 1230, press comments and native musical interludes, ending at 1300 with "Jai Bangla".

● AFGHANISTAN

The evening boardcast to Europe in English from Radio Aghanistan, Kabul, is now from 1800 to 1830 on **11785** (25.46m) and on **15265** (19.66m).

● IRAN

Recently reported in these columns as operating on **9020**, Radio Iran, Teheran, has been recently logged here on a measured **9004** (33.31m) although for some weeks past (at the time of writing) the frequency has varied between the limits stated here. Radio Iran can also be heard on the 'out-of-band' channel of **12185** (24.62m), but listen on the **15084** (19.89m) channel for the taping of Iranian music.

● KUWAIT

The English Service of Radio Kuwait is radiated from 1830 until 2100 on **11845** (25.33m) replacing the **11925** outlet. (BBCMS).

● TUNISIA

The National Programme of the Tunsian Radio is now heard on **15216** (19.71m) from 0458 until 2330, replacing **9595**, according to BBCMS.

● ISRAEL

Kol Yisrael may now be heard in English from 2035 to 2115 on **6170** (48.62m), **9009** (33.30m) and on **9625** (31.17m) beamed to both Europe and Africa.

● SOUTH AFRICA

The English programme from RSA Johannesburg can now be heard from 1900 until 1950 on **15155** (19.80m) and on **21480** (13.97m). This programme is directed to the UK and is only part of the service in English.

● PAKISTAN

The English Service from Radio Pakistan, directed to the UK, may now be heard from 2000 to 2130 on **11672** (25.70m), **11860** (25.30m) and on **15520** (19.33m).

CURRENT SCHEDULES

● SRI LANKA

The Asian Indian Service from Radio Sri Lanka is currently from 0030 to 0430 on **6075** (49.38m), **9720** (30.86m) and **15120** (19.84m), also from 1230 to 1730 on **7190** (41.72m) and **9720**. The All Asia Hindi Service is heard from 0030 to 0430 on **7180** (41.78m) and on **11800** (25.42m); from 0630 to 0830 on **6075** and from 1330 to 1730 on **11800**. The All Asia Tamil Service also uses the two latter channels from 1030 to 1330. The latter Service is directed to South East Asia from 1030 to 1130 on **11740** (25.55m), **15120** and on **17830** (16.83m). Sri Lanka, formerly Ceylon.

● CANADA

The European Service in English is currently radiated as follows – from 1217 to 1313 on **11850** (25.32m) and **15325** (19.58m). From 2115 to 2152 on **11845** (25.33m), **15325**, **17820** (16.84m) and on **21595** (13.89m).

The Afro-European Service in English is from 0710 to 0745 on **9625** (31.17m), **11720** (25.60m), **15325** and **17820**, the last two frequencies being relays from Daventry.

The African Service in English is from 1831 to 1915 on **11845**, **15325** and **17820**.

Additionally, programmes to the Canadian Forces in Europe are radiated as follows – from 0558 to 0630 on **9625** and on **11725**. From 1055 to 1215 on **11850** and on **15325**. From 1630 to 1700 on **11850**, **15325** and on **17820**. From 2045 to 2115 on **11845**, **15325**, **17820** and on **21595**; also from 2158 to 2230 on **11845** and on **15325**.

● SWITZERLAND

Programmes in English from Berne are now as follows – from 0645 to 0730, from 1100 to 1130, from 1300 to 1345, from 1515 to 1600, from 1800 to 1815 and from 2100 to 2130 daily on **6165** (48.66m) and **9535** (31.46m) from 0645 to 1530 and on the additional channel of **3885** from 1530.

● PARAGUAY

According to BADX, the new high power (100kW) transmitter of Radio Nacional, on **5273** (56.89m) has commenced operations. Readers will recall that the low-powered experimental transmissions were reported some months ago.

● SWAZILAND

Swazi Radio is now on the air from 0400 to 1700 on **6155** (48.74m) and from 1600 to 2200 on **3223** (93.09m). The address is - Swaziland Commercial Radio (Pty) Ltd., P.O. Box 941, Mbabane, Swaziland or P.O. Box 23022, Joubert Park, Transvaal.

● U.S.S.R.

From 'Bandspread', we learn that contacts between the ground and manned spaceships can be heard on **18000** (16.66m) and on **18035** (16.63m)

● MAURITANIA

The Republic of Mauritania has a 30kW transmitter at Nouakchott operating on **4850** (61.86m) that can often be logged here in the UK. The weekday evening schedule is from 1800 to 2230 whilst on Sundays it is from 1700 to 2300. Listen around 2030 or so for this one, languages are French, Arabic or local vernaculars.

● ARAB AMIRATES

Dubai Radio is reported by BADX on **6040** (49.67m) around 1500 to 1700 daily. Identification is given as "Idahat el Dubai el Amirates al Arabia"; roughly translated as "This is Dubai, Arab Amirates, here".

● TURKEY

The Voice of Meteorology, Ankara, operates on **6900** (43.47m) and has been heard with Turkish vocal music at 1850. The station is operated by the Turkish State Meteorological Service and broadcasts Turkish music and weather reports on the hour during the periods as follows – from 0500 to 0700, from 0800 to 1000, from 1200 to 1600 and from 1800 to 1930. The address is – P.O. Box 401, Ankara.

The Turkish Home Service can be heard from 0355 to 0600 on **11880** (25.25m) and on **9515** (31.53m) from 0800 to 1100.

Broadcasts in English, according to the schedule, can be heard from 1330 to 1400 on **17820** (16.84m) and from 2200 to 2230 on **9515** and on **15195** (19.74m).

The clandestine Bizim Radyo (Our Radio) operates on **5915, 6200, 9500** and on **9585**, according to BBCMS. All programmes are in Turkish, listen on either **6200** or **5915** (48.39m and 50.72m respectively) around 2030.

● NIGERIA

The Voice of Nigeria on **15185** (19.76m) may be heard with a programme in English at 0700 according to BADX.

Lagos on 4990 (60.12m) has been logged recently with an evangelical programme in English at 1940, complete with local preacher and choir.

● AUSTRALIA

Radio Australia can be heard daily at 0700 on **9570** (31.35m) when it was recently logged with 'Mailbag'.

Radio Australia can also be heard on **15240** (19.69m) around 2150 with a newscast.

The Pacific Islands Service was noted by us recently on **9590** (31.28m) at 2130 when the identification and intended target area were announced.

● KUWAIT

Radio Kuwait can be heard on **15345** (19.55m) at 1615 with African and Arabic news in English followed by 'pops'.

● TANZANIA

Radio Tanzania is to be heard on **15435** (19.44m) at 1900 with the news in English.

● SEYCHELLES

FEBA can be heard in English on **15435** (19.44m) around 1730.

● SENEGAL

Ziguinchor on **3336** (89.95m) can occasionally be logged here in the U.K. if conditions are right. The 4kW signal was recently heard at 1955 when a programme of marches, with announcements in French, were heard – also the surrounding utility transmissions!

● CHINA

Radio Peking was heard recently on **9965** (30.11m) with news of Vietnam in English at 1955; also heard on **15165** (19.78m) with a programme in an Asian dialect at 1640, similarly on **9020** (33.26m) at 2035; also on **9030** (33.22m) at 2344 with a programme in English.

● ROMANIA

Radio Bucharest can be logged, with the English programme, on **11940** (25.13m) at 2100, also in parallel on **9690** (30.96m).

● ANGOLA

CR6RG Radio Commercial de Angola may be heard on **4795** (62.57m) where it was logged by us recently at 1825 with a musical programme, identification at 1830.

● FRENCH GUIANA

The latest schedule of ORTF Cayenne (just to hand) is – Monday to Friday from 0915 to 1130 on **3385** (88.63m) and **4972.5** (60.33m); from 1500 to 1730 on **4972.5** and **6170** (48.62m); from 2030 to 0115 on **3385** and **4972.5**. Saturdays from 0915 to 1130 on **3385** and **4972.5**; from 1500 to 0200 on **4972.5**; from 1500 to 2030 on **6170**; from 2030 to 0200 on **3385**. Sundays from 1000 to 0115 on **4972.5**; from 1000 to 1200 and from 2030 to 0115 on **3385**; from 1200 to 2030 on **6170**. All transmitters are 4kW except **4972.5** which is 1kW only. (BADX).

● U.S.A.

WINB Red Lion has been reported on **17720** (16.93m) at 2055 with "Mail Call" in English and requesting reports; off at 2100. WINB has been logged by us at 2115 on **15185** (19.76m) with a sectarian sponsored programme and full identification at 2130.

● MOZAMBIQUE

Radio Clube Mozambique may be heard fairly regularly here in the U.K. on **4762** (63.00m) where it was recently heard by us at 2020 with a musical programme and announcements.

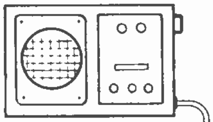
● MALI

Bomako can be heard on **4783** (62.72m), often logged here around 1900 or so with announcements in French, transmitter is 18kW.

● ITALY

Rome was recently heard here on **9710** (30.90m) with identification and programme in English at 1945.

In your workshop



This month Smithy the Serviceman, aided as always by his able assistant Dick, takes a respite from servicing work and discusses the latest batch of hints received from readers

"WHAT WE WANT IN THIS WORKSHOP," announced Dick, "is a microwave oven."

Smithy's assistant glanced down discontentedly at the last of his lunch-time sandwiches. Smithy, on the other hand, appeared to be entirely satisfied with his own mid-day fare, and he took a gargantuan bite out of his Wall's pork pie.

"What on earth," he asked indistinctly, "do we need a microwave oven for?"

"So that we can warm up things to eat."

"Such as?"

"Well," said Dick reflectively, "things like pasties or beefburgers or shish-kebabs. Things like that."

"Humph," grunted Smithy, taking a further bite and masticating vigourously. "I think it would be better to let matters stay as they are. Besides, these microwave ovens are a bit too expensive for just warming up odd pasties and beefburgers. What were those other things you mentioned?"

"Shish-kebabs."

READERS' HINTS

Smithy frowned, and a look of determination spread over his face.

"I don't think," he remarked resolutely, "that I'll take this conversation any further. I've got a funny feeling that, if I do, I'm liable to encounter things which are even more mind-bending. We shall now change the subject."

Smithy put the last of his pork pie into his mouth, poking it in to its entirety with the tip of his index finger.

"All right," returned Dick, hastily averting his eyes. "We'll talk about something else, then. What do you suggest?"

But there was no response from the Serviceman, and Dick had to wait a full thirty seconds before, with one last prodigious swallow, Smithy finally despatched the remnants of the pie. He next proceeded to pick up his disgraceful tin mug, from which he drank noisily.

"Ye gods," exclaimed Dick, disgustedly. "The R.S.P.C.A. ought to put out special drinking bowls for people like you. Anyway, what *do* you suggest we talk about?"

"I can think of an excellent topic," responded Smithy, obviously refreshed by his repast. "What about readers' hints?"

Dick immediately forgot all his grievances about his lunch-time food.

"Readers' hints?" he repeated enthusiastically. "Why, that would be smashing, Smithy. It's ages since we last had a go at those."

"It *is* rather a long time," agreed Smithy. "As it happens, quite a few hints have come in since our last session, so if you'd be good enough to fill my mug for me I'll go and sort them out."

Eagerly, Dick took up Smithy's mug and carried it over to the sink, alongside which were ranged the cracked and battered culinary effects of the Workshop. Whilst Dick replenished Smithy's mug, that worthy opened a drawer in his bench and took out a sheaf of letters. He was already glancing through the uppermost letter in the pile when Dick returned and placed Smithy's mug, now recharged with the precious fluid so necessary for the Serviceman's well-being, down on his bench. Drawing up his stool, Dick settled himself alongside the Serviceman.

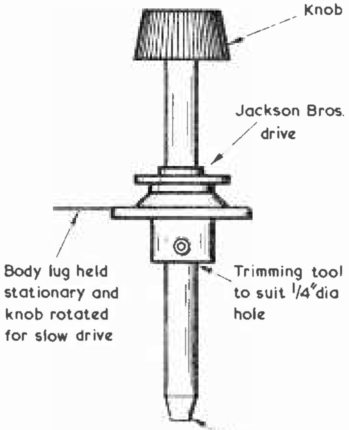


Fig. 1. An unusual trimming device which enables critical adjustments to be carried out

"Here," remarked Smithy looking more closely at the letter in his hand, "is a good one to start off with. It's an idea for a trimming tool, and there's a diagram of it in the letter."

Smithy showed Dick the diagram. (Fig. 1).

"I'll read out what the letter says," he continued, "'When re-aligning or peaking coils or trimming capacitors in radio receivers, difficulty is sometimes encountered in accurately tuning these. This is particularly true if the final trimming position is very sharp, and it is often difficult not to over-adjust and go beyond the peak. In cases like these it isn't always possible to know whether the trimming is as accurate as it should be. A simple solution is to use a slow-motion drive as shown in the sketch. This can consist of a knob and a Jackson Brothers ball drive type 4511 or 4511/F coupled to a non-metallic trimming tool. It is an easy matter to use the device. Simply locate the trimming tool on the trimmer or coil core to be adjusted, then turn the body of the ball drive for initial rough trimming. Finally, hold the body of the ball drive stationary with one hand and turn the knob with the other to obtain fine adjustment. With the Jackson drive, the step-down ratio in rotation is 6:1. In circuits where hand-capacitance is evident an extra-long plastic trimming tool is required. The slow motion drive can, of course, be of a different type offering possibly a higher ratio, but the one used here is about the cheapest and simplest that can be obtained'."

Smithy put down the letter and took up his mug, from which he drank deeply.

"That," remarked Dick warmly, "was a jolly good idea. What's the next hint, Smithy?"

Smithy placed his mug on the bench and examined the next letter.

"This," he chuckled, after some moments, "is another of the toothpaste tube hints."

"What d'you mean?"

"It's yet another scheme," grinned Smithy, "for using the screw tops from toothpaste tubes. I sometimes wonder whether the chaps who design these screw tops realise how many uses radio construction enthusiasts find for them! This present one is particularly neat and takes advantage

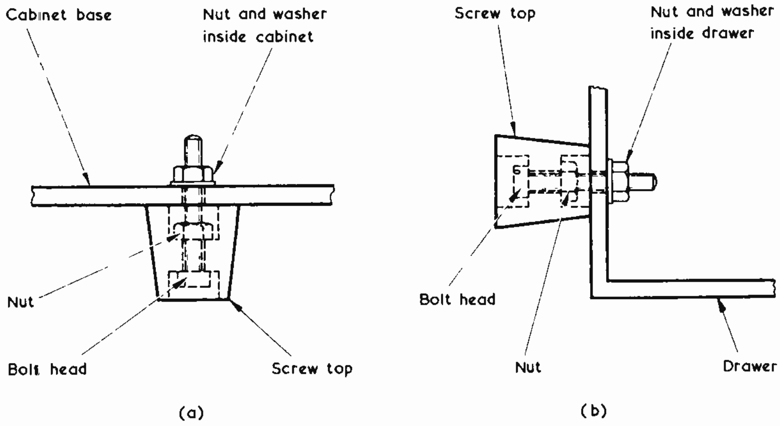


Fig. 2 (a). Toothpaste tube screw tops with recesses in the head make excellent cabinet feet

(b). The screw tops may also be used as knobs for small drawers

of the fact that many toothpaste tube screw tops nowadays have a tapered shape with a considerable recess in the top side. This makes it possible, after a hole has been drilled through the centre of the screw top, to fit a nut and bolt to it with the bolt head completely inside the recess. Four screw tops mounted in this way may then be employed as cabinet feet, whereupon they give a colourful finish to any cabinet with which they are used and also ensure that it doesn't scratch any surface it's placed on. If you keep components or nuts and bolts in small drawers, the screw tops can also be used as drawer knobs. In this case, they're turned round so that the wider part is on the outside."

Smithy passed the letter over to Dick, who looked closely at the two sketches in it. (Figs. 2 (a) and (b).).

"And here," went on Smithy, picking up a third letter, "is an idea which, whilst not being entirely new, is certainly worthy of being more widely known and acted upon than it is. It's a safety precaution and it has to do with panel-mounting fuseholders."

"Panel-mounting fuseholders?" repeated Dick in some surprise, as he handed the previous letter back to Smithy. "I shouldn't have thought you could have anything much safer than a panel-mounting fuseholder as it stands. So far as the front of the panel is concerned, all the fuseholder innards are covered and completely insulated. How is it that you need a safety precaution?"

"The innards are covered and completely insulated," Smithy corrected him, "only when the fuse is inserted and the cover is screwed up. The time when accidents are liable to happen is when you're inserting or removing the fuse."

Smithy indicated three sketches in the letter. (Figs. 3 (a), (b) and (c).).

"If the panel-mounting fuseholder is in a high voltage circuit," he went on, "you should never connect the source of voltage to the fuseholder contact which is nearer the panel. This is because the inside end of the fuse may touch the associated metal thread when it is being inserted or withdrawn. If the fuse is good the outer contact, which is not at this stage inside the housing, becomes connected to the source of voltage and the person handling the fuse can get a nasty or even dangerous shock. The source of voltage should connect to the *rear* fuseholder contact. The fuse cannot then make contact to it until it's nearly fully inserted, at which point all the internal connections are completely covered by the insulated parts of the fuseholder."

"Gosh," remarked Dick. "That's something I'd never thought of before. I'll be careful when wiring up these fuseholders in future. Particularly if they're in mains circuits."

"I should," recommended Smithy. "I know that you're usually supposed

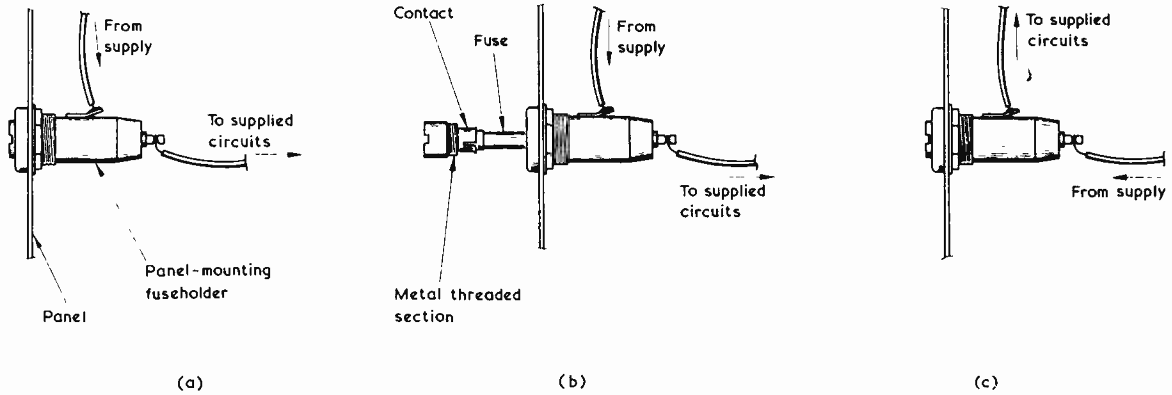


Fig. 3 (a). If a panel-mounting fuseholder is in a supply circuit having a high voltage with respect to earth, the method of connection shown here should never be used

(b). This is because, if the fuse is not blown, a large metal surface area outside the fuseholder can momentarily take up the high potential when the fuse is being fitted or withdrawn

(c). With the correct method of wiring the fuseholder shown here, in which the supply is applied to the rear contact, connection to the supply voltage is only given when the fuse is nearly fully inserted

to switch off before you fit or take out a fuse, but it's easy to forget to do this. Also, in some mains-operated equipment the fuse may appear on the mains side of the on-off switch."

SHUNT STABILIZER

Smithy put down the letter and took a further copious draught from his mug. A morose expression suddenly appeared on his features.

"It's no good," he sighed. "My curiosity, as always, is getting the better of me. What in heck are shish-kebabs?"

"Shish-kebabs?" repeated Dick. "Why, a shish-kebab is a lot of bits of meat and stuff all impaled on a skewer. They eat shish-kebabs out in Egypt and places like that."

"Then," remarked Smithy, "even if we did have a microwave oven, I hardly think we'd be able to warm up exotic Eastern foods like shish-kebabs. So far as suppliers of cooked food are concerned, all we've got in this locality are a Wimpy, an Indian restaurant which serves Vesta curries and a take-away Chinese kitchen which just sells chicken and chips with noodles."

"You're forgetting Joe's Caff."

"Joe's Caff," repeated Smithy incredulously. "Isn't Joe the chap who keeps changing that scruffy old place of his around and who gives it a different name each time?"

"That's right."

"Since when has Joe been selling Egyptian food?"

"For quite a long time now," replied Dick. "He got the idea after hearing how popular this Egyptian Tooting Common show up in Smoke has been. He reckons that if people are as interested as that in Egyptian things he's going to cash in on it."

"I knew it," said Smithy regretfully. "I *knew* it! I should have had enough sense to have dropped this conversation at the shish-kebab stage. Now, I've *got* to keep on. At least, however, I can try to straighten things out as I go along. To start off with, that business up in London is not a show, it's an Exhibition and it's showing the treasures taken from Tutankhamun's Tomb. Tutankhamun, you should know, was a king of Egypt around 1400 B.C., and he died before he was twenty."

"Did he?" replied Dick politely, and without the slightest trace of interest. "Well, you know what Joe's like when he gets an idea into his head. He's changed his place round now so that it's all Egyptian. He's got Egyptian style pictures on the walls. Right queer pictures they are too, with geysers in smocks and dog's heads on them, and palm trees and oases in the background. Also, he's given new names to his regular dishes."

Smithy gritted his teeth.

"Tell me."

"Let's think now," said Dick. "Ah yes, well, there's Cairo Collation."

"What's that?"

"Egg and chips. Then there's Alexandria Appetiser."

"Go on."

"That's beans and chips. Then there's Sahara Special, which is pie and chips."

Dick paused, and a glint of naked voraciousness gleamed in his eyes.

"The best of the lot," he went on droolingly, "is Sarcophagus Supreme."

Smithy raised his eyes to the ceiling.

"I'll have to know," he groaned. "What's Sarcophagus Supreme?"

"It's egg, beans, pie and two lots of chips, together with three good dobs of chop sauce on the side of the plate!"

"That's enough," said Smithy hurriedly. "That's *more* than enough for now. Let's get back to those hints again."

"As you like," said Dick equably. "Still, you have to agree that old Joe does have a bit of style about him."

"I wouldn't argue about that," retorted Smithy. "Anyway, let's get on with the next letter."

Firmly, he turned his attention to the next letter in the pile on his bench. As he read it, all thoughts of the activities of the innovation-prone Joe passed from his mind.

"Ah," he said keenly. "This is a good one, too. You'd better have a look at the circuit that goes with it."

Smithy removed a circuit diagram which had been clipped to the letter and passed it over to his assistant. (Fig. 4 (a).).

"This circuit," he went on, "is for a novel stabilized power supply. The voltage on the zener diode is passed to the two transistors, each of which is connected as an emitter follower. TR1 is a power transistor, such as the OC28, whilst TR2 is a smaller transistor, and could be, say, an ACY18. Neither type is critical provided it can cope with the voltages and currents in the circuit. TR2 needs a reverse base-emitter voltage rating that is greater than the zener diode voltage. The zener diode voltage is present across the 400μF capacitor and will be applied as a reverse voltage to the base and emitter of TR2 if the stabilized output should be accidentally short-circuited. Incidentally, the maximum reverse base-emitter voltage for the ACY18 is 12 volts."

"I think I can see," said Dick frowning, as he concentrated on the diagram, "how this works. Since TR1 and TR2 are emitter followers, the zener voltage, plus the small forward voltage drops in the base-emitter junctions of the two transistors appears at the emitter of TR1."

"That's right," confirmed Smithy. "The series resistor Rx is given a value which causes slightly more than the maximum desired output current to flow through it. To take an example, let's assume that we want a stabilized output at around 10 volts with a maximum current of 100mA, and that the

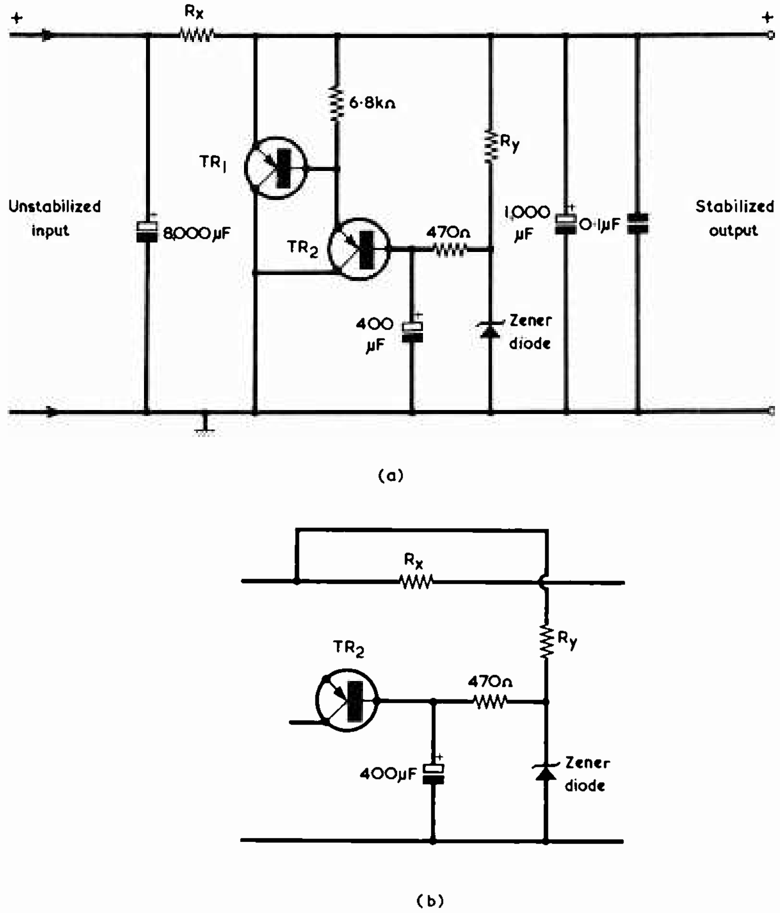


Fig. 4 (a). Experimental stabilized power supply circuit. The value of Ry should be chosen to suit the zener diode employed

(b). To ensure a greater voltage drop across it, Ry could, alternatively, be returned to the left hand side of Rx

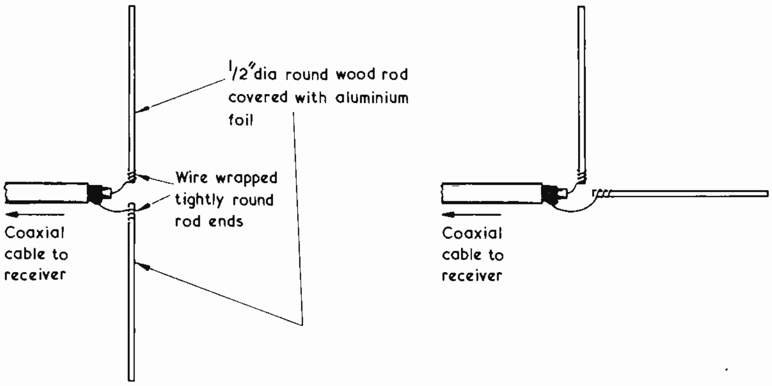
unstabilized input voltage is approximately 15 volts when, say, 125mA is drawn from it. We can choose a zener diode just below the 10 volt level, whereupon the emitter of TR1 is 10 volts above chassis. Let's next give Rx a value of 40Ω. This will cause our current of 125mA to flow through it. If no output load is connected, practically all this 125mA will flow through TR1. If an output load is connected, some of the 125mA will flow through it and the remaining current will flow through TR1, but the output voltage will still remain the same. If the maximum output current of 100mA is drawn, only 25mA will now flow through TR1, but the output voltage will still be the same."

"Blow me," said Dick enthusiastically. "That's neat! All the time you've got the same current flowing through Rx, which means that the load on the unstabilized input remains constant."

"Exactly," confirmed Smithy. "This factor will assist in obtaining good stabilization. With the figures I've used the dissipation in Rx is 5 volts multiplied by 125mA, which comes out to – let me see now – 0.625 watts. For zero output current the dissipation in TR1 is 10 volts multiplied by 125mA, which is equal to 1.25 watts. This would require TR1 to be mounted on a smallish heat sink, and an incidental advantage of the circuit is that the collector of TR1 is at chassis potential, whereupon it can be bolted direct to the power supply chassis. The chassis will then act as a heat sink."

"I see," remarked Dick, "that the zener diode series resistor, Ry, is returned to the output voltage. But that voltage will only be a little higher than the zener voltage itself."

"True enough," agreed Smithy. "The zener current is the sum of the current through this resistor plus the small base current for TR2, and in most practical cases the latter could be ignored. The circuit is in the experimental category, and it might be of interest to return the zener series resistor to the unstabilized end of Rx instead. It will, of course, require a value which does not cause zener diode dissipation to be excessive. In most cases the zener diode could be a 400mW type." (Fig. 4 (b).).



(a)

(b)

Fig. 5 (a). An indoor TV aerial for Bands I and III can be made as shown here. The aerial is a half-wave diople

(b). If space is limited, the lower section may be at right angles to the upper section

POLYSTYRENE TILES

Smithy put the letter to one side and picked up another, which he read carefully.

"Now this is another interesting one," he announced after some moments, "and I think that the best thing I can do is to read out the letter to you as it stands. 'Here are some suggestions,' our correspondent starts, 'which you might find of value and they concern the usefulness of polystyrene ceiling tiles in the construction of electronic devices. The large surface area of polystyrene tiles allows them to dissolve rapidly in solvents like xylene or benzene, which are available from chemists. A strong trickly solution is given which, when painted on wires and on the underside of printed circuit boards, forms a quick-drying insulating film which prevents short-circuits.' "

"That," remaked Dick, "sounds to me like a jolly useful dodge. Those polystyrene tiles aren't all that expensive, either."

"There's more to come yet," commented Smithy, as he continued to read through the letter. "Another suggestion here points out that a polystyrene tile forms a useful components 'park' whilst one is constructing a project. Components can be jabbed into the tile by their wires instead of lying around and getting lost. A piece of thin paper placed over the tile can be written on to identify the components and the constructor can then easily tell what components have been used. Yet a further idea is that projecting wires on the underside of a printed circuit board can be exploited for anchoring the board to a polystyrene tile when the board is under test. This is far better than having the board flap around on a bench amongst bits of wire, beads of solder ,and all the other things which tend to clutter up the surface of a bench."

"Stap me," remarked Dick elegantly. "Those ideas certainly take full advantage of polystyrene tiles. I particularly like the last one. Loose printed circuit boards can be an awful menace on the bench, particularly if they're small ones."

"They can be a nuisance," concurred Smithy, reaching for another letter. "Now, what have we here? Ah yes, this is one of those nice simple ones which often prove to be amongst the most useful of all. The idea is for an indoor Band I - Band III TV aerial. All it consists of is a half-wave dipole, and each element is made up of ½ inch diameter wooden rod around which is wrapped aluminium cooking foil."

Dick leaned over and examined two sketches which Smithy had taken from the letter and laid out on his bench. (Figs. 5 (a) and (b).).

"The advantage of this approach," Smithy continued, "is that each section of the dipole has an adequate width for reasonably broad band reception of the channel for which it is resonant. At the same time, the materials employed are inexpensive and easy to obtain. The foil can, of course, be secured at various points along the length of the wooden rods by Sellotape or similar adhesive tape. The bottom section of the aerial need not be vertical. If it is found more convenient, it can be at right angles to the top section."

"What about the lengths of the sections?"

Smithy stood up, leaned over his bench, and took a copy of "TV Fault Finding" from the shelf above it.

"Each section of the aerial," he replied, as he turned the pages of the book, "will be a little shorter than a quarter-wave. But there's no need to work out the lengths because they've been listed here in the chapter on aerials. Let's see now. Here we are: the length of each section should be 5 feet 2 inches for Channel 1, 4 feet 6 inches for Channel 2, 4 feet 3 inches for Channel 3, 3 feet 9½ inches for Channel 4 and 3 feet 6½ inches for Channel 5."

"What," asked Dick, "about Band III?"

"For Band III," replied Smithy, "the lengths are 1 foot 3¾ inches for Channel 6, 1 foot 3¼ inches for Channel 7, 1 foot 2¾ inches for Channel 8, 1 foot 2¼ inches for Channel 9, 1 foot 1¾ inches for Channel 10, 1 foot 1¼ inches for Channel II, 1 foot 1 inch for Channel 12 and 1 foot and ¾ inch for Channel 13. You'll probably find that an indoor aerial of this kind won't be so good at Band III as it is at Band I. If you're lucky, an indoor aerial made for a local Band I transmission will cope reasonably well at Band III, even though it won't be properly resonant at the Band III frequency. Blimey, all this talking has made me thirsty!"

POOL ALARM SYSTEM

Smithy reached over and took an enormous draught from his tin mug.

As he placed the mug back on his bench, a thought struck him.

"I know I'm tempting Providence," he said reluctantly, "but there's one final thing that I must know about Joe's Caff before I finish."

"Oh yes," said Dick, "and what's that?"

"Well," continued Smithy, "when Joe changes his place round he always gives it a new name. Has he done so this time?"

"He has," confirmed Dick, "and what's more he's chosen a really smashing one, too. It sounds all Egyptian and mysterious."

"What's he called it?"

"He's called his place 'The Sphinx's Inscrutable Smile'."

Smithy looked impressed.

"I must say," he remarked approvingly, "that sounds very effective. Is there any reason for this choice?"

"Oh, definitely," replied Dick. "Apparently there's some ancient Egyptian folklore involving the Sphinx, together with the sands of the Nile and the gloom of the camel."

"Is there?" commented Smithy. "I must say that you can always give Joe credit so far as the picking of names is concerned."

His curiosity satisfied, Smithy returned to his letters.

"Now, here," he remarked, as he perused the next letter, "is quite an unusual one, and it comes from a reader who lives in Australia. Our correspondent has a swimming pool, and he wanted a device which would indicate when, during refilling, its level had reached a certain height. He took an old moving-coil meter, cut the pointer short and soldered a piece of hair spring wire onto it. Another contact was made from a brass pin inserted in a piece of Perspex, this being fixed so that the hair spring wire touched it when a current was passed through the meter coil. This sketch shows the idea."

Smithy pointed to a drawing in the letter. (Figs. 6 (a) and (b).).

"The water level sensing contact," he resumed, "is a brass tip sticking out of a piece of plastic tubing. This tip is held at the desired height by securing the tubing in one half of a pair of compasses, the tubing being passed through the part which normally holds the pencil. The level contact is wired to one side of the meter coil, which is sited some distance away from the pool. Only one wire between the level contact and the meter is needed, and the other side of the meter coil connects to a battery and thence to an earth connection."

"It's easy to see how this device works," broke in Dick eagerly. "When the water level reaches the brass tip a circuit is completed from the battery to the meter coil via earth and the water of the swimming pool. The meter pointer then moves over and the brass hair spring wire touches the insulated brass pin on the modified meter, thereby causing the bell to ring."

"That's right," said Smithy. "As you can imagine, the process of modifying the meter is one which should only be tackled by those who are capable of carrying out fine work. Incidentally, this letter says that the prototype set-up has been in use successfully for a long time now. Since it is battery operated, there is no risk of any mains leakage into the pool."

"I wonder," queried Dick, "what sensitivity the meter should have."

"I would suggest that something like a 0-1mA movement would be the sort of thing required," replied Smithy. "The current through the meter coil when the water completes the circuit would be mainly limited by the resistance between the water and the contact tip. I would think also that it would be a good idea to measure that current by inserting an additional meter in series. If the current passing through the meter coil was well in excess of the f.s.d. value for the meter before it was modified it would be wise to insert a fixed resistor in series to limit it to, say, about twice the f.s.d. value."

"Are there any more hints?"

Smithy looked at the letters on his bench.

"There's just one I haven't dealt with," he remarked, picking up the final letter. "Now let's have a look at this."

Smithy read the letter carefully.

"This letter points out," he said, "that the construction of odd projects purely for fun tends to be rather expensive if Veroboard or printed circuit board is used. An alternative method is to make up the project on cardboard or similar material, the various connections being made to brass eyelets. The eyelets recommended have coloured heads and an inside diameter of slightly more than an eighth of an inch, and are available from most tool shops in packets of several hundred together with a pair of eyelet pliers. It is very easy to affix a number of these eyelets to a piece of cardboard, whereupon the components can be soldered to the unpainted brass sections. Here are a few samples which have come with the letter."

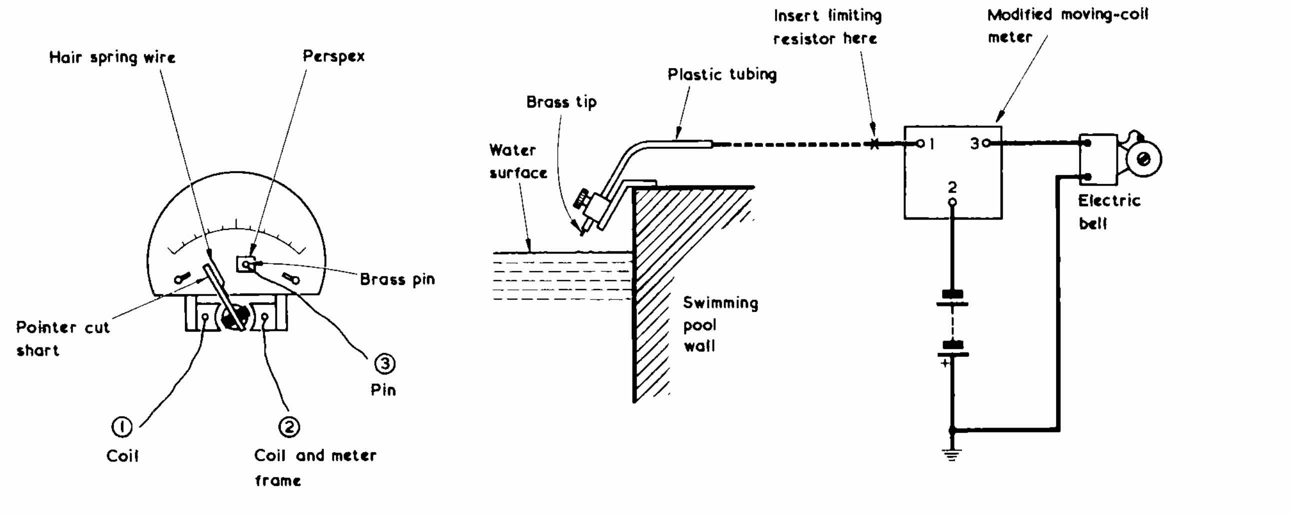
Smithy passed an eyelet, and some small pieces of cardboard to Dick, who examined them with interest. (Figs. 7 (a) to (d).).

"The brass parts of these eyelets," he remarked, "open out into six parts after the eyelet pliers have been applied."

"That's right," agreed Smithy. "You'll notice one of those sample cards has a circuit drawn out on it. If the eyelets are inserted at the drawn circuit junctions, the components corresponding to the circuit symbols can then be soldered to them."

"Blow me, that's neat," exclaimed Dick. "There's another piece of cardboard here which has the word 'Tagstrip' written on it."

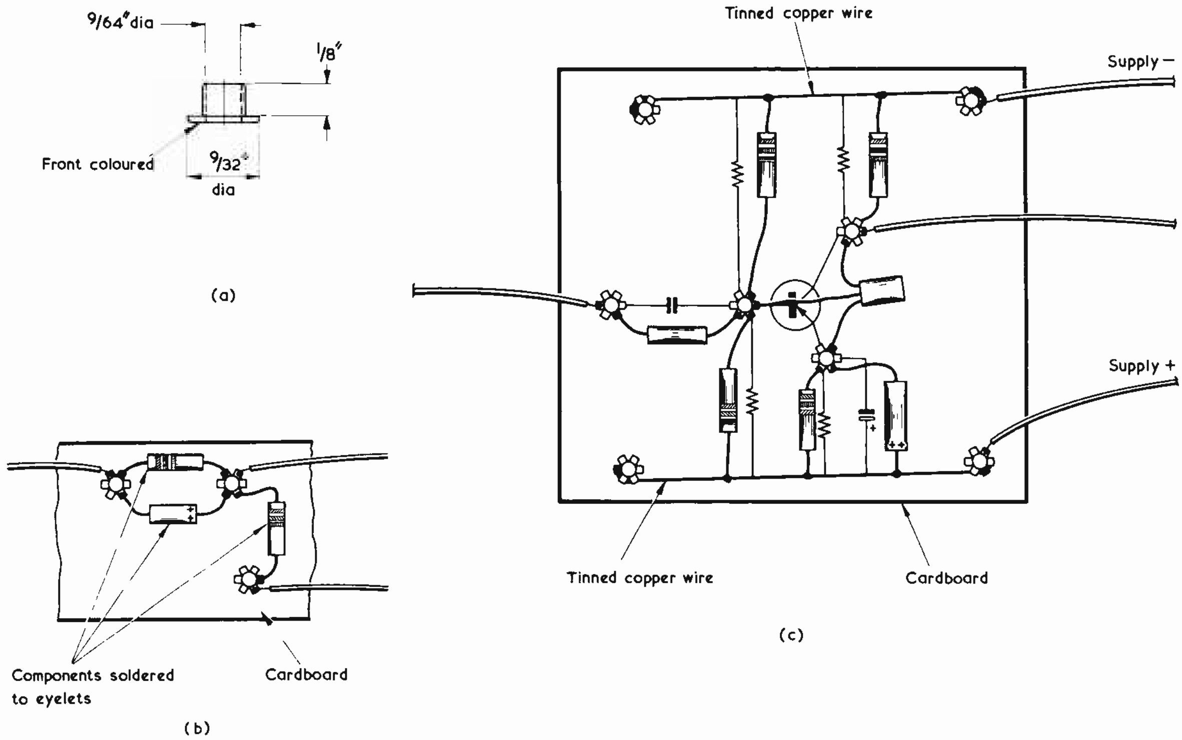
"Ah yes," said Smithy, consulting the letter. "That's another application for the eyelets. The coloured heads on



(a) (b)

Fig. 6 (a). A water level sensing device incorporates a moving-coil meter modified in the manner shown here

(b). The complete circuit of the water level sensing device. It is advisable to monitor current flow at the point marked with a cross and, if necessary, then insert a suitable current limiting resistor at this point



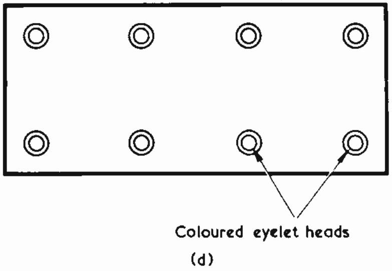


Fig. 7 (a). Brass eyelets mounted on cardboard may be employed for temporary circuits where a high level of insulation is not necessary. Approximate dimensions of a suitable eyelet size are given here

(b). Components are soldered to the turned-over sections of the eyelets

(c). A circuit can be initially drawn on the cardboard first, after which eyelets are inserted at circuit junctions and the components added to agree with the circuit. Tinned copper wires, each between two eyelets, provide negative and positive supply busbars

(d). A 'tagstrip' can be made up using the eyelets. Their coloured heads may be employed to provide a wiring colour code

the other side can then be used to form a wiring code. Crafty, isn't it?"

LAST WORDS

"I'll say," replied Dick enthusiastically, "We've had some jolly good hints today, Smithy, haven't we?"

"Definitely," replied Smithy. "Still, we always do have useful hints sent in to us. I must confess I enjoy these hint sessions."

"So do I," said Dick warmly. "They make a real break from the normal run of things."

Smithy rose and, with an air of finality, gathered up the letters he had just read and returned them to the drawer in his bench. He chuckled as a thought occurred to him.

"I wonder," he queried, "what will be the next craze old Joe gets up to."

"From what he was saying a couple of days ago," replied Dick, "he's already fed up with this Egyptian bit, and he's soon going to change his place over to something that he feels is more in keeping with the current scene."

"Why don't I keep my big mouth shut," groaned Smithy. "Now I've *got* to ask you what his next theme will be."

"It will be Women's Lib."

Smithy winced.

"And has he," he faltered, "chosen the new name for his place yet?"

"He has," replied Dick. "He's going to call it 'The Nonsuch Brasserie'!"

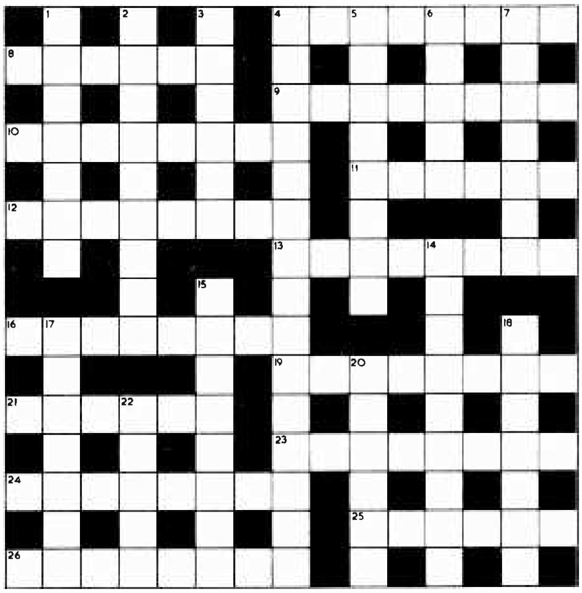
EDITOR'S NOTE

The hints described in this episode of 'In Your Workshop' were submitted, in the order in which they appear, by I. G. Bennett, Vincent S. Evans, S. G. Peters, L. Cook, E. Switalski, F. Howard, B. A. Peach and B. K. Langley.

Further hints for this feature are welcomed and payment is made for all that are published.

The book 'TV Fault Finding' is published by Data Publications Ltd. ■

R. C. CROSSWORD



Clues Across

4. Shunt connection applicable also to bars. (8)
8. Bring on as a consequence. (6)
9. Too much of this feedback causes howls. (8)
10. Benders or twisters in crystal microphones. (8)
11. Even upset timers have their virtues. (6)
12. Ultimate demise of the transmitter p.a. section. (5, 3)
13. Complete harmony, despite having ac. or d.c. in a muddle. (2, 6)
16. Virtually, f.e.t. cut-off. (5-3)
19. Dielectric with permanent poles. (8)
21. Temporary circuit-checking assembly (if initially changed, can indicate frequent result!). (4-2)
23. Draws out (e.g. teeth). (8)
24. Resident engineers do this to equipment. (8)
25. The Yaxley switch is essentially this. (6)
26. Second dip in the solder-pot. (8)

Clues Down

1. Hold back, as at a gate input where output is suppressed. (7)
2. This receiver scans a wide frequency range. (9)
3. Pass away, as with time. (6)
4. Any number from zero to 360, lag or lead! (5, 10)
5. Add a square and this defines effective a.c. amps or volts. (4, 4)
6. In its early days was fondly referred to as 'lolly acquisition scheme for expensive research'. (5)
7. Points in for p.n.p., points out for n.p.n. (7)
14. What one of '18 Down' does after switch-off. (9)
15. Amplification in a closed path. (4, 4)
17. A diode can do this by passing signals in only one direction. (7)
18. The last things transistors want are these valve essentials! (7)
20. Complete. (6)
22. '18 Down' are inserted in cylinders made of this metal. (5)

(For Solution see overleaf)

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Radio Topics

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MANY CONSTRUCTORS BUILD THEIR equipment direct from published designs, and obtain a considerable amount of satisfaction from the process. Others like to design all their equipment for themselves and this is an approach which gives even greater pleasure, since the enjoyment of construction is enhanced by a quality which more closely approaches the creative. I, myself, belong to both categories although, over recent years, I have devoted myself more to the assembly of home-brewed designs. Many of these have, however, been assisted by published designs including in particular, basic text-book circuits and manufacturers' Application Notes.

LOGICAL APPROACH

If you are going to design your own equipment it is well-nigh essential to adopt a logical approach. You must first say to yourself what exactly it is you are going to build and then sit down and work out its circuit. The circuit should be complete with component values. In some cases it is economical to use components, particularly the more expensive types, which are already on hand, and this can qualify one's approach to the design and its final specification. Such matters are, of course, the basic fundamentals of home construction.

No matter how keen you feel, it is always inadvisable to start an experimental project unless you have to hand *all* the components you think you'll need. It is frustrating, to say the least, to advance part-way with the construction of an item and then have to put it on one side until the missing parts can be obtained. It is far better to have all the components available, since the process of construction can then proceed unbroken.

Having acquired the parts, the next task is to work out the layout in which they will appear. This is another instance in which the wisdom of having all the components on hand becomes evident, since these can then be laid out physically and thus give a practical illustration of the dimensions required in the chassis, printed circuit board or Veroboard on which they are to be fitted. The layout must, of course, follow the usual common-sense rules required for successful functioning. Amplifier inputs should be kept away from amplifier outputs, a.c. mains wiring should not too closely approach unscreened high impedance a.f. input circuits, and so on. If some of the circuitry is experimental, leave a little more space for it than is required by the components you *think* it will need. It may well be that, in the end, the experimental section requires one or more extra resistors or capacitors than had been originally anticipated.

Next proceeds the actual work of construction. Assuming that the parts are to be assembled on a metal chassis, it is a good plan to complete all the metal-work before any components are mounted and wired. Even so, it sometimes happens that an extra hole or holes has to be drilled to accommodate some part which hadn't been foreseen. Great care should be taken to avoid damaging components which have already been mounted if this additional metal-work has to be undertaken. Should any air-spaced variable capacitors be fitted on the chassis, their vanes should be closed whilst carrying out additional metal-work, since these components are especially vulnerable to physical damage. And, of course, all drill-shavings, etc., must be removed after the metal-work has been completed.

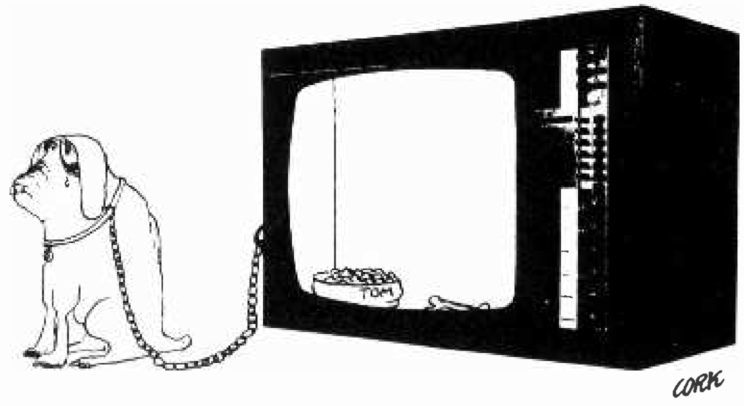
Eventually, the item is completed and is tried out. With luck, it will work satisfactorily at the first attempt, but it is more than likely that one or two components, especially resistors and capacitors, may require adjustment in value. The experienced experimenter will have calculated what the most likely components in this respect are likely to be, and he will have connected them into circuit temporarily only. It is quite possible that the final value required in a resistor or capacitor is one which is not available in the spares box. Under these final circumstances it is then quite in order (provided there is no risk of incorrect operation in r.f. circuits) to make up the values, temporarily again, with several resistors or capacitors in series or parallel to ensure that the correct performance is given from the electronic point of view. The item of equipment is then nearly complete and its circuit operation is proven. It only remains to obtain, on the next component shopping expedition, correct resistors and capacitors to replace the temporary ones, after which these can be finally soldered into circuit.

One thing is essential for experimental work, and that is a testmeter. Fortunately, testmeters with quite a reasonable performance are available at low cost these days and, provided they are employed with care, can be of invaluable help. Experimental work without a testmeter is virtually impossible, since one is then working completely in the dark.

SPARE METERS

Talking of testmeters reminds me that one of the most useful buys I have ever made, so far as experimental work is concerned, consists of two Government surplus panel-mounting meters, one having an f.s.d. of 100μA and the other an f.s.d. of 1mA, which I obtained very cheaply some 20 years or so ago. I still occasionally use one or other of these to monitor current in an item of equipment if I require my testmeter for other tests in that equipment. But I use those two meters much more frequently as *voltmeters*.

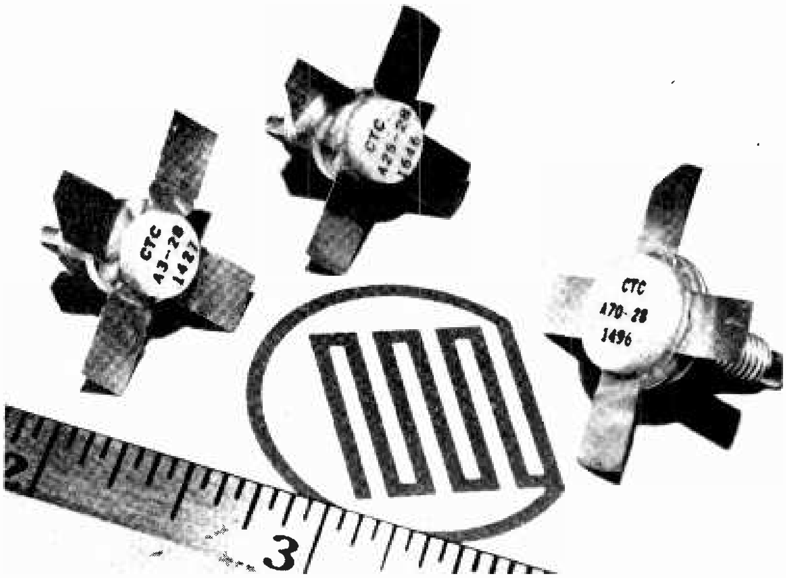
A typical instance arises if I want to keep an eye on the voltage at any part of the equipment I'm checking and I can't spare the testmeter for the job.



If, for instance, the voltage to be monitored is of the order of 6 to 7 volts, I take the 0-100μA meter, temporarily connect a 200kΩ variable resistor in series with it, and hook this combination across the two circuit points to be monitored. It is important to ensure, at this stage, that the variable resistor inserts maximum resistance into circuit. I also connect my testmeter, switched to an appropriate volts range, across the same circuit points; after which I reduce the resistance in series with the 0-100μA meter until it gives a reading corresponding to that in the testmeter, i.e. 60μA with 6 volts, 70μA with 7 volts, and so on. The 0-100μA meter may then be left in circuit to function as a 0-10V voltmeter. If the voltage to be monitored is less than 1 volt, I temporarily connect a 20kΩ variable resistor in series with the meter and carry out a similar adjustment to produce a 0-1V voltmeter.

Should the circuit being monitored be able to withstand a higher meter current, the 0-1mA meter can be employed in the same way. This time the series resistance required is one-tenth of that needed for the 0-100μA meter.

All of which goes to show just how easy it is to make up one's own test voltmeter incorporating a panel-mounting meter. One simply needs to fit the meter in an insulated case and provide series resistors for each voltage range required, each resistor being terminated in a separate socket. The other terminal of the meter is connected to a 'common' socket. A 0-100μA meter would be better than a 0-1mA meter for an application like this because, apart from the smaller current it draws, the series resistors dissipate an extremely low wattage. The series resistor for a 0-100V range would, for instance, be 1MΩ and, at meter f.s.d., this would dissipate only one-hundredth of a watt!



Three new power transistors introduced by EMI-Varian for operation at 30-80 MHz. (See 'R.F. Power Transistors')

R.F. POWER TRANSISTORS

EMI-Varian announce the introduction of three new communications power transistors. These, shown in the accompanying photograph, are specifically designed for operation in broadband Class C or linear power amplifiers over the lower v.h.f. range, and are now available from EMI-Varian Limited, Hayes, Middlesex.

Operating from 28 volts and covering the frequency range of 30 to 80 MHz, the devices are the 3 watt type A3-28, the 25 watt type A25-28 and the 70 watt type A70-28. When used in a chain consisting of one 3 watt, one 25 watt and two 75 watt devices, a 140 watt output is achieved from an 0.2 watt input.

All the devices are 100% tested and guaranteed to withstand infinite v.s.w.r. at all phase angles when operated at 80 MHz, 28 volts rated power. Other features include reliable passivated single chip construction, greater high frequency performance in low inductance hermetic stripline packages, and optimized power distribution via graded nichrome resistors.

PATIENT WEIGHING

From Finland comes an interesting story concerning electronic equipment for the weighing of hospital patients. As can be readily imagined, an important measurement in many intensive care situations is the stabilizing of a patient's weight, and this has been particularly difficult in the treatment of burns, pre- and post-operative therapy, pediatrics and geriatrics, dialysis and intravenous treatment. The patient under treatment can now, however, be weighed with a minimum of disturbance whilst still in bed with the aid of the Datex WM-104 Patient Weighing System.

The weighing system comprises four strain gauge load cells, which can be slipped under the legs of the bed, and an electronic control and display unit. Signals from the four load cell transducers are conducted to the control unit to tare and weight circuits and amplified to provide a readout on a panel meter. (Tare, in this case, is the weight of the bed and bedding without the patient). The patient's weight is determined in kilograms and grams (after electronic cancellation of tare) by zeroing the meter panel deviation. Weight is displayed to six decimal figures with a maximum patient weight of 170kg. and a maximum tare-plus-patient weight of 370kg. The meter reading sensitivity is better than 10g. and with a separate suitable recorder the sensitivity is 1g.

Changes in weight can be shown directly on the panel meter, or from an external recorder, or they can be entered into a computer via a digital voltmeter. Several equipments can be connected to a central monitoring station and optional features include a weight change alarm system, a recorder, a carrying case for the transducers and a stand for the electronic control unit.

In Helsinki University Hospital the fluid balance of patients with 70% burns has been controlled successfully using this system. The readout is not seriously affected by patient movement or temperature fluctuations and the system can be installed in less than 30 seconds without disturbing the patient. The transducers can be sterilised by gas or liquids and, as they are connected only by cable, can be used with any bed or other equipment such as an incubator.

Further details on the equipment are available from Datex Oy, P.O. Box 10, 02100 Tapiola, Finland. ■

Solution to the puzzle on page 757.

ACROSS. 4, Parallel; 8, Entail; 9, Acoustic; 10, Bimorphs; 11, Merits; 12, Final end; 13, In accord; 16, Pinch-off; 19, Electret; 21, Mock-up; 23, Extracts; 24, Maintain; 25, Rotary; 26, Replunge.

DOWN. 1, Inhibit; 2, Panoramic; 3, Elapse; 4, Phase difference; 5, Root mean; 6, Laser; 7, Emitter; 14, Contracts; 15, Loop gain; 17, Isolate; 18, Heaters; 20, Entire; 22, Konel.

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4mfd	10V	3p	100mfd	25V	4p
4mfd	25V	3p	100mfd	50V	8p
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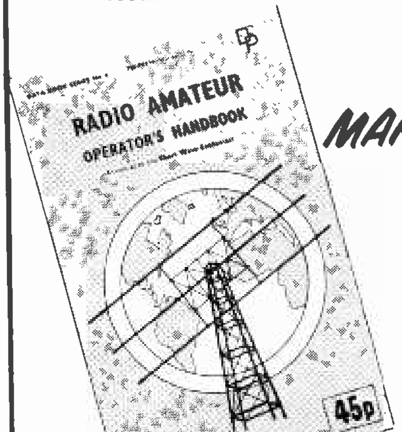

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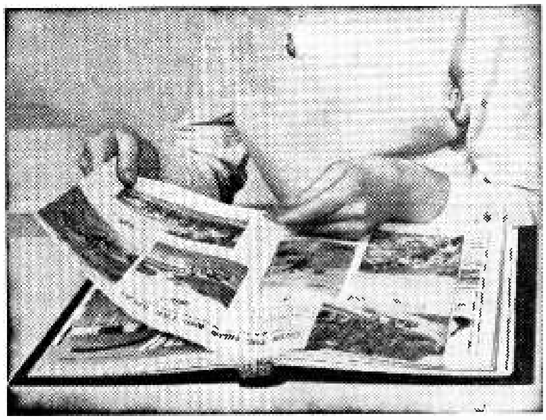

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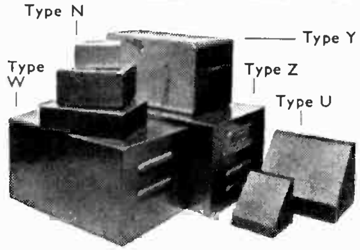

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8x4x2″	38p	19p	13x8x2½″	76p	38p
8½x5½x2″	44p	21p	14x7x3″	80p	36p
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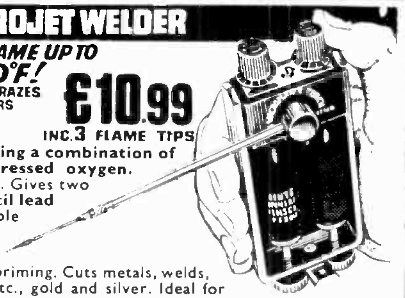

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CAN ANYONE HELP?

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CONSTRUCTOR'S DATA SHEET

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Copper Wire Data II

Completing the Copper Wire Data series, the Table gives simplified data for wires from 25 to 39 s.w.g. The diameters given for enamelled wire are the mean of upper and lower tolerances for synthetic enamel 'M'. The minimum turns/in. figures are estimated, to the nearest quarter turn. All other values are nominal. The current figures are based on 1,000 amps per sq. in. (This augments Data Sheet 18, published December 1968).

S.W.G.	*Diameter plain (in.)*	*Diameter plain (mm.)*	*Diameter enamelled (in.)*	*Min. turns/in. enamelled*	*Min. turns/in. enamelled s.r.c.*	*Resistance per 1,000 yds. at 20° C (ohms)*	*Current rating (amps)*
25	0.020	0.5080	0.0223	44	42.5	77.78	0.3142
26	0.018	0.4572	0.0201	48.25	46.75	96.03	0.2545
27	0.0164	0.4166	0.0184	52.5	50.75	115.68	0.2112
28	0.0148	0.3759	0.0167	58.5	56.5	142.05	0.1720
29	0.0136	0.3454	0.0155	63	61	168.22	0.1453
30	0.0124	0.3150	0.0142	68.5	66.25	202.4	0.1208
31	0.0116	0.2946	0.0133	73.0	70.5	231.2	0.1057
32	0.0108	0.2743	0.0125	77.5	74.5	266.7	0.0916
33	0.0100	0.2540	0.0116	83.25	79.5	311.1	0.0785
34	0.0092	0.2337	0.0107	90	86	367.6	0.0665
35	0.0084	0.2134	0.0099	98	93.5	441.0	0.0554
36	0.0076	0.1930	0.0090	107.5	101	538.7	0.0454
37	0.0068	0.1727	0.0081	119	110	672.9	0.0363
38	0.0060	0.1524	0.0071	135	123.5	864.3	0.0283
39	0.0052	0.1321	0.0063	151.5	137	1,150.7	0.0212

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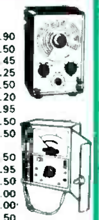

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AF105	50K/Volt Multimeter	£8.50
	With case	£9.50
U4341	AC/DC Multimeter with transistor tester with steel case	£10.50
TE20D	RF Generator 120KHz – 500MHz Carr 35p	£15.95
TE22D	Audio Generator 20Hz – 200KHz. Carr 35p	£17.50
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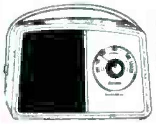

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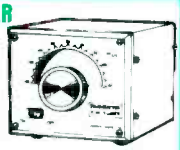

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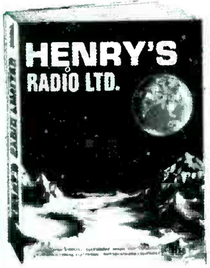

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