

THE

RADIO CONSTRUCTOR

Vol. 24 No. 2

SEPTEMBER 1970

3/6



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1. Gram Amplifier (Illustrated Above)
2. Tone Control Pre-Amplifier (October Issue)
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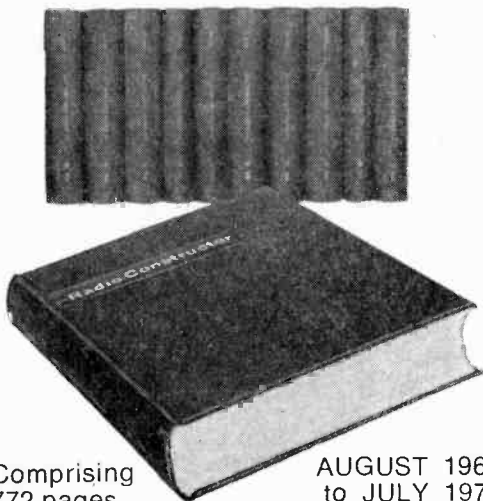
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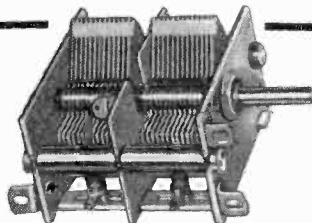
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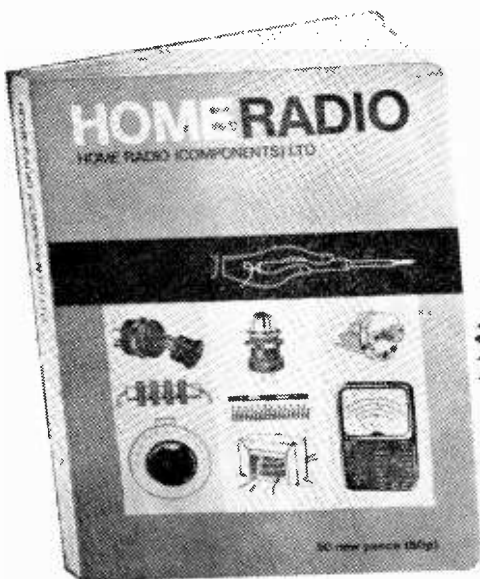
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SIMPLE F.E.T. REGENERATIVE RECEIVERS

by

A. S. CARPENTER, G3TYJ

Junction field-effect transistors are now available at quite low prices, and they are suitable for a number of receiver applications. In this article our contributor describes three simple f.e.t. receivers, concluding with constructional details for a 2-transistor receiver incorporating an f.e.t. and an a.f. amplifier stage

NOW THAT FIELD-EFFECT TRANSISTORS ARE available to constructors at reasonable prices it becomes possible to try out some interesting circuit configurations.

The junction field-effect transistor (JFET) is a three-terminal, solid-state device offering a high impedance input when connected in common-source form. In some respects a JFET can be compared to a triode valve: the transistor terminations are designated Gate, Source and Drain, and as shown in Fig. 1 may for a N-channel type be considered as comparable to the grid, cathode and anode respectively of a thermionic valve. Even tiny thermionic valves are physically enormous when compared to f.e.t.'s, the 'shells' of which are little larger than the 'hot' end of the familiar matchstick! Since f.e.t.'s are happy to work from quite low d.c. potentials - nine to 15 volts - they are obviously greatly to be preferred to valves in many instances.

Field-effect transistors may be used as oscillators, radio-frequency amplifiers, mixers, etc., and in Amateur radio circles they frequently feature in 'Two' and 'Four' metre converter designs; they also work well as regenerative demodulators.

The construction of simple regenerative receivers is in fact a pleasant and painless way of getting one's 'feet wet' with f.e.t.'s and some surprises may be in store for anyone who has not yet tried out the devices! Strong headphone signals can be obtained when using but a single f.e.t. and a handful of small components.

SOME 'LEAKY-GATE' CIRCUITS

An easily tried receiver circuit is shown in Fig. 2. Here TR1 performs both as signal demodulator and

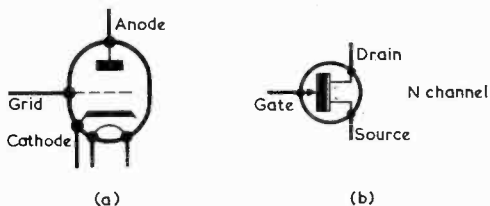


Fig. 1. An N-channel JFET is comparable with a triode valve

audio amplifier. Briefly, demodulation is effected by the gate and source acting as a diode, with the complete transistor functioning thereafter as a simple

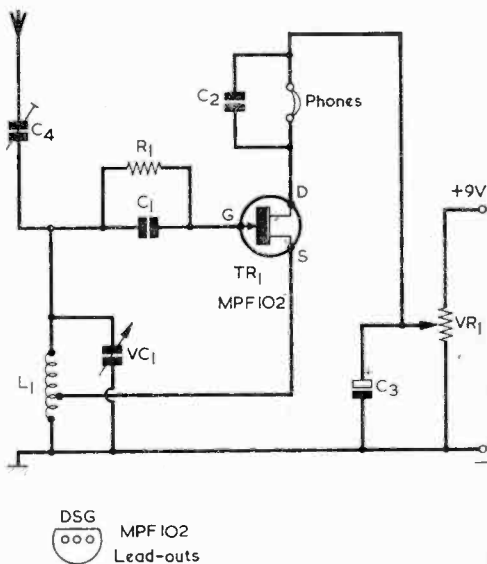


Fig. 2. A simple f.e.t. receiver with regeneration

COMPONENTS

(Fig. 2)

Resistors

- R1 1M Ω 10% $\frac{1}{4}$ watt
- VR1 10k Ω potentiometer, linear

Capacitors

- C1 100pF ceramic
- C2 5,000pF ceramic
- C3 100 μ F electrolytic, 15V wkg.
- C4 100pF trimmer
- VC1 200pF variable, air-spaced (Wavemaster)

Transistor

- TR1 MPF102

Phones

- 2,000 Ω headphones

audio amplifier. Signal selection is obtained by means of the tuned circuit, L1 and VC1, in the usual way.

Simple receivers of this sort need a regenerative peaking system to improve their performance and this may be accomplished by feeding some of the r.f. present in the output circuit back to the input. In Fig. 2 positive feedback from transistor drain to gate is effected by connecting the source not to the negative supply line but to a tapping on coil L1. Under certain conditions the circuit will oscillate continuously when switched on and in this state will be useless for the reception signals. However, by fitting a variable control, VR1, oscillation can be prevented from taking place and the system can be brought to the point of maximum sensitivity, i.e. to the brink of oscillation. Under these conditions tuning is sharp. Unfortunately, control VR1, cannot be made a preset item for it needs to be adjusted each time the vanes of VC1 are moved.

COMPONENTS

(Figs. 3 and 4)

Resistors

R1	220k Ω 10% $\frac{1}{4}$ watt
VR1	10k Ω potentiometer, linear
VR2	10k Ω potentiometer, miniature preset

Capacitors

C1	100pF ceramic
C2	5,000pF ceramic
C3	100 μ F electrolytic, 15V wkg.
C4	100pF trimmer
C5	0.47 μ F paper or plastic foil
C6	30-250pF trimmer
VC1	200pF variable, air-spaced (Wavemaster)

R.F. Choke (Fig. 4 only)

RFC1	2.5mH r.f. choke type CH1 (Repanco)
------	-------------------------------------

Transistor

TR1	MPF102
-----	--------

Phones

2,000 Ω headphones

Nevertheless, by carefully manipulating both controls simultaneously the circuit may be kept at maximum sensitivity over the whole tuning range. Trimmer C4 is normally preset for best results in connection with the aerial used.

An alternative arrangement is depicted in Fig. 3, where a double-wound coil is employed. In this L1 and L2 are wound on the same former, the windings being placed close to each other. For improved selectivity the aerial may be tapped down the coil at the expense of received signal strength. Positive feedback is arranged by letting r.f. present at the transistor drain pass through coil L2, which is appropriately phased to produce regeneration. Feedback is then inductively coupled into the gate tuned circuit. The degree of feedback can be controlled coarsely by means of C6 which, if set to too high a capacitance, will pass all r.f. present to chassis. With C6 set up correctly, fine control of regeneration can be given by VR1. Preset control VR2 is fitted to ensure that the maximum transistor current does not exceed about 5mA.

Yet another variation is shown in Fig. 4 and here

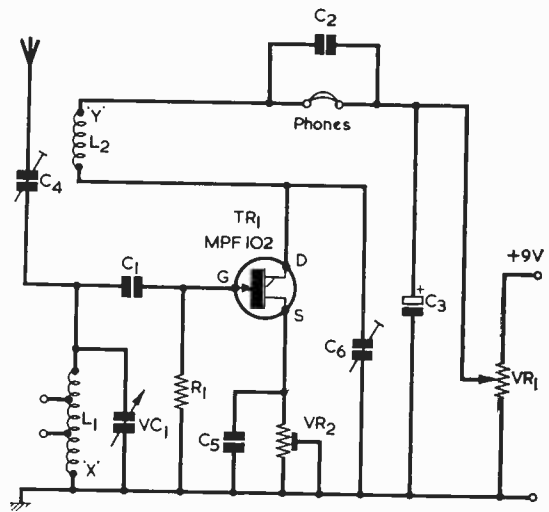


Fig. 3. An alternative design employing inductive feedback

r.f. is again coupled back inductively into the gate circuit; it is roughly controlled by trimmer C6, now placed in series with the feedback coil. Capacitor C6 must not be omitted or the d.c. supply will be short-circuited. Since r.f. is not wanted thereafter it is filtered out by means of choke RFC1 and capacitor C2.

REGENERATIVE PHASING

In circuits such as those depicted in Figs. 3 and 4 it is important to have the two coil windings correctly phased to provide the necessary positive feedback conditions. Since many experimenters like to try winding coils of their own it is always a good rule to consider the windings as a single coil. Thinking in terms of a single coil wound on a suitable former, if one end of the winding is connected to the gate circuit and the other to the drain circuit, phasing will be correct. The coil may then be 'snipped

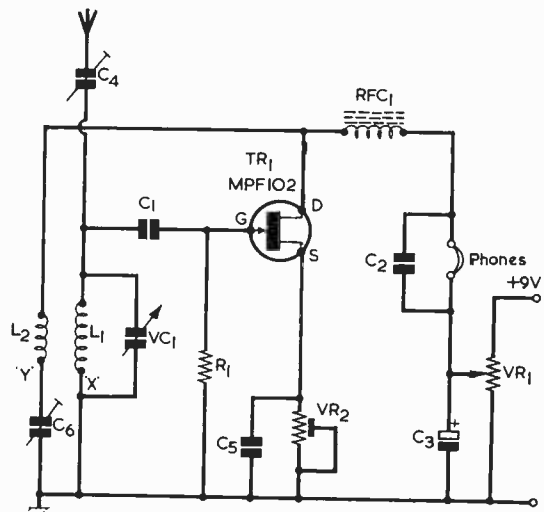


Fig. 4. A variation on the circuit of Fig. 3

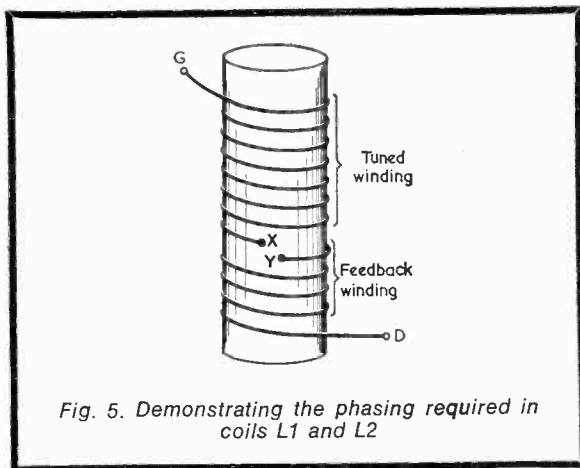


Fig. 5. Demonstrating the phasing required in coils L1 and L2

open,' as it were, a few turns from the drain end to provide the other two connections. Usually it is satisfactory if the regenerative winding turns are made approximately one-fifth of those used for the tuned winding. Remember: 'for positive feedback the coil outer ends go to gate and drain.' Fig. 5 shows the idea pictorially. What could originally have been a continuous winding has been opened at points 'X' and 'Y'; these points correspond to the similarly identified points in Figs. 3 and 4.

A 2-TRANSISTOR RECEIVER

A slightly more complex circuit is depicted in Fig. 6 and this may be used either as a headphone receiver providing good 'punchy' signals or as a

simple tuner for use with a valve or transistor audio amplifier.

Using the components specified, the test model tuned over a frequency range of approximately 1.8 to 4 MHz, this embracing both the 80 and 160 metre Amateur bands plus shipping. A ready-made coil from the Denco Miniature Dual-Purpose (Valve) series simplified construction. The numbers alongside the coil in Fig. 6 apply to the pin numbers of the B9A valveholder into which this coil is plugged. As in

TABLE

Coil winding details using 30 s.w.g. enamelled copper wire, $\frac{1}{8}$ in (10mm) diameter dust-cored coil formers and a 200pF tuning capacitor.

Tuned winding turns	Feedback winding turns*	Approximate frequency range - MHz
17	4	5.2-23 dust-cored 7.6-32 air-cored
25	6	4-18 dust-cored 5.5-25 air-cored
32	7	3-16 dust-cored 4-24 air-cored

*Spaced approximately $\frac{1}{8}$ in. from 'earthy' end of tuned winding.

All turns should be closewound. For lower frequency ranges, use of a ready-made commercial coil is recommended.

the earlier circuits, controlled regeneration is incorporated to increase sensitivity and sharpen tuning.

The common-source connected f.e.t. performs as already described and audio signals filtered of r.f.

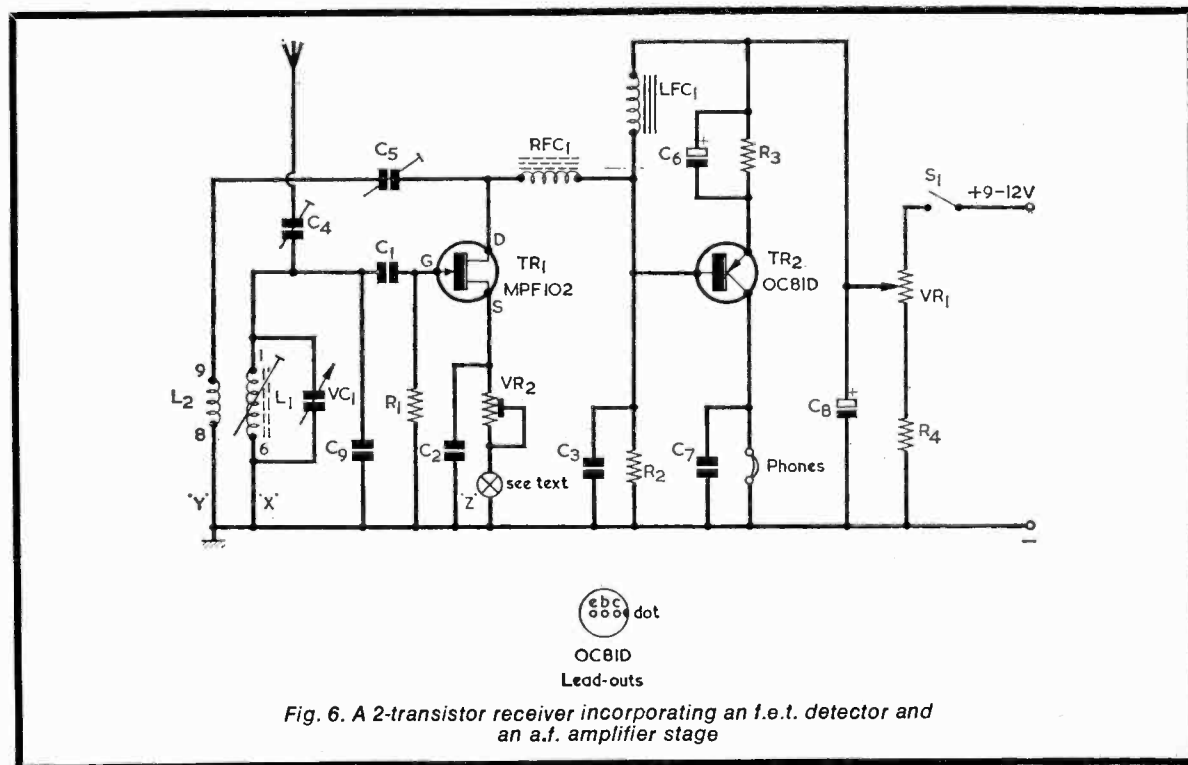


Fig. 6. A 2-transistor receiver incorporating an f.e.t. detector and an a.f. amplifier stage

are presented to the base of transistor TR2 for additional amplification. The audio frequencies are developed mainly across low frequency choke. LFC1, which additionally becomes part of the transistor base potential divider in conjunction with R2. Choke LFC1 may be the primary winding of a transistor-type driver-to-push/pull transformer and if its measured d.c. resistance is around 250Ω it will be satisfactory. The choke used in the test model was the primary winding of a Weyrad type LFDT4. Types JOT or JDT, available from Henry's Radio, are also suitable and are less expensive.

Transistor TR2 operates as a common-emitter amplifier and output is available at the collector. If phones are preferred they should be connected as shown; alternatively a resistor of approximately 3.9kΩ may be used in their place and, with capacitor C7 left *in situ* the output taken from the collector circuit to a suitable audio amplifier via a capacitor of 0.01μF. See Fig. 7. A p.n.p. OC81D works well in the TR2 position but other similar audio types may be used successfully. Regeneration can be smoothly controlled by means of VR1.

CONSTRUCTIONAL NOTES

The complete receiver can be constructed easily on 'breadboard' lines using a section of 6 by 6in. 18 s.w.g. aluminium sheet bent to provide a panel and base, each measuring 3 by 6in. It is essential to use a reduction drive for the shaft of VC1; the other panel controls will be VR1 and S1. A phone or audio outlet socket is required. Aerial and earth sockets may be placed at the rear.

To avoid making soldered connections to the coil spills, the coil may be mounted on the base plate via its threaded stem and polystyrene nut with spills upward. A B9A valveholder can then be inverted and plugged on to the coil spills. This approach also allows spare tags to be used for anchoring components.

It is a good plan to obtain a pair of transistor holders which can be appropriately wired prior to plugging the transistors in to them; this affords complete protection for the transistors.

A suitable layout with some of the wiring included is given in Fig. 8; components not shown can be placed as is most convenient.

TESTING

Initially the slider of VR1 should be set to the end of the track connected to R4 and that of VR2 set to approximately half-travel. A testmeter switched to read 0-10mA should be inserted at point 'Z'. With phones and battery connected the receiver can next be switched on and the current at 'Z' checked; a reading of 5mA approximately is to be aimed at by adjustment of VR2. If the fixed vanes of VC1 are now touched with a penknife blade or similar piece of metal a healthy crackle should be heard in the phones, whereupon an aerial - and an earth if possible - should be connected up. Thereafter it is but necessary to adjust C4, C5 and the core of L1 in such a way that it is possible to bring the unit to the edge of oscillation at any setting of VC1 with control VR1. It will be found that as VR1 is advanced noise in the phones increases as sensitivity

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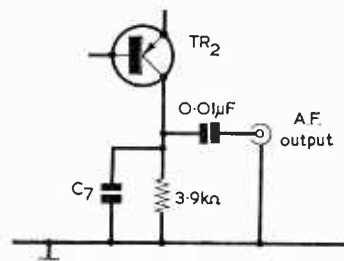


Fig. 7. The output circuit of Fig. 6 may be modified, as shown here, to enable the receiver to feed a subsequent a.f. amplifier

COMPONENTS

(Fig. 6)

Resistors

(All fixed values 10% ¼ watt)

R1	220kΩ
R2	15kΩ
R3	820Ω
R4	1kΩ
VR1	10kΩ potentiometer, linear
VR2	10kΩ potentiometer, miniature preset

Capacitors

C1	100pF ceramic
C2	0.47μF paper or plastic foil
C3	0.01μF ceramic
C4	100pF trimmer
C5	56pF trimmer, Mullard concentric
C6	100μF electrolytic, 6V wkg.
C7	5,000pF ceramic
C8	100μF electrolytic, 15V wkg.
C9	50pF ceramic
VC1	200pF variable, air-spaced (Wavemaster)

Inductors

L1	Two Miniature Dual-purpose (Valve) Range 3, Blue (Denco)
RFC1	2.5mH r.f. choke type CH1 (Repanco)
LFC1	See text

Transistors

TR1	MPF102
TR2	OC81D (see text)

Sockets

Two transistor holders type H14/15 (Henry's Radio)
B9A valveholder
Phone jack
Aerial socket
Earth socket

Phones

2,000Ω headphones

Battery

9-volt battery

Miscellaneous

Vernier drive type T502 (Eagle)
Knob
Tagstrip (See Fig. 8)
Aluminium sheet, 6 by 6 in., 18 s.w.g.
Connecting wire, nuts, bolts, etc.

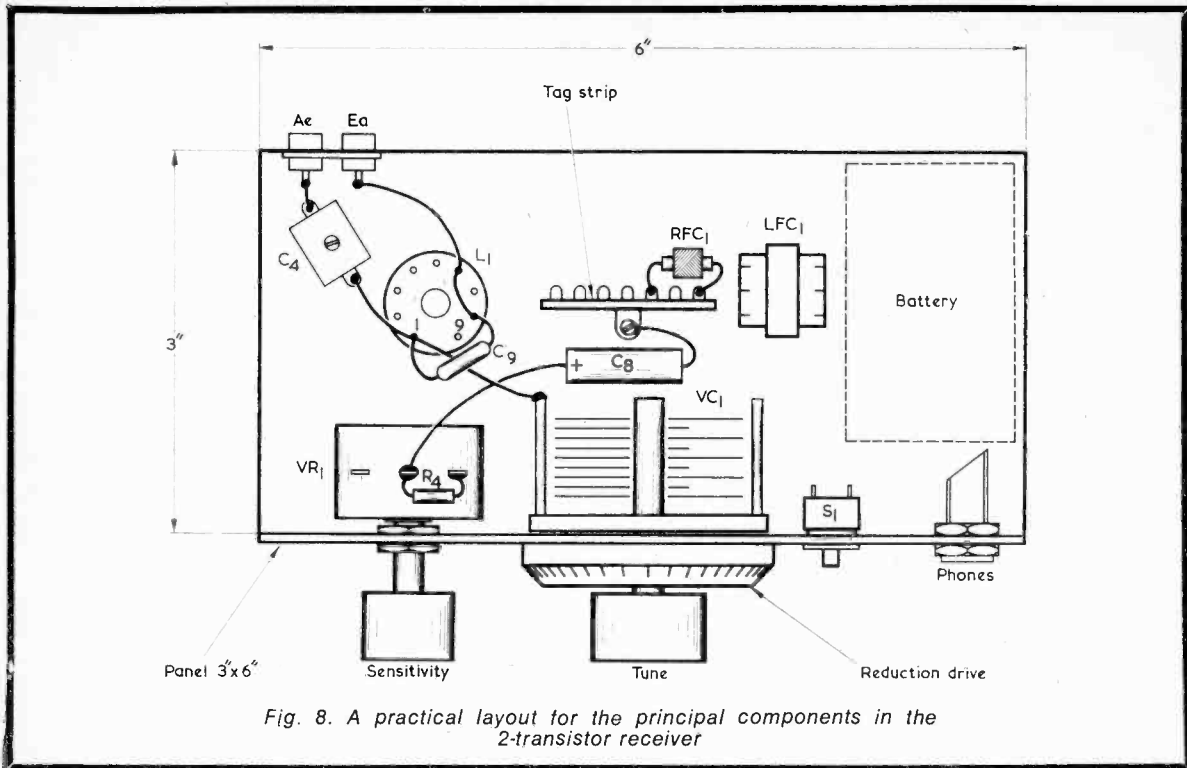


Fig. 8. A practical layout for the principal components in the 2-transistor receiver

improves, and any signals heard will rise dramatically in strength. If however VR1 is advanced over-much signals will disappear completely and leave a sustained whistle; in this condition the receiver is useless and the control must be retarded immediately.

A short time spent experimenting with the controls will soon reveal the best method of operating – it will also be found that the various controls interact and that the aerial also has a large effect on performance. Control VR2 can be readjusted for enhanced performance as necessary compatible with a source current of approximately 5mA; once set it should need no further adjustment.

All regenerative receivers of the type described are apt to be temperamental and adjustments have to be made carefully if best results are to be obtained; this is the price that must be paid for simplicity. Nevertheless surprisingly good reception can be expected from what is, after all, but a handful of components!

If the reader wishes to try winding his own coils the accompanying Table will be useful as a guide. Precise frequency ranges obtained will, of course, depend a great deal upon the position of the iron dust core in the coil, the aerial employed, and stray capacitances, etc. ■

CAN ANYONE HELP?

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

Cosmos U.S. Signal Corps Wire Recorder. — R. A Hounslow, Higgins House, The Carlton School, Carlton, Nr. Bedford — handbook, loan or purchase, also supply source of wire.

Oscilloscope Type 11. — F. P. Murphy, Big Street, Termonfeekin, Drogheda, Ireland — handbook, loan or purchase, or circuit diagram with component details.

Wireless Set SR HQ. — G. Pheban, 34 Birmingham Road Kidderminster, Worcs. — circuit, power re-

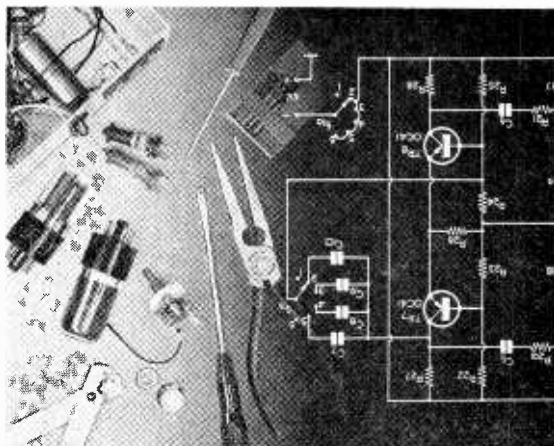
quirements and other information on this transmitter/receiver marked "ZA 20657 Serial No. 0059 PC Ref. No. 92092".

Standard Tx Type 5AH. — T. G. Wallis, 1 Park View Terrace, Rawdon, Nr. Leeds. — circuit diagram, manual or any other information.

Oscilloscope Type 10. — H. Bottomley, 19 Whittle Street, Worsley, Manchester — circuit or manual. Unit marked with legend No. 10SB/108. ■

SWITCH-OFF REMINDER

by G. A. FRENCH



BUSY SERVICE ENGINEERS AND amateur experimenters frequently employ a large quantity of mains-driven test equipment on their benches. As a result, they can sometimes forget, after finishing work for the day, to switch off all the equipment, whereupon one or more items of test gear are left switched on overnight.

The device which forms the subject of this month's 'Suggested Circuit' gives visual indication whenever any mains-driven equipment is switched on, and it thereby ensures that there is no risk of any equipment being accidentally left on after work has ceased for the day. It operates with mains loads of 5 watts or more, the maximum load it is intended to cope with being 500 watts.

CIRCUIT OPERATION

The circuit of the device appears in the accompanying diagram. In this, the 6.3 volt winding of transformer T1 is inserted in series with the live side of the mains supply to the bench equipment. Whenever any of this equipment is switched on, therefore, a current flows in the 6.3 volt winding, inducing an alternating voltage across the 250 volt winding.

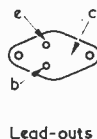
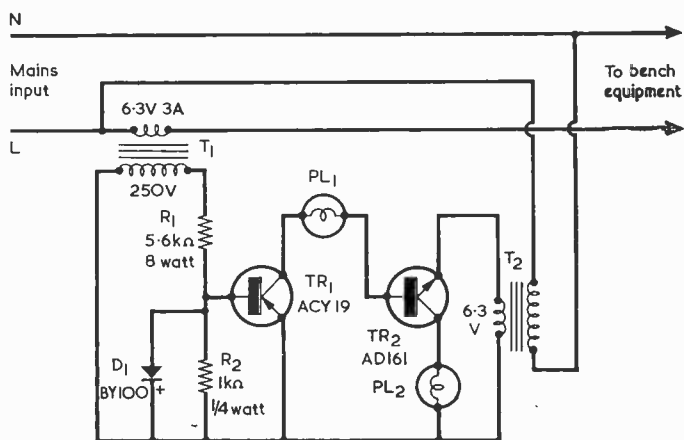
This voltage is applied, via R1, to D1 and the base of TR1. During half-cycles which cause the base of TR1 to go negative, the base-emitter junction of this transistor acts as a diode and conducts. Diode D1 conducts on the alternate half-cycles, whereupon virtually all the alternating voltage from the 250 volt winding of T1 appears across R1. In consequence, this resistor functions as a load and limits the voltage appearing across the 250 volt winding and, therefore, that across the 6.3 volt winding as well.

Diode D1 serves the secondary function of limiting the reverse voltage which can appear across the base-emitter junction of TR1. Without D1 in circuit the reverse base-emitter voltage could rise to a high value and cause breakdown in the transistor. Resistor R2 does not enter into this process, its function merely being to reduce leakage current in TR1 when no voltage is applied to it from T1.

On its own, TR1 does not have sufficient gain to operate a warning device, such as the pilot lamps used in the present circuit, when

the current in the 6.3 volt winding of T1 is low, and so its collector is coupled via PL1 to the base of TR2. PL1 could, if desired, be replaced by a 100Ω resistor, since one of its functions is to act as a limiting resistor to prevent excessive collector current flow in TR1. However, it also gives a visual indication of the magnitude of the power consumed by the bench equipment and the writer feels that the use of a bulb here, instead of a resistor, represents a marginal advantage.

TR2 amplifies the collector cur-



PL1 - 6V 0.06A
PL2 - 6.5V 0.15A

The circuit of the 'switch-off reminder' unit. This gives visual indication when any bench equipment consuming 5 watts or more is switched on

rent in TR1 and, when any bench equipment is turned on, causes pilot lamp PL2 to become illuminated. PL2 lights up when any equipment consuming 5 watts or more is switched on, whilst pilot lamp PL1 lights up when the mains consumption by the bench equipment increases above some 25 watts.

The power for TR1 and TR2 is derived from the 6.3 volt secondary of transformer T2. Since TR1 and TR2 can only become conductive during alternate half-cycles from T1 there is no point in providing a rectified power supply for these two transistors. All that is necessary, then, is to use the alternating supply from T2 secondary, this transformer being connected into circuit such that the emitter of TR2 goes negative during the same half-cycles that cause the base of TR1 to go negative. The primary of T2 is connected permanently across the mains supply. Assuming a good-quality component, the current it consumes should be negligibly low.

Summing up the overall operation of the circuit it may be stated that, in the absence of voltage from the 250 volt winding of T1, both TR1 and TR2 are cut off. When a voltage appears across the 250 volt winding, TR1 passes current and causes a further, amplified, current to be passed by TR2. Pilot lamp PL2 then lights up when any bench equipment consuming more than 5 watts is switched on. Pilot lamp PL1 also lights up when the bench power consumption rises above some 25 watts. Both lamps remain illuminated for equipment consumption up to and exceeding the maximum of 500 watts for which the circuit has been designed.

COMPONENTS

Transformer T1 can be any mains transformer having a 6.3 volt 3 amp winding and a 250 volt winding. This last voltage is not critical, and the circuit should function just as well if the winding is rated between 200 and 275 volts. The transformer

used by the author was a Douglas type MT1AT, the 250 volt winding being provided by half the 250-0-250 volt h.t. secondary. All other windings on this transformer were ignored. Transformer T2 can be any 6.3 volt heater transformer.

Pilot lamp PL1 is a 6 volt 0.06 amp component, whilst pilot lamp PL2 is rated as 6.5 volt 0.15 amp. These are both MES lamps and are available from Home Radio under Cat. Nos. PL7 and PL8 respectively. Lamps with a higher current consumption should not be used.

Transistors TR1 and TR2 are fairly critical components, and it would be preferable to use the types specified or, at worst, near equivalents. TR2 is run well below its maximum power rating and hardly requires a heat sink.

Resistor R1 has a high wattage rating because, when the bench equipment consumes 500 watts, about 160 volts is applied across it, resulting in a dissipation of some five watts. The r.m.s. current flowing in the base-emitter junction of TR1 on alternate half-cycles is then 30mA, which is well below the maximum base-emitter current rating for the ACY19.

Diode D1 can be any silicon rectifier capable of passing a forward current of 30mA. Due to the presence of TR1 the reverse voltage applied to this diode is negligibly low. The writer employed a BY100 because this happened to be to hand, but any other suitable silicon rectifier could be used instead.

SETTING UP

The circuit may be assembled in any desired manner, provided that attention is paid to two important points. The first of these is that TR1 must be mounted in a cool position, well away from R1 and the two transformers. This is to ensure that its leakage current, in the absence of voltage from T1, is kept low. The second point is that the two transformers should be mounted with their axes at right angles to

each other, in order to prevent voltage being induced in the windings of T1 due to the field from T2.

After the circuit has been built up it may be wired into the mains supply to the bench equipment, whereupon pilot lamps PL1 and PL2 should light up under the conditions described earlier. If the lamps fail to become illuminated the connections to the 6.3 volt secondary of T2 need to be reversed. Should TR1 exhibit excessive leakage current, PL2 may remain illuminated when all the bench equipment has been switched off. If this occurs the value of R2 should be reduced until the effect clears. Judging from results given with the prototype, in which several ACY19's were checked in the TR1 position, it is doubtful whether this change in value will be necessary, but the point needs to be mentioned, nevertheless.

PROTOTYPE PERFORMANCE

The prototype circuit functioned in the manner already discussed for power loads from five to 500 watts. Indeed, the circuit was sufficiently sensitive to allow PL2 to light up with a bench load of 4.2 watts, this being provided by a 15k Ω resistor. Although both PL1 and PL2 pass current on alternative half-cycles only, it was found that the illumination they provide is more than adequate for the present purpose.

The voltage dropped across the 6.3 volt winding of T1 was approximately four volts at a bench load of 500 watts, this dropping proportionately to 0.8 volts at 100 watts, 0.4 volts at 50 watts, and so on. The circuit was deliberately overloaded for a short period by applying a one kilowatt load (given by an electric fire element) whereupon the voltage across the 6.3 volt winding of T1 rose to eight volts. Apart from slight overheating in R1 the circuit withstood the overload comfortably and continued to function satisfactorily afterwards for lower power loads. ■

MANCHESTER ELECTRONICS EXHIBITION

Every exhibit at MELEX, the new Manchester Electronics Exhibition next year, will be vetted by specialists in the industry, members of the Electronic Promotion Group exhibition committee.

The show, from October 5th to 8th, 1971, will be held at the City Hall, Deansgate, Manchester.

It is a wholly specialist electronics exhibition dealing only with professional-grade products in three main groups: electronic equipment, electronic components and apparatus for industrial measurement and control.

Distributors and wholesalers can take part in the show, but they must nominate the specific products they wish to show. Although MELEX is not classed

as an international show, foreign firms can take part either directly or through their British agents. They will, however, have to abide by the committee's ruling on quality and suitability of exhibits.

The exhibition is specifically organised for the Manchester and North West area but it is expected to generate interest in the North East and Scotland as well.

The Electronic Promotion Group is an alliance of major manufacturers whose aim is to promote professional-grade electronic products.

The Group has presented compact specialist shows at the Hotel Piccadilly, Manchester, since 1967. Last year a similar exhibition was held in Coventry.



Q
S
by **X**

FRANK A. BALDWIN

(All Times GMT)

● **AMATEUR BANDS**

With the advent of high Summer and the usual conditions which tend to prevail during this period, Dx has not been all that plentiful. On the LF bands Summer static tended to mar many a QSO whilst on the HF bands conditions for Dx working have been spasmodic. However, as the following report shows, some Dx was apparent during the period.

1.8MHz

Despite the high noise level which predominated at times, some activity was noted on this band at the CW end.

CW: GD3TNS, GM3PFQ, GM3XTT/P, OK1AQA/P, OK1ARZ, OK1HBT, OK1KRS, OK1KWS, OL2AND, OL5ALY, OL7ANL, PAØPN.

7MHz

This band, much neglected by SWL's, provided some pleasant surprises at the CW end during some late evening and early morning sessions.

CW: CM2FV, CO2JC, H18NMA, JH4DSM, K3JLA, PY2AXZ, PY2EYE, PY5CEK, PY7BHL, PY7GM, PY7NJ, PY8RH, PZ1DD, PZ2VDT, VE3GBW, VE3DN, W4CTF, W4ZMQ, WA4PWF, WB4LRY, W7KDE.

H18NMA gave his QTH as - Box 951, Santa Domingo.

14MHz

The favourite band of most listeners continued to provide much of the Dx and excitement although, at the CW end, one had to really dig under all the Eastern European signals to get at the interesting stuff.

CW: AX3MH, AX3MJ, CR6NN, DU1OR (14050), JH1EXV, KP4DHI, KZ5AT, LU4BH, OX5BT, VK3KF, ZM2IR, 5X5MP, 8P6BU (14019).
SSB: AX2AGN, AX2VK, AX2VP, AX5FM, AX6MK, AX7GC, AX7IH, AX7RX, CR6OK, ET3DS, FG7XE, HC1JR, HC2GG/M, HK3AFB, HK3BCA, HK4BTY, HT1COF, OA4QJ, OA4US, PJ2CC, TA1NC, T18PE, VK5FM, VK6WB, VP2DAE, VP2VI, ZM1BEM, ZM4PX, 5J3KK, 7Z3AB, 8P6BQ.

CR6OK gave his QTH as Postbox

275 Angola; VP2DAE QSL via VE3EWH; VP2VI QSL via VE3ACD.

21MHz

A migration to this band often pays dividends, during some late afternoon and early evening periods the following were noted.

CW: CEØAE, CR6AL, CR6DN, CR6HM, CR7IZ, CX9BE, EA8GR, EL2CB, EL7NB, FB8XX, HK5APE, HK5AR, HP8C, JA1YAG, JA4BNT, JA4ELC, JA7AGO, JH1VOE, JH1WIX, JR1CPB, KP4AXM, KP4CBJ, KP4DIS, VP9BDA, ZC4BX, ZS5LB, 6W8BJ, 9V1PA, 9V1PC.

CEØAE QSL via WA3UP.

SSB: CE3BX, CR6GA, CR6HM, CR6KV, EA8DV, EL2CB, FM7CMC, HC2LF, JA4KLO, JY1, KG4AA, MP4BFO, MP4BIB, MP4BIR, PJ2PS, VP5TV, ZC4IK, ZC4MT, ZS4HC, 5J3CC, 5Z4HW, 9Q5GR, 9Q5NW, 9V1PA, 9Y4AA.

9V1PA QSL via G3LQP.

After this month is over we shall commence to move into Autumn and then Winter conditions when we can expect the LF bands to perk up and provide some worthwhile Dx.

This Summer will be remembered for the large volume of CW traffic on the 14MHz band, almost from end to end of the allocated portion, from Eastern Europe and Asiatic Zones of the U.S.S.R.

● **BROADCAST BANDS**

On these bands some interesting catches have been made but conditions have not approached those of last year, this especially applying to the LF tropical frequencies. Several late night and early morning sessions were almost a waste of time but on two occasions the Dx was there to be heard.

● **S. AMERICAN STATIONS**

3245kHz 0316 YVKT Caracas, Venezuela, heard with a programme of typical Latin American music.

3300kHz 0340 Belize, British Honduras, with announcements in English. This station has a power of 1kW and broadcasts in both English and Spanish. The Home Service is radiated on this channel from 2200 to 0500 with the English programme from 0030 to close at 0500. Newscasts at 0100 and 0300.

3365kHz 0305 HIRL Radio Exitos, Santiago, Dominican Republic, logged with identification followed by Latin American songs. With a power of 1kW, HIRL has a schedule from 1200 to 0500. Santiago de los Canalleros is a city in the densely populated North Central part of the Republic.

3340kHz 0400 HCVA4 Esmeraldas, Ecuador, with identification "La

Estación de la Alegria'.

3355kHz 0250 YVLC Valencia, Venezuela, radiating Latin American songs and music. Valencia is the most industrialised town in the country.

3378kHz 0330 HCDY4 Esmeraldas, Ecuador, with identification 'Radio Iris' followed by music programme. This one has a power of 0.25kW.

4712kHz 0410 HCAV3 'Radio Luz y Vida' Loja, Ecuador, with typical S. American music. HCAV3 has a power of 0.25kW and closes down at 0500. Loja is the capital city of the province of that name.

4730kHz HCEH3 'Radio Nacional Progreso' Loja, Ecuador, with identification. This one has a power of 0.2kW and has been wandering about the band during the past few months. Frequency given here was measured.

4895kHz 0303 PRF6 Manaus, Brazil, with commentary and identification as 'Radio Bare', then suddenly signing off without National Anthem at 0303.

5025kHz 0330 HCOB5 'Radio Splendit', Cuenca, Ecuador, logged with identification and programme of songs. This is where the Panama Hats are woven! Founded in 1557, it is set in the rich agricultural basin of the Ecuadorian Andes.

5985kHz 0305 HJHA Tunja, Columbia, with musical programme. This one has a power of 10kW and normally closes at 0300 - presumably on extended schedule.

6250kHz 0341 OAX7A Cuzco, Peru, with identification as 'Radio Cuzco', songs and music. Cuzco is at an altitude of 11,207ft. and legend has it that it was founded by the first Incan ruler, Manco Capac.

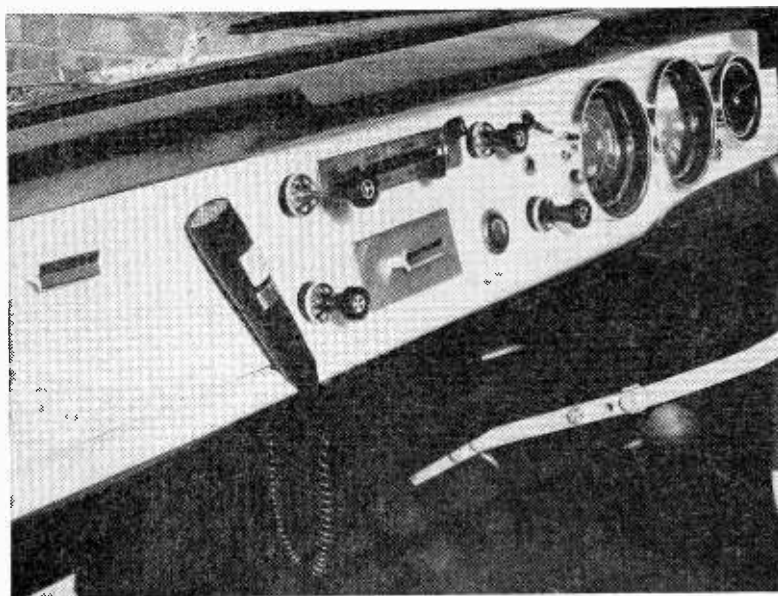
● **BEGINNERS CORNER**

The following stations may provide an interesting task for newcomers - see if you can log them.

7215kHz 2015 VUD All India Radio, Delhi, with their English programme. With a power of 100kW it radiates a newcast, Indian press review and interesting sidelights on life and events in India.

7270kHz 2100 RSA Johannesburg, S. Africa, opening with National Anthem, five 'pips' and identification. From 2053 an interval signal consisting of a guitar melody is radiated. RSA can also be heard on **21480** in English at 1815. ■

S. G. BROWN INTRODUCES MAGNETICALLY MOUNTED MICROPHONE



The microphone magnetically adhering to the dashboard

A versatile new hand microphone has been introduced by the communications division of S. G. Brown Ltd., of King George's Avenue, Watford, Herts. It can be used with both mobile short-wave radio equipment and for base communications installations.

Known as the "Classic", this lightweight instrument has a powerful magnet fitted in the grip which enables it to 'stick' to any ferrous surface. A user in a motor vehicle can place the instrument in the most convenient position on the vehicle's dashboard, eliminating the need for a conventional microphone holder.

The "Classic" weighs only 5 oz. (142 g.) and can be converted to a desk microphone for fixed installations by using a specially designed stand and the instrument's magnet as a means of attachment.

A steel plate, fixed by screws or double-sided tape, is available for attaching the microphone to plastic, aluminium and other non-ferrous surfaces.

The "Classic" dual-purpose microphone has been specified by five leading British manufacturers of communications equipment, and S. G. Brown has already received substantial initial orders for the equipment.

BRITAIN'S FIRST MARITIME LADY RADIO OFFICER

The first woman ever to go to sea as a radio officer in the British Merchant Navy is 28-year-old Dallas Marilyn Bradshaw, who joined the seagoing staff of the Marconi International Marine Co. Ltd., on 1st May this year and has now been appointed to her first ship, the 15,000 ton *Duncraig*, an ore-carrier operated by J. & J. Denholm (Management) Ltd., of Glasgow.

Miss Bradshaw is a Canadian girl from Victoria, British Columbia, who has lived in Colwyn Bay, North Wales, for the past five years, two of which she devoted to studying to pass the examinations which qualified her as a seagoing radio officer.

Mr. Neil McAslan, Director of Administration and Personnel at Denholm's, added: "The recently published Rochdale Report on the shipping industry recommended that there should be greater opportunities for the employment of women at sea."

AUTOMATIC BOAT

A strange vessel which can sail to any part of the world's oceans without a crew, can operate alone for many months and then find its own way back to port. Skamp (Station Keeping and Mobile Platform) sails under radio control and, on station, can keep its position to within one-tenth of a mile. Skamp was designed and built for the Radio Corporation of America and is used for charting ocean currents and for navigational experiments. Its two curved sails are made from light-weight plastic. A nine-foot diameter circular raft supports the two rigid sails and the electronic components. Skamp will also be used in experiments with a navigational satellite which can transmit experiments from earth orbit.

VIDOR BATTERIES TO CUT COST OF USING TRANSISTORS

A new range of Vidor dry batteries which it is claimed will cut the cost of running transistor radios using the familiar 'round-cell' type of battery has been developed by Crompton Parkinson Ltd.

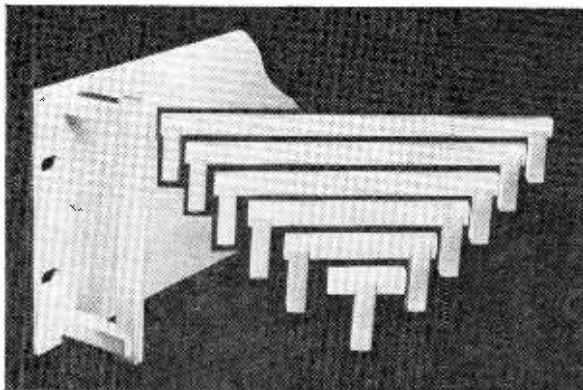
The principal difference from ordinary torch batteries lies in the formulation of the depolariser which was developed to give better performance when used in transistor sets.

Three batteries from the new Vidor SP range which are suitable for both lighting and transistor radio applications, are illustrated.

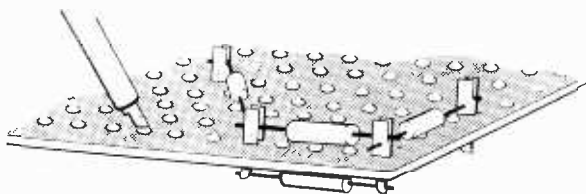


THE RADIO CONSTRUCTOR

COMMENT



New range of Vero panel handles



New Vero miniature terminal clip

At the International Instruments, Electronics and Automation Exhibition at Olympia, Vero Electronics Limited of Chandler's Ford, Hants., showed their complete universal printed circuit wiring boards from their range of Veroboard, Fingerboards and D.I.P. Boards, together with many accessories for use with them, for example, Edge Connectors, Terminal Pins and Card Handles. New items included Miniature Terminals and a Group Board. Vero, are well known for their frame systems, and on show there were samples of Vero Module Rack System 1A, and also various types of the extremely versatile Card Frame System 3. This year cases were particularly featured, not only with the increasingly popular 'D' Series Instrument Case, but also with the 'B' Series Multiple Case, and the 'C' Series Module Box, the latter incorporating modules from the 19in. Frame System.

POLITENESS AND THE SWITCHBOARD

If you add 'please' when you ask a telephone operator for a number, she is more likely to make mistakes than if you do not. Apparently the addition of polite but irrelevant information interferes with her memory process, and no amount of training makes much difference.

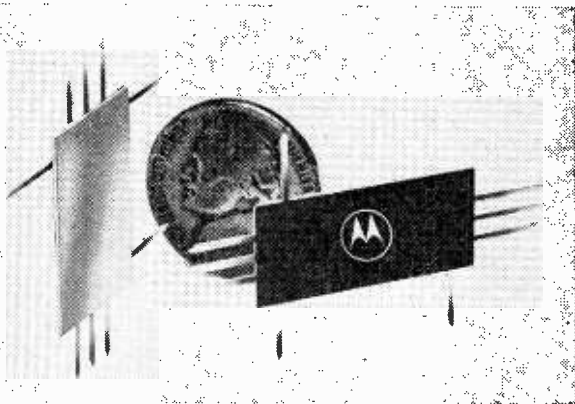
According to a report by our author, George Short, the discovery was made in an investigation into short-term acoustic memory at the Applied Psychology Unit at Cambridge. However, it provides no excuse for brusqueness. If you say 'please' before, not after, the number, it has no harmful effect.

SEPTEMBER 1970

MICROWAVE SOLID STATE DUPLEXER

The type MCH 5890 solid-state microwave duplexer just announced by Motorola Semiconductors provides a compact, low-cost, convenient method of switching an aerial between a receiver and transmitter. It consists of two step-recovery diodes, one connected in series between the transmitter terminals and the receiver terminals and the other one shunting both pairs of terminals. The aerial terminal is connected between them so that the length of conductor between the aerial terminal and the shunt diode is approximately a quarter wavelength for frequencies between 400 and 500MHz.

In the transmit mode, an external current of ten to 20mA is fed in to bias the diodes into conduction so that the series diode feeds the aerial signal to the transmitter. The shunt diode, however, being a short circuit at the end of a quarter wavelength transmission line, gives rise to a high impedance between the aerial and the receiver. In the receive mode, the bias is removed so that the series diode blocks the signal path to the transmitter while the shunt diode has little effect on the signal to the receiver.



WASHINGTON INVITATION

The Foundation for Amateur Radio Inc., a non-profit institution, announces the establishment by it of a Hospitality Committee with the objective of providing visiting foreign licensed radio amateurs with opportunities to meet local active amateurs, visit amateur stations and see the Capital City, etc. Any visiting foreign amateur can get in touch with the Hospitality Group by calling 893-8383, during the hours 0800 to 2000 daily. If writing, the address is: Suite 72, 1150 Connecticut Avenue, N.W., Washington, D.C.

83

CATHODE SIGNAL INJECTION

by

E. PEARCE

This article describes a neat method of injecting an additional signal into a valve a.f. amplifier without disturbing its existing mode of operation

RECENTLY, THE WRITER WAS FACED WITH A MINOR problem. The radio equipment in his den consists of a medium and long wave superhet tuner coupling into quite a respectable valve amplifier which (shades of '1066 and all that') was conceived in the days when nobody had even thought of the word 'solid-state'. But it works very well indeed and consists of a triode voltage amplifier, a triode phase-splitter and two trustworthy 6V6's in push-pull in the output stage, these delivering a comfortable eight watts or so without the slightest deviation from Class A operation.

INPUT CIRCUIT

The amplifier also takes an input from a record-player deck and the input circuitry is that shown in Fig. 1. As will be seen, both the a.m. tuner unit and the record-player deck connect to 1M Ω volume controls, the sliders of these coupling to the grid of the first triode in the amplifier by way of 470k Ω series resistors. The idea behind these series resistors is to ensure that the input level provided by one volume control is not seriously upset by adjustments

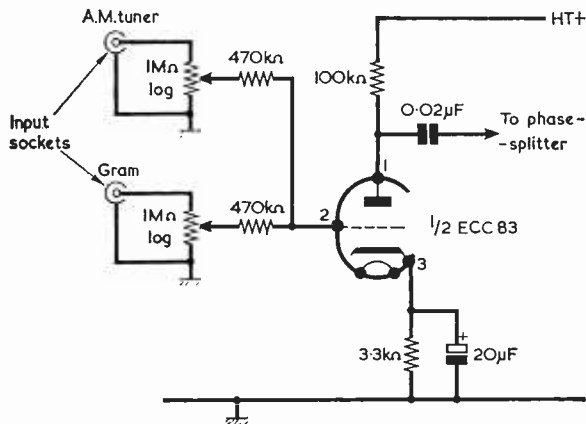


Fig. 1. The existing input circuit of the amplifier

to the other volume control, and they meet this requirement adequately enough in practice. Incidentally, the input triode is one half of an ECC83. The other half of this ECC83 is the phase-splitter which feeds the two 6V6's in the output stage.

The writer's problem arose after he had constructed a transistor f.m. tuner from a kit, this tuner being intended to feed into the amplifier also. There was space on the front panel of the amplifier for a third volume control and input socket but it was felt that adding yet a third 470k Ω series resistor into the input circuitry would be straining its capabilities to too great an extent. If two of the volume controls in such a circuit were set to the minimum volume position, the series resistor on the third would be effectively feeding into a 235k Ω resistor given by the other two 470k Ω resistors in parallel.

Now, the transistor f.m. tuner was capable of feeding into low input impedances, as are associated with transistor a.f. amplifiers, and it was this fact which enabled the writer to add a third input to the amplifier without upsetting the existing input circuitry. The arrangement used is shown in Fig. 2, and it will be seen that the cathode bias resistor and capacitor for the triode are removed, these being replaced by a p.n.p. transistor. The base of the transistor couples to chassis via a resistor, the value of which has to be determined experimentally. In the writer's case it was 100k Ω .

The output of the f.m. tuner connects to a 25k Ω volume control, whose slider feeds, via a 2 μ F capacitor, to the base of the transistor. This functions as an emitter follower and feeds the a.f. from the f.m. tuner into the cathode of the triode. As a result, the signal appears between cathode and grid, to produce the same variation in anode current as would have occurred if it had been applied to the grid in normal manner.

PRACTICAL POINTS

An advantage with the circuit is that practically any cheap a.f. transistor can be employed for the

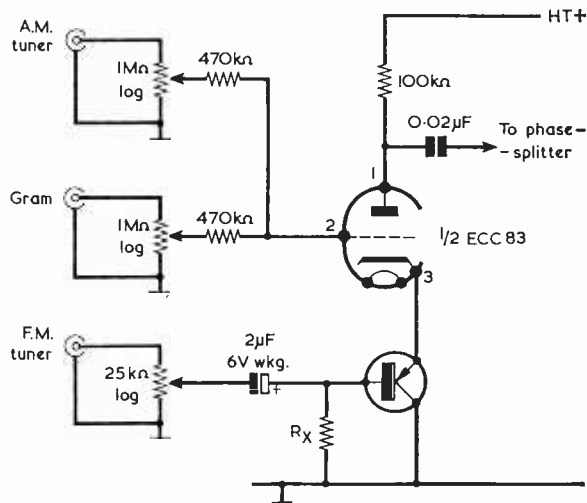


Fig. 2. A third input, with its own volume control, was added in the manner shown here

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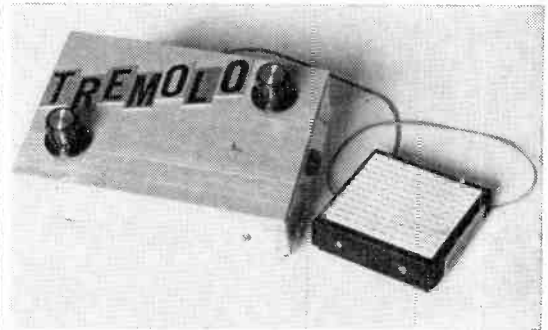
job, and there seems to be no reason why a transistor input circuit of this nature could not be applied to any other voltage amplifier triode or pentode. The removal of the cathode bypass capacitor might result in the introduction of hum in some instances, but this did not occur in the writer's amplifier where the heaters are fed from a 6.3 volt mains transformer winding having a centre-tap which connects to chassis.

When fitting the transistor input circuit, the procedure is to measure the cathode bias voltage given by the existing bias resistor, remove this, together with its bypass capacitor, and fit the transistor and attendant circuitry in its place. A 200k Ω variable resistor is temporarily inserted in the Rx position and its value experimentally varied until the same cathode bias voltage as was given previously is provided once more. The variable resistor is then replaced by a fixed resistor of the required value. The writer used an old OC71 for the transistor and found that this gave the 2.2 volts previously provided by the cathode bias resistor when Rx was 100k Ω . The value of Rx will depend upon the current gain of the transistor and it will probably be best to purposely avoid using a transistor having a high gain. If a transistor with a very high gain were employed, the requisite value in Rx might approach or even pass the half-megohm mark, whereupon leakage currents could start to become troublesome.

The circuit has no protection against thermal runaway but, so far as damage to components is concerned, no harm could result even if such runaway should occur. The current through the triode and the transistor is limited to about 2mA by the anode load of the triode and so no current greater than that could pass through either of these two components. So far as voltage across the transistor is concerned, this is limited to the grid cut-off voltage for the triode. Thus, if Rx should become open-circuit, the voltage across the transistor cannot exceed, for an ECC83, some five volts or so. However, in this respect some valves, such as the ECC82, have much higher cut-off voltages and it would be wise to bear this in mind when initially finding the value of Rx. The temporary potentiometer should, in such instances, be adjusted from around a 50k Ω value and the circuit should not be switched on without resistance in the Rx position. Returning to the question of thermal runaway there has, in any case, been no evidence of this in the writer's own amplifier. The cathode of the ECC83 triode remains steady at 2.2 volts after hours of operation.

At the time of writing, the author has had the circuit of Fig. 2 in use for a number of weeks. It has given every satisfaction. There is no noticeable change in the operation of the existing a.m. tuner and gram input circuits, and the a.m. tuner and gram signals are handled by the amplifier exactly as before. The output from the f.m. tuner is also amplified adequately, and without distortion. There is, again, no interaction whatsoever between adjustments in the 25k Ω volume control and the two 1M Ω controls.

What is more, that valve amplifier has accepted its semiconductor infiltrator as though it had been purposely designed to take it!



ULTRA-SIMPLE TREMOLO UNIT

Using very simple circuit techniques, this economic design is capable of providing tremolo modulation of an electric musical instrument which is controllable both in depth and speed.

FREE FREE FREE

A three-page art paper cut-out colour supplement featuring Circuit Diagram, Components List, Printed Board Details, Point-to-Point Wiring Diagram and Cabinet Details for this 2-transistor (ACY19, OC44) unit.

TONE CONTROL PRE-AMPLIFIER

This is the second article in the 'Tri-add' series and the pre-amplifier described may be employed directly with the Gram Amplifier described in this issue, or with any similar amplifier.

TRANSISTOR SUB-STANDARD FREQUENCY MARKER

Using four readily available and inexpensive transistors, together with a dual crystal unit, this frequency marker offers sine and square wave outputs both at 100kHz and 1MHz. Calibration markers are available at frequencies in excess of 100MHz.

PLUS

- OTHER CONSTRUCTIONAL PROJECTS (see page 89)
- DATA SHEET 43
- SUPPORTING FEATURES

ON SALE OCTOBER 1st

NOW HEAR THESE

Times = GMT

Frequencies = kHz

● CLANDESTINE

The Voice of the Basque Underground, Radio Euzkadi, can be heard in Spanish at 2030, 2130 and 2230 on **13250** and **15080**. Suspected location of the transmitter is S. America but the address is given as BP59, F, 035, Paris 16, France.

● COSTA RICA

TIRICA La Voz de la Victor, San José, has been reactivated after a period of silence and can be heard on **9615** around 0300 to 0400 (50kW).

TIQ Radio Casino may be heard with an English programme from 0430 to 0600 on **5954** (1kW).

● ANGOLA

CR6RF Radio Clube de Benguala has been heard at 2125 with French lessons for English speaking listeners on the regular **3395** (0.25kW) channel.

CR6RG Radio Commercial de Angola can be heard until 1845 on **4795** (10kW).

Another Angolan station to log is **CR6AZ** A Voz de Angola, Luanda, on **5960** (100kW) from 1100 to 1400.

● ARGENTINA

LR Y1 Radio Belgrano, Buenos Aires, now radiates an English programme at 0300 on **6090** (35kW).

● PERU

OAX5U Radio La Vox de Huamanga, listed on **4815** has been heard on the new channel of **6205** (1kW) until sign-off at 0555.

● AFGHANISTAN

Radio Afghanistan has lately been using the new channel of **15160** in parallel with the usual **17780** (50kW) with news in English.

● BELGIUM

ORU Brussels is still searching around for an interference-free channel and has lately been heard at 1930 on **17865** (100kW). Listed on **17860**.

● ALBANIA

Radio Tirana has been reported on the new channel of **6900** until 1700 when **5080** is used. Our Listening Post reports R. Tirana currently using **7090** at 2015 with news in French. (50/240kW).

● NIGERIA

Lagos has been reported with an English and African programme at 0600 on a new channel of **7308** - formerly used by Radio Biafra. Our Listening Post regularly hears Ibadan on **3204** (10kW) around 1915.

● GHANA

Ejura can be regularly heard on **3350** (20kW) with good signals around 1900 to 2000.

Accra on **3366** (10kW) can also be heard around the same times.

Ghana can best be heard from 2045 to 2215 on **9545** (100kW) and **15285** (100/250kW) with an English programme beamed to Europe. The address for reports is - Ghana Broadcasting Corporation, Broadcasting House, P.O. Box 1633, Accra.

Acknowledgements to our own Listening Post and SCDX.

INTO BATTLE

AT LAST THE DREADED MOMENT HAD ARRIVED. Redland was invading BlueLand and, as a member of BlueLand's defending army on a summer day long ago, I took the Field of the Cloth of Khaki - not to confer, but to conquer the advancing hordes.

BlueLand's army, gallantly fighting a supposedly bitter rearguard action, didn't look much like an array of panoplied might that hot sultry day - still less the signal section of a certain unit currently engaged in (a) desperately laying landlines from horseback, (b) setting up mobile (sic) W/T stations fitted to horse-drawn wagons and (c) generally sweating their individual guts out amid the usual 'order and counter-order-disorder' that inevitably resulted from labouring under multitudinous seniors! Salisbury Plain was anything but a welcome sight in those days - we much preferred the seclusion of our barrack room with its 30 crowded occupants.

Our barrack room - what memories that place conjures up - ill lit with three 40 watt bulbs and in winter time inadequately heated by a coal fire for just two evenings a week - after which the coal ration was exhausted. We fitfully slept on springless iron beds, three small hard-as-nails mattresses termed 'biscuits' and one folded blanket. The remaining three blankets of the issue were pulled over our goose-pimpled torsos. The much re-issued blankets were so thin that daylight was readably visible through them. As it had been willed that the army should be run on the cheap this fact was reflected by the then ancient equipment that festooned our bodies and those of our horses.

To return to the Plain - perish the thought - my particular task was to help lay a D.Mk. III telephone line from point A to B, a distance of about a mile. Hanging from my saddle were two drums of cable, a hand-held wire laying device, a horse feed nosebag and an empty canvas water bucket. Strapped to the rear of the saddle was a large roll formed by a greatcoat, blanket and groundsheet. I was lumbered with a heavy leather-cased D.Mk. III handset, complete with batteries and a cranking handle for ringing-up and, to help matters, the full regalia of FSMO (Field Service Marching Order) which had to be seen to be believed!

The first trick was to mount into the saddle without catching one spur in the rear-of-saddle roll. Non-success often resulted in the horse carrying on without the luckless rider. It was a common sight to see riderless mounts careering about all over the Plain - whereupon there then took place a rodeo-like round-up, the war (sic) being temporarily forgotten!

Galloping along with the reins in one hand and the heavy drum of wire and laying device in the other it was most unseemly of fate to decree that the wire being laid by yours truly should become caught between the inside top of the tail and the backside of the unfortunate horse. Taking an extreme dislike in having its rear quarters wired for heating purposes, it's resultant performance would have put to shame an unbroken wild west bronco. Be it sufficient to say that this equestrian was violently converted to a pedestrian! Ever since that time I have had great sympathy with all those Redskins that are inevitably doomed it seems to bite the dust. Have you ever bitten the dust? From painful practical experience I can inform you that the only thing you can do is to grit your teeth!

Returning to the signal section crestfallen, fallen and unmounted, I was upbraided in no uncertain manner for (1) injuring the horse and (2) failing to lay the landline. Result - 7 days CB. Into battle hadn't brought me any victory but as a fallen soldier I had at least defeated one enemy - the fear of crashing into terra firma at the gallop.

As it is September with the commencement of Autumn upon us, perhaps I should have headed this column - The Fall!

C.W.

MINIATURE STABILIZED POWER UNIT

by

G. W. SHORT

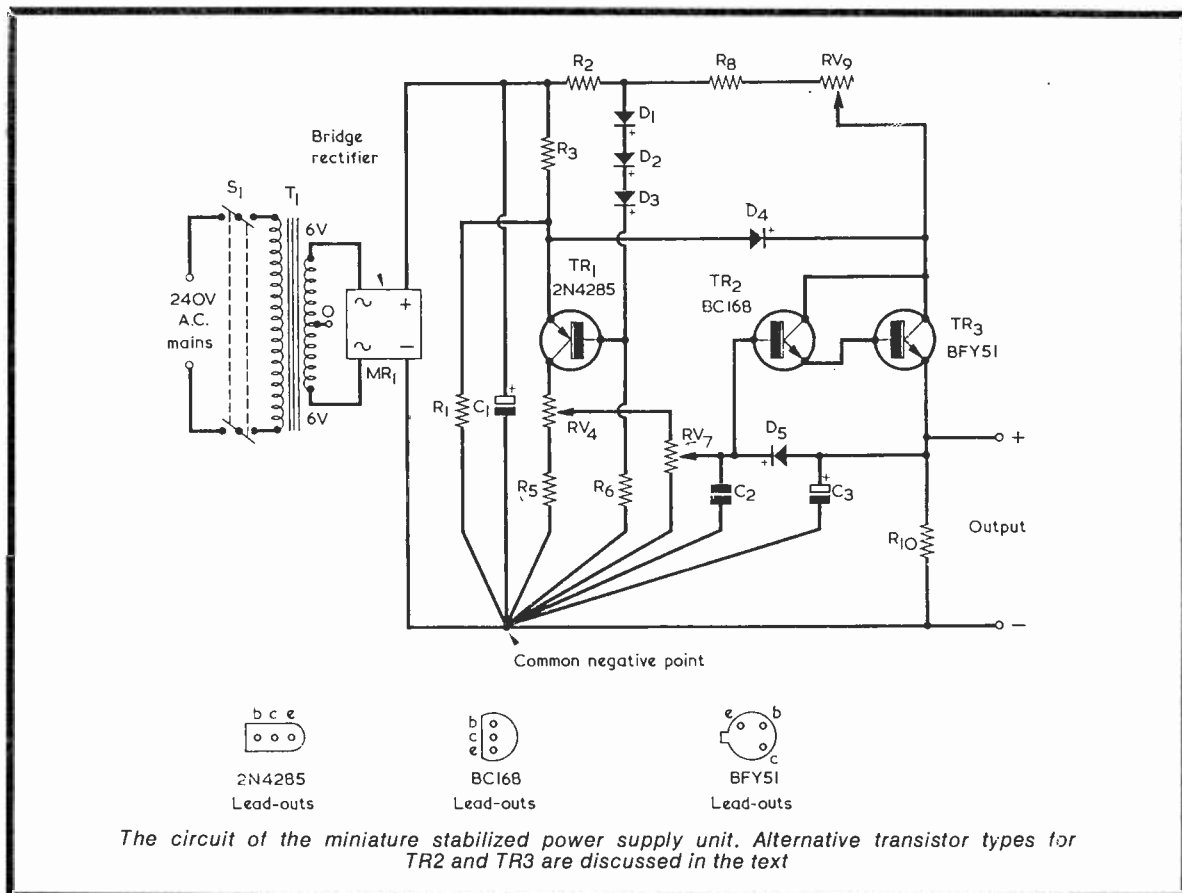
The stabilized power unit described in this article delivers 1.5 to 9 volts d.c. at currents up to 50mA. It incorporates an overload circuit which enables the maximum output current to be limited from approximately 5 to 60mA, and a simple manual voltage limiter which helps the user to avoid inadvertently applying too high an output voltage to the supplied equipment

THE CIRCUIT OF THE POWER UNIT APPEARS IN THE accompanying diagram. The regulator part uses a compound emitter follower as a series-connected output element. The theory of this particular circuit was described in detail in an earlier article*

* G. W. Short, "Rubber Zener" Circuits", *The Radio Constructor*, December, 1967.

but briefly, it works like this. TR2 and TR3 form a composite emitter follower with unity gain and a very high input impedance. A voltage applied to the base of TR2 gives rise to an output voltage at the emitter of TR3 which is about 1 volt lower and fairly stable despite variations in output current.

If, therefore, the voltage on the base of TR2 is



stabilized, then the output voltage is stabilized also. To ensure constancy of the voltage at the base of TR2 use is made of the fact that a constant current driven through a resistance produces a constant voltage drop. In the present case, TR1 acts as a constant current generator and the resistance is made up of RV4, R5, and RV7. The stabilized output voltage is controlled by both RV4 and RV7. (Two controls are used for reasons which are given later.)

The output voltage is therefore about 1 volt less than the voltage at the slider of RV7, and in fact is 0 to 10V. However, the performance of the regulator falls off at low voltages, so for practical purposes the lower end of the useful range is 1.5 volts. The upper limit is likely to be affected somewhat by local mains variations, which may prevent the full 10 volts from being reached, at any rate at the full output current. For these reasons the range given in the performance specification is 1.5 to 9 volts, which covers most of the usual dry battery voltages.

CURRENT LIMITER

The current limiting circuit is of the type which causes the output *voltage* to drop when more than the selected output current is taken. Readers may be familiar with an alternative system which switches the unit *off* if there is an overload, and holds it in the "off" condition until a "reset" button is pressed.

COMPONENTS

Resistors

(All fixed values $\frac{1}{2}$ watt 5%)

R1	100k Ω
R2	1 Ω
R3	1k Ω
RV4	10k Ω potentiometer, carbon track, log or linear
R5	820 Ω
R6	33k Ω
RV7	100k Ω potentiometer, carbon track, log or linear
R8	27 Ω
RV9	500 Ω wirewound, 2 watts, linear or inverse law (see text)
R10	10k Ω

Capacitors

C1	1,000 μ F electrolytic, 25V wkg.
C2	0.1 μ F paper or plastic foil
C3	50 μ F electrolytic, 25V wkg.

Transformer

T1	Mains transformer, secondary 6-0-6V 100mA, type MT6 (Eagle)
----	---

Semiconductors

TR1	2N4285
TR2	BC168, BC169, BC109, etc.
TR3	BFY51, MC140, etc.
D1-D5	IS44
MR1	Bridge rectifier type B30C150

Switch

S1	d.p.s.t. mains switch (may be ganged with RV4)
----	--

The writer prefers the first type of protection, and it so happens that it can be easily incorporated in this stabilizer.

The relevant components are R8, RV9, and D4. The output current flows through R8 and RV9 on its way to the output transistors. The voltage dropped across these resistors therefore varies with the output current and can be used to operate a protection process. The process consists of biasing TR1 towards cut-off if the current exceeds the required value. The silicon diode D4 is normally reverse-biased by the voltage drop across R3. As the output current rises, however, the voltage drop across R8 and RV9 overcomes this bias and D4 begins to conduct. This causes extra current to flow through R3, driving the emitter of TR1 negative and so reducing its collector current. This, of course, reduces the voltage at RV7, which governs the output voltage.

With RV9 set to zero, only R8 is left to limit the output (there is also R2, but this is so low in comparison that it can be neglected) and with R8 at 27 Ω the current is then limited to about 60mA. With RV9 at maximum resistance, the limit falls to about 4mA. It is possible to use a higher value of RV9 than 500 Ω and so set the limit still lower, but if RV9 has a linear law its operation will be too "fierce" for most users. The ideal law is inverse square or inverse log, but suitable potentiometers are not easy to obtain on the home constructor market. Since the precise value of RV9 is not very important, the constructor may find it of advantage to use any potentiometer which comes to hand which is capable of handling 60mA and offers a maximum value in the range 100 to 1,000 Ω . A 100 Ω potentiometer will only set the low current limit down to about 15mA, but this is still quite useful. Alternatively, RV9 may be replaced by a multi-position switch which inserts a fixed resistance on each position. Resistances in the range 27 Ω to 5k Ω will provide a selection of useful current steps down to about 1.5mA.

UNREGULATED SUPPLY

This uses a miniature mains transformer, Eagle Type MT6, which is roughly 1 $\frac{1}{2}$ in. cube (1 $\frac{1}{2}$ in. overall length including the fixing feet). Potentially, therefore, the complete pack can be made quite small. The MT6 has a secondary with a centre-tap, giving 6-0-6 volts at 100mA. In the present circuit, the centre tap is not used. Instead, a bridge rectifier is connected across the entire secondary, and receives a nominal 12 volts r.m.s. input. To keep the power the same as in the normal 6 volt full-wave rectifier arrangement the output current is restricted to 50mA. In fact, the bridge rectifier configuration makes a more efficient use of the transformer, and it is probably safe to exceed the 50mA limit slightly. This is why R8 has been chosen to set the limit at 60mA under fault conditions, thereby permitting 50mA under normal conditions.

The bridge rectifier is a subminiature selenium type, the Siemens B30C150. (This, in company with the semiconductors specified, is available from Amatronix, Ltd.) Despite its very small size the B30C150 is rated at 30 volts r.m.s. input, 150mA d.c. output, so it is operated well within its ratings here. The reservoir capacitor C1 is probably the largest

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item in the unit. It should be at least $500\mu\text{F}$ and have a d.c. working voltage rating of at least 25 volts. (The off-load voltage is 25 volts on 240 volt mains.) Any capacitance over $500\mu\text{F}$ may be used; there is no need to insert a limiting resistor between the capacitor and the rectifier because the requisite limiting resistance is provided by the winding resistance of the transformer.

CIRCUIT REFINEMENTS

Several refinements are incorporated in the stabilizer circuit shown here. R2 modifies the reference voltage (provided by the voltage drop across D1 to D3) which is applied to the constant current transistor as the output current increases. This compensates for residual variations in output voltage caused by variations in the base-emitter voltage drops of the output transistors. R1 stabilizes the constant-current circuit against variations in the un-stabilized input voltage.

To discourage high frequency oscillation due to stray impedances in the earth line, all the negative connections, as indicated in the diagram, are taken straight to the negative tag of C1. C2 also acts as a parasitic stopper.

The amount of mains ripple which reaches the output may be reduced to a very low level by increasing C2 to $50\mu\text{F}$, 25 volt working, but the charge stored in this larger capacitance prevents the current limiting section from operating properly for a second or two. Constructors who need a power supply with very low hum may consider the risk worth taking, and in any case it is always possible to use a fixed C2 of $0.1\mu\text{F}$ with a switchable $50\mu\text{F}$ to be put in circuit when needed. Another point here is that the hum level with the lower value of C2, which is not more than about 35 millivolts peak-to-peak at maximum current, can be reduced sharply by operating RV9 until the output voltage just begins to fall.

Both current and voltage may be metered. Current can be indicated by a milliammeter in the collector circuit of TR2 and TR3. A 1mA meter in series with R10 will read 0-10 volts. (Insert the meter at the earthy end of R10, and use a close tolerance resistor.)

SEMICONDUCTORS

TR1 must be a 2N4285, but there is ample choice for the other semiconductors. Almost any type of silicon junction diode may be substituted for the 1S44. TR2 can be any high-gain low-current n.p.n. planar transistor. TR3 must be able to dissipate 1W; possible types are BFY51 with a good cooling clip, and MC140 with a heat sink of $\frac{1}{16}$ in. aluminium lin. square (or larger). Many metal-cased silicon n.p.n. types in TO-5 cans will serve provided that they have good cooling clips or heat sinks.

CONSTRUCTION AND OPERATION

No special constructional precautions are needed, apart from attention to the earth wiring and ensuring adequate ventilation. Since the unit has a current limiter it is impossible to damage it by a short-circuit, but there is always the possibility that the equipment to which the unit is connected may accidentally receive too much current, or voltage, or both. It is always best to start off with a low-voltage setting and slide the voltage upwards. This simple precaution has saved many an experimenter from disaster in the shape of damaged components. Likewise, the current trip can be set initially at the low current end and slid upwards. Remember, however, that if the current limit is too low to begin with the voltage will be limited even when the circuit under test is in correct functional order.

A particular danger is that the constructor, pre-occupied with watching a meter, may slide the voltage up too far. This is why two voltage controls are provided. The idea is to use RV4 as a master control, to preset the voltage at the beginning of an experiment. RV7 is then used as a "slide-up" control, with the advantage that the voltage can never exceed the preset value. ■



SEPTEMBER 1970

IN OCTOBER ISSUE

REFLEX TAPE TUNER

A simple single-transistor reflex tuner unit for medium wave reception enabling a high degree of selectivity and sensitivity to be achieved. Ideal for the tape recorder enthusiast.

INTEGRATED CIRCUIT GRAM AMPLIFIER

One of the more attractive integrated circuits for amateur use is the General Electric PA237, which consists of an amplifier capable of giving an output of two watts into a 15Ω speaker. The amplifier described in this article incorporates a PA237 and is intended for operation direct from a crystal pick-up.

COMPUTERS FOR ANALYSIS AND CONTROL IN MEDICAL AND BIOLOGICAL RESEARCH

A Conference on Computers for Analysis and Control in Medical and Biological Research will be held at the University of Sheffield, on 7th, 8th, 9th September, 1971. It is being organised by the IEE Control and Automation Division in association with the Institute of Electrical and Electronics (UK and Republic of Ireland Section), the Institute of Mathematics and its Applications, the Institution of Electronic and Radio Engineers, the Biological Engineering Society and the British Computer Society.

The Conference is intended to interest those already working in the Medical and Biological field, where computers are used for research purposes and to provide discussion amongst those interested in the following topics:

Models of physiological systems and processes, control systems, harmodynamic muscular, respiratory, biochemical systems, ionic equilibrium.

On-line computers for control of experiments, neurophysiology, behavioural sciences, etc.

Analysis of data from on-line data acquisition, EEG, ECG, unit potentials, etc., pattern recognition, cardiac output measurements.

Clinical research in medicine, pathology, on-line control in clinical chemistry, statistical techniques.

Offers of contributions for the Conference programme are invited and intending authors should submit a 250-word synopsis to the IEE Conference Department before 5th November, 1970.

Further details and registration forms will be available in due course from the Manager, Conference Department, IEE, Savoy Place, London, WC2R 0BL.

LONDON ELECTRONIC COMPONENT SHOW

The International London Electronic Component Show next year, at Olympia from May 18th to 21st, is already showing record-breaking possibilities. Long before the dead-line for exhibitors' bookings there is already a steady flow of companies taking space.

The 1971 LECS is the second since the exhibition went international. Previously it was confined to British manufacturers.

The organisers, Industrial Exhibitions Limited, state that nearly 25 per cent of the early bookings come from abroad. At the last show, foreign firms represented 17 per cent of the exhibitors.

The last exhibition, in 1969, occupied 130,000 square feet of space. For the 1971 show, the National Hall at Olympia has been added to the Grand and West Halls, increasing the exhibition area to 190,000 square feet.

The International London Electronic Component Show is promoted by the Radio and Electronic Component Manufacturers' Federation and organised by Industrial Exhibitions Limited.

Multi-voltage Switching Circuit

by
W. PHILIPS

A deservedly popular mains transformer on the home-constructor market is the Douglas type MT3, the secondary windings of which can offer no less than 13 voltages ranging from 3 to 30 volts. This short article describes a circuit which enables 12 of these voltages to be selected with the aid of a switch

MANY READERS WILL HAVE ENCOUNTERED THE Douglas mains transformer type MT3 (alternatively listed in some catalogues as MT3.AT) which offers a wide range of secondary voltages, all at a current rating of 2 amps.

The actual secondary voltages offered by this transformer can be seen in Fig. 1, in which tapings between 0V and 30V are given at 12V, 15V, 20V and 24V. By choosing the requisite tapings it is possible to obtain any of the following secondary voltages: 3V, 4V, 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V and 30V. As may be gathered this is a very versatile transformer indeed, and it represents an ideal choice for the experimenter who wishes to work with low voltage equipment.

SECONDARY SWITCHING

It occurred to the writer that the transformer could be employed most usefully for experimental projects by connecting a switch to its secondary which could select any of the voltages available. The number of possible voltages is 13, and it was felt that the 9V output could best be sacrificed whereupon all the remaining voltages could be selected by means of a 12-way switch.

It was anticipated that the switching circuit would be fairly complex but, after some head-scratching

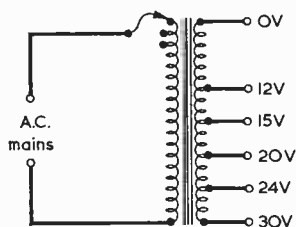


Fig. 1. Illustrating the secondary voltages offered by the Douglas mains transformer type MT3

(and a dozen sheets of foolscap!), it was eventually found possible to evolve the circuit shown in Fig. 2. This represents about as simple a switching circuit as can be obtained; although the writer would agree that there may be several alternative combinations which would represent the same order of simplicity.

The switch in Fig. 2 is a 2-pole 12-way component, shown as S1(a), S1(b). The contacts are drawn out in a straight line instead of in the usual semicircular form, as this enables the circuit information to be presented most easily. The lines ending in arrows at the left of each switch bank indicate connections to secondary taps having the voltage indicated.

Several examples will illustrate how the switching circuit works. As shown, S1(a) and S1(b) are in the 8V position, whereupon the arm of S1(a) connects to the 20V secondary tap of the transformer whilst the arm of S1(b) connects to the 12V secondary tap. The difference, 8V, then appears across the output terminals. When S1(a) and S1(b) are in the 18V position, S1(a) selects the 30V tap and S1(b) the 12V tap, thereby allowing a difference voltage of 18V to be applied to the output terminals. The other voltages selected by S1(a) and S1(b) can be similarly traced through the circuit of Fig. 2.

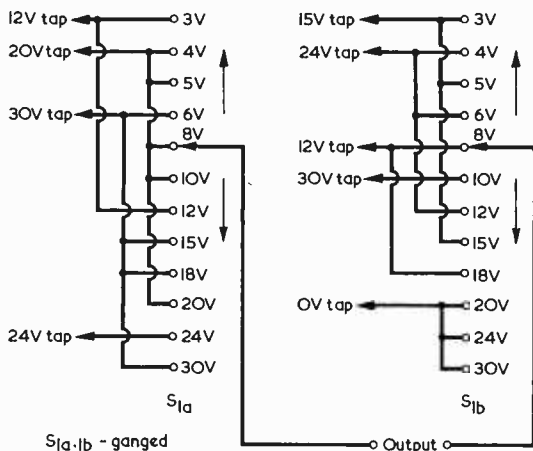


Fig. 2. The switching circuit. Operation is described in the text

APPLICATIONS

The application to which the switching circuit will be put depends upon the requirements of the constructor, but it is most probable that the circuit will be employed in a variable voltage power supply, as in Fig. 3. Such a supply will offer a wide range of d.c. output voltages at good regulation simply by adjusting S1(a)(b) as required. It will be noted that a bleeder resistor, R1, is connected across the reservoir capacitor C1. Its function is merely to ensure that this capacitor, and C2, discharge fairly rapidly to a new voltage if the switch is adjusted to a lower setting with no load current flowing. R1 may be of the order of $4.7k\Omega$ $\frac{1}{2}$ watt for the values of reservoir and smoothing capacitance normally likely to be encountered. The rectifiers and capacitors in Fig. 3 must, of course, be rated for 30 volt operation.

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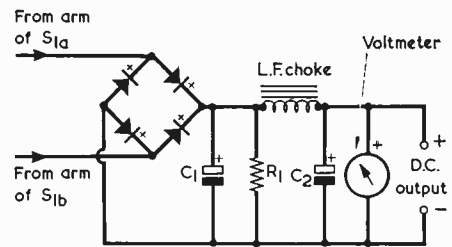


Fig. 3. One probable application for the switching circuit is in a variable voltage power supply, as shown here

The only disadvantage with the circuit is that, for high current working, the constructor will have to 'shop around' for a suitable 2-pole 12-way switch, as these are not available for 2 amp working through the larger mail-order houses. For lower current operation standard rotary switches of the 'wave-change' variety are ideal, and two of the Radiospares 'Maka-Switch' 1-pole 12-way wafers could be used. (These wafers, together with the associated 'Maka-Switch' kit, are available from Henry's Radio and Home Radio.) The wafers are rated up to 300mA at 50V, such a current being adequate for many experimental power supply applications.

One final, and very important point, is that the switch wafers *must* be 'break-before-make' types. If 'make-before-break' wafers are employed, there will be fireworks when switching from one voltage to the next!

NEW EMI CALIBRATOR FOR INFRA-RED SCANNERS

A high-stability, solid-state unit for calibrating infra-red scanners used in medical and industrial thermography has been introduced by EMI. The equipment - "Thermocal" - comprises a 'black body' unit mounted on an infusion-type stand and a separate power unit which is located conveniently at the base of the stand. The 'black body' unit contains five modules. Each has a thick-film heat element with a pre-set temperature control and small integral thermometer. The 'black body' unit has excellent heat emission characteristics. Each module can be set independently to any temperature in the range $30^{\circ} - 40^{\circ}\text{C}$. It is maintained by control circuits to within 0.25°C for variations in ambient temperature from $15^{\circ} - 30^{\circ}\text{C}$.

The controlled temperature range makes the equipment especially suitable for calibrating medical thermography equipment, such as the EMI "Thermocal".

The 'black body' unit and the power supply are of similar dimensions, 380 x 100 x 76 mm. (15 x 4 x 3in.). Each weighs approximately 2.5 kg. (5.25 lbs.).

"Thermocal" has recently been ordered by the Ministry of Health and Social Security for calibrating medical thermography systems.

RAIN DETECTOR

by
J. T. NEILL

The fact that an electric bell or buzzer continually breaks its own circuit makes it possible for such a component to be both turned on and off by gate current to a thyristor. This feature forms the basis of the rain detector circuit described here. The detector also has several other applications, and these make it an attractive instrument for use in the workshop

THE UNIT TO BE DESCRIBED IN THIS ARTICLE HAS been in use in the author's household as a rain detector for some time. This is not the limit of its usefulness, however, for it can also be employed as a diode tester and continuity checker, and it has a further use as a simple Go/No-Go transistor tester. A brief outline of such uses of the unit that have occurred to the writer is given towards the end of the article.

Ingenious constructors will no doubt think of additional uses, both in the house and workshop.

The rain detector, as such, is ideally suited to the beginner or others who have no experience of thyristor operation.

CIRCUIT OPERATION

The detector uses the current gain of an emitter follower to amplify the small current passed by the sensor employed; the resultant much larger current then triggers a thyristor (silicon controlled rectifier

or s.c.r.) into conduction. An alarm bell is operated by this latter device, although a buzzer could be employed in its place.

The circuit diagram of the rain detector is given in Fig. 1, and it will be of value to initially consider the two semiconductor devices, these being the transistor, TR1, and the thyristor, TH1. The transistor is connected as an emitter follower whereupon, although it gives no voltage gain, it provides a high current gain. In consequence, an amplified version of the current in the base circuit of TR1 is fed to the gate of the thyristor. R4 acts as a limiting resistor

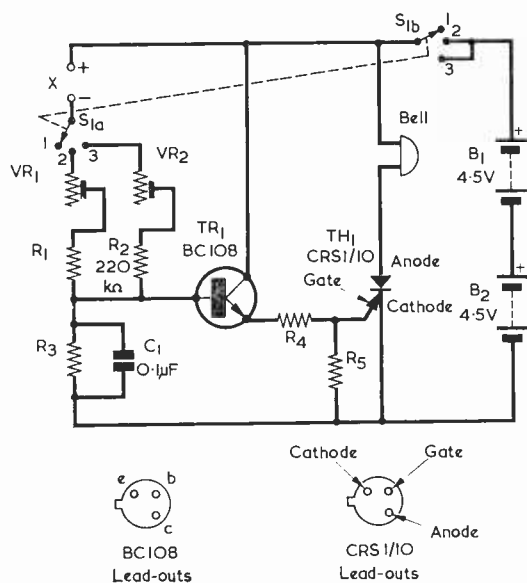


Fig. 1. The circuit of the rain detector

COMPONENTS

Resistors

(All fixed values $\frac{1}{4}$ watt, 10%)

- R1 100k Ω
- R2 220k Ω
- R3 100k Ω
- R4 100 Ω
- R5 2.2k Ω
- VR1 250k Ω variable preset, skeleton
- VR2 250k Ω variable preset, skeleton

Capacitor

- C1 0.5 μ F paper or plastic foil

Semiconductors

- TR1 BC108
- TH1 CRS1/10 (Henry's Radio, Ltd.)

Switch

- S1(a)(b) two-pole three-way, rotary

Batteries

- B1,2 4.5 volt battery type 1289 (Ever Ready)

Miscellaneous

- Electric bell or buzzer
- Eddystone diecast box, $4\frac{1}{2}$ by $3\frac{1}{2}$ by 2in, Cat. No. E650 (Home Radio)
- Insulated screw terminal, red
- Insulated screw terminal, black
- Knob (for S1)
- Veroboard, 0.15in matrix, as required

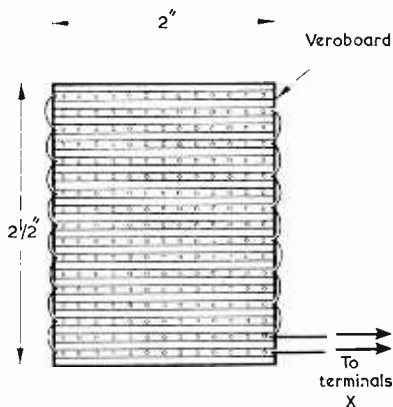


Fig. 2. A sensor may be conveniently made up by using a piece of Veroboard

whilst R5 completes the gate-cathode circuit of the thyristor and prevents any tendency for spurious triggering to occur.

Let us next examine the particular characteristics of the thyristor.

First of all, a thyristor is essentially a diode having an anode and cathode, with the addition of a third electrode, called the gate. Even with a positive voltage on the anode and the corresponding negative voltage applied to the cathode, no current (apart from a diminutive leakage current) will flow if the device is not triggered.

On the other hand, current will flow, as in a conventional diode, if the gate electrode is made positive with respect to the cathode. The trigger voltage needs to be derived from a low impedance source so that a current of up to, say, 30mA can flow into the gate in the case of heavy current thyristors. Lower power thyristors such as are used here need only 5mA or so for conduction to start. Once current flow is established in the thyristor the gate voltage may be removed, whereupon the current flow in the anode-cathode circuit will continue. If, however, this current should fall below a certain, rather low value (called the holding current) then the anode-cathode current will cease.

In passing, it is worth noting that thyristors have the capability of handling much larger voltages and currents, physical size for physical size, than transistors. A 100 volt one amp thyristor is normally housed in a T05 case – the same size as is used for transistors such as the ACY17, 2N1304, BFY50, etc.

Ample current can be passed by even the smallest thyristor to operate a bell or buzzer, which can be an ordinary household type such as is employed for door warning, etc. (However, avoid using very low-cost electric bells as are sold in chain stores, since some of these can pass excessively high currents – Editor).

The current through such a bell is, of course, self-interrupted by the nature of the bell functioning, but as long as the gate of the thyristor is suitably supplied the current will be re-established as soon as the contact in the bell re-makes. When the gate current is removed, bell operation ceases.

SEPTEMBER 1970

TRANSISTOR INPUT

The input circuit of the transistor in Fig. 1 calls for a little explanation. With the terminals at X open, R3 ensures that no current flows into the base of TR1, and hence no current flows into the thyristor base. Thus the thyristor is non-conductive, or blocking, and the bell is silent.

Capacitor C1 ensures that no incidental 50Hz hum pick-up takes place at the transistor base. Such unwanted pick-up could otherwise occur very readily due to the high input impedance (for although the equipment is battery operated, stray fields are present in almost all situations) and if it did, spurious operation of the bell might occur. C1 has a sufficiently low reactance to bleed away to earth all 50Hz voltages likely to be encountered.

Next, consider the position with the terminals at X joined together, and the switch at position 3. If VR2 is set to a sufficiently low value, enough current will flow from the positive supply rail through VR2 and R2 to the transistor base to cause the thyristor to conduct and sound the bell. Thus a short-circuit, selected by the switch in position 3, will operate the bell.

If the terminals at X are now bridged by a high value of resistance, say 50kΩ, and the switch put to position 2, VR1 can be adjusted to again sound bell.

It can be seen that by suitable adjustment of the appropriate preset variable resistor, any desired broad level of resistance can be identified.

To complete the rain detector a suitable sensor is

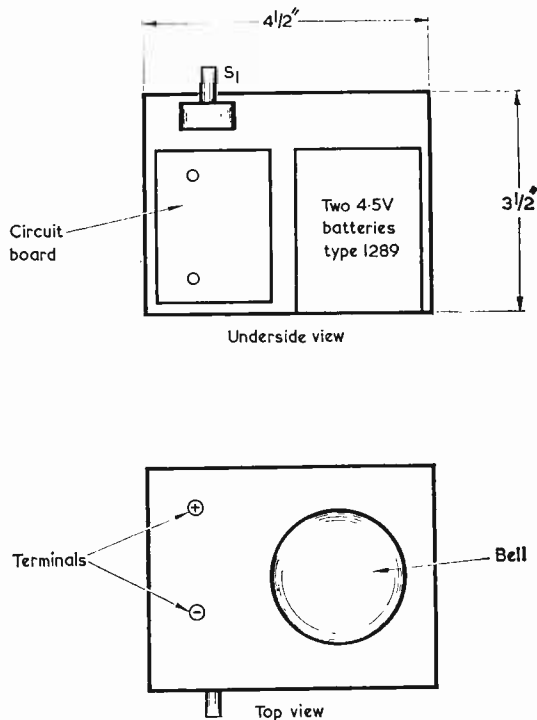


Fig. 3. The layout employed in the prototype rain detector unit

required, and for this a piece of Veroboard with a hole spacing of 0.15in is suggested.

This is arranged with alternate copper strips connected to one terminal and the intervening strips to another terminal, as in Fig 2. Normally a very high value of resistance (several megohms) will exist between the two terminal points. If water is allowed to fall on the copper side of the sensor, drops will bridge adjacent strips and the resistance between the terminals will be reduced to a level where, with the switch at position 2, the bell will be operated.

PRACTICAL DETAILS

That completes the outline of the basic principles involved, and the description of the circuit. Now for practical details.

The author's unit is housed in an Eddystone diecast box measuring 4½ by 3½ by 2in, this being robust, convenient and easy to work. As Fig. 3 shows, the bell is mounted on top. The two 4.5 volt flat batteries are fitted inside, leaving sufficient room for the components to be built on a piece of 0.15in Veroboard measuring 2½ by 1½in. This Veroboard is held in place on the rear of the two terminals, which pass through two holes drilled in the board. Due to the simplicity of the circuit, no difficulty should be experienced in making up a suitable Veroboard layout. The rotary switch, providing the two sensitivities and an 'Off' position, is fitted to the side of the box.

With the two batteries held together by a rubber band it will be found that they can be tightly held in place by the clamping action of the box lid if a piece of foam plastic is placed under the batteries before fitting.

The batteries suggested should last for a considerable time, for while the bell is silent only leakage current flows; and this should be of the order of microamps only. Connection to the batteries is therefore quite a simple matter. Leaving the manufacturer's cardboard protection in place, wires are easily soldered to the brass strips.

Leads to the Veroboard holding the components should be left a little longer than might otherwise appear necessary, so that the operation of the unit can be checked before the Veroboard is mounted, inside the box, to the rear of the terminals.

The arrangement of the piece of Veroboard which is used for the rain sensor can be to suit individual requirements. The author merely mounted it on a

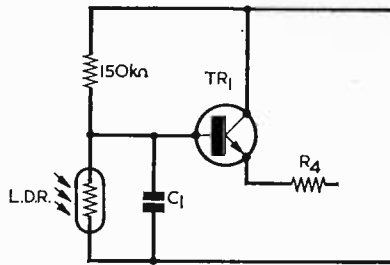


Fig. 5. A modification of Fig. 1, which enables the bell to sound when light intensity decreases

piece of block-board some inches larger than the Veroboard, using panel pins for that purpose. It is, of course, placed in the area where it is desired to sense the presence of rainfall – near Monday's washing, for example.

A length of twin flex couples the sensor to the terminals on the diecast box, which would usually be situated indoors in some convenient place with the switch at position two. When the bell sounds, the unit is switched to position one in order to silence it.

ALTERNATIVE USES

Alternative uses for the rain detector were mentioned at the beginning. Here are some of them.

Since the unit is triggered off by the presence of water across the terminals, it is possible for the two leads from the diecast box to be bridged by, for example, the water level rising in a tank or bath. The device thus forms a useful over-level detector.

Uses for the detector in the home electronics workshop can be many and varied. With the switch put to position three, a useful continuity tester results, giving audible indication in place of the visual indication provided by the more usual testmeter. This facility is often better where it is desired that the operator keeps his eye on the test points under inspection.

Since the two test terminals are polarised, with the upper terminal of Fig. 1 positive, diodes and transistors can be given a quick Go/No-Go test. If the positive terminal is connected to the anode of a diode, with the other terminal to the diode cathode, continuity will be indicated on switch position 2. Reversal of the connections will, with a diode in good condition, show no such continuity. Burnt out or otherwise unserviceable diodes usually show continuity in both directions.

Transistors can be considered as being equivalent to two diodes, back to back, as indicated in Fig. 4, where both p.n.p. and n.p.n. transistors are shown.

The tests given above concerning diodes can now be applied to a transistor (paying attention to polarity, of course). It is possible that some large power-handling germanium transistors may show continuity in both directions; this indicates leakage, which may or may not be important in the application envisaged for the particular transistor concerned.

With regard to the checking of small low power transistors, the author tested in this way two batches of transistors bought at around 30 for 10s. from advertisers in *The Radio Constructor*. Both sets –

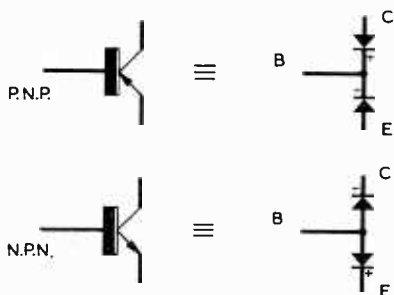


Fig. 4. The detector unit has several other applications, including the checking of diodes and transistors. A transistor is treated as two diodes connected back to back

one ACY17 series p.n.p. and the other BC108 series n.p.n. – were successfully classified as 'good' or 'reject' with the aid of the rain detector.

In these tests of diodes and transistors it is worth noting that a very low level of current, of the order of $40\mu\text{A}$, flows through the device under test, and hence no damage can be caused. The same applies, of course, when continuity testing is undertaken; this could be an important point when such things as sensitive moving-coil meters are being checked.

For the uses just described it would sometimes be preferable to use a buzzer in place of a loudly sounding bell, and this is quite in order.

Many light dependent resistors have a suitable range of resistance values to operate the unit. As the light level rises, the l.d.r. falls in value, so that if it is connected across the terminals the bell will sound.

It would often be more convenient to have an alarm sound as light level falls, and this can be obtained if the circuit modification shown in Fig. 5 is carried out. As long as the l.d.r. has a low value of resistance, as occurs when the light level is high, the voltage at the transistor base will be low and the bell will not sound. When the light level falls and the l.d.r. resistance rises, current can flow via the $150\text{k}\Omega$ resistor into the base of the transistor, so causing the thyristor to conduct.

Incidentally, the value of the resistor shown as $150\text{k}\Omega$ may need to be altered to suit individual l.d.r.'s, or to have operation occur at a different light level.

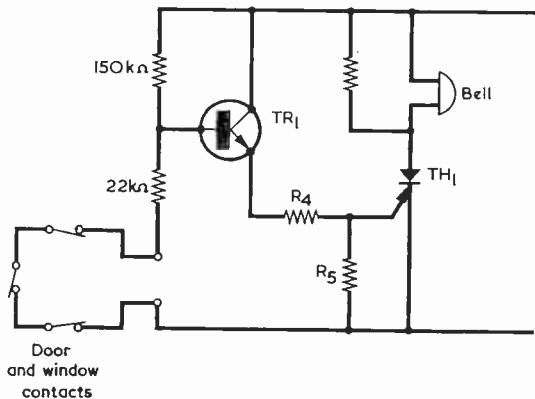


Fig. 6. Another modification, which introduces a 'latch-on' resistor, enables the circuit to function as a burglar alarm

A further use is shown in the modified circuit given in Fig. 6, which provides the basis for a burglar alarm system.

So long as the window and door contacts remain completed the bell is silent. Should any of these become open-circuit, the $150\text{k}\Omega$ resistor will cause sufficient current to flow to operate the bell. In the previous versions of the circuit the bell would, however, be silenced if the open contacts were closed again, but in Fig. 6 the presence of the resistor connected across the bell prevents this, for it provides a path for current to remain flowing through the thyristor even when gate drive is removed.

(Continued on page 110)

CURRENT SCHEDULES

Times = GMT

Frequencies = kHz

★ IRAN

Radio Iran, Teheran, currently radiates the English programme from 2000 to 2029 on **12175** (100kW). Two additional channels announced are **7064** and **15084**.

★ BRAZIL

ZYZ43 Radio Emissora Paranaense, Curitiba, on **9545** (7.5kW) has changed the station name to Radio Universo de Curitiba and has an increased schedule from 0900 to 2100.

★ ALGERIA

Radio Algiers is now operating on a new frequency of **11715** in parallel with the usual **11835** (100kW) until 1600. The French Network signs on at 0600 on these channels. The usual channels of **6080** and **9510** are not heard at this time.

★ ARGENTINA

The schedule of overseas services of RAE are as follows – to Europe, N. Africa and Middle East in Spanish from 1900 to 2000; in German from 2000 to 2100 and in Italian from 2100 to 2200 over LRY1 Radio Belgrano **6090** (35kW), LRA35 Radio Nacional **11710** (100kW) and LRY2 Radio Belgrano **11780** (8kW). In French from 2200 to 2300 and in English from 2300 to 2400 but only over the **11710** channel. To North, Central and South America in Portuguese from 0000 to 0100 and Spanish from 0100 to 0300 over LRA32 Radio Nacional on **9690** (100kW). In English from 0300 to 0400; Spanish from 0400 to 0600 and in English again from 0600 to 0700 on **6090**, **9690** and **11780**. To Asia in Japanese from 0900 to 1000 on **9690**.

★ NORTH KOREA

Radio Pyongyang now carries English programmes as follows – to S.E. Asia from 0800 to 0900 on **6540** (120/240kW) and **15150** (120/240kW). From 1100 to 1200 and from 1400 to 1500 on **9540** and **15150**. To Near and Middle East, Africa and Europe from 1900 to 2000 on **6540** and **9540** and from 0200 to 0300 on **6540** and **15150**.

★ INDIA

All India Radio has been carrying out a test transmission daily to Mauritius from 1245 to 1255 in Hindi over the Bombay transmitter on **9575** (100kW). Reports are requested to P.O. Box 500, New Delhi.

The AIR programme directed to N.E. Asia, from 1000 to 1100, is now on the usual channels of **21555** (100kW) in addition to the usual channels of **15105** and **17380** (both 100kW).

★ POLAND

Radio Warsaw has been carrying out test transmission to N. America from 0200 to 0255 and from 0300 to 0355 on **7125** (15kW), **9540** (40kW), **9550**, **11800** (both 100kW), **15275** and **15355** (both 40/100kW).

★ CENTRAL AFRICAN REPUBLIC

Radio Bangui on **5035** (30kW) has the following schedule – Monday, Wednesday and Friday from 0430 to 0730; 1100 to 1400 and from 1630 to 2230. On Tuesday and Thursday from 0430 to 0730 and from 1100 to 2230. On Saturday and Sunday from 0430 to 2300.

Acknowledgements to our own Listening Post and SCDX. ■

THE 'TRI-add' SERIES

THE 'TRI-add' G

F. G. RAYER

This is the first of a series of three components: a main amplifier, a tone control pre-amplifier, and a superhet tuner. A particularly attractive feature of the series is its versatility, since the main amplifier may be used on its own or with either of the other two units. Power from the

THERE ARE SEVERAL ADVANTAGES IN BUILDING AN amplifier, pre-amplifier and radio tuner as separate items of equipment. Construction is simplified, because it can be carried out in stages, and the whole equipment is more versatile. It is also easier to service individual parts of the equipment, if this is ever necessary.

The 'TRI-add' equipment consists of three items. Further details of these are given later, but their purpose is briefly as follows:

- (1) A two-stage amplifier with power supply and speaker, for 33, 45 and 78 r.p.m. records. This may be used alone for record playing.
- (2) A tone-control pre-amplifier, giving up to 15dB treble and bass boost or cut.
- (3) A superhet tuner, built in such a way that it tunes medium waves only or allows complete coverage from 30MHz to 150kHz in five bands.

As mentioned, Unit 1 can be wholly adequate employed alone. Unit 2 may be plugged in when extra gain is required for a microphone or low level pick-up, or when records or other signal sources make comprehensive tone control necessary. Unit 3 is of course for radio reception, and can if wanted give extensive short wave coverage, as well as allowing reproduction of ordinary broadcast entertainment through the main amplifier.

GRAM AMPLIFIER

The 'TRI-add' amplifier has a single valve as a two-stage amplifier, and gives very good results with the popular type of crystal pick-up. The whole amplifier, with speaker and power pack, occupies a case measuring 10 x 6 x 6in. It is straightforward and economical to build.

COVER ILLUSTRATION

The illustration on this month's cover shows the first of the units which make up the equipment. These are the Gram Amplifier (described this month), the tone-control pre-amplifier and the superhet radio tuner. Constructional details for these last two units will be given in the next two issues.

Fig. 1 gives the circuit. The triode section of an ECL82 is the first audio amplifier, following volume control VR1. The pentode section drives the loud-speaker through the speaker transformer T1, and maximum output is about 3 watts.

Cathode bias for the first stage is provided by R2, negative feedback from the output transformer secondary being coupled back to this cathode via R6, VR2 and C5. VR2 functions as a tone control by varying the feedback level of the higher audio

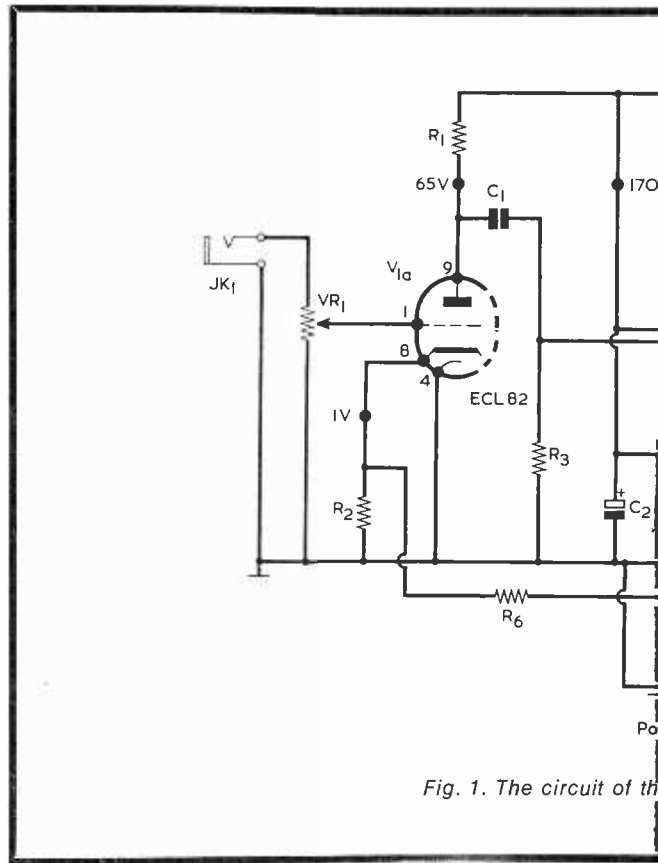


Fig. 1. The circuit of the

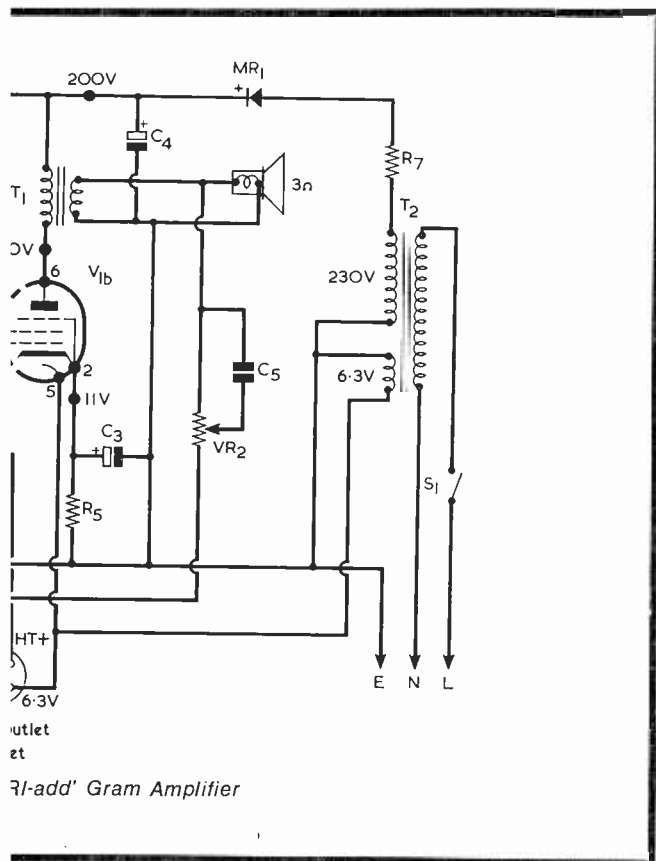
GRAM AMPLIFIER

Assoc.I.E.R.E.

Instructional articles describing, in turn, amplifier and a superhet radio tuner. A sign of these three units is their versed as a viable item of equipment on er two units. The latter obtain their main amplifier

frequencies. Since the negative feedback loop includes both sections of the ECL82 and also takes in the output transformer, overall quality level is high and there is adequate control of response for both records and radio reception.

To secure complete isolation from the mains, the heater and high tension supplies are provided by transformer T2. Half-wave rectification gives about 200 volts for the h.t. line. R4 and C2 provide additional smoothing for the triode anode and output



RI-add' Gram Amplifier



Cover Feature

COMPONENTS

Resistors

(All fixed values 10%)

- R1 220kΩ ¼ watt
- R2 2.7kΩ ¼ watt
- R3 1MΩ ¼ watt
- R4 4.7kΩ 1 watt
- R5 330Ω 1 watt
- R6 2.7kΩ ¼ watt
- R7 100Ω 1 watt
- VR1 1MΩ pot., log
- VR2 25kΩ pot., linear, with switch S1

Capacitors

- C1 0.01μF paper or plastic foil, 350V wkg.
- C2 32μF electrolytic, 350V wkg.
- C3 50μF electrolytic, 25V wkg.
- C4 16μF electrolytic, 350V wkg.
- C5 0.05μF paper or plastic foil, 150V wkg.

Inductors

- T1 Speaker transformer, approximately 50:1
- T2 Mains transformer, secondaries 230 volt 45mA, 6.3 volt 1.5A, Cat. No. TM26A (Home Radio)

Valve

- V1 ECL82

Rectifier

- MR1 Contact cooled rectifier, 250 volt 50mA, Cat. No. MR18 (Home Radio)

Jack

- JK1 Input jack

Switch

- S1 S.P.S.T. switch, part of VR2

Speaker

- 3Ω speaker, 5in. round

Sockets

- B9A valveholder
- 3-way power outlet socket with matching plugs (see text)

Chassis Case

- Chassis, 8 x 5½ x 2in. aluminium Dinkicase, 10 x 6 x 6in. (Electroniques)
- Front and rear panels (see text)

Miscellaneous

- Two knobs
- 2-way tagstrip
- 3-way tagstrip
- Solder tags, grommets, etc.

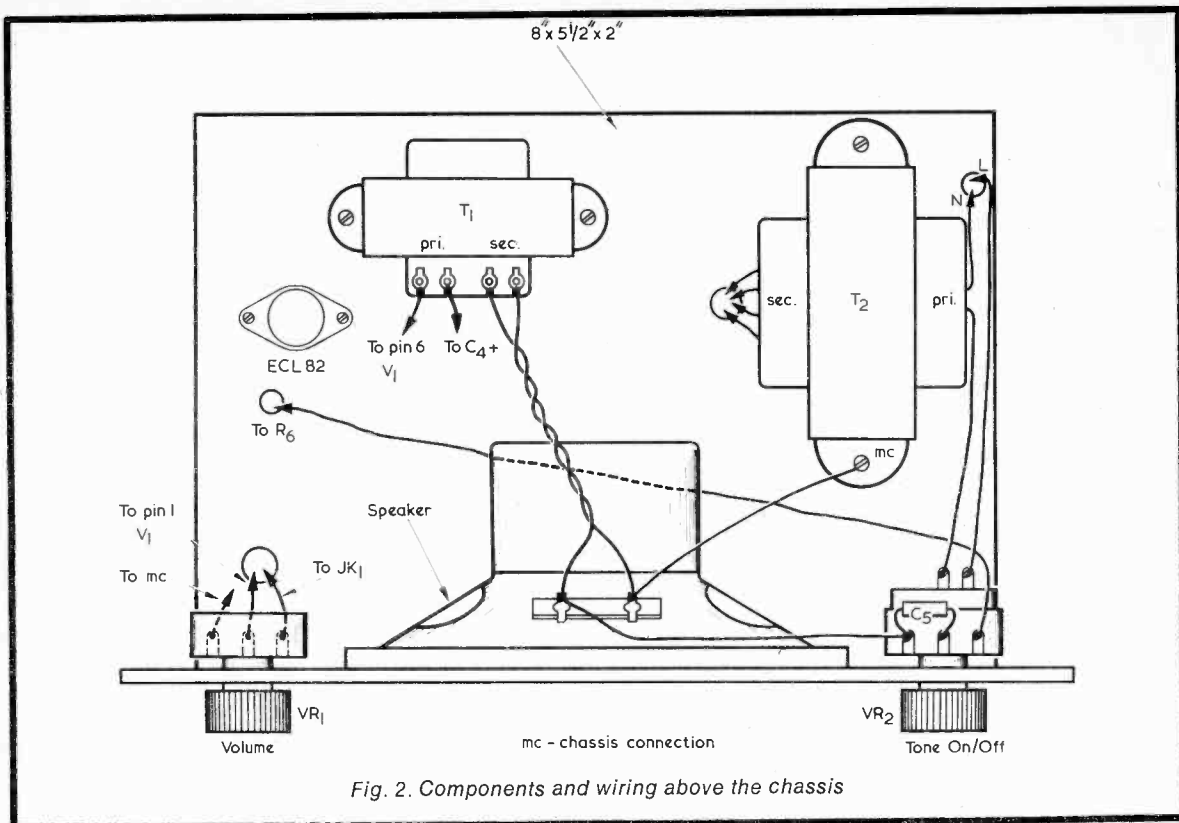


Fig. 2. Components and wiring above the chassis

stage screen-grid. The heater requires 6.3 volts at 0.78A from T2. If the pre-amplifier or radio tuner are in use, the h.t. and heater current is drawn from a power outlet on the main amplifier.

A 5in. speaker is accommodated in the cabinet; this is satisfactory for all general purposes, and allows the whole equipment to be self-contained. Should a larger, or favourite, 2 to 3Ω speaker be available with cabinet or baffle, this could be used instead. The amplifier should then be built exactly as shown, except that the speaker and its aperture would be omitted. Also the secondary of T1 would be connected to a twin socket strip, the external speaker being plugged in to this.

CHASSIS AND CASE

The case is 10 x 6 x 6in. and the chassis is 8 x 5½ x 2in. A section approximately 1½ x 4½in. shaped as in Fig. 3 must be cut from the chassis, to accommodate the bottom of the 5in. speaker. The actual dimensions of the cut-out depend on the particular speaker employed. The case has a ¼in. flange running round inside and the chassis must

clear this, so it must be fixed ¼in. higher than the front panel bottom edge. Alternatively, ¼in. is cut from the portions of the front runner remaining after the speaker cut-out has been made, and the chassis front corners are snipped off to match.

A steel panel was supplied with the case, but was not used in the present equipment. Instead, a hard-board panel was cut, marking round the steel panel with a pencil. The speaker opening is then readily made with a keyhole or small pad saw. The panel is glass-papered, dusted off and given a coat of gold crackle paint. Speaker gauze is afterwards glued across the aperture inside. The input jack and one bolt secure the chassis and panel together.

Fig. 2 shows the components on top of the chassis. A screw-up ¼in. chassis cutter is most suitable for making the valveholder hole. Bolt holes are ¼in. for 6BA. Make ¼in. diameter or similar holes in the chassis for the mains transformer leads, mains lead, and wires to VR1. These holes should be fitted with grommets.

POWER OUTLET SOCKET

This is bolted in a clearance hole in the back runner. Its purpose is to supply high tension and heater currents to the pre-amplifier or radio tuner, and to provide a common chassis connection.

Any non-reversible plug having three or more pins, with a matching socket, will be suitable. In the author's amplifier a small 4-pin type valveholder was fitted (Hivac) because plugs for this were available. An octal valveholder may be used, either with

THE RADIO CONSTRUCTOR



the bases of old octal valves for plugs, or with a Home Radio Cat. No. P112 octal plug. Various other plugs and sockets, having three or more pins, are equally suitable.

Use one socket connection for h.t. positive, another for the 6.3 volt supply, and a third for the common chassis return. One matching plug is required for the pre-amplifier, and one for the radio tuner. The power supply cords for the pre-amplifier and tuner were made of coloured flex – red for h.t. positive, blue for heater, and black for the common return. These leads are soldered to the appropriate pins of the multi-way plug.

T2 has a 1.5A secondary for heaters. The ECL82 requires 0.78A so 0.72A remains for the pre-amplifier or for the tuner. These units actually require less heater current than this.

WIRING

The wiring should prove to be straightforward, working from Figs. 2 and 3, but a few points can be noted.

Input Jack. This is so wired that the plug tip contact connects to VR1, and the plug sleeve to chassis, as in Fig. 3. Some jacks have a different construction to that shown in Fig. 3 but the method of connection remains the same.

Volume Control VR1. The fixing bush, metal case and one tag of this potentiometer are joined to the chassis by a lead, as shown in Fig. 2 (where the tags are on the underside of the component body). The centre tag connects to pin 1 of the valveholder.

On-off Switch and Tone Control VR2. The rear



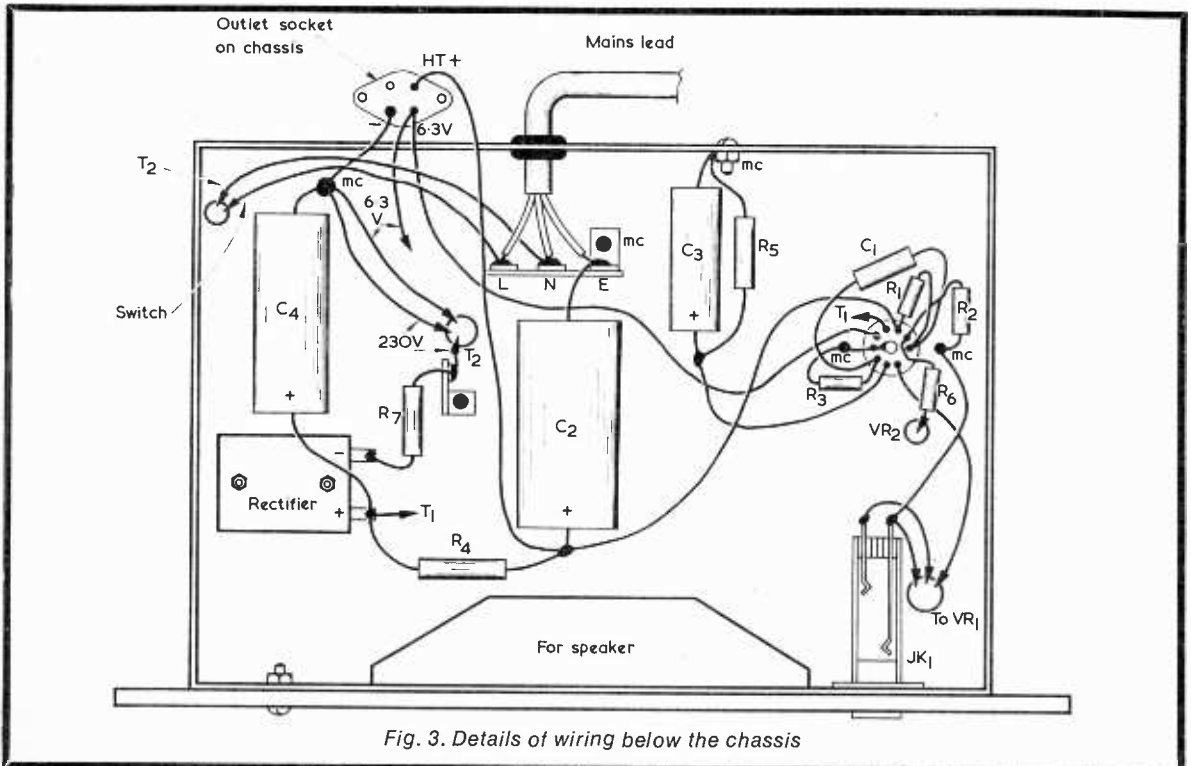
tags of this component are for the switch, and are placed in the L (live) lead from the mains to the primary of T2.

Mains Lead. Use a 3-core cord, anchored at the tagstrip in Fig. 3, and passing out through a grommet. The green-and-yellow striped core is Earth E, the light blue core is neutral N, and the brown core is live L. Take the cord to a 13 amp plug fitted with a 2 amp or 3 amp fuse.

Mains Transformer. The secondary leads from this transformer pass through the chassis. The h.t. secondary connects to R7 and chassis, and the 6.3 volt secondary to chassis and pin 5 of the valveholder, as in Fig. 3. Note that the insulated tag of a 2-way tagstrip anchors the end of R7 which connects to the transformer secondary.

Rectifier. The rectifier listed and used is a contact cooled type, bolted to the chassis, which acts as a heat sink. Remove burr from the holes to obtain good metal-to-metal contact.

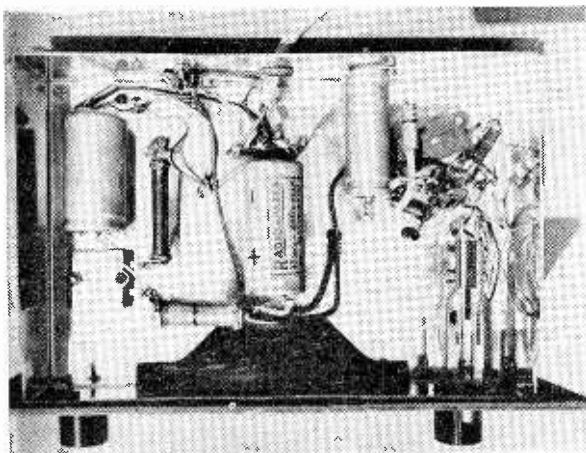
Speaker Transformer. This is T1, Fig. 2, and leads from the primary pass through the chassis to C4 positive, and pin 6 of the valveholder. The two connections from the secondary to the speaker may have to be reversed later. Some speaker transformers may have their primary and secondary tags posi-





tioned differently to those shown in Fig. 2, and this point should be checked before wiring. If the speaker transformer has lead-out wires instead of tags, the secondary lead-outs can connect directly to the speaker tags, the primary lead-outs passing through the chassis to the appropriate circuit points. Should the lead-out to pin 6 of the valveholder then need to be extended in length, take care to ensure that the joint with the extension lead is adequately insulated. Any small speaker transformer at or near the ratio specified may be used. A suitable type is the Home Radio Cat. No. T043.

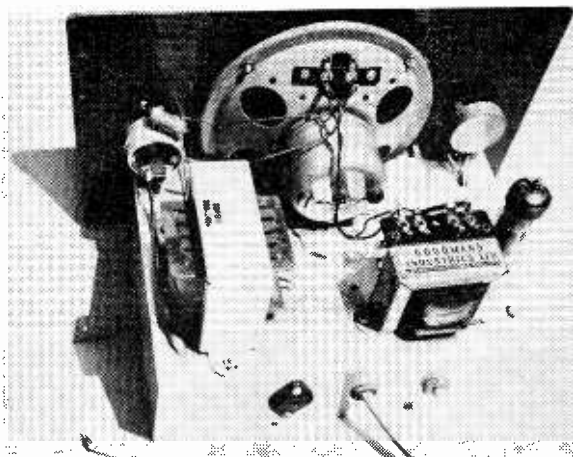
Other wiring points will be seen from Figs. 2 and 3. Leads are best run as shown, with grid and anode connections close to the chassis. Points marked 'MC' are tags bolted to the chassis. If there is any risk of the junction of C2 and R4 moving at a later stage and thereby short-circuiting to chassis, either clamp the body of C2 to the chassis or fit a 2-way tagstrip near its positive end to provide an insulated anchoring point for this junction.



Components below the chassis

TEST VOLTAGES

The voltage readings given in Fig. 1 should be a useful guide, but may vary somewhat, according to the mains voltage, exact resistor values, and other factors. The readings were taken with a 10,000 Ω per



Top view of the chassis, showing the simple uncluttered layout

volt type meter, after the valve has reached operating temperature, and are with respect to chassis.

The listed transformer is rated to supply 45mA for h.t., and the ECL82 takes a little over 30mA. This leaves sufficient current for the pre-amplifier or radio tuner.

USING THE AMPLIFIER

If a howl commences soon after first switching on, feedback is not in the wanted phase. Switch off *immediately*. Unsolder and reverse the two connections to the secondary of the speaker transformer T1. The effect of the negative feedback circuit can be checked by temporarily removing the connection from R6 at VR2. When this lead is connected, volume falls, but quality of reproduction improves. Adjust VR2 for the tonal results wanted.

The usual screened lead is employed from the record player pick-up. The outer braiding forms the chassis or "earth return."

Gain is more than sufficient for the popular type of crystal pick-up and similar inputs, and for the radio tuner forming Item 3 of the equipment. For a low level input, the pre-amplifier (to be described next month) is needed.

A definite metal connection does not exist between the chassis and case, when using a hard-board panel. In consequence, a short flexible lead from the chassis is put under one of the rear fixing screws of the case when the equipment is installed. The solid back plate provided with the case must not be used as this permits no ventilation. Instead, use the plate as a guide to cut a piece of perforated metal of similar size, and fit this to the back flanges of the case with the screws provided. ■

INSTRUMENT C.R.T. WITH 8 x 10 cm. DISPLAY

The M-O Valve Co. Ltd., has introduced a new single gun, spiral p.d.a. oscilloscope cathode ray tube type 1400C. It has a flat rectangular face and features an 8 x 10 cm. display.

The screen has a thin aluminised backing for operation at 4kV, and side connected deflection plates

ensure wide band operation.

Maximum x and y deflection sensitivities are 15.5 and 8.5 V/cm. respectively.

Provision is included for deflection blanking, and a choice of internal graticules can be specified.

THE RADIO CONSTRUCTOR

CROSSOVER NETWORKS

by

A. J. WHITTAKER

Loudspeaker crossover networks are not things of mystery, as this article amply demonstrates. Our contributor also gives details which will enable the inductive section of a network to be home-wound

L OUDSPEAKER CROSSOVER NETWORKS, OR HIGH AND low pass filters to give them their correct name, are employed to improve acoustic reproduction by the use of two or more loudspeakers fed over assigned frequency bands from the filter network. This article will describe in simple terms how these devices work and the construction of the inductive element. The capacitive element may be of the paper, low voltage, type or the non-polarised electrolytic type.

Although excellent sound reproduction may be obtained by using a single popular priced double cone loudspeaker mounted in a tuned enclosure, this cannot cover the entire audio spectrum with the degree of realism that is demanded by the more exacting listener. However, an approach to the ideal may be achieved by employing two or more loudspeaker units, the audio spectrum being split and the various passbands fed to specialised reproducers via the crossover network.

Two advantages of using more than one loudspeaker with a crossover network are that the frequency response is extended and that intermodulation is avoided. Such distortion is caused by one frequency modulating another; thus, in single speaker operation the bass may cross-modulate the treble,

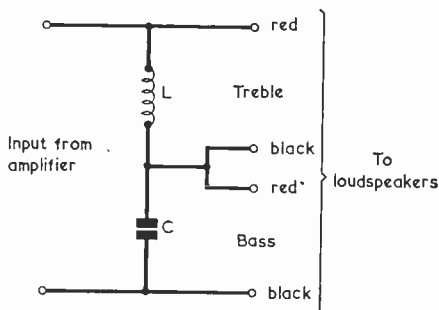


Fig. 1. Quarter section series filter with crossover at 1,000Hz

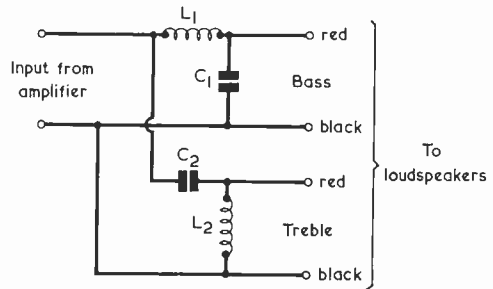


Fig. 2. Half section parallel filter with crossover at 1,000Hz. This offers steeper attenuation than the quarter section filter

causing a 'fuzziness' or distorted sound. A third advantage is levelling of the impedance curve.

FILTER CIRCUITS

The most popular crossover networks for domestic installations take the form of either a quarter section series filter or a half section parallel filter.

The quarter section series filter comprises one choke and one capacitor in a series connected circuit, giving an attenuation gradient between assigned passbands of 6dB per octave. The power insertion loss is about 1dB.

The half section parallel filter, made up of two quarter sections in a parallel connected circuit, gives an attenuation gradient of 10dB to 12dB per octave. The insertion power loss is 2dB.

TABLE 1
Component values for Fig. 1

Speech Coil Impedance (Ω)	C (μ F)	L (mH)	Coil Turns, 20 s.w.g. enamelled copper wire
4	40	0.65	163
8	20	1.3	242
16	10	2.6	340

Fig. 1 gives a circuit diagram of the quarter section series filter. As the frequency rises, the capacitor reactance falls and effectively lowers the voltage applied to the bass loudspeaker since this is connected across it. At the same time the reactance of the coil rises and the rising voltage across it is applied to the treble loudspeaker speech coil. At crossover, usually 1,000Hz in domestic systems, the coil and capacitor have equal reactances. This is the crossover point and thereafter the passbands overlap, but attenuating at the rate of 6dB per octave.

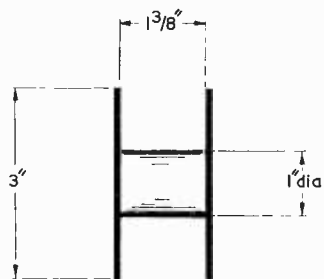
The filter input impedance is the same as the impedance of the loudspeakers used. Thus, if both loudspeakers are 4 Ω , so also is the input impedance.

Table 1 gives the values of capacitor and inductor for the series circuit at 1,000Hz crossover. The capacitors may be Hunts non-polarised electrolytic, but the more ideal approach is to use low voltage

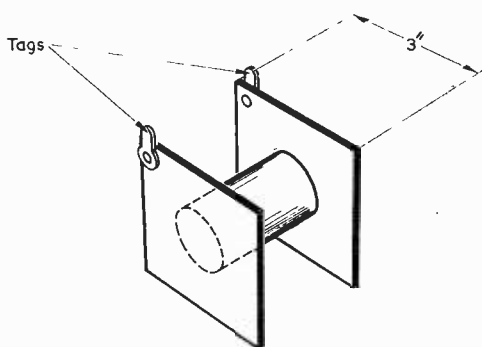
(150 volt) paper capacitors. The Table also gives the number of turns for a suitable air-cored coil (whose construction is discussed later).*

PARALLEL FILTER

Fig. 2 gives a circuit diagram of the half section parallel filter. As the frequency rises the reactance of coil L1 increases whilst that of capacitor C1 falls, thereby reducing the voltage applied to the speech coil of the bass loudspeaker. At the same time the reactance of C2 falls and that of L2 rises. Hence the voltage applied to the treble loudspeaker speech coil rises, and with it the acoustic output from the loudspeaker. The circuit tends to offer a constant impedance to the amplifier because, as the impedance of the high frequency (treble) section rises, that of the bass section of the filter falls and so the input impedance to the filter tends to remain sensibly constant. At the crossover frequency the inductive and capacitive reactances cancel, and thereafter the pass-



(a)

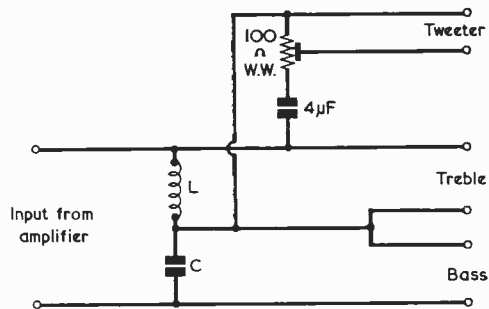


(b)

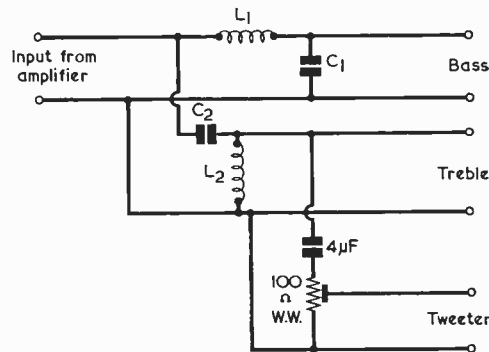
Fig. 3(a). Side view of the former on which the coils are wound
(b). End view of the coil former

bands overlap, attenuating (with the component values used here) at the rate of 10dB per octave. The values of capacitance and inductance required are given in Table 2.

* If difficulty is experienced in obtaining suitable capacitors, a range of high-value paper capacitors is available from G. W. Smith & Co. (Radio) Ltd., 3 Lisle Street, London, W.C.2. The values available may necessitate the connection of a number of capacitors in parallel to obtain the capacitances quoted in the Tables. — Editor.



(a)



(b)

Fig. 4(a). The series filter of Fig. 1 with additional filter capacitor to feed a tweeter loudspeaker

(b). A similar tweeter feed circuit added to the parallel filter of Fig. 2

COIL CONSTRUCTION

Fig. 3 shows the coil former required for the air-cored coils. The side cheeks may be made either from 1/4 in plywood or plastic sheet. The centre may be turned from wood or it may be square cross-section. The assembly should be securely glued together. The author used an all-wood construction, this being glued with Araldite.

TABLE 2
Component values for Fig. 2

Speech Coil Impedance (Ω)	C1,C2 (μ F)	L1,L2 (mH)	Coil Turns, 20 s.w.g. enamelled copper wire
4	28	0.9	205
8	14	1.8	280
16	7	3.6	390

The enamelled 20 s.w.g. copper wire is pile-wound on the former. Errors of 10% may be tolerated and would offend the mathematician rather than cause noticeable errors in the functioning of the filter.

THREE-SPEAKER NETWORK

Figs. 4(a) and (b) show the method of connecting a three-speaker network. The additional high frequency unit, or tweeter, will have the same speech coil impedance as the treble and bass units, although it is considered by some that the tweeter impedance may be lower, this offsetting the rise in speech coil impedance with frequency. The 100 Ω preset potentiometer is adjusted to set the level of the tweeter to suit the room acoustics, which are affected by the furnishings and the volume in cubic feet.

TYPES OF LOUDSPEAKER

With two loudspeakers the usual practice is to ensure that both have the same speech coil impedance and equal sensitivity. This latter requirement means that the magnet system of each should have the same flux density. A 12in bass unit with a 5in treble unit would be a good combination, provided that the sensitivity of each is equal. A 10in bass unit with a 3in treble unit will also give satisfactory results. A more ambitious system using three loudspeakers could have 15in bass, 8in middle register, and a 3in treble unit.

When using two or more loudspeakers it is important that the sound from one speaker does not cancel the sound from another, thus creating a dead area between them. To avoid this effect the speech coils must be connected in phase, so that the cones move in and out together. Nowadays most loudspeakers have red and black terminals or solder tags. For correct phasing, these should be connected as indicated in the diagrams. It is not important for the tweeter to be correctly phased. Strictly speaking, phasing is only important when low frequencies are being considered. ■

SEMICONDUCTOR DEVICES

A new filmstrip (No. 136) produced by the Mullard Educational Service provides an introduction to semiconductor physics that is readily understood by anyone with a basic knowledge of electronics.

Entitled 'Semiconductor Devices', the filmstrip opens by defining a semiconductor material and showing how it can be made to conduct easily by doping to form n- or p-type material. The production of semiconductor materials is briefly described, and their use to form a p-n junction diode explained. This is followed by an explanation of the transistor and its ability to amplify current, voltage and power. Several practical circuits show the various configurations used.

Further frames illustrate the different types of transistor and reference is made to the particular advantage of each. Then follows a description of the important characteristics of the transistor. The filmstrip ends with short descriptions of other semiconductor devices, such as the thyristor, phototransistor, field effect device, Gunn 'diode' and integrated circuit.

The filmstrip is intended for science students in schools, colleges and universities. The filmstrip has 45 coloured frames and is supplied with teaching notes. Copies of the filmstrip can be obtained from The Slide Centre Limited, Portman House, 17 Broderick Road, London, S.W.7.

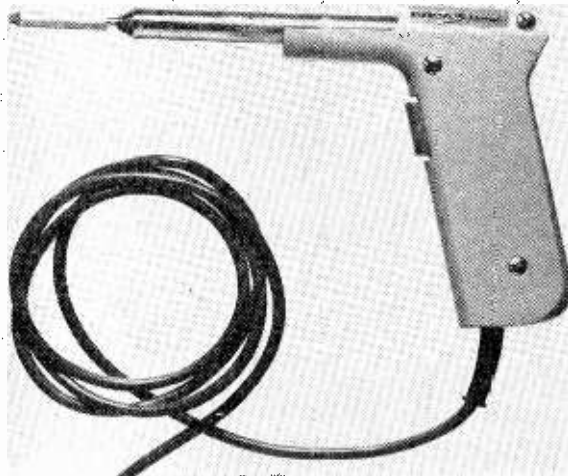
SEPTEMBER 1970

TRADE REVIEW . . .

ERSA 'SPRINT' SOLDERING IRON

This soldering iron is unique in that it heats up in just ten seconds and weighs only seven ounces.

The technique for using the 'Sprint' is slightly different from that of using the usual type of quick heating iron. Once the operating temperature is reached the switch is released, the bit subsequently retaining a working temperature for some time. With the sample iron we tested, solder could be readily melted up to 1.75 minutes after switch off with the bit freely suspended in air at an ambient temperature of 80°F.



The current consumption is 150 watts during the heat up period dropping to 80 watts when the operating temperature is reached. During a normal constructional session it is likely that for half the time the iron may well be used at nil current. No danger will arise if the switch is depressed after the working temperature has been reached, there will just be more tendency for the bit to oxidise.

Although marked 220V, the iron will work perfectly over the range 220 to 250V a.c. and indeed will work satisfactorily down to 200V a.c. Any part of the iron can be changed in seconds.

We found the Erska 'Sprint' iron a delight to use, it is highly efficient and easy to handle (pistol grip).

The 'Sprint' can be obtained from Home Radio (Components) Ltd., 234-240, London Road, Mitcham, Surrey, CR4 3HD, and retails at £3 19s. 6d. A complete spare part service is available. ■

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UNDERSTANDING TAPE RECORDING

This fifth article in our short series on tape recording examines the basic operation of a typical recorder amplifier, both on record and on replay

IN LAST MONTH'S ARTICLE IN THIS series we completed our examination of the basic magnetic theory that is encountered in tape recording by discussing the part played by a.c. bias during the recording process. We also looked at the function of the erase head, which ensures that any previous magnetisation on the tape is removed before it is drawn past the record head. We saw that both the erase and a.c. bias frequencies are the same and that they are provided by a single oscillator. The output of this oscillator couples directly to the erase head, and via an attenuating circuit to the record head.

We shall next turn our attention to the electronic circuit design encountered in the tape recorder.

CIRCUIT DESIGN

Probably the best approach towards understanding the electronic circuits of a tape recorder is to start by examining the complete amplifier for a relatively simple machine, and it will be helpful here to refer to a valve design rather than to one incorporating transistors. This is because the amplifier design of simple domestic recorders employing valves has evolved to a relatively 'standardised' state, a very large proportion of recorders in this category employing the same amplifier stage line-up, which consists of a valve type ECC83 followed by a valve type ECL86. Different manufacturers introduce variations in the smaller details of design within the ECC83-ECL86 framework, but the functions of the valves themselves are the same for almost all the recorders which employ them.

In consequence, the reader who examines a representative ECC83-ECL86 amplifier circuit is not only able to gain knowledge concerning general matters of tape recorder electronics but is also in a position

to familiarise himself with an overall design approach that is applicable to a wide number of machines in actual use.

Fig. 1 illustrates a representative example of a basic tape recorder amplifier using the ECC83 and ECL86. All ancillary items, such as recording level indicators, filter switching circuits for different tape speeds, etc., have been omitted, and will be dealt with in later articles. The circuit of Fig. 1 does not represent a specific amplifier circuit due to one manufacturer. Instead, it embodies the design points used by the larger tape recorder manufacturers, taking advantage of those which can be presented in the simplest manner.

Dealing with the two valves themselves, the ECC83 (which is equivalent to the 12AX7) is a double-triode whilst the ECL86 is a triode-pentode, the pentode section being of the power output type. The ECC83 is a high-gain valve, each of its triodes being capable of offering a voltage gain of some 60 to 70 times. The triode section of the ECL86 similarly offers a gain of some 60 times, whilst the pentode section is capable of an output of 4 watts. It will be gathered that the use of these three triodes and the output pentode in successive stages indicates that a very high level of gain is required in a tape recorder amplifier. This is true, but quite a large amount of the gain available from the valves is cancelled by negative feedback. The greatest gain is required for the replay function, because the signal obtained from the replay head is low, being typically of the order of several millivolts, and the output of the amplifier has to drive a speaker.

The circuit of Fig. 1 represents an economic design approach since the same amplifier stages are employed both for record and for replay. Changing from one function to the other is achieved with the

aid of the five-pole switch, S1(a) to S1(e). In the diagram all sections of this switch are shown in the 'Record' position, as indicated by the letter R. Letter P (for 'Playback') indicates the switch position taken up for replay.

With the amplifier switched to 'Record' an input from a microphone is applied via S1(a) and C1 to the grid of V1(a). The microphone may be either a crystal microphone, which has a high impedance output, or a moving-coil microphone incorporating its own step-up transformer. V1(a) has its cathode connected direct to chassis, and operates with 'grid current bias' due to the high value of R1. 'Grid current bias' is attractive here not only because it removes the necessity for the cathode bias resistor and capacitor that would otherwise be required but because it also ensures that there is zero impedance between the cathode and chassis. Due to the high amplification in a tape recorder, hum pick-up in the first stage from heater wiring can be extremely troublesome, and the direct connection between cathode and chassis avoids bypass capacitor layout problems. Also, if such a bypass capacitor were used, it might well require a much larger value than would normally be necessary for a voltage amplifier triode.

The amplified signal at the anode of V1(a) is next applied via C2 to potentiometer R3. This is a standard log track component of the volume control variety and, with the amplifier switched to 'Record,' functions as the record level control.

The slider of R3 connects to the grid of V1(b), the further amplified signal at the anode of this triode being passed by way of C4 to V2(a), which is the triode section of the ECL86. This triode is also shown in Fig. 1 as having 'grid current bias', but such a practice is not common with all manufacturers.

THE RADIO CONSTRUCTOR

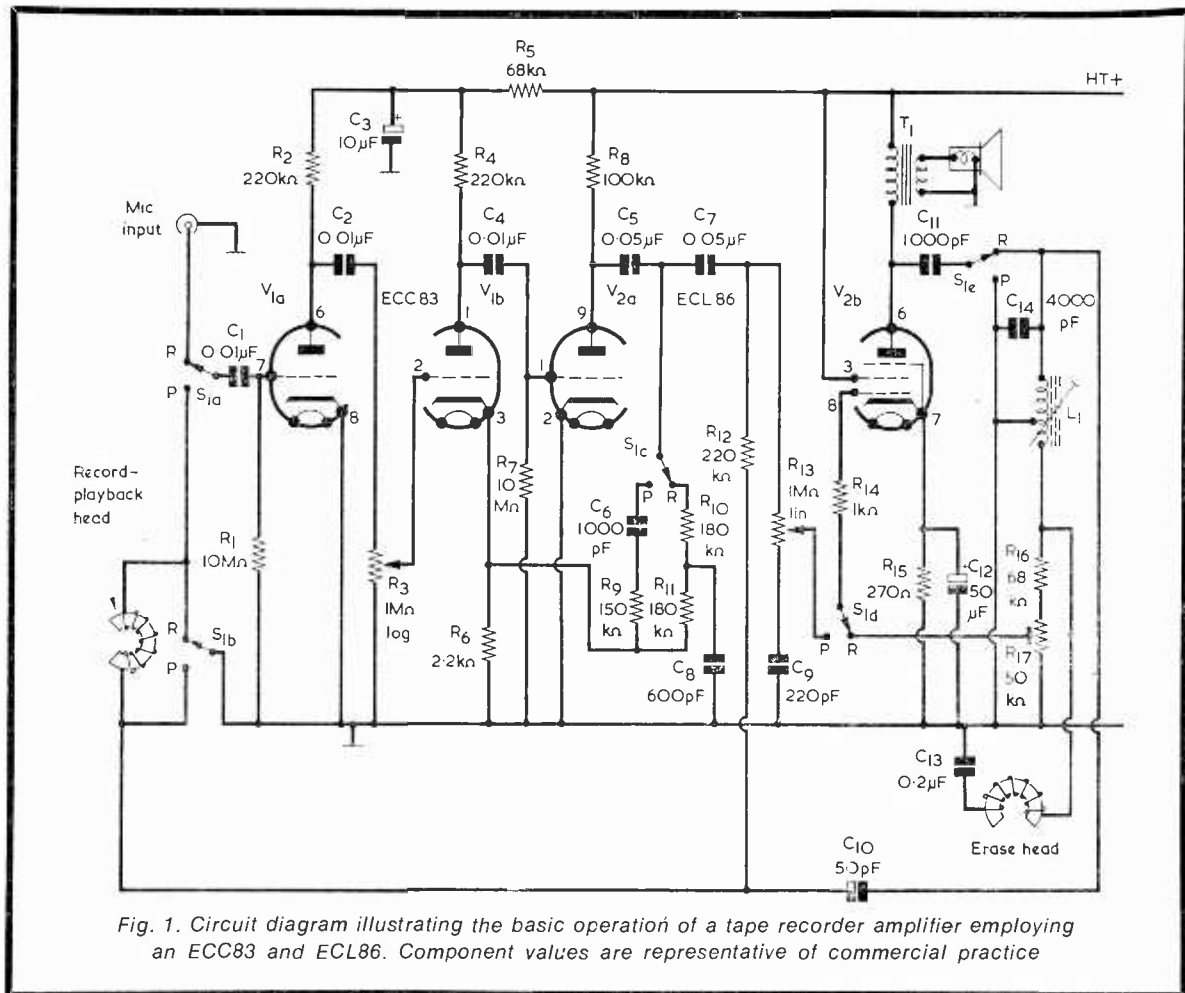


Fig. 1. Circuit diagram illustrating the basic operation of a tape recorder amplifier employing an ECC83 and ECL86. Component values are representative of commercial practice

The valve may alternatively have conventional cathode bias, employing a resistor and bypass capacitor in the usual cathode bias circuit.

Equalisation is obtained by negative feedback, via a frequency selective filter, from the anode of V2(a) to the cathode of V1(b). The frequency selective filter shown in Fig. 1 for the 'Record' function is a slightly simplified version of those encountered in most tape recorders, but it nevertheless clearly illustrates the general mode of functioning. Since S1(c) is in the 'Record' position the signal at V2(a) anode is fed back to V1(b) cathode by way of R10, R11 and C8. The reactance of C8 decreases with rise in frequency, whereupon the level of signal feedback decreases as the frequency increases. Since there is less negative feedback at the higher frequencies the overall gain of the amplifier at these frequencies becomes greater, and the requisite treble boost required for recording is achieved.

After leaving the equalising feedback circuit the signal is passed to C7 and R12. R12 is the high value resistor required for 'constant current' recording drive (as was discussed in Part 1 of this series, published in the last May issue) and it couples to the record-playback head at the left of the diagram. The other terminal of the record-playback head connects to chassis by way of S1(b), thereby completing the drive circuit to the head.

Summing up the process so far, the input signal from the microphone has been amplified by V1(a), V1(b) and V2(a), after which it has been applied to the record-playback head via a high value resistor to obtain 'constant current' drive. The treble boost required during recording has been given by a frequency selective negative feedback filter, switched in by S1(c). It will be noted, incidentally, that adjustments in potentiometer R13 have no effect on the process of recording as its slider is, at present, taken out of circuit by S1(d). R13 is a tone control and it operates only during replay.

ERASE CIRCUIT

As we learned last month, it is necessary, when recording, to provide erase and bias signals for the erase and record-playback heads respectively.

ERASE CIRCUIT

As we learned last month, it is necessary, when recording, to provide erase and bias signals for the erase and record-playback heads respectively.

The erase oscillator valve is V2(b) which, during replay, functions as an output valve and drives the speaker. However, a speaker output is not required during the recording process, whereupon V2(b) is free to function as the erase oscillator. The fact that this valve is an output pentode is of advantage here, since many erase heads require a watt or more of power at the erase frequency to function satisfactorily.

With switch S1(d) and S1(e) in the positions shown in Fig. 1, the anode of V2(b) couples, via C11, to one end of coil L1. A tap in this coil connects to chassis whilst its other end couples via R16, R17 and R14 to the grid of V2(b). A capacitor, C14, connects across part of the coil, causing a resonant circuit to be formed. The circuit is a tuned anode oscillator and it oscillates at an erase frequency of around 50 to 60kHz, the actual frequency being that chosen by the designer of the particular recorder in which the circuit appears.

As we learned last month, it is necessary, when recording, to provide erase and bias signals for the erase and record-playback heads respectively.

The primary of speaker transformer T1 provides an inductive anode load for V2(b). The erase frequency is, in consequence, applied to the speaker itself, but the latter will have an impedance at this frequency which is very much higher than its nominal a.f. impedance and little power will be dissipated in its speech coil. The speaker will not, of course, produce any audible response because the erase frequency is well above the audio spectrum. The end of L1 remote from the anode of V2(b) connects direct to the erase head, the circuit to chassis being completed by C13. Preset potentiometer R17 is set up for the desired voltage at erase frequency (typically some 45 volts) across the head. Resistor R14 in the grid circuit of V2(b) is a grid stopper for use when the valve is employed as an output valve, and it has no significant function when V2(b) operates as an oscillator. A final point concerned with oscillator operation is that both the primary of T1 and the erase head present inductance to the oscillator resonant circuit proper, i.e. to L1 and C14. In consequence, the values of inductance and capacitance in these two components are such that the total distributed inductance and capacitance allow oscillation to take place at the correct frequency.

The erase oscillator also provides bias for the record-playback head. This bias voltage is taken from the anode end of L1 and is passed to the head via C10. The relatively low value of this capacitor ensures that the bias frequency power available at the record-playback head is considerably lower than that at the erase head.

The erase oscillator circuit around V2(b) which is shown in Fig. 1 is based on a circuit employed in some Grundig tape recorders. The same basic approach will be encountered in recorders of other manufacture in which the output valve serves also as erase oscillator, but it will be found that the switching arrangements tend to be rather more complex.

OPERATION ON REPLAY

Let us next examine the circuit of Fig. 1 during replay. In this instance we shall be reproducing a signal which has already been recorded on the tape. All the switch sections, S1(a) to S1(e), are changed over to position P.

S1(a) and S1(b) now connect the record-playback head, via C1, to the grid of V1(a). This amplifies the signal from the head and passes it to V1(b) via R3, which is now the replay volume control. The output from V1(b) is next fed to V2(a). S1(c) now switches in the frequency selective filter given by C6 and R9 into the negative feedback coupling

back to V1(b) cathode. The reactance of C6 reduces as frequency rises, with the consequence that overall gain decreases with increase in frequency. The result is that bass boost is obtained, as is required for replay. The circuit represented by C6 and R9 in Fig. 1 is the filter employed in a single-speed B.R.C. recorder. The filters employed in other recorders are usually more complex, although they serve the same purpose and operate on a similar principle.

The signal is next passed to the top-cut tone control circuit given by R13 and C9 (also encountered in B.R.C. recorders). In this circuit the a.f. from V2(a) anode appears across R13 and C9 in series, the reactance of C9 reducing as frequency increases. Because of this, the higher frequencies across C9 have a smaller amplitude than do the middle and low frequencies, so that the process of adjusting R13 slider towards the lower end of its

track' which is employed in output pentode anode circuits. All the erase oscillator components are switched out of circuit.

POWER SUPPLY CIRCUITS

Because of the large amount of exposed metal work in a tape recorder which must, to avoid hum pick-up, be connected direct to amplifier chassis, all mains-operated tape recorders have an isolating mains transformer. Full-wave h.t. rectification is used and it is normal to employ a bridge rectifier instead of two diodes and a centre-tapped h.t. winding on the transformer, because the bridge arrangement allows a saving in cost and space in the transformer to be achieved. In some recorders the tape recorder motor connects directly across the mains supply immediately after the on-off switch, whilst in others it is connected to one of the primary voltage taps, as in Fig. 2. This latter circuit

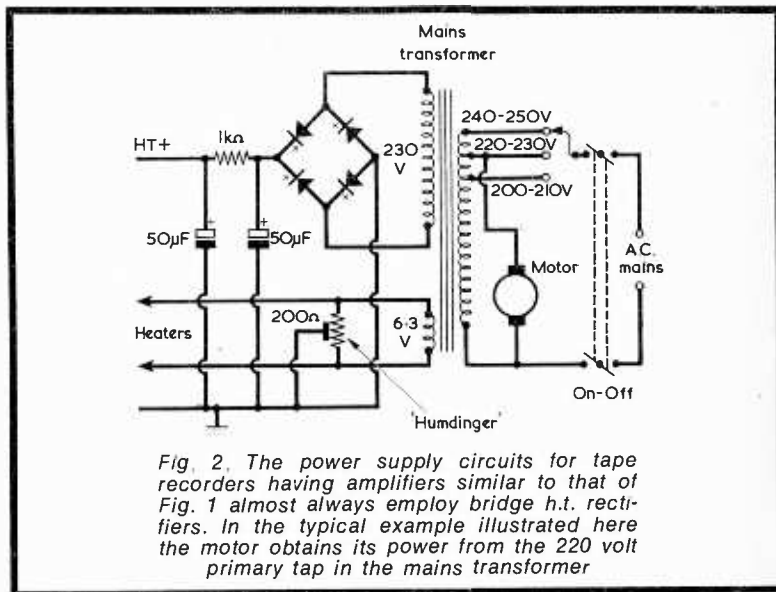


Fig. 2. The power supply circuits for tape recorders having amplifiers similar to that of Fig. 1 almost always employ bridge h.t. rectifiers. In the typical example illustrated here the motor obtains its power from the 220 volt primary tap in the mains transformer

track results in a continually increasing attenuation of the treble frequencies passed to V2(b). The reactance of C9 is about 600kΩ at 1kHz, with the result that the high frequency attenuation becomes significantly noticeable at frequencies above 2kHz.

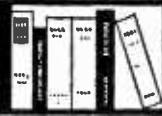
The a.f. at the slider of R13 next passes via S1(d) and grid stopper R14 to the grid of V2(b). The d.c. circuit from this grid to chassis is completed via R14, R13 and R12, the lower end of the last resistor now being connected to chassis by S1(b).

The anode of V2(b) connects to the primary of T1 and drives the speaker in normal fashion. Capacitor C11 now connects to chassis via S1(e), whereupon it functions as the familiar 'tone correction capaci-

device ensures that the same nominal mains voltage is applied to the motor for all mains voltages at which the recorder is used.

As has already been mentioned, one of the greatest design problems in valve tape recorders is the reduction of hum pick-up in the grid circuit of the first a.f. valve, this situation being aggravated by the necessity of taking a 6.3 volt a.c. heater supply to the heater of this valve. To keep hum level as low as possible it is very common practice to incorporate a 'humdinger' potentiometer in the heater circuit, as is also shown in Fig. 2. This 'humdinger' is adjusted for minimum hum level, either on record or on replay according to the advice of the manufacturer.

RECENT PUBLICATIONS



REFERENCE DATA FOR RADIO ENGINEERS, Fifth Edition. 1,177 pages, 6½ x 9½ in.

Published by Howard W. Sams & Co. Inc. Price £9 10 0d.

Reference Data For Radio Engineers first appeared in the U.K., in 1942, as a 60-page brochure compiled by W. L. McPherson of Standard Telephones and Cables, Ltd., which company published it. Its immediate success prompted the parent company, International Telephone and Telegraph Corporation, to publish an American version in the United States. There then followed four editions, these appearing in 1943, 1946, 1949 and 1956. These have now been succeeded by the fifth edition, which is under review, and which is published by Howard W. Sams, a subsidiary of I.T.T.

The fifth edition is a prodigious work and provides information on virtually every possible subject connected with radio and electronics. Entirely re-typeset, it contains about 50 per cent more material than appeared in the fourth edition, and includes completely new chapters on such subjects as microminiature electronics, space communication and quantum electronics. All other material has, where necessary, been brought up to date. The authors comprise more than 100 engineers, each writing in his own specialised field.

The 45 chapters in the volume cover an exceptionally wide range, taking in (to choose titles virtually at random) radar fundamentals, nuclear physics, information theory, reliability and life testing, transmission lines and digital computers. The material is intended for the professional engineer and for the student, and consists fundamentally of facts with just sufficient explanatory matter for backing. The pages are packed with figures, formulae, tables and graphs. The vast quantity of subjects dealt with may be realised when it is appreciated that the index alone takes up 41 three-column pages!

The book is written by professionals. As such, it carries out its function of providing reference data superbly well.

TRANSISTOR-TRANSISTOR LOGIC 9000 SERIES. 70 pages, 8½ x 11½ in.

Published by Marconi-Elliott Microelectronics Limited. Price 30s.

This handbook is offered, in the main, for the engineer or student who is actively engaged in work with DTL or TTL integrated circuits, and is devoted entirely to the 9000 Series of TTL i.c.'s manufactured by Marconi-Elliott Microelectronic. Despite this apparently narrow scope, the publication contains much practical detail, offering a broad background to the whole subject of TTL logic devices, including in particular their circuits and their applications.

The publication deals with the 9000 family of integrated circuits, covering their operating conditions and discussing typical applications. After a brief introduction giving general details of characteristics (which include a typical high level noise immunity of 1.9V, and a typical power dissipation of 11mW per gate function at 50% duty cycle) the main body of the handbook covers the 9000 family of devices, the basic 9000 series gate, gating elements, J-K flip-flops and the 9601 monostable multivibrator.

The authors of 'Transistor-Transistor Logic 9000 Series' are R. K. Buckley, M. W. Ramsey and R. S. Whiskin, and the handbook is available direct from Marconi-Elliott Microelectronics Limited, Witham, Essex for 30s. including postage.

PHOTOELECTRONIC DEVICES. By J. B. Dance, M.Sc., B.Sc. 182 pages, 5½ x 8½ in.

Published by Iliffe Books Ltd. Price 42s.

There is always considerable fascination in the use of photoelectronic devices, this being true for simple applications where light beams actuate warning or counting circuits, and for more sophisticated applications such as those which are provided by image intensifier tubes.

The book under review provides a practical working outline of the operation of all important devices (with the exception of television camera tubes) which detect or produce radiation in the spectrum from infra-red to ultra-violet. As is to be expected, the range covered is comprehensive indeed, and the subjects dealt with are photoemissive materials, photoemissive diodes, photomultiplier tubes, homogeneous semiconductor photodevices, junction photodevices, image intensifiers and converters, and electroluminescent devices (including injection lasers). A 3-page appendix gives tables listing spectral response numbers for photosensitive surfaces and window materials, together with the properties of semiconductor materials. There is also a chapter on semiconductor fundamentals, and the book ends with a good index. Lists of references, some extremely extensive, appear at the ends of all the chapters.

The book is concisely written with clear drawings and circuit diagrams, the latter giving component values. The dust jacket states that the book will be of value to university and college students taking physics and electronics and also to industrial personnel who wish to use photodevices. The reviewer feels that the book will be useful to a wider readership than this, including in particular the more experienced home-constructor who is interested in experimental work involving devices operating in the allied fields of light and electronics. ■

V.H.F.-F.M. Reception at 200 miles

by
DESMOND WALSH

How to improve f.m. reception whilst employing a standard commercially manufactured receiver

NOW THAT LOCAL RADIO STATIONS ARE TO BE SET up over most large centres of population in the British Isles, many more v.h.f.-f.m. receivers and tuners will be sold. In this article some help with long distance reception is given. The writer's experience in long distance f.m. reception has been acquired mostly at his home in the South-Eastern part of Ireland, where some B.B.C. stations are received fairly well on ordinary equipment.

CHECK THE RECEIVER

The first check to make, before adding any signal amplifier stages, making existing aerials higher, etc., is to ensure that the receiving end is in good condition. If the receiver is not properly aligned improvements elsewhere are not going to be of much use. Make sure that the front-end (aerial, mixer and oscillator) stages are in alignment and that they are tracking properly. The i.f. stages and detector should also be correctly aligned as sensitivity and fidelity of the signal will otherwise suffer. Modern v.h.f.-f.m. tuners and receivers of the transistor variety are very sensitive; making sure that they are in correct alignment will give the best signal-to-noise ratio with weak long distance signals.

The main object to bear in mind when receiving weak signals is to get as many microvolts as possible into the receiver. The a.g.c. and other circuitry will overcome effects such as fading, flutter due to overhead aircraft and interference from car ignition systems. To obtain maximum signal input there are two means of improving an existing receiver and aerial system. These are, first, the addition of a low noise, high gain, signal amplifier, and second, the installation of a better aerial system.

SIGNAL AMPLIFIER

The signal amplifier should have the desirable qualities of high gain with low noise thereby giving optimum results with even the weakest of signals. Of the multitude of transistor types on the market there are many v.h.f./u.h.f. high gain, low noise, devices available. The one chosen by the author was the Mullard BF180, which is reasonably priced and readily obtainable. The circuit finally used is shown in Fig. 1.

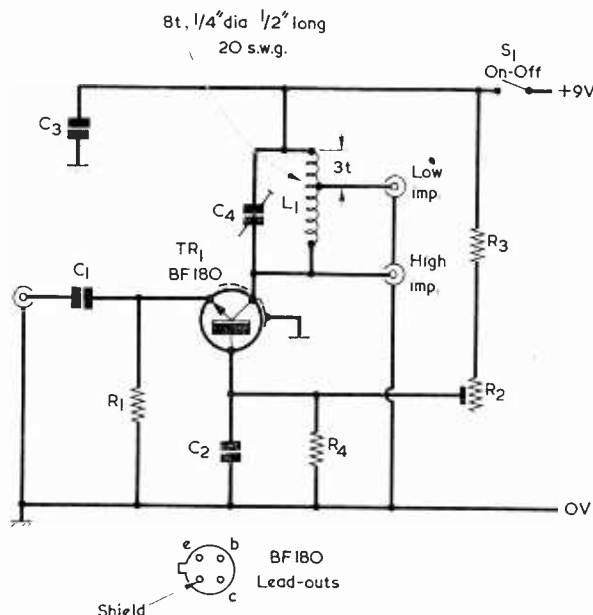


Fig. 1. Circuit of the aerial signal amplifier for the f.m. band

COMPONENTS

Resistors

(All fixed values $\frac{1}{4}$ watt 10%)

- R1 100Ω
- R2 100kΩ skeleton preset potentiometer
- R3 10kΩ
- R4 12kΩ

Capacitors

- C1 1,000pF ceramic
- C2 1,000pF ceramic
- C3 1,000pF ceramic
- C4 6 - 60pF trimmer, Mullard concentric

Inductor

- L1 See text

Transistor

- TR1 BF180 (Mullard)

Switch

- S1 s.p.s.t. switch

Miscellaneous

- 3 coaxial sockets

In this circuit the common base mode of operation gives good gain and does not need input tuning as the low input impedance corresponds roughly to the impedance of the coaxial cable from the aerial. The output at the collector is at high impedance and will feed into the high impedance offered by some receiver circuits. Coil L1 in the author's amplifier consists of 8 turns of 20 s.w.g. bare tinned copper wire spaced to a length of $\frac{1}{2}$ in. and wound to a diameter of $\frac{1}{4}$ in. A tap is taken at the third turn from the 'cold end' for matching to coaxial cable, this providing an output for receivers with 75Ω input impedance. If the receiver does not have series isolating capacitors at its 75Ω input, insert a 1,000pF ceramic capacitor between the coil tap and the low impedance output of the signal amplifier, as in Fig. 2. All signal-carrying and bypass wiring must, of course, be kept very short.

The variable resistor R2 is adjusted for best results, these being normally given at around 2mA emitter current. The BF180 transistor has a forward gain control characteristic, i.e. as the current through it increases from a low value its gain tends to decrease. This property is utilised in i.f. amplifiers, r.f. stages and other circuits where a variable gain characteristic is required. After setting the current, R2 should not need altering again. The envelope of the BF180 is internally connected to the shield.

If desired, a high value resistor (not shown in Fig. 1) can be added across the input socket to guard against the possibility of static building up and damaging the transistor. The number of turns in the output coil may require a little experimental alteration, but the details just given of the coil used by the author represent a good starting point.

When the signal amplifier is coupled to the receiver an increase in noise will be observed. This is not a bad sign as it will be mostly aerial noise and it shows that the circuit is performing correctly. Quite a respectable increase in signals will be noticed. If the unit tends to be very noisy or causes heterodyne beats in the receiver it is oscillating, and this may be due to poor layout. Tapping the output coil nearer the collector of the transistor will improve stability and also broaden the bandwidth.

AERIAL SYSTEM

Naturally an outdoor aerial system should be used as attenuation of signals in buildings is very large. Height is important, in that the aerial should be well

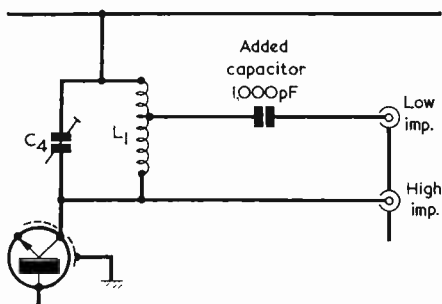


Fig. 2. A blocking capacitor has to be added if the receiver 75Ω input has no isolating capacitors

SEPTEMBER 1970

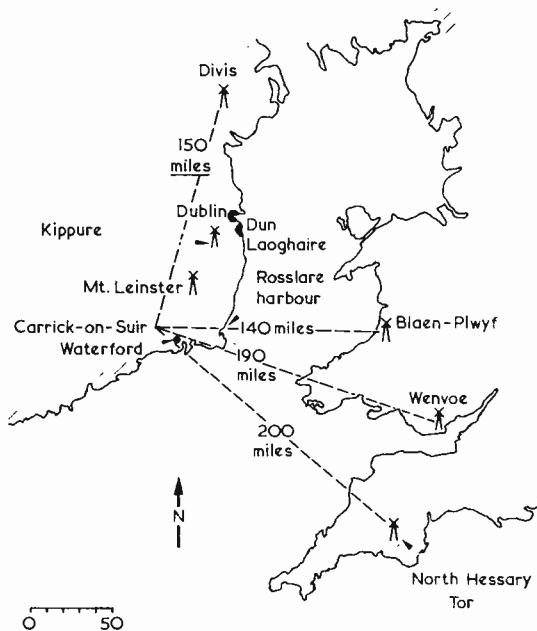


Fig. 3. An indication of the reception possible with a highly efficient receiving installation. Distances are approximate

in the clear and not near any metal objects. Chimney height is usually sufficient.

Coming to the subject of the aerial itself this requires, first and foremost, a high forward gain. The question of directivity depends on whether or not interference occurs on wanted signals. In the writer's case high discrimination against local stations was needed, thus a highly directional f.m. aerial was required. The aerial finally chosen was the J-Beam Model FM6S. This is a 6-element yagi having very good performance over the 88 to 98MHz band. A semi broad-band technique is used in its construction, and it does not employ a folded dipole for matching to coaxial cable. By carefully choosing director lengths J-Beam have produced an aerial with high gain and a clean polar diagram, making it possible for long-range stereo reception. Complete with universal mast clamp, this aerial is just right for long distance v.h.f.-f.m. reception.

The FM6S aerial has allowed reception, in South East Ireland, of f.m. signals from Wenvoe (near Cardiff), Blaen-Plwyf in the Cardigan Bay area of West Wales, North Hessay Tor in South West England and Divis in Northern Ireland, at times when reception was quite poor by tropospheric propagation. The approximate distances are shown in Fig. 3.

Long distance v.h.f. signals will be best received during summer and autumn periods, when weather conditions favour tropospheric methods of propagation. TV interference from European stations will also be noticed at these times.

CONTINENTAL RECEPTION

Readers in favourable areas in the Eastern and

Southern parts of England should, with the aid of the signal amplifier and high gain aerial just discussed, find that reception of Continental f.m. stations is possible all the time. This reception will be from the coastal areas of France, Holland, Belgium or Germany at distances of up to 300 miles, and good quality should be possible.

pure transmitter (in the Wicklow Mts.) will be able to receive experimental stereo transmissions on Saturday nights around 9 p.m. R.T.E. frequencies are given in the accompanying Table.

For those who would like to sample local commercial radio (and perfectly legal unlike the Pirates of old) Manx Radio, Douglas, Isle of Man, can be received in areas bordering the Irish Sea. The v.h.f. channel is 88MHz. It also transmits on 188 and 232 metres during the day.

TABLE

R.T.E. v.h.f.-f.m. frequencies

Kippure (Wicklow Mts. area)	95.3MHz
Mount Leinster (Co. Carlow area)	94.9MHz
Truskmore (Co. Sligo area)	89.7MHz
Maghera (Co. Clare area)	94.1MHz
Mullaghanish (Co. Cork area)	93.5MHz

For readers in South West England, coastal Wales, Lancashire and South West Scotland, reception of signals from Radio Telefis Eireann (R.T.E.) is feasible. Those within reaching distance of the Kip-

RAIN DETECTOR

(Continued from page 95)

The optimum value required for the resistor across the bell is best found by experiment, since each thyristor will have its own value of holding current. This is likely to be around 10mA for a thyristor of the type used here, but of course more current can be permitted to flow if desired. With this in mind a resistor of, say, 330Ω could be tried; in fact such a resistor worked well in the prototype.

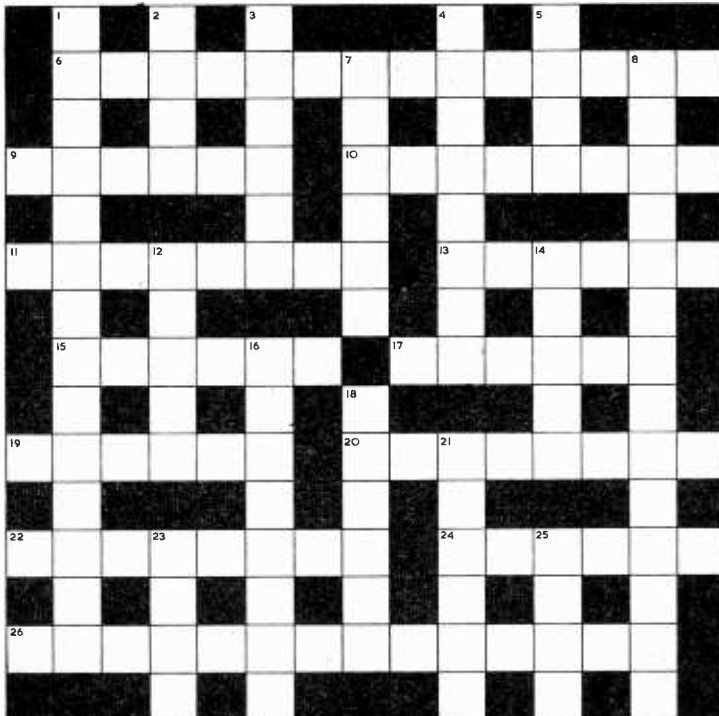
The facility of having the alarm bell 'latch on' can also be provided for any of the previous circuits. This could sometimes increase their usefulness, as in, for example, those instances where an indication of momentary contact only is required.

CROSSWORD

Across

- 6. A logical approach to maths. (7,7)
- 9. Change from flip to flop or, for that matter from flop to flip. (6)
- 10. What's needed to raise the diode to tetrode status. (3,5)
- 11. Filament metal derived from wolfram. (8)
- 13. An aerial not recommended for colour TV. (6)
- 15. Corrects the electromagnetic conclusions? (6)

- 17. Even the absence of ethics can provide a moral. (6)
- 19. De-gums that sticky spot! (6)
- 20. Thin-film alternative to the electroscope's active material? (4,4)
- 22. What C and L in series do when w^2 LC becomes unity. (8)
- 24. It's well above our heads (by 25 to 50 miles). (1-5)
- 26. Telegram from the Underground? (10,4)



Down

- 1. 0.1 abamp, and surely the surest current going! (8,6)
- 2. Descriptive of the differential amplifier tail. (4)
- 3. Demodulate. (6)
- 4. Decimal arithmetic which long preceded 6 across. (8)
- 5. This cell effectively modulates light. (4)
- 7. The NAND gate opened out. (3,3) Airborne device for counting angels? (5,9)
- 12. Harmonica component above F sharp produces weakness. (5)
- 14. A unit of elastance which literally sends up the farad! (5)
- 16. Throws in gambling — to make metal mouldings? (3,5)
- 18. The go-ahead you get after disabling the red and blue guns? (1,5)
- 21. An attenuator with sound mixing properties. (6)
- 23. Abbreviated notice lamenting the binary digit's demise? (4)
- 25. Perfectly right, the angle between vertical and X this. (4)

(Solution on page 117)

This month Smithy the Serviceman, together with his able assistant Dick, find that they have just the right amount of time available to allow them to undertake a further discussion on the latest hints received from readers

In your workshop

“FIFTEEN-TWO, FIFTEEN-FOUR,” said Smithy excitedly, “and three for a run. That’s seven. Blimey, two more points and I’ll have won this game of crib.”

“You haven’t made those points yet,” warned Dick.

Exultantly, Smithy moved his match-stick the appropriate number of positions along the peg-board.

“I will, next hand,” he boasted confidently. “Besides, you have got another twenty-four to make.”

“Don’t forget it’s my box in the present hand,” returned Dick. “Now, first let’s see what I’ve got in my hand. Ah, here we are! Fifteen-two, fifteen-four, fifteen-six, fifteen-eight. And six for three of a kind. That’s already fourteen of the twenty-four I need.”

Smithy’s assistant moved his match-stick the appropriate number of holes along the peg-board.

“Next,” he continued, turning over the cards in front of him, “let’s see what I’ve got in the box. There’s fifteen-two, fifteen-four, fifteen-six and a run makes nine.”

“Which makes you,” gloated Smithy “just one point short of the twenty-four you want.”

“I haven’t,” said Dick. “finished counting, mate. If you look closely, you’ll see that there’s a jack in my box which is the same suit as the card turned over. So that’s an extra one for his knob, and it brings me up to ten, and it completes the game with me winning!”

READERS’ HINTS

Triumphantly, Dick inserted his match-stick into the game-hole on the board.

“One shilling,” he went on firmly, “if you don’t mind.”

Unwillingly, the Serviceman dug deeply into a capacious pocket, produced a coin and reluctantly handed it over to his assistant.

“I don’t know,” he grumbled, “of any card game in which you haven’t got the luck of the devil. Dash it all, it was only a couple of days ago that I started teaching you how to play crib, and now you’re winning every darned game we play.”

“Ah,” said Dick diplomatically, as he pocketed the shilling. “That only goes to show what an able instructor I had.”

“Humph,” grunted Smithy suspiciously. “Well, that’s enough crib for today, so far as I’m concerned.

The trouble is that we’ve still got half an hour to kill before packing-up time, so any suggestions you can offer which don’t involve the enrichment of yourself at my expense will be welcome.”

Smithy fell silent. The pair gazed with a certain degree of pride at the ‘Repaired’ racks, which were packed tight with recently serviced receivers. It had been an extremely successful day, and they had cleared the last of the Workshop’s entire stock of unserviceable receivers some twenty minutes earlier.

Dick frowned.

“I know what we can do,” he exclaimed suddenly. “Let’s have a session on readers’ hints. The last one we had seems to have been ages ago.”

“Now, that is a good idea,” commended Smithy. “As it happens, we’ve received quite a few letters since that last time, and I’m certain that there must be some really interesting ideas in them that deserve wider airing.”

Smithy turned towards his bench, pulled a drawer, and extracted a sheaf of letters. He placed these on his bench, then proceeded to examine them in turn.

“Here’s a good one for starters,” he stated after some moments. “It describes a simple method of muting the internal speaker in valve tape recorders and similar items of equipment, when these have an extension

speaker output jack whose contacts silence the internal speaker when a jack plug is inserted. Incidentally, a speaker muting facility like this will normally be required for such instances as when the tape recorder is coupled to a hi-fi amplifier, with the latter obtaining its input at a relatively low distortion level from a voltage amplifier valve preceding the output stage.”

“All this sounds intriguing,” remarked Dick. “Tell us about the hint.”

“Well,” said Smithy, studying the letter in his hand. “It starts off by noting the fact that many panel-mounting potentiometers are sold these days with plastic jacks instead of the old metal spindles.

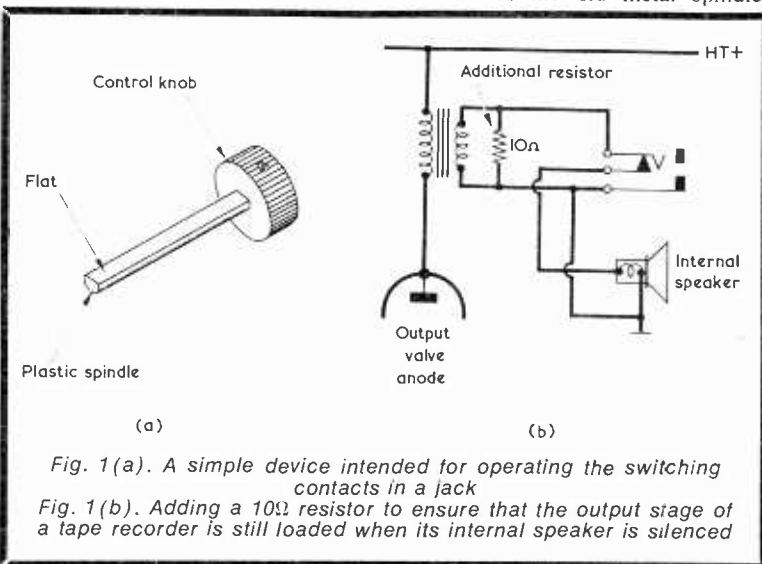
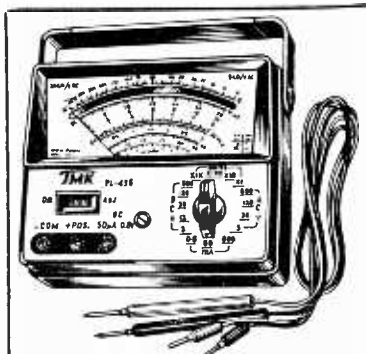


Fig. 1(a). A simple device intended for operating the switching contacts in a jack

Fig. 1(b). Adding a 10Ω resistor to ensure that the output stage of a tape recorder is still loaded when its internal speaker is silenced



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It's usually necessary to cut off quite a lot of the spindle when fitting one of these potentiometers into a piece of equipment, and the otherwise unwanted length of spindle is then made use of in the present idea. The piece of spindle must have a 'flat' on one side, and it is cut to approximately the same length as the sleeve and tip sections of a standard jack plug, plus a little extra to allow a small control knob to be fitted at one end. Here we are, there's a sketch in the letter showing what's required."

Dick leaned over as Smithy showed him the sketch, (Fig. 1(a)).

"The length of spindle," continued Smithy, "is inserted into the extension speaker output jack, ensuring that the flat on the spindle slides under the contact springs without lifting them and breaking the internal speaker circuit. A little judicious filing may be necessary here to increase the depth of the flat. When a satisfactory fit has been achieved the internal speaker can be silenced by simply rotating the control knob on the end of the spindle through half a turn so that the jack contacts are raised by cam action. The internal speaker circuit is then broken in the same way as would occur if a jack plug were inserted."

Dick looked thoughtful.

"Won't that involve," he asked, after a moment, "operating the output stage of the tape recorder without a load?"

"It could do," said Smithy. "If the use of the jack plug substitute means that the output stage will be employed without a load, the solution is to permanently wire a 10Ω ½ watt resistor across the output transformer secondary, (Fig. 1(b)). This will provide an adequate load for the output stage when the internal speaker is disconnected, and it won't reduce output level or upset output matching to any serious extent when the internal speaker is in circuit. By the way, this value of 10Ω assumes that the internal speaker has an impedance of 3Ω, as will almost always be the case. If it has a higher impedance, a resistor should be used whose value is approximately three times the speaker impedance."

"That's certainly a neat wheeze," remarked Dick approvingly. "I should imagine that there may well be a number of other applications in which it is convenient to be able to open jack switching contacts without actually inserting a jack plug."

RESISTANCE SUBSTITUTION

"True enough," agreed Smithy, turning back to the letter. "I see that there's a second hint in this letter. This offers a useful servicing dodge, the idea being to use a test-meter switched to its voltage ranges

as a resistor substitution box."

"Blimey," said Dick. "How do you do that?"

"Simply by switching the test-meter to a range which enables it to offer roughly the same order of resistance as a suspect open-circuit resistor in a piece of equipment being serviced. The idea is only practicable with fairly insensitive testmeters of the order of 1,000 or 2,000Ω per volt and, even then, can only be used in circuits where the current flow is lower than that required for full-scale deflection in the meter."

"I see," said Dick thoughtfully. "Well now, if it's a 1,000Ω per volt meter its full-scale deflection current will be 1mA, won't it?"

"That's correct," confirmed Smithy, "and if it's a 2,000Ω per volt meter the full-scale deflection current will be 0.5mA. So the use of the meter in this manner is restricted to such things as anode and screen-grid resistors in a.f. voltage amplifier valve stages, or to grid leaks and things like that. To give an example of how the test-meter is used, let's assume that we want to check whether or not an anode load resistor has gone open-circuit. We first set the testmeter to a voltage range higher than the h.t. voltage in the equipment under test, connect its leads across the suspect resistor then, if necessary, switch it to lower voltage ranges to obtain the required resistance, taking care to see that the meter isn't taken past full-scale deflection at these lower ranges. The equipment is, of course, switched on whilst you're doing all this."

"I'm not quite with you here," said Dick. "What do you mean by switching the meter to lower voltage ranges to obtain the required resistance?"

"Well," replied Smithy, "suppose you've got an anode load resistor of 150kΩ which you suspect as being open-circuit. If you have a 1,000Ω per volt testmeter this will give you a resistance between its terminals of, say, 100kΩ if it's switched to a 100 volt range. This value will be near enough to 150kΩ to enable the voltage amplifier valve to start working again if its anode load resistor had been open-circuit, but you'd start off initially with the meter switched to a voltage range higher than the h.t. voltage in the equipment. This particular dodge can be quite useful if you're doing fault-finding in somebody's house instead of on the bench, and you haven't got a lot of spare parts on hand."

Smithy put the letter he had been reading to one side and picked up another.

"Here," he remarked after a moment, "is a hint of quite a different sort, and it consists of a circuit for a single transistor i.f. signal injector. This is it."

THE RADIO CONSTRUCTOR

Smithy detached a sheet with the circuit diagram on it and placed it on the bench (Fig. 2 (a)).

"As you can see," he remarked, "the injector is dead simple. All you need is any 470kHz transistor i.f. transformer with a single tuned winding. The collector of the transistor connects into the tuned winding, whilst the untuned winding couples back into the emitter. It will be necessary to reverse the connections to the winding if the oscillator doesn't run initially. The value of R1 is found experimentally and should be that which gives a nice clean oscillation at a low battery current. It would probably be O.K. to start with 100kΩ here and adjust it as required after you've got the oscillator working."

"It hasn't," confirmed Smithy. "Our contributor suggests that it could be modulated by connecting an a.f. multivibrator to the same power supply. It occurs to me that an alternative method of modulating it would consist of returning R1 to one of the collectors in the a.f. multivibrator. Like this."

Smithy pulled his note-pad towards him and sketched out a suitable multivibrator circuit. (Fig. 2 (b)).

"There's another modification you could carry out," said Dick suddenly. "Instead of having the oscillator run at a single fixed frequency you could have it cover all the intermediate frequencies likely to be encountered in practice, say from 450 to 480kHz, by putting a small

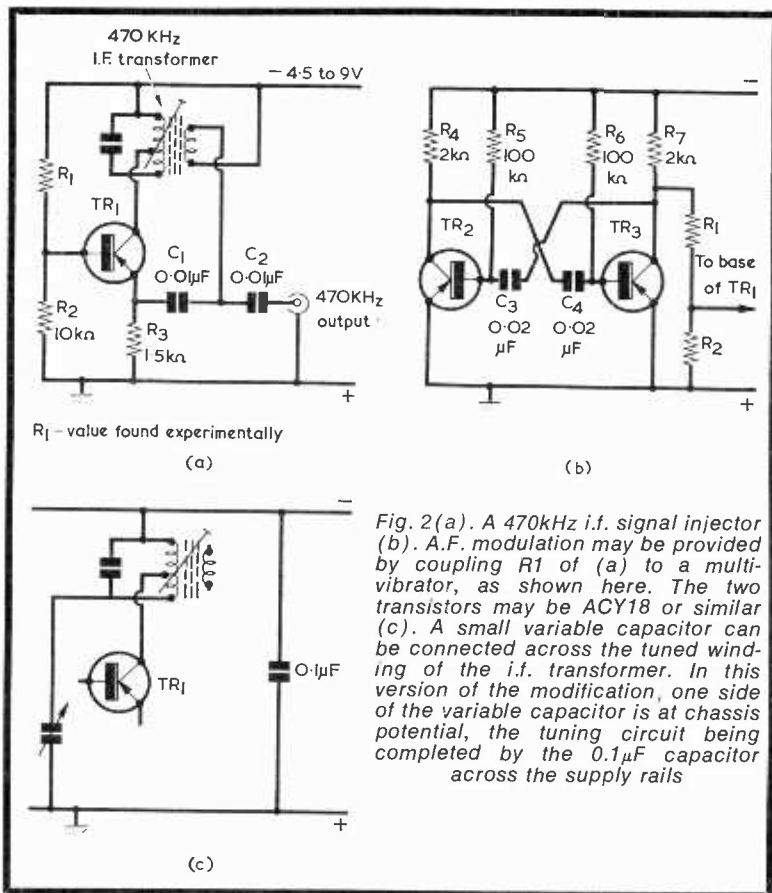


Fig. 2(a). A 470kHz i.f. signal injector (b). A.F. modulation may be provided by coupling R1 of (a) to a multivibrator, as shown here. The two transistors may be ACY18 or similar (c). A small variable capacitor can be connected across the tuned winding of the i.f. transformer. In this version of the modification, one side of the variable capacitor is at chassis potential, the tuning circuit being completed by the 0.1µF capacitor across the supply rails

"What transistor type should be used?"

Smithy consulted the letter again. "Virtually any r.f. or i.f. transistor will cope," he replied, "typical examples being the OC44, OC45, AF115, and OC170."

Dick looked at the circuit once more.

"It's certainly a nice simple circuit," he remarked. "It doesn't look, though, as if the oscillator has any audio modulation."

variable capacitor across the tuned winding. (Fig. 2 (c)). You'd adjust the core of the transformer so that, with the variable capacitor vanes fully open, the circuit oscillated at the highest frequency in the range, after which lower frequencies could be obtained by adjusting the capacitor."

"That's a good idea," said Smithy approvingly. "The value of the variable capacitor will have to be found by experiment because it will

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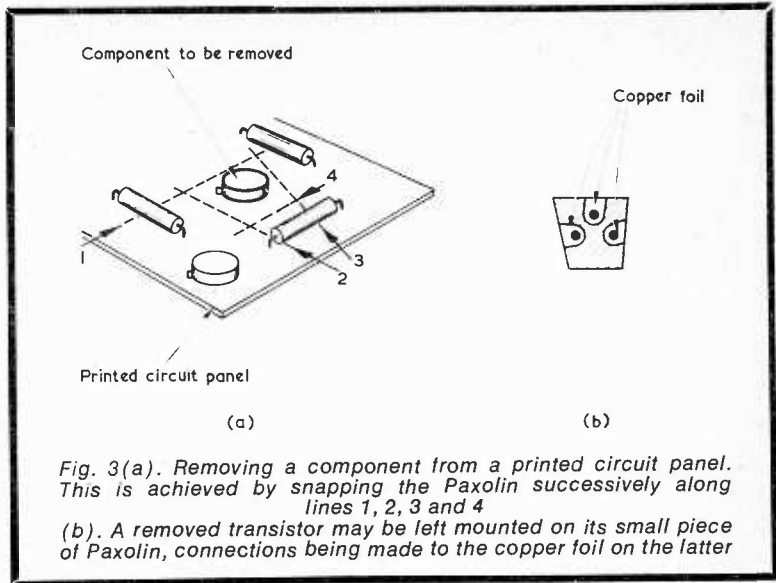
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depend upon the value of the fixed capacitor inside the transformer itself, but this little point shouldn't present any difficulties to the keen constructor. I'd hazard a guess that the value required in the variable capacitor would be round 50pF for most i.f. transformers likely to be used in the circuit, but it's impossible to be certain here, of course."

"It seems to me," replied Dick. "that the thing to do would be to use a fairly large value capacitor initially, and discover from this the capacitance range required. Incidentally, isn't it funny the way that one idea sparks off further ideas?"

"That always happens," said Smithy. "These sessions are just the thing for getting the old imagination going."

REMOVING COMPONENTS

The Serviceman once more returned to the letters.

"Here's another instance," he remarked, "where we've had two hints from one reader."

"Good show," said Dick enthusiastically. "That means there are twice as many to discuss. Fire away, Smithy!"

"Righty-ho," replied the Serviceman obligingly. "The first of these two hints deals with the removal of components from printed circuit boards, such as those 'computer panels' which are currently being offered at low prices. With these panels the main items of interest are the components themselves and not the boards. Many surplus panels are packed with parts ranging from i.f. transformers to u.h.f. transistors, and they represent quite a good bargain. Whilst it is a simple matter to unsolder components with two leads, such as resistors, from these

panels, the situation becomes much more difficult when you try to unsolder i.f. transformers and other multi-terminal components without overheating them."

"I've recently had a bash myself at stripping down several boards for their components," put in Dick. "and I agree that dealing with some of the multi-terminal parts does raise difficulties. What's the reader's solution to the problem?"

"He takes advantage of the fact that Paxolin snaps easily," replied Smithy. "The idea is that, with the aid of a pair of sharp-nosed pliers or preferably wire-cutters, you attempt to cut across the Paxolin board. The board will snap cleanly along the line of cutting, and not much force is necessary. To remove a component you need only snap the circuit board in a few directions to enable the component to be taken out on a single small piece of Paxolin, and you can then snap this between the terminals as well if necessary. There's a diagram in the letter showing the basic idea."

Dick examined the diagram attentively. (Fig. 3(a)).

"That's quite a crafty approach," he remarked. "By the way, there's another diagram in that letter you haven't mentioned yet."

"I'll be coming to that in a minute," promised Smithy. "But before doing so I'll pass on our correspondent's comment that components are far less likely to be damaged by mechanical shock than by excessive heat from a soldering iron, with the result that the reclamation of components with the aid of this process is much more likely to be successful than is given by the use of a soldering iron only. I'll now get on to that further diagram you saw in the letter. This shows a transistor which is still

THE RADIO CONSTRUCTOR

soldered to a small bit of cut-away Paxolin. (Fig. 3 (b)). Our correspondent says he prefers to leave transistors taken from these panels on their own little pieces of Paxolin. They can then be wired into new equipment by making circuit connections to the copper areas left on the Paxolin, this being a better approach than is given by unsoldering the transistors and making connections direct to their lead-outs. The lead-outs frequently tend to be rather short."

"That's certainly a knobby scheme," said Dick. "We're getting some good hints this time, aren't we, Smithy?"

"We always do," replied Smithy. "I always look forward to these sessions because of the new ideas they introduce. Anyway, let's have a look at the second hint from this reader. Now, this really is a cunning idea and it consists of a design for an insulated test probe which can be locked on to any wire in a piece of equipment under test,

thereby leaving the hands free for making adjustments elsewhere. It is particularly useful when it is necessary to make a test connection to such things as h.t. points for long periods of time. If you use an ordinary test prod this is liable to slip every now and again, with a consequent risk of short-circuits to chassis. A further point is that the probe can be locked on to a high voltage point whilst the voltage is present, because the locking operating is carried out by twisting an insulated barrel."

"This," said Dick eagerly. "sounds like the answer to a service engineer's prayer! Go on, Smithy."

"You'd better look at the sketches in this letter if you want to follow the manner in which the probe is made up," commented Smithy, laying a sheet of drawings down on his bench. "To start off with, you require an old ball-point pen with a screw-on top and, preferably, a metal tip. (Fig. 4 (a)). You next

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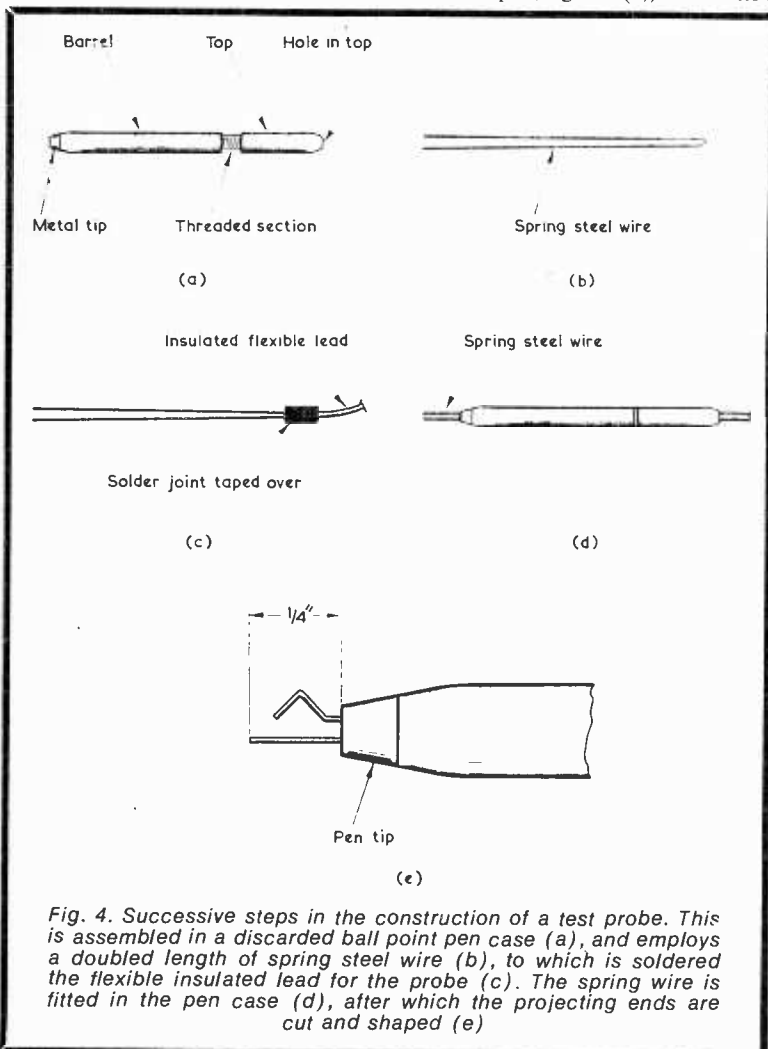


Fig. 4. Successive steps in the construction of a test probe. This is assembled in a discarded ball point pen case (a), and employs a doubled length of spring steel wire (b), to which is soldered the flexible insulated lead for the probe (c). The spring wire is fitted in the pen case (d), after which the projecting ends are cut and shaped (e)

discard all the innards including the push-down button in the upper end and the bits and pieces coupled to that button. You are then left with the empty barrel of the pen and a screw-on top, the latter having a nice convenient hole for the probe flex lead."

Smithy paused, and then indicated the second sketch on the sheet. (Fig. 4(b)).

"Next," he continued, "you obtain some thin spring steel wire, which could consist of piano wire, spring wire or anything similar, and cut from this a length which is twice the length of the pen plus one inch. You bend this double, after which you solder the flexible wire for the probe to the steel wire at the bend, and tape up the joint. (Fig. 4 (c)). Next, pass the flexible wire through the hole in the top of the pen and wedge the joint with its covering tape tight up into the inside of this top. Naturally, you'll need to ensure that just the right amount of tape has been used to enable the joint to wedge in properly. Next, screw the pen barrel fully onto the top, so that the two free ends of the steel wire pass out through the bottom end of the pen case. (Fig. 4(d)). Cut these wires $\frac{1}{4}$ in. away from the end of the pen and bend one of them in the manner shown in the sketch. (Fig. 4 (e)). The other wire is left straight."

Smithy ceased his description, whereupon his assistant looked at him expectantly.

"Well," remarked Dick, "don't leave me on tenterhooks. What comes next?"

"That's it. I've just given you all the gen on making up the probe."

"All right then," persisted Dick impatiently, "but how do you use it? How does it lock on to pieces of wire?"

"If," retorted Smithy, "you'll give me a chance to collect my thoughts, I'll tell you. What happens is that you first of all position the probe so that the two bits of steel wire

poking out at the end straddle the wire you want to lock on to. (Fig. 5(a)). Then, holding the top of the pen, you unscrew the barrel. This causes the tip of the pen to travel over the steel wires, bringing the angle in the bent wire closer to the straight wire. When you have unscrewed the barrel sufficiently, the wire you're locking on to becomes held firmly between the bent steel wire and the straight steel wire, with the consequence that the probe end is now mechanically secured to the wire in the equipment. (Fig. 5(b)). The probe will then stay in place on its own without being held, and will only become released when the barrel is screwed up again so that the steel wires open out once more."

VALVE CHECKER

"Gosh," said Dick, "now that's what I call a real *Bramah* of a hint!"

"It's an excellent one, isn't it?" agreed Smithy. "Well now, I'm just going to deal with one more hint, and after that we'll have to call it a day for this present sesh."

Smithy picked up another letter from his bench and scrutinised it carefully.

"Now, here's a really good hint to finish off with," he remarked. "This one describes a valve checker, and once again there's a diagram to look at whilst I tell you what's in the letter."

Dick examined the sketch which accompanied the letter with interest. (Fig. 6).

"It looks," he remarked, "as if this is one of those valve checker gadgets which comprise a valveholder and plug."

"That's exactly right," confirmed Smithy. "The device is mainly intended for use in receivers where valveholders are difficult to get at for test purposes. It includes a B9A plug and valveholder fitted back to back with the corresponding terminals linked together. The plug then fits into the valveholder

mounted on the equipment under test, and the valve plugs into the valveholder on the checker. Fly leads are taken from each pin of the checker to a 10-way terminal block, the last terminal of this block taking a tenth fly lead which clips to the chassis of the equipment under test. Pins 4 and 5 are usually heaters on a B9A base and these are taken direct to the terminal block by way of a twisted pair of fly leads."

"Hang on a jiffy," said Dick. "If the other leads also connect direct to the terminal block, won't there be a very considerable risk of instability taking place in the valve stage due to the stray couplings between them?"

"This is where we come to the crafty bit," chuckled Smithy. "Each of the remaining leads is isolated at the checker by means of a series resistor connected close to the appropriate valveholder pins. What's more, each resistor has a value which is equal to the resistance offered by the testmeter to be used when it is switched to a high voltage range. For instance, our correspondent's testmeter has a sensitivity of 20,000 ohms per volt, and gives a resistance of $5M\Omega$ when its switched to a 250 volt range, whereupon all the isolating resistors in his version of the checker have the same value. If the particular testmeter to be used happened to be, say, 10,000 ohms per volt and it had a 300 volt range, you'd make each of the series resistor $3M\Omega$. Got it?"

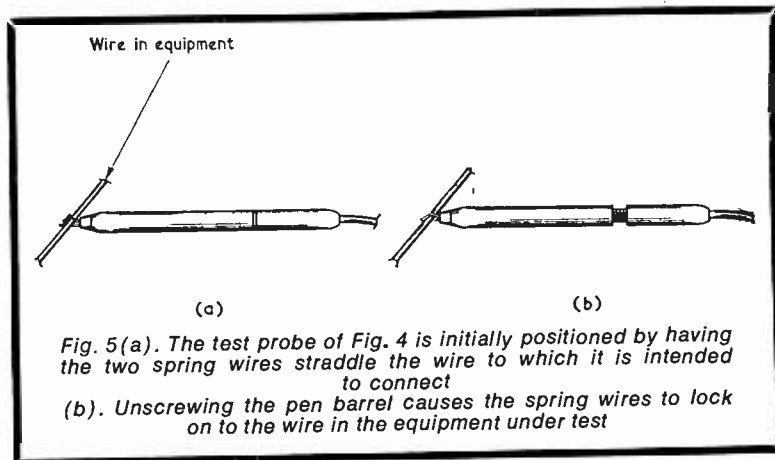
"Not entirely," replied Dick, frowning. "A little further elucidation please, Smithy!"

"You'll see what it's all about in a minute," said Smithy. "At any event, you'll appreciate that these high value resistors effectively isolate the valve electrodes from the fly leads to the 10-way terminal block, so that the checker can be used with the equipment under test switched on and it won't cause any serious upset to the performance of the valve stage in which it's fitted. As I've already mentioned, the checker plugs into the socket at the valve stage under test, the valve being refitted to the socket on the checker. The testmeter is then set to the high voltage range I've just referred to, thereby allowing voltage readings to be taken between terminal 10 of the terminal strip and any of the remaining terminals except 4 and 5. The important point to remember is that each voltage reading obtained has to be doubled."

"Stap me, I see it now!" exclaimed Dick. "Since each series resistor is equal to the resistance offered by the testmeter, the latter will indicate exactly half the actual voltage existing at the appropriate pin."

"You've got it," chuckled Smithy.

THE RADIO CONSTRUCTOR



"Now, there are two final points about the valve checker which need to be mentioned. The first of these is that the heater voltage of the valve under test can also be checked, this being done by connecting an a.c. voltmeter to terminals 4 and 5 of the terminal strip. And the second is that, by joining terminals 4 and 5 together with a resistor of suitable value, the valve may be removed without upsetting operating conditions in a series heater chain. Okay?"

"Definitely," Dick assured him. "Let's see now. If the valve has a 6.3 volt heater rated at 0.3 amp, the resistor required will be 21Ω , won't it?"

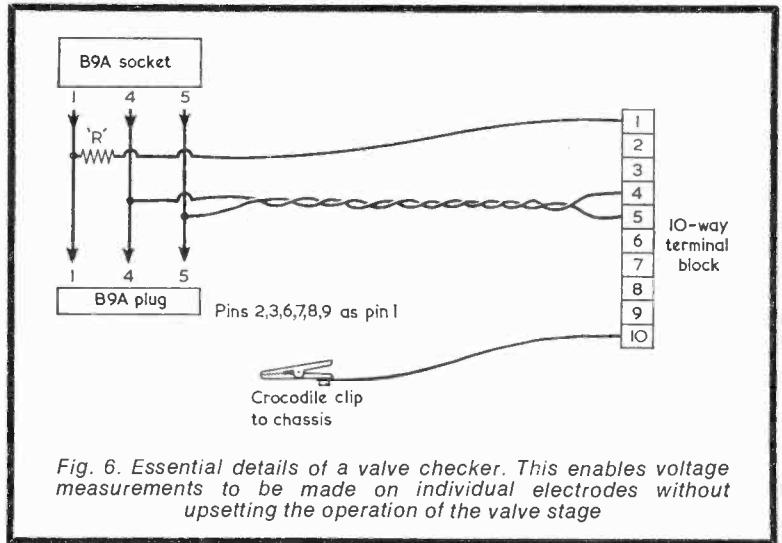
"True," agreed Smithy. "And it will require a wattage rating in excess of the 1.89 watts it will be called upon to dissipate. You can soon work out the resistance and wattage ratings for the more common valves and you could then make up a stock of suitable resistors to replace their heaters in a series chain."

TIME TO GO

With a decisive gesture Smithy gathered up the letters on his bench, returned them to the drawer, and closed it.

"It looks as though I've timed things very nicely," he remarked cheerfully, as he looked at the Workshop clock. "Another minute and we are officially due for the off."

There was no reply from Dick, and Smithy turned round to glance at his assistant.



"Oh no," he groaned, "not again!" But it was too late, and Dick was already emerging from the state of suspended animation that betokened yet another visitation from his Muse.

"Here we are, Smithy! How about this to finish off our present sesh?"

Striking a suitable pose, Dick gave voice to his latest creation.

*"If you can dream
Up a suitable scheme,
Or have an idea
In the servicing sphere,
Just send us your hint.
It could get into print!"*

Dick beamed proudly at the winning Serviceman.

"How about that, then?"

"Very good," said Smithy politely. "Also, it was concise and to the point. It could be described, indeed, as a bonanza stanza of terse verse."

Dick turned a suspicious eye on to the Serviceman.

"Come to think of it," continued Smithy, warming to his theme, "Seldom have I heard such sublime rhyme or neater metre. Its manner of composition classes your poem as an empiric lyric, its humour classes it as a giggle madrigal, and the wealth of information it conveys makes it nothing less than a portanteau canto!"

And, for once, Smithy was able to leave the Workshop for the day having completely routed his youthful and ebullient assistant.



CROSS-WORD

SOLUTION

- ACROSS**
- Boolean Algebra
 - Toggle
 - Two Grids
 - Tungsten
 - Indoor
 - Emends
 - Amoral
 - Smudge
 - Gold Foil
 - Resonate
 - D Layer
 - Resistance Wire

- DOWN**
- Absolute Ampere
 - Long
 - Detect
 - Algorism
 - Kerr
 - Not And
 - Radio Altimeter
 - Greed
 - Daraf
 - Die Casts
 - A Green
 - Ladder
 - Obit
 - Axis

Editor's Note

The hints described in this episode of 'In Your Workshop' were submitted, in the order in which they appear, by R. Wallace, W. Brooks, M. J. Tucker and C. P. Finn. Further hints for this feature are welcomed, and payment is made for all that are published.

COURSES OF INSTRUCTION

LONDON BOROUGH OF EALING

RADIO AMATEURS' EXAMINATION COURSE

Radio Amateurs' Examination Courses: Wednesdays, 6.30-9.00 p.m. starting 23rd September. Enrolments: Wednesday and Thursday, 9th and 10th September, and Wednesday, 16th September, from 6.15 to 8.15 p.m., Room 8, Acton Technical College, opposite Acton Town Hall, Acton, London, W.3. Fee: For three terms, £3 0s. 0d.
Lecturer: W. G. Dyer, M.I.E.E., G3GEH.

LONDON BOROUGH OF HOUNSLOW

BASIC ELECTRONICS HOBBY COURSE

The making up of novel and interesting electronic circuits of all descriptions using transistors and other modern electronic devices. It will be assumed that participants are without previous knowledge.
HESTON: Friday

HIGH FIDELITY AND TAPE RECORDING

The course is designed to give an insight into the technique of high fidelity, tape reproduction and recording and to get the best out of existing apparatus and machines, including notes on construction and maintenance. Programming and special applications, both stereo and mono, will be dealt with, as will be sound on tape or film for cine work.
BRENTFORD: Wednesday

MATHEMATICS OF RADIO

This course has been specially designed to help those who are interested in radio but need help to comprehend the mathematics involved. It will be useful both to those taking radio servicing and to those studying for the R.A.E. The course will start on 6th November, 1970. Fee is £3 or as an extra class 20/-.
BRENTFORD: Friday

RADIO AMATEURS' COURSE

This course is in preparation for the City and Guilds Examination which qualifies the successful candidate for recognition by the Postmaster-General for the purpose of Radio Transmission. The work includes: simple magnetism and electricity, principles of radio, valves and transistors and circuits, radio receivers, low-power transmitters, aerials, measurement of frequency meters. After the examination the course will include lectures on equipment design.
BRENTFORD: Monday

RADIO HOBBIES

For the amateur radio enthusiast. Learn how to build and operate your own set. A transmitter is available.
CRANFORD: Monday

RADIO AND TELEVISION SERVICING

Electron theory, magnetism, resistors, capacitors and inductors. Valves and transistors. Test equipment. Circuits. Fault finding. The course should enable the layman to keep his radio and television set in good repair, and prevent accidents from ignorant handling.
BRENTFORD: Tuesday (1st year), Thursday (2nd year)

CITY OF GLASGOW

RADIO AMATEURS' EXAMINATION COURSE

The Course will meet at the College on Tuesdays and Thursdays from 7.00-9.30 p.m., commencing Tuesday, 15th September, 1970. Enrolment will take place at the College at 7.00 p.m. on the opening evening, and the fee for the course is £3. 0s. 0d., payable on enrolment. Students under the age of 18 on 1st August, 1970, will not be required to pay a fee.
The syllabus of the course embraces theory, licence conditions, and morse instruction, and no prior knowledge is assumed or required.
The Glasgow College of Nautical Studies, 21 Thistle Street, Glasgow, C.5.

BARKING, ESSEX

RADIO AMATEURS' EXAMINATION COURSE

A Course for the R.A.E. will be held at the Cascoigne Recreation Centre, Cascoigne School, Morley Road, Barking, on Tuesday evenings at 7.30 p.m. commencing on the 22nd of September.

Radio Topics

By Recorder

MANY, MANY, YEARS AGO, when I was even greener than I am at present, I took out two Provisional Patents. One was for a television line hold control circuit which saved a potentiometer and used an adjustable inductor instead, and the other was for an electromagnetic ion trap magnet. To explain the reason for the latter, I should tell you that in those far-off days some TV manufacturers had trouble with the steady spot which remained at the centre of the screen after switching off the set. With some tube circuits this spot could be so bright as to burn the unprotected phosphors on the inside of the screen. The idea behind the electromagnetic ion trap magnet was that no current would flow through its coil after the set was switched off, whereupon the electron stream from the gun would not be directed towards the screen but would merely bash harmlessly away against the side of the tube neck.

The reasons why neither of these ideas ever showed any signs of success are because the variable inductor in the line hold control circuit was a darned sight more expensive than the pot it replaced, and because electromagnetic ion trap magnets had been in use in the States for many years previously but nobody had told me.

NEW INVENTIONS

Since those days I have felt that it is better to pick up a fee for publishing bright ideas in the technical press than it is to keep quiet about them and pay a fee to a Patent Agency. In consequence, I now pass on details of some of the latest ideas I'm developing.

The first of these is the "Recorder Electrical Fly-Trap". Take a piece

of Veroboard with 0.1in. hole matrix and connect alternate copper strips (i.e. every other strip) together at one end. Then, at the other end, connect together the interleaving alternate strips. Next, connect the two sets of strips to the a.c. mains, smear some Hartley's Raspberry Jam across them, switch on and wait for your first victim. It's going to be a very light-footed fly who doesn't allow at least one pair of its complement of legs to fall on alternate strips.

A development of this basic scheme is to connect the sets of alternate strips to a bridge circuit instead of to the mains. The bridge circuit is coupled to a sensitive d.c. amplifier which operates a solenoid. When a fly settles onto the Veroboard it will cause a resistance to appear between the sets of strips, whereupon the bridge becomes unbalanced and the solenoid operates, causing a large mallet to descend on the fly. The only snag with this last idea is that the jam used for bait has to be non-conductive, but I'm working on that.

A further projected scheme is intended to guard against those people who leave lighted cigarettes on ash-trays and forget all about them. What happens then is that, as the cigarette burns away, the weight of cigarette outside the ash-tray edge becomes greater than that inside, with the result that the lit cigarette falls over the edge of the ash-tray and proceeds to burn the furniture surface underneath. With my idea, a thermistor is mounted near the ash-tray edge and exhibits an increased resistance if its temperature rises due to the burning away of a forgotten cigarette. The increased re-

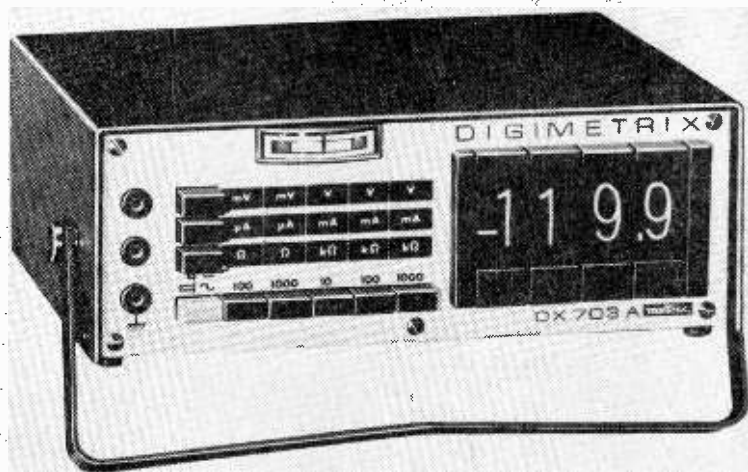
sistance is then made, by way of a suitable amplifier, to energise a solenoid-actuated pair of scissors which neatly snip off the projecting length of cigarette. This falls harmlessly to the surface under the ash-tray whilst the lit section is left to finally burn itself out, staying safely within the ash-tray area.

Perhaps the best of my recent ideas is an electronic power oscillator for driving a standard electric clock. This uses two 6V6's in push-pull in the output stage, runs at 50Hz and provides an output at 240 volts which is more than adequate for the low power requirements of a clock. To ensure that the oscillator runs accurately at 50Hz, a small coupling capacitor keeps it synchronised with the a.c. mains.

I hope to release further details of my latest inventions, as and when they materialise, in future issues of this journal.

NEW TYPE OF ENGINEER

As, I think, most people who have had experience in factory production of electronic equipment will agree, there is a serious gap in communication between the design and production departments of the larger companies. All too often the design boys dream up a new assembly or sub-assembly under the happy self-delusion that it will build up on the production line just as easily as it did in the development laboratory (even if they *did* have to ask the tea-woman to hold a thumb on the top of a cluster of resistors whilst three technicians soldered up their common connections to a single 6BA tag).



The 'Digimetrix' digital multimeter Model DX703A, also available from ITT Components Group Europe, measures a.c. and d.c. voltage up to 1,000 volts, a.c. and d.c. current up to 1 amp, and resistance up to 1M Ω .

This lack of communication is high-lighted in a report entitled 'Electronic Production Testing in British Industry - The Present Situation and a Pattern for the Future', which is available from the Research Division, The Marconi Company, Widford Hall, Chelmsford, Essex. The report comprises ten volumes at £10 the set, or £1 for each volume. I appreciate that this is not the sort of literature which the home-constructor would feel was within his interests or his pocket, but quite a few readers of *The Radio Constructor* are directly employed in the electronics manufacturing industry and are involved in what the report has to say. Also, what goes on in the factory concerns all of us, if only as consumers of completed products.

The report is the result of an intensive study aimed at the problem of maintaining and improving the quality of British electronic products, and was carried out by an Advisory Panel consisting of five senior officers of the Ministry of Technology and fifteen senior engineering executives drawn from industry and the Post Office. It was sponsored jointly by The Marconi Company and the Ministry of Technology.

The report is largely concerned with adequate testing of components and products, and recommends that design engineers should understand better the effect that their design actions have on the costs of detecting and correcting product faults. A plan of production testing should be started at the earliest possible design stage of a product, and it should include the testing methods to be used and the levels of quality to be achieved at each stage of production. It must be continually open to modification as new production experience is obtained, so that the most cost-effective checking of quality can be achieved.

These requirements can only be fulfilled by combining design skill with a thorough experience of production methods. In view of the urgency of the requirements, and due to the communication gap between design and production departments I mentioned earlier, the report recommends the creation of a new and separately managed engineering activity which would be named 'Test Engineering (Planning)'.

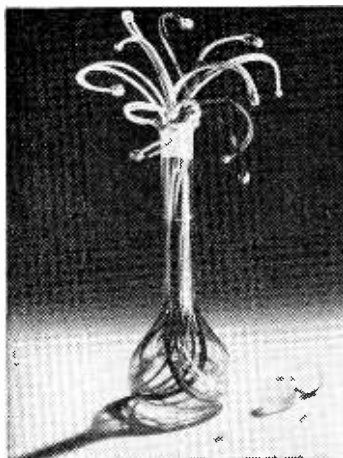
For this activity a new type of engineer must be trained who can work as an active link between designers and testers. He must be able to evaluate the latest methods of testing and make constructive proposals to designers aimed at achieving more cost-effective production testing.

The study report, which includes proposals for industrial and government action to remedy the present situation, is at the time of writing

these notes under consideration by the Ministry of Technology.

THERMISTOR RANGE EXTENDED

The photograph shown below this month illustrates, in very striking manner, the fact that the range of 'Positte' thermistors manufactured by ITT Components Group Europe (Thermistor Product Division, Edinburgh Way, Harlow, Essex) has been extended to cover a switching temperature range from 80°C to 170°C. Previously, these thermistors have only been available for operation at 120°C and 130°C.



A selection of the 3mm and 5mm diameter thermistors from the new 'Positte' range manufactured by ITT Components Group Europe for overload and overheat protection purposes

'Positte' thermistors consist of small discs of doped barium titanate, with electrical connection made by two flexible p.t.f.e.-coated lead-out wires. These thermistors have a positive temperature coefficient and a nominal impedance at the reference temperature of 1,000Ω. The reference temperatures at which 'Positte' thermistors are now available are 80°C, 90°C, 95°C, 110°C, 120°C, 130°C, 140°C, 155°C and 170°C. The extended range includes both 3mm and 5mm diameter discs with lead-out lengths of 130mm or 120mm.

DIGITAL MULTIMETER

The other photograph illustrates another ITT Components Group Europe product, this being the 'Digimetrix' digital multimeter model DX703A.

This multimeter measures a.c. and d.c. voltages up to 1,000 volts, a.c.

and d.c. currents up to 1 amp and resistance up to 1MΩ. Input impedance is 10MΩ, remaining constant on every range. The instrument is well protected; it will take for example 1,000 volts d.c. or 350 volts a.c. without damage even on its most sensitive ranges.

Two input terminals suffice to connect to all 25 ranges of the multimeter, selection being by means of push-button switches. An unusual feature is the built-in analoguous meter, which shows which way the quantity being measured is varying, and provides a check on overloads.

The instrument has a carrying handle which also acts as a stand. It weighs 6lb., is 9in. wide, 6½in. deep and 3¼in. high, and is available from ITT Components Group Europe, Trading Services, Edinburgh Way, Harlow, Essex.

BASIC THEORY

It isn't a bad thing every now and again to get down to a little basic electronics, so let's just take a quick look at something which could quite definitely happen in theory - although you might have difficulty in proving it in practice!

We start off with two flat metal plates of equal area and shape, together with two very thin sheets of insulating material which offers infinite resistance to the flow of electric current. These two sheets are equal in thickness and have a shape and area which allow them to overlap all edges of either of the metal plates if placed over it.

First of all we place one insulated sheet over one metal plate, with the sheet overlapping all the metal plate edges, then put the second metal plate over the insulating sheet so that it is positioned exactly over the first plate. The result is a capacitor. We next charge this to 50 volts by connecting a 50 volt battery to the two metal plates. We then disconnect the battery, remove the top metal plate by means of an insulated pair of pliers (again assume infinite resistance), insert the second insulating sheet over the first and replace the top metal plate.

What's the voltage across the new capacitor that is now formed?

The answer is 100 volts. To understand why this should be so remember that in a capacitor the charge in coulombs (Q) is equal to capacitance in farads (C) multiplied by applied voltage (E). Under our theoretical conditions none of the original charge from the 50 volt battery was allowed to leak away. At the same time, by adding an extra sheet of insulating material we halved (approximately) the capacitance. Since Q is unaltered and C is halved, E must be doubled.

LATE NEWS

Times = GMT

Frequencies = kHz

★ AMATEUR BANDS

● LIBERIA

EL7NB has been logged on 21080 using c.w. and giving the name as Laura and QTH as Tchien.

● ANGOLA

CR6OK has been heard on 14MHz s.s.b. giving the QTH as Post Box 275 Angola.

● UGANDA

5X5MP, recently logged using 14MHz c.w., asked for QSL's via LA8ML. 5X5FS has also been heard using the c.w. mode on this band.

● BRITISH VIRGIN ISLANDS

VP2VI, very active recently on 14MHz s.s.b., has VE3ACD as his QSL Manager.

● DOMINICA

VP2DAE heard on 14MHz s.s.b., asks for QSL cards to be sent via VE3EWH.

● EASTER ISLAND

All who logged CEØAE on 21MHz c.w. during the recent Dx-pedition should QSL via WA3HUP.

● MALAYSIA

9M6HM has been heard on various frequencies in the 14MHz band using s.s.b. Also heard was 9M8FMF.

★ BROADCAST BANDS

● BOLIVIA

CP30 Radio Santa Cruz, listed on 6135 (1kW) has been reported on the new frequency of 9605 around 0130.

● MALAWI

Radio Malawi, Blantyre, can be heard with the new 100kW transmitter on 3380 and 5955. An English programme is radiated at 1930 and the station signs off at 2115 with the National Anthem.

● UNITED ARAB REPUBLIC

Cairo now radiates programmes in English as follows – from 0200 to 0330 on 9475 (50/100kW) to N. America; from 2145 to 2300 on 9675 to Europe; from 1730 to 1845 on 17655 (100kW) to Africa; from 2030 to 2200 on 17755 to W. Africa and from 1315 to 1430 on 17920 (50/100kW) to S. Asia. The 9675 and 17755 channels are not listed.

● MONACO

Radio Monaco now broadcasts a music programme entitled "Flying Records" every Sunday from 1800 to 1825 on 6035 and 7135 (both 30kW).

● CONGO

The People's Republic can be heard over Brazzaville on the listed 4800 (4kW) channel but sometimes wanders to 4802. Brazzaville has also been logged on the 3232 (1.5kW) channel.

● NORTH VIETNAM

Hanoi radiates an English programme at 2000 and has been heard with station identification at 2010 on 15023 (listed 15018).

Acknowledgements to our own Listening Post and SCDX.

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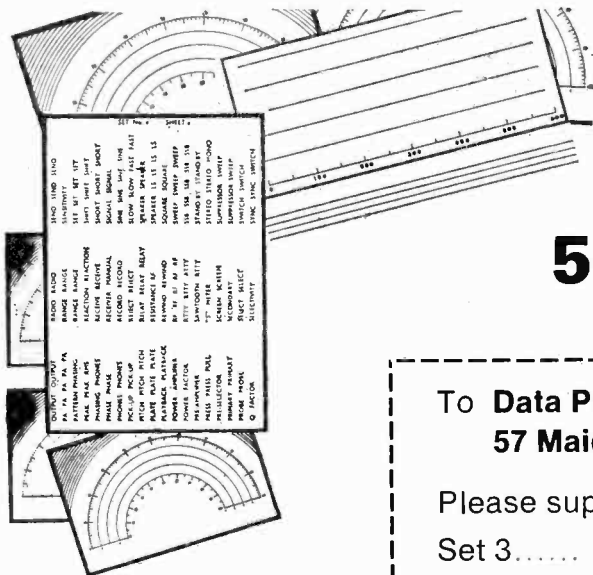
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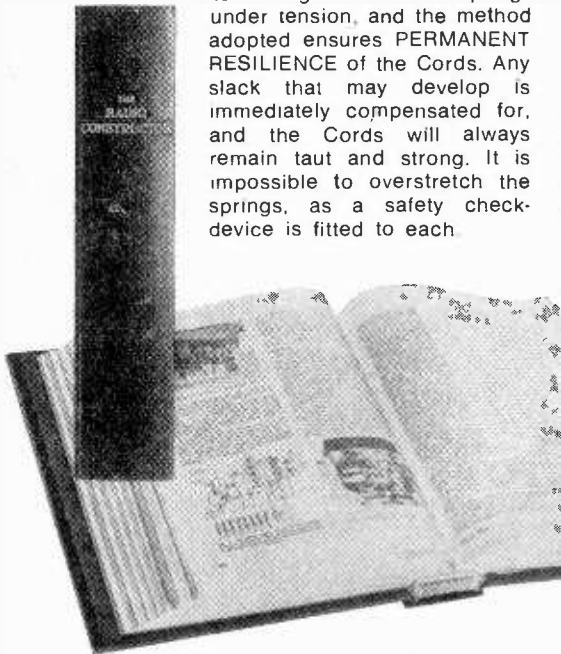
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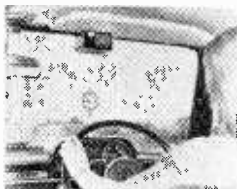
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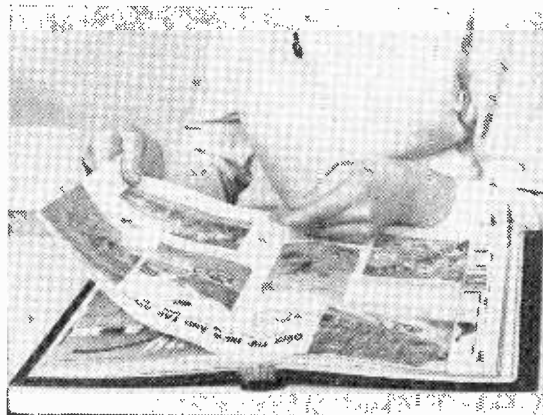


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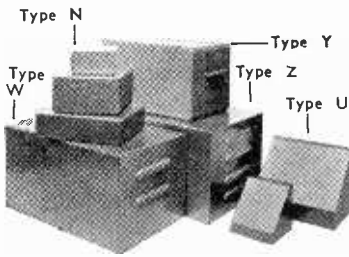
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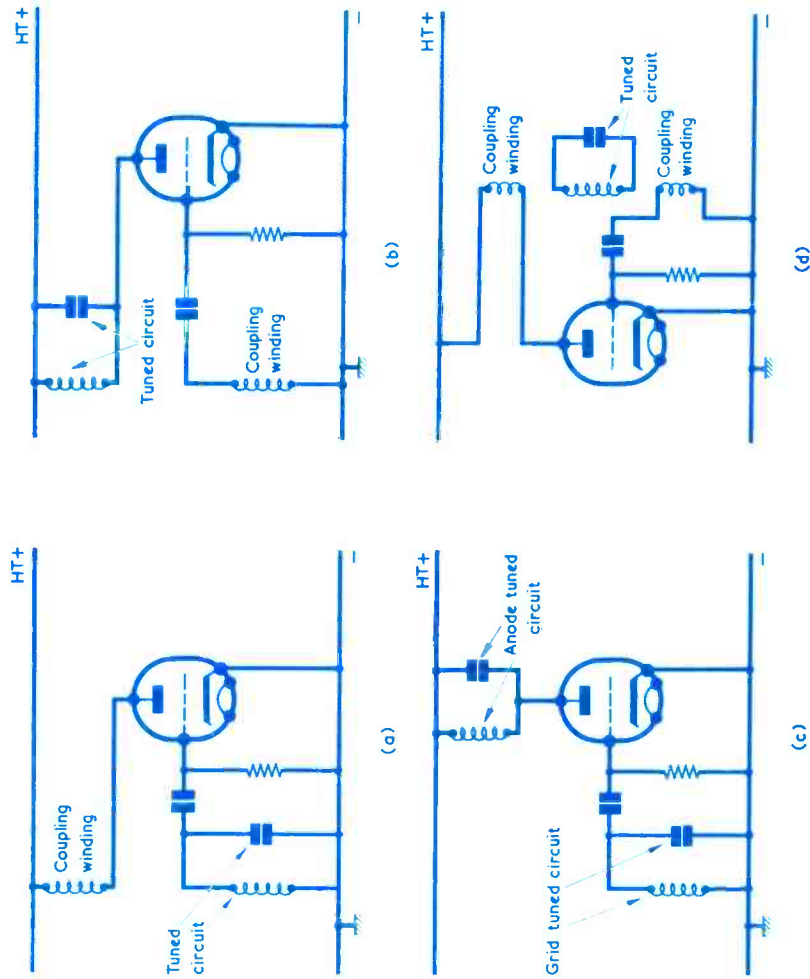
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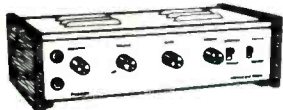
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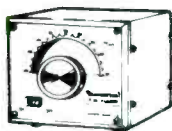


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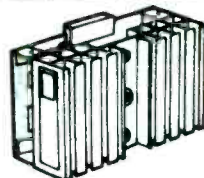
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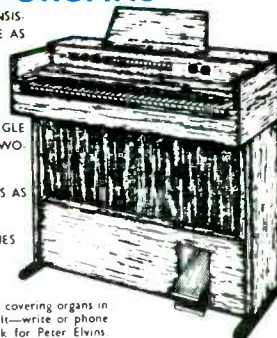
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