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Volume 9
Number 2
SEPTEMBER 1955

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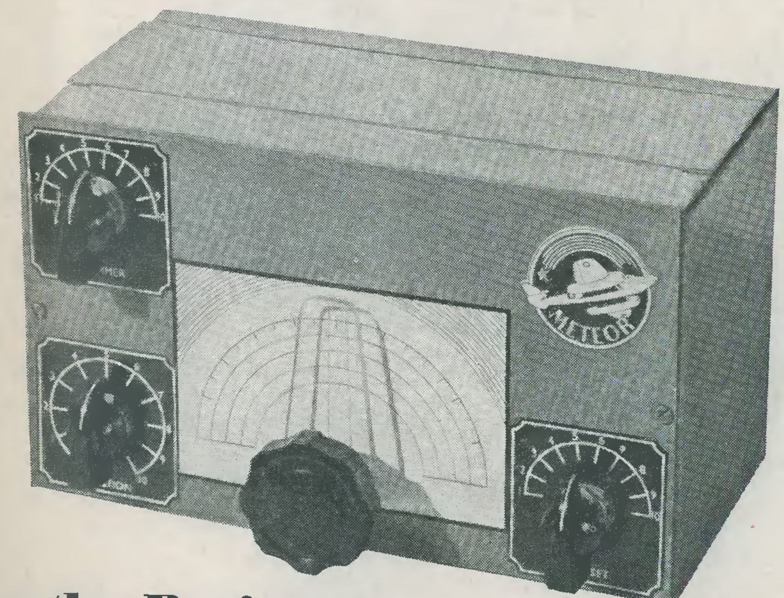

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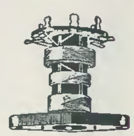

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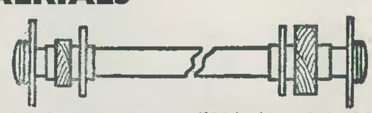

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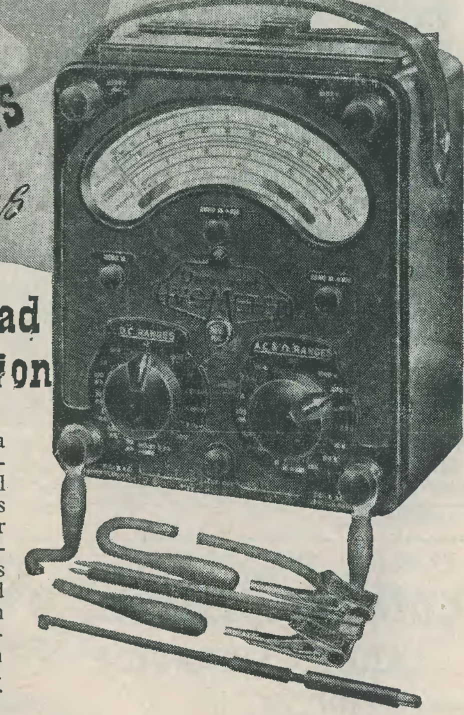

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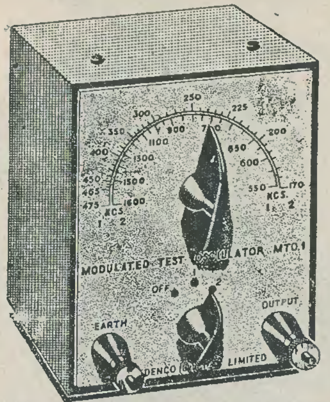

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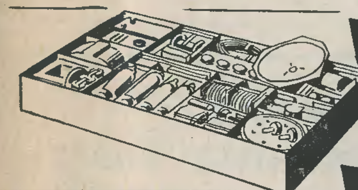

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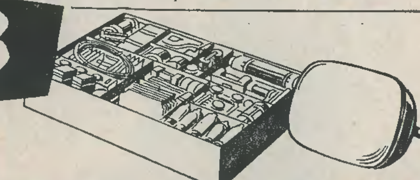

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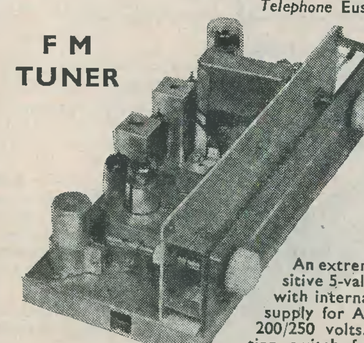

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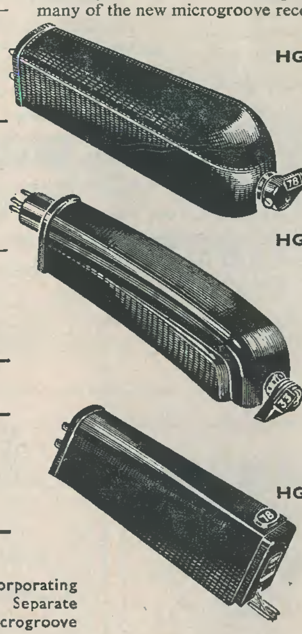

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As HGP 35-I but slightly longer.
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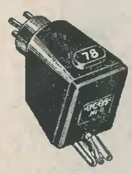

HGP 55-I
Hi-g pick-up head incorporating cantilever sapphire styli. Separate heads for standard and microgroove records.
Ask for Data Sheet No. 5300.

Price 32/6 (Plus 10/5 P.T.) for all types except the HGP 39 & 55 models which are **32/-** (Plus 10/3 P.T.)

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ACOS devices are protected by patents, patent applications and registered designs in Great Britain and abroad.

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The

Radio Constructor

incorporating THE RADIO AMATEUR

CONTENTS FOR SEPTEMBER

VOL. 9 NO. 2

SEPTEMBER 1955

ANNUAL SUBSCRIPTION 18/-

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9

Telephone
CUNNINGHAM 6141 (2 lines)

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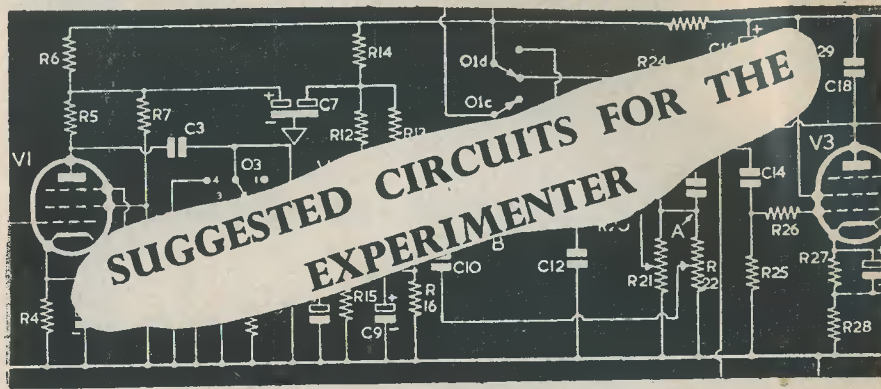
NOTICES

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

All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

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

ALL CORRESPONDENCE should be addressed to THE RADIO CONSTRUCTOR 57 Maida Vale London W9



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

No. 58: AMPLIFYING BLACK-SPOTTER SYSTEMS

A DISTRESSING FEATURE INHERENT IN television reception of the positive modulated signals employed in this country is given by the fact that impulsive interference results in "whiter-than-white" voltages being fed to the picture tube. In consequence, interference becomes far more noticeable and annoying than would occur if a negative modulation transmission system were used instead.

The interference circuits which are fitted to many televisors do not prevent the pulses of interference from appearing on the screen in the form of white dots or lines. However, they effectively *limit* the amplitude of the interference pulse, thus preventing it from causing overloading of the video circuits or the picture tube. More effective arrangements, "grey-spotters," use voltage delayed circuits which reduce the amplitude of the interfering pulse to a value which is lower than peak white. The most ambitious circuits of all employ some degree of amplification and phase inversion, causing the interference pulses to appear on the screen as black spots or lines. The fact that the interference pulses are altered in nature from white to black results in their becoming far less irritating to the eye. They are also, of course, practically invisible against dark backgrounds.

Quite a few black-spotter circuits have been published in the technical press from time to time. Some of these suffer from the disadvantage that the pulse voltages derived from the black-spotter amplifier are built up across relatively high-value resistors connected in series with one of the modulating electrodes of the picture tube. High resistor values in these positions are not normally to be recommended, since they are liable to attenuate the high-frequency response of the tube. In the two circuits described this month, good results should be obtained when the series resistors have values as low as 10kΩ.

Cathode Modulation

Fig. 1 illustrates a circuit suitable for receivers employing cathode modulation. Considered as an "add-on" unit, the modifications to the associated receiver would consist of connecting V_1 to the cathode of the picture tube, the anode of $V_2(b)$ to its grid, and inserting R_3 in series with the brilliance control voltage applied to this same grid. Heater and h.t. supplies would also, of course, be required.

The double-triode V_2 should be a 12AU7, or equivalent. The anode of $V_2(a)$ is connected to the full h.t. supply and, in the absence of any voltage being passed to its

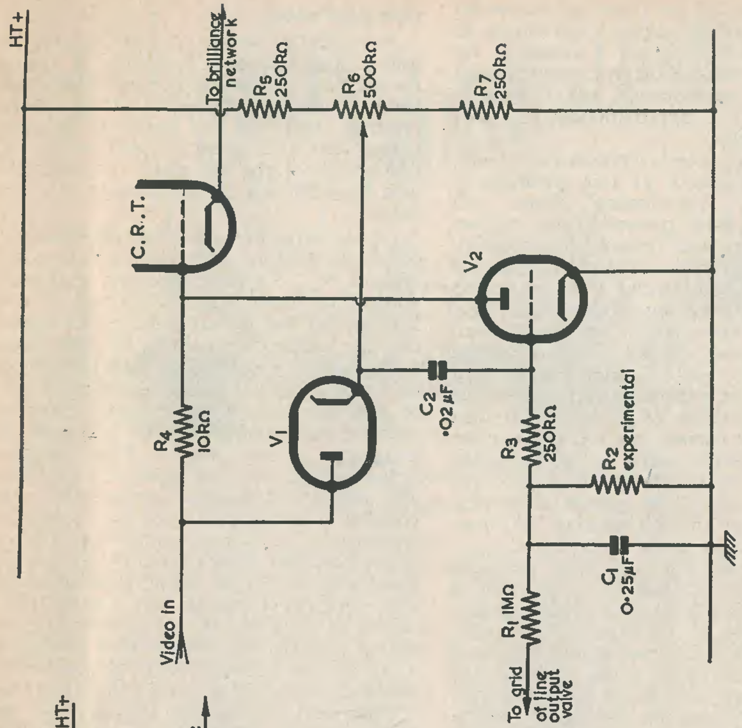


Fig. 2

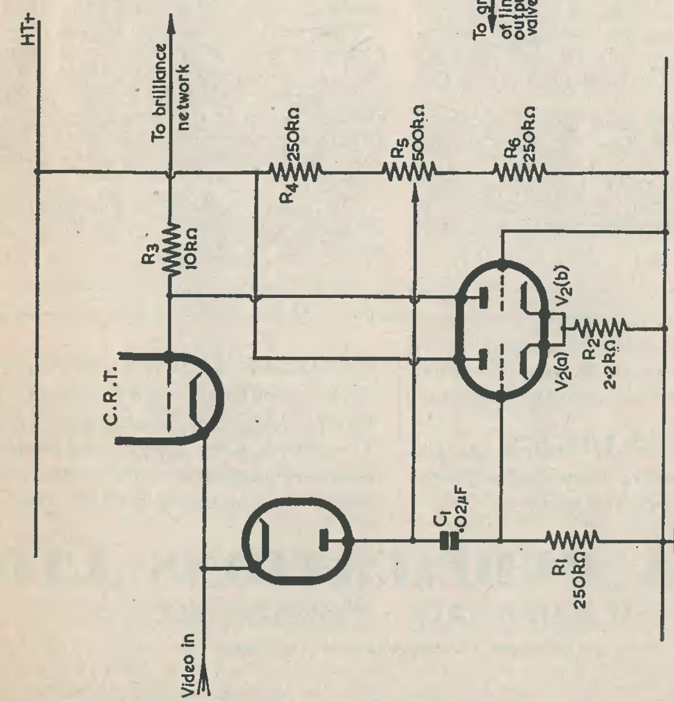


Fig. 1

E202

Amplifying Black-Spotter Systems for Fig. 1, Cathode Modulated, and Fig. 2, Grid Modulated Picture Tubes grid via C_1, builds up a voltage across R_2 which is capable of biasing $V_2(b)$ almost to cut-off. $V_2(b)$ receives its h.t. supply via R_3 and the brilliance control network; and its anode, in consequence, has a positive potential equal to approximately half that of the h.t. supply.

As the picture tube is cathode modulated, the video intelligence at this electrode is negative-going. Interference pulses will result in negative pulses having higher amplitudes than the peak-white potential. The anode of V_1 is biased by R_5 to approximately the same potential with respect to chassis as is given by peak-white video. As a result, it conducts on the arrival of an interference pulse, passing a negative pulse to the grid of $V_2(a)$. $V_2(a)$ functions as a cathode follower, applying a further negative pulse to the cathode of $V_2(b)$. $V_2(b)$ then draws a heavy current via R_3, causing the grid of the picture tube to go negative. The negative excursion at the grid of the picture tube should be greater than that at the cathode; thereby causing the interference spot or line to be blacked out.

The circuit of Fig. 1 should be quite easy to put into practice, but care must be taken to prevent leads which carry pulses from having too high a capacity to chassis. It is possible that the small standing current drawn by $V_2(b)$ may upset the existing brilliance control circuits on some receivers such that the optimum setting is outside the range of the control. In such cases R_2 should be increased in value until the trouble clears.

Adjustment of the black-spotter is carried out with the aid of R_5. The slider of this potentiometer should be advanced from the negative end of its track until deterioration of peak-white signals is just visible. It should then be slightly retarded from this point.

Grid Modulation

A somewhat similar circuit suitable for grid modulated tubes is shown in Fig. 2. As may be seen, the diode V_1 is reversed, since interference pulses will now have a positive, and not a negative, potential higher than that given by peak white. V_2 is a triode of the 6J5 class, whose grid is held negative via R_3. Normally V_2 is at cut-off.

On the arrival of an interference pulse V_1 conducts, passing a positive pulse to the grid of V_2. V_2 then conducts, causing a volts drop across R_4. As a result of this, the grid of the picture tube goes negative and the interference pulse is blacked out.

The negative voltage applied to the grid of V_2 in Fig. 2 is obtained from the grid of the line output valve. In almost all modern receivers this valve is biased by leaky-grid action and a high negative potential is, in consequence, available. The voltages at the line output grid is decoupled by means of R_1 and C_1, the voltage required for V_2 being obtained with the aid of the potential divider given by R_1 and R_2. The value of R_2 is found experimentally. This component should have a value which causes V_2 to be just at cut-off when the line output stage is in a synchronised condition, a normal picture is resolved on the screen, and R_6 is set to the positive end of its track.

Constructional points apposite to the circuit of Fig. 2 are similar to those for Fig. 1. Adjustment is also carried out in the same manner; with the exception that the slider of R_6 is in this case brought forward from the positive end of its track; and not from the negative end, as occured with R_5 of Fig. 1.

The diodes V_1 in both diagrams may be replaced by suitable germanium diodes, should this be desired.

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IN YOUR WORKSHOP

In which J. R. D. discusses Problems and Points of Interest based on Letters from Readers and his own experience

At the time of writing, there is that slight lull in the radio industry which presages the usual autumnal storm. Activity during the next few months will be continually increasing, especially in the London area, as the weeks advance towards two important dates. The first of these is that marking the opening of the Annual Radio Show; and the second is the inception of Band III transmissions. One or two seasoned engineers attached to manufacturers have been known to get extremely flustered in the past during last minute "panics" for the Show. Add to the normal activities the anticipated Band III rush and there may be, this year, quite a few more people getting severely worked up! As is common with almost every exhibition which has ever been held, no matter how well things are organised beforehand something is always sure to go wrong at the very last moment.

Seasonal Sales

Despite the "slight lull" I mentioned in the opening paragraph, the radio trade in Great Britain is in the comfortable state of enjoying a minor boom just now. Nevertheless, it still exhibits fairly marked "seasonal" tendencies—although these are, fortunately, by no means as severe as they used to be before the war.

During the summer of each year, things begin to go quietly. Sales commence to drop; and orders appear not quite so readily as they did during the spring. Most members of the public are out in the open air and the sun (when it shines), and interest in radio and television naturally decreases. As the summer continues, things get quieter and quieter; until the Show arrives. The Show gives emphasis to all the new models which have become available, and the orders start to roll in again. Gradually, the tempo increases until what is known as the "Christmas rush" comes into being.

This "Christmas rush" is something of a phenomenon, but it definitely exists. It is probably partly due to the fact that people who have ordered receivers earlier in the winter start worrying their suppliers to deliver them before Christmas Day. Receivers which are intended as Christmas presents also become in short supply. Delivery dates begin to suffer. After Christmas Day activity eases off slightly, but, as the winter is now beginning to set in more heavily, sales of receivers still stay at a high level.

Then, spring appears; public interest in radio and television drops; and things begin to get quieter once more. Until the next Show!

Conversion Troubles

This year there will certainly be an added complication due to the fact that a large number of televisors will still require conversion to Band III when the I.T.A. programmes commence. Retailers are already converting as many receivers as possible at the time this article is being written, but there are sure to be plenty of set-owners who will leave things to the last moment. There is little doubt that some people will find it difficult to make up their minds whether to convert their existing sets or to buy new ones instead. If the existing receiver has

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already given a good number of years' service, this is not an easy problem to solve. Others may wait to see if the prices of converters will "come down." It is doubtful if the latter will occur, since practically all Band III converters are tied, in some way or another, to the standard 2-valve circuit arrangement; and existing prices already seem to be pretty close to the bone.

It is possible that one or two minor "firms" may try to cash in on the situation by undertaking to carry out Band III conversions at bargain prices; the actual jobs being done in a slipshod and careless fashion. Such things have been known to happen before. The best safeguard for the domestic set-owner is to have his televisor converted by a good, reputable dealer, *who is an accredited retailer for the manufacturer who made the original receiver.* (In most instances this will, of course, be the dealer who sold the receiver in the first place.) Such a retailer will have access to any technical information and equipment issued by the manufacturer for converting the receiver, and he will be the man who is capable of doing the job correctly and properly.

Another word of advice concerns, especially, superhet televisors. If the receiver is a superhet and a converter unit is available from the manufacturer who made the existing receiver (the unit being especially designed to feed into the i.f. strip of the receiver), then that converter will be the one which it is definitely most advisable to employ. In such a case it would be better to wait a little while for delivery of the correct converter than to use one which feeds direct into the aerial socket of the receiver. One of the reasons for this is that with the second type of converter the whole arrangement becomes a double superhet, and it is possible that whatever oscillator and i.f. harmonics are generated may cause interference with the received picture. Also, of course, it is obviously preferable to use a converter which is expressly designed for the job.

So far as converters whose i.f. output is at a Band I frequency are concerned, there is also the question of breakthrough of the Band I signal. Unless the existing receiver is sited close to the Band I transmitter this trouble may not be so severe as has earlier been anticipated. Further, if a strong Band III signal is available it may tend to swamp out the Band I breakthrough. Since the Band I breakthrough signal will be carried mainly by the co-axial lead from the Band I aerial, it should often prove to be advantageous to insert an attenuator in this lead *before* it connects to the converter switching circuits. The trouble of Band I breakthrough will not prove too difficult, of course, if channel switching over Band I is available on the existing receiver. The converter i.f. output frequency may then be set to a channel other than that of the local Band I transmitter while receiving Band III.

F.M.

A third feature which should be causing a lot of bustle this year is the fact that frequency modulation transmissions are now on the air. However, things seem to be fairly quiet on the f.m. front, and it is possible that manufacturers are seeing "how the land lies" before going into full production.

The difficulty, of course, lies in cost. People have become so used to buying sound receivers at fairly low prices that they are not keen on spending the few extra pounds required for a combined a.m.–f.m. receiver. Perhaps some enterprising firm will introduce an f.m.-only receiver that would combine low price with reasonably good reproduction (accepting the necessarily small cabinet dictated by price) and this may go down quite well. However, as the only transmitter in use at present is at Wrotham, and as most of the existing bad reception areas have yet to be offered an f.m. service, such a receiver might not be a good financial proposition at this stage.

Quite a few members of the public do not even know that there is such a thing as f.m. available! Still, with time, the fact should become accepted. It is quite possible, also, that a few f.m. sets will be bought purely on account of their "snob" value. For once in a while, I am not at all certain that such an occurrence may not turn out to be a good thing. This is because few people, after listening for some time to a receiver which has a top response extending above 3 or 4 kc/s, will really be content to return to those all-too-frequently encountered a.m. receivers which can only offer "deep, rich, bass" and "one-note-thump."

One does not expect the whole nation to become high-fidelity minded just because f.m. is here. Nevertheless, now that the necessity for narrow bandwidth a.m. superhets is being obviated there is every chance of receivers being made and sold which offer pleasant and balanced reproduction over a much larger part of the audio spectrum than is at present possible. Would it be too much to hope that, in several years time, receivers which give strong bass accentuation will be considered as being old-fashioned?

Shock Hazard

Twice in the last fortnight I have read in the newspapers of people being killed by faulty pieces of electrical equipment. One of these cases concerned a radio receiver.

I know I have mentioned the question of shock hazard before, but I do not think that it is something which can be overstressed. This is especially true when one considers that there are newcomers to radio swelling this Magazine's readership every month.

What has to be remembered all the time whilst working with radio is that under certain conditions the domestic electric mains supply is lethal. The greatest care must be taken always, particularly when one is working with "live" chassis. There is, incidentally, no guarantee whatsoever that because a piece of equipment has a mains transformer its chassis is automatically isolated from the mains. In some cases the mains transformer is an auto-transformer, and a direct mains connection to chassis is still in existence. In others, it requires only the breakdown of a mains-modulation condenser, the fraying of a lead, or any other similar causes, to make a seemingly safe chassis become "live." The on-off switch on the chassis itself also offers no certain protection, since it is frequently inserted in one mains lead only.

One golden rule is: never keep one's hand on a chassis whilst reaching with the other for a tool, a soldering iron, or anything else. If the chassis is "live" and the other hand touches any "earthy" metal work a very nasty circuit will be completed. Similar circuits can also be completed by the feet, or any other part of the body, through the floor, or bench, etc. Particularly dangerous are concrete floors and any metalwork.

There is nothing "clever" in receiving a shock. Commonsense and continual attention to the risks incurred when handling mains equipment are the only safeguards.

CLUB NEWS

Details for insertion in this section should reach us not later than 7th of the month before publication

EDGWARE AND DISTRICT RADIO SOCIETY

Meetings are held on Wednesday evenings, 8 p.m., at 22 Goodwyn Avenue, Mill Hill. Talks on a wide range of subjects of interest to the amateur radio enthusiast are given, and there are also practical evenings and regular junk sales.

New members, especially beginners, are welcomed. Hon. Sec.: E. W. Taylor, G3GRT, 99 Portland Crescent, Stanmore, Middx.

BRITISH TWO-CALL CLUB

Membership is open to all British subjects who have held two calls—one of which is overseas. Application forms can be had from the Hon. Secretary, G2DHV. New members this year include G3JFC/VS1GN, G2CDN/EI5B/SU1CX/ZC1AR/ZC6AR, AR1LA, G6UT/ZS1RC, G3JYF/ZL1AIO, G3DFI/ZD6BX, GM3ITN/DL2YI. Hon. Sec.: G. V. Haylock G2DHV, 63 Lewisham Hill, London, S.E.13.

CLIFTON AMATEUR RADIO SOCIETY

The first Clifton transmitting field day, held on Sunday 24th July proved so popular that members have requested another contest later in the year. This has been fixed for 2nd October and will take place in the vicinity of Farnborough, Kent. Five stations took part in the first contest and the winner was C. Hatfull, G3HZI, who used 0.5 watt on 80 metres. Other contestants were G3DIC, G3FNZ, G3FVG and G3IWL, together with club members, who acted as log-keepers, etc.

Programmes for October:

2nd—Transmitting field day. 7th—Field Day discussion. 14th and 28th—Constructional Evening and Ragchew. 21st—"Radio Frequency Cables," by Mr. R. J. Slaughter of Telcon.

Meetings are held every Friday at 7.30 p.m. at the clubrooms, 225 New Cross Road, London, S.E.14. Details of membership can be obtained upon application to the Hon. Secretary: C. H. Bullivant, G3DIC, 25 St. Fillans Road, Catford, S.E.6.

QRP SOCIETY

The end of the month will see the final judging of the Portable Amateur Radio Equipment Contest. Entries can still be accepted up to 30th September.

The Society is fast making a name for itself overseas, and is keen to enrol low-power enthusiasts everywhere to help further the cause of QRP.

Transmitting amateurs, SWL's and experimenters in the low-power field are assured of a warm welcome, and are invited to write for particulars of membership. Hon. Sec.: John Whitehead, 92 Rydens Avenue, Walton-on-Thames, Surrey.

RADIO AMATEURS' EXAMINATION COURSES

The Grafton Radio Society have again made arrangements with the Islington L.C.C. Men's Evening Institutes to hold an official course of instruction for the Radio Amateurs' Examination during the coming winter months at GRAFTON SCHOOL, EBURNE ROAD, HOLLOWAY, N.7 (one minute from the "Nags Head").

Classes (for beginners) are as follows:— Mondays: Radio Theory 7–9 p.m.; Morse 9–10 p.m. Wednesdays: Practical 7–9 p.m.; Morse 9–10 p.m., the full fee being 10s. Classes commence on Monday, 26th September (enrolment week 19–23rd Sept.) under the instruction of Messrs. A. Perry (G3DKX) and L. Barber.

In addition, the Grafton Society also meet on Friday evenings at 7 p.m. for the usual club activities (including lectures by leading "hams" and the trade) at which Morse will be available, 9–10 p.m.

Application in the first instance should be made to the Grafton Radio Society Hon. Secretary: A. W. H. Wennell (G2CJN) at 145 Uxendon Hill, Wembley Park, Middlesex.

Courses of instruction have been arranged at the Ilford Literary Institute (High School for Girls), Cranbrook Road, Ilford. (Adjacent to Gants Hill station, Central Line.)

An eight-months course for those intending to take the examination: Wednesdays, 7.30 to 9.30 p.m.; Morse and Codes of Practice. A six-month course for those who wish to learn Morse up to G.P.O. requirements for an amateur licence. Arrangements have been made for those who, in the opinion of the instructors, have reached the required speed, to be tested at the Institute by a representative of the Post Office. For students living in the Essex County Council area the fee for either course is 10s. or 17s. 6d. for both. Students from other areas will be admitted provided the Local Authority is informed.

Enrolment nights: 5th to 8th September inclusive, 7 to 8.30 p.m. Classes commence 19th September.

To ensure a place in the classes, please write to Mr. C. H. L. Edwards, G8TL, 28 Morgan Crescent, Theydon Bois, Epping, Essex, in the first instance.

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A STROBOSCOPIC LIGHT SOURCE

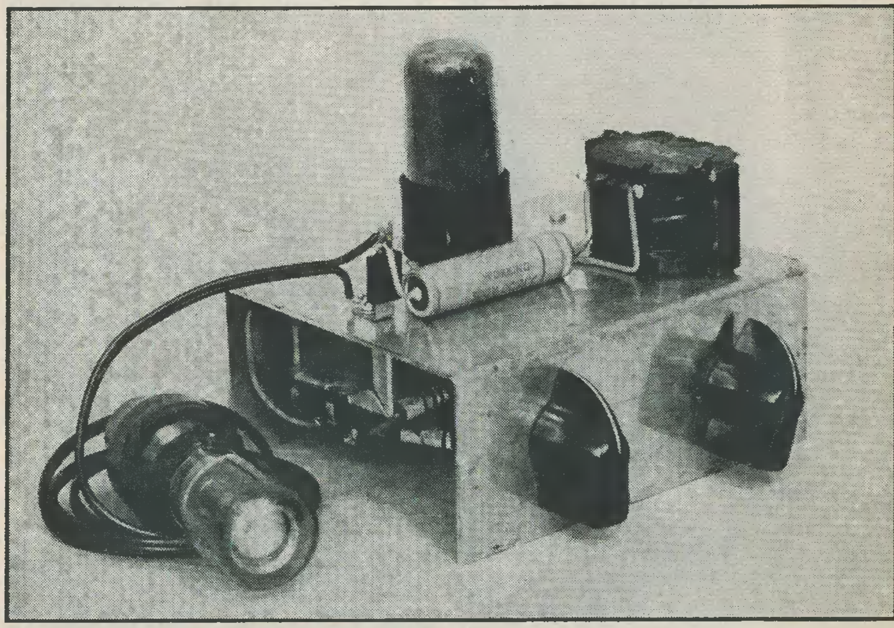
by **J. W. BAGNALL**

THE READER WILL NO DOUBT BE FAMILIAR with the stroboscopic disc used to check the speed of a record turntable. It consists of a disc which is divided into a predetermined number of black and-white bars. When placed on the revolving record and viewed under a lamp fed from a 50 c/s supply, the bars appear to be stationary at the correct r.p.m.

The device about to be described performs a similar function, namely the ability to "stop" any rotating machinery when viewed by the light of a neon lamp which is part of the instrument. To accomplish this there are a number of conditions which have to be met. necessary for one light flash to be produced for each cycle of movement. For instance, if a motor shaft is revolving at 2,000 r.p.m., to make it appear stationary a frequency of 33.3 c/s would be required.

The light source has to be turned "on" for the shortest time possible; this will be more clearly understood when it is considered that while the light is on, the object continues to move. If the light flash is too long it will result in a blurred outline due to the object having appreciable movement during the viewing time.

After consideration of the above, the reader will realise that an incandescent lamp



The Prototype Stroboscope

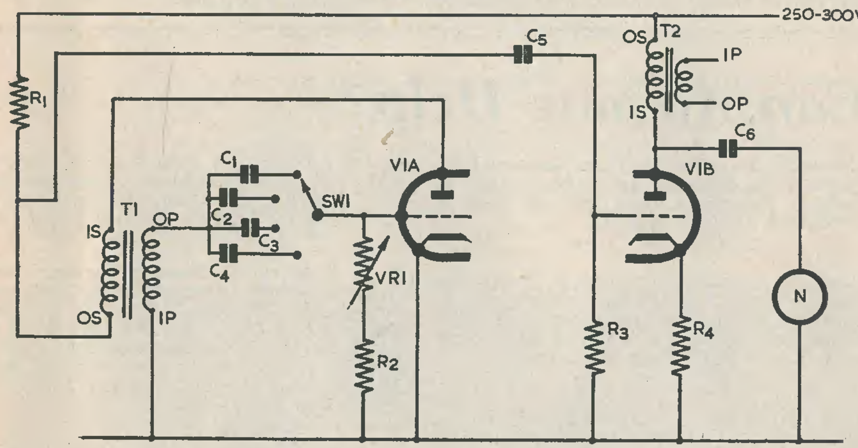
The electronic stroboscope has to be capable of generating short duration light flashes over a wide range of frequency. To create the illusion of a stationary object it is cannot be used for the light source owing to the thermal inertia of the filament. Commercial instruments of this type make use of a neon gas-filled tetrode, known as a "Neostron," which has a high peak light intensity. As the question of cost had to be considered, a 0.5 watt neon lamp has been used in this design. While this has limitations regarding light output, it has proved to be quite satisfactory in use providing it is used in darkened surroundings.

The Circuit

It will be seen that a double triode valve has been used, the section V_{1a} acting as a variable frequency blocking oscillator. The circuit is essentially that of the ordinary grid detector with reaction. The coupling between the transformer windings is very tight so that the valve oscillates violently for one half- by the special characteristics of the feedback transformer.

The speed or repetition rate at which the valve oscillates may be controlled in two ways. Changing the value of the grid condenser will provide a number of coarse ranges, while the use of a variable grid leak will give a smooth intermediate control. With the component values shown a frequency coverage of 10 c/s to 11 kc/s has been achieved in four overlapping ranges.

When the valve oscillates, current is drawn through the resistance R_1 causing a voltage drop across the resistor. This produces a short negative-going pulse which is passed to the grid of V_{1b} via the condenser C_5. This



E203

COMPONENT LIST

R_1	2.2kΩ ¼W	C_6	0.1μF 500V wkg
R_2	100kΩ ¼W	V_1	6SN7
R_3	220kΩ ¼W	N	230V 0.5W Neon
R_4	150Ω ¼W	T_1	TV Frame Blocking Osc. Igranic KP7976 or similar
C_1	0.1μF 350V wkg	T_2	See text
C_2	0.01μF 350V wkg	SW_1	1-pole 4-way switch
C_3	500pF 350V wkg	VR_1	2MΩ variable
C_4	50pF 350V wkg		
C_5	0.01μF 350V wkg		

cycle. Heavy grid current flows during oscillation and charges up the grid condenser so that the grid goes rapidly negative and the valve can no longer oscillate. The capacitor then discharges through Vr_1 and R_2 until the grid potential becomes low enough for the valve to restart the cycle of operation again. Most blocking oscillators can be designed to provide nearly rectangular pulses of plate voltage and current, which is made possible triode has very little bias and passes a current of some 12mA. On arrival of the negative pulse, the valve is suddenly cut off. As the current through the valve begins to fall, a large self-induced voltage is generated across the secondary of T_2 in the form of a positive-going voltage pulse approximately 500 volts in amplitude. This is condenser coupled to the neon, causing it to strike and remain alight for the duration of the pulse.

Construction

No power supply has been shown in the circuit diagram as the prototype has been connected to the bench supply when needed. A power pack giving 250 to 300 volts of h.t. at some 15mA, with the appropriate heater voltage, will be sufficient. The layout is in no way critical, although the appearance would be improved by the addition of a front panel and the use of Panel Signs. The "Test Equipment" series containing a suitable scale would enable the instrument to be calibrated in terms of frequency.

The transformer T_2 was removed from a surplus unit Type 25 receiver where it was used as a microphone transformer; it may be identified by the numbers 10K/245. Should this not be readily available, a loudspeaker output transformer could be used in this position.

The constructor is recommended to use a bakelite lamp holder for the neon, and also plastic covered flex for its connection. Owing to the high peak voltages that exist at the output, the gear should not be run without the neon being in circuit.

A further use for the device, which has not been mentioned, is that of an audio and r.f. signal source. As the output is far from being sinusoidal, it may be used for this function due to the fact that a large number of harmonics are generated which extend well into the broadcast range. The output for this purpose should be taken from the terminals marked I.P.–O.P. via a suitable volume control. Enough power is available to run a loudspeaker, if required.

Can Anyone Help?

S. Barden, 5 Andlers Ash Farm Cottages, Liss, Hants, would like to obtain a list of values of ex-Govt. condensers, fixed and variable, to correspond with 10C numbers, etc.

* * *

Novice W. Laws, M/V Camroux II, 79 Crabtree Lane, Fulham, S.W.6, would like to buy or borrow a circuit, wiring diagrams and other information on a 3 or 4-valve t.r.f. or superhet receiver for 100/110V d.c. ship's mains.

* * *

Douglas Byrne, 3 St. Saviour's Road, St. Helier, Jersey, C.I., requires information on the Hambander receiver.

* * *

R. Inglis, 8 St. Alfege Passage, Greenwich, London, needs the manual, circuit or crystal frequency for the R.C.A.F. GR-10 10-valve communications receiver.

* * *

F. G. Miles, 113 Westbourne Street, Hove 3, Sussex, needs, and is willing to pay for, the circuits and/or information on the ex-Army Receiver R109 and the ex-R.A.F. Transmitter 1154.

* * *

R. O. Gaunt, 69 South View Crescent, Sheffield 7, wishes to convert a U.S. Signal Corps Indicator type BC.929A (R.A.F. ref. No. 110QB/29) to a 'scope, and would like to obtain a copy of the original circuit (or on loan).

* * *

J. Fortnum, "Pype Hayes," Old Lane, Crowborough, Sussex, still has a 30-Line Scanner, and would like to obtain, or borrow to have copied, one of the records which were made of t.v. signals at that time.

* * *

T. Cox, 7 Crescent Road, Leyton, London, E.10, will gladly reimburse anyone who can supply him with the circuit, data, valve line-up, etc., of the Air Ministry Receiver type R.1082.

* * *

K. T. Roberts, c/o Borough Engineer, Town Hall, Blackburn, Lancs, needs a service sheet for (1) the Emerson t.r.f. a.c./d.c. receiver line-up 12SF5, 12K7, 12J5, 50L6, 35Z5; (2) the circuit for the B.36 Communications receiver, 1-20 Mc/s; (3) Valve line-up of the English Electric C.R.T. Ignition Tester, patt. 563562, 6-12-24V d.c., 230V a.c.

* * *

J. McFall, 3 Woodridings Avenue, Hatch End, Middx., requires information, buy or borrow, on the Transmitter/Receiver TR1196. The manual is the A.P. 2535C, Vol. 1.

* * *

C. L. Tucker, 24 Melbury Road, Kenton, Middx., wishes to buy or borrow the circuit or service sheet of the Gamages 1950 10in T.V. Receiver, manufactured by Felgate Radio, London.

* * *

J. A. Edwards, "Windy Ridge," 18 Tyndall Avenue, Moston, Manchester 10, would like to obtain the circuit and details of the Spartan model 457 receiver.

* * *

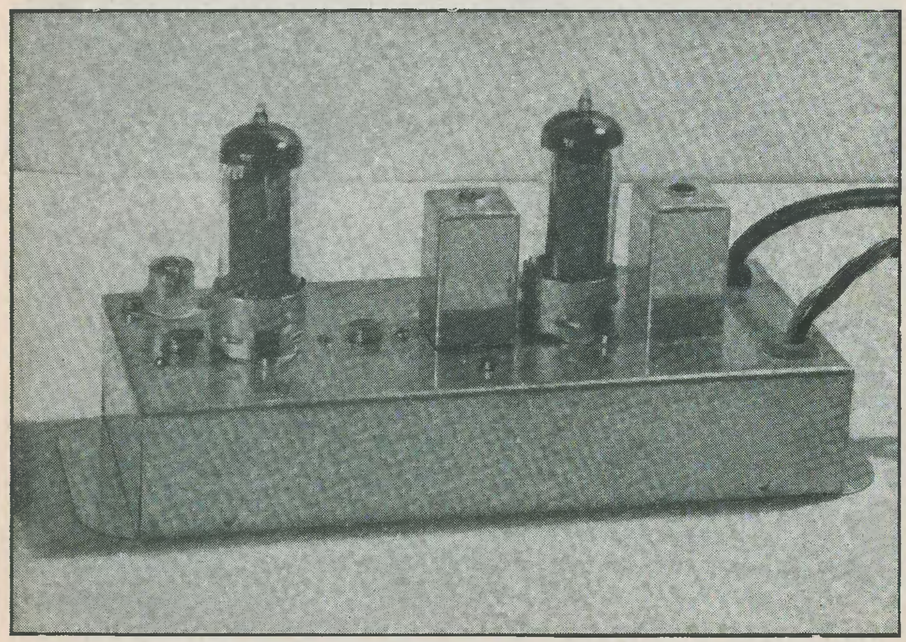
D. R. Coad, 14 Sandy Lane, Fair Oak, nr. Eastleigh, Hants, needs information such as circuits, power supplies and conversion data on the ex-R.A.F. Receiver type R1125A, code 10D/6, and the Receiver type 81A, code 10D/1342. The latter is the receiver section of a transmitter/receiver, and has the number 1120 painted above the 12-way power and output plug. He would also like to obtain information on the modulator and output stage of this job.

BAND III TELEVISION for the HOME CONSTRUCTOR

PART 3. *by* S. WELBURN

This article gives full constructional details of a Band III converter which may be built at home; and is the third in our Band III series written by that popular writer on television topics, S. Welburn.

Many readers have written to *The Radio Constructor* asking for particulars of a converter which may be built at home. It is, therefore, with great pleasure that the writer is enabled to present a Band III converter which can not only be constructed at home, but which may also be brought into operation without a signal generator. The converter (developed by the Teletron Co. Ltd.) can be relied upon to give good results provided that reasonable care is employed in its manufacture. Several models have been built and tested (using the experimental Belling-Lee transmissions from Croydon) and satisfactory operation has been reported to us in every case.



The Teletron Band III Converter.
This model was built and supplied for review by Clyne Radio Ltd.

The Circuit

The circuit of the converter is given in Fig. 1. This diagram includes all components, but does not show a power pack. However, the latter can be quite a simple arrangement employing, say, a mains transformer and metal rectifier. Alternatively, the converter may obtain its supplies from the existing televisor.

In Fig. 1, the signal from the Band III aerial is applied, via L_1C_1, to the grid of V_1. The input impedance of V_1 at Band III frequencies is very low, and the match to the nominal 75Ω aerial impedance is in consequence quite satisfactory. L_1C_1 form a rejector circuit and are tuned to the Band I frequency, Their function is to attenuate Band I signals picked up on the Band III aerial, which might otherwise cause interference with the received I.T.A. signal.

V_1 is a high-slope r.f. pentode. Its anode feeds into the pi-network provided by L_2 and the capacities to chassis at either end of this coil. L_2 connects into a nodal point on the oscillator coil, L_3, and thus allows additive mixing to take place at the grid of V_2. The anode h.t. feed to V_1 is supplied via R_4, R_5 and L_2. The h.t. feed to the oscillator section of V_2 is supplied, similarly, via R_4 and R_5.

V_2 functions as a mixer, its control grid and screen grid forming the effective grid and anode, respectively, of a triode oscillator. The tuned inductance for this oscillator is provided by L_3. In practice, the oscillator is a Colpitts—the two condensers forming the capacitive earthy tap being provided by C_5, in series with the capacity between grid and cathode of V_2, to one end of the coil; and by the capacity between screen-grid and cathode, in parallel with that between screen-grid and suppressor, to the other end. There are further stray wiring and valveholder capacities which affect the earthy tap into the tuned circuit. It cannot be emphasised too strongly that, as a certain amount of tuning capacity must inevitably be supplied by circuit strays, great care must be taken to follow the layout given in this article when building the converter. An additional important point is given by the desirability of providing V_2 with a ceramic valveholder in order to reduce frequency drift. A ceramic valveholder for V_1 is desirable also, but is not essential. Condenser C_{12}, shown in the diagram, is required only for the London frequencies.

The intermediate frequency appears at the anode of V_2. Transformer T_1 is tuned to this i.f. output, its primary being damped by R_6 to provide adequate bandwidth for the video passband. The value chosen for this resistor, 5.6kΩ, will enable a flat 3Mc/s bandwidth to be obtained with all television receiver input circuits. With some televisors it may be possible to increase the value of R_6 whilst still retaining an adequate bandwidth. Such a course can be proceeded with, if desired; and may result in a slight increase in gain.

The secondary of T_1 is specially wound to enable the tuned circuit provided by C_6 and the primary to match into 75Ω cable. The other end of this cable may then be plugged into the aerial input socket of the existing receiver.

Since the i.f. of the converter is equivalent to the Band I input signal, the oscillator must tune *below* the input Band III signal. If it were to tune above the Band III carrier the vision and sound signals will be reversed, the

COMPONENTS LIST

Resistors (All ¼ watt unless otherwise specified).

R_1	1kΩ
R_2	15kΩ
R_3	180Ω
R_4	470Ω
R_5	2.2kΩ
R_6	5.6kΩ
R_7	22kΩ
R_8	2.2kΩ 1 watt
$R_{9, 10}$	2MΩ (required only for live version)

Condensers

C_1	25pF, ceramic
C_2, C_3, C_4, C_7, C_8, C_9	0.001μF, ceramic
C_5	10pF ceramic
C_6	2–8pF. Concentric trimmer
C_{10}, C_{11}	0.001 μF 350V a.c. working (required only for live version)
C_{12}	2–8pF Concentric trimmer (required only for London area)

Valves

V_1, V_2 Z719

Valveholders

2 B9A Ceramic

Inductors

L_1	Teletron (Green spot)
L_2	Teletron (Blue spot)
L_3	Teletron (Red spot)
T_1	Teletron (Yellow spot)

Supplied separately or as a kit by the Teletron Co. Ltd.

Power Supply

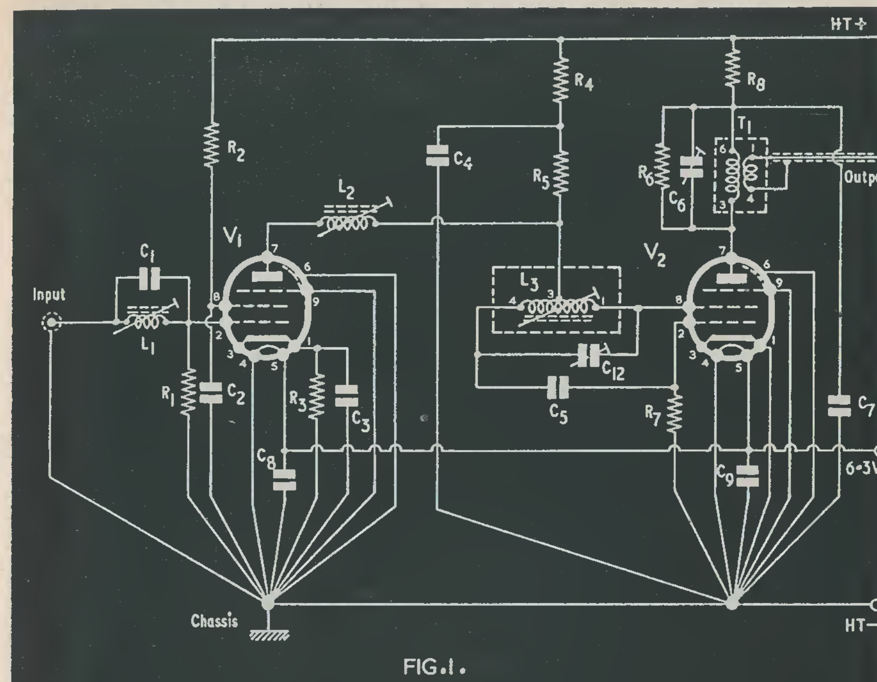
Mains Transformer, Electrovoice type 104 (H. L. Smith & Co. Ltd., Edgware Rd.)

Rectifier, 6X4, DRM1B or to suit

Resistors, 1 120Ω ½ watt

1 1.5kΩ 2 watts

Condensers, 24 + 24 μF electrolytic



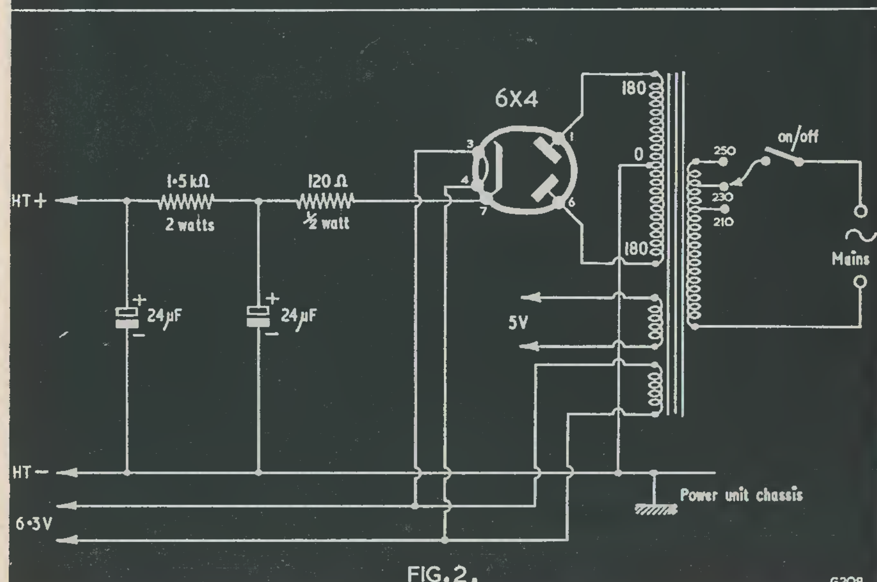


Fig. 1. The circuit of the Band III converter. C_{12} is required only for the London area

Fig. 2. A suitable power unit for the converter. The mains transformer is Electrovoice type 104 (*H. L. Smith & Co. Ltd., Edgware Road*)

vision appearing in the i.f. at a lower instead of a higher frequency than the sound.

To summarise the operation of the converter, it can be stated that V_1 amplifies the Band III signal and applies it to the mixer, V_2. V_2 provides an intermediate frequency equivalent to that of the Band I frequency of the existing television receiver. This i.f. signal is then fed into the aerial socket of the receiver. In London, the i.f. will be that of Channel 1 (i.e. 45 Mc/s vision, 41.5 Mc/s sound).

smoothing filter. If desired, the 6X4 may be replaced by a metal rectifier, such as the Brimar DRM1B, this working in a half-wave circuit. When a metal rectifier is employed, only half of the h.t. secondary winding is required, the other half being left disconnected. Other rectifier arrangements may also be employed, as this part of the circuit is not at all critical. The smoothed h.t. voltage finally obtained should lie between 180 and 240 volts.

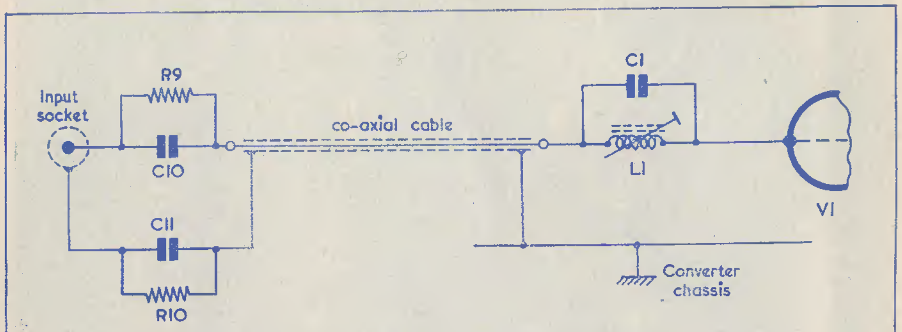


FIG. 3.

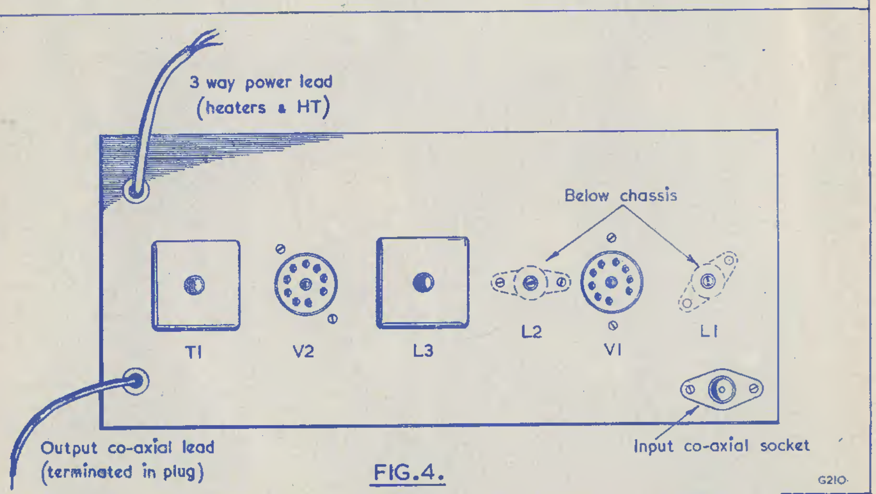


FIG. 4.

Fig. 3. The isolating components needed for the aerial input circuit when a transformerless mains supply is employed

Fig. 4. Top layout of the converter

Power Supply

A suitable power supply circuit is illustrated in Fig. 2. This employs a mains transformer, a 6X4 rectifier, and a conventional low-pass

A transformerless power supply may also be used if considered necessary, although care must be taken to ensure that the consequently live chassis of the converter is adequately

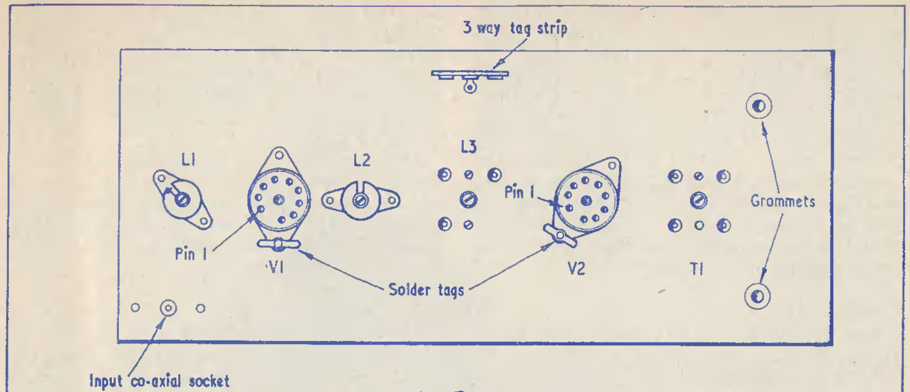


FIG. 5.

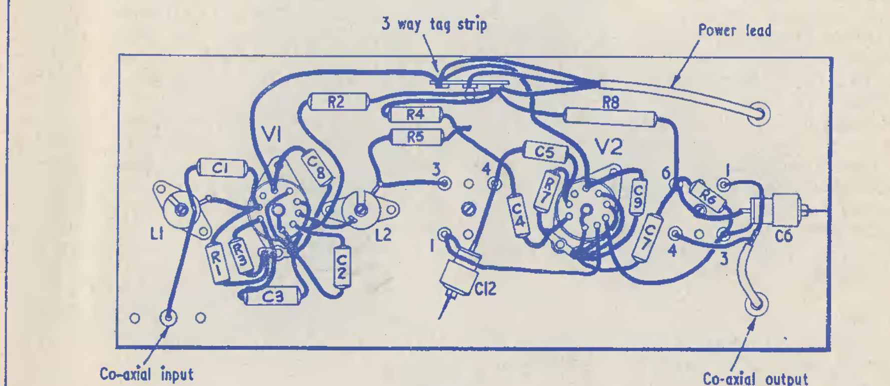


FIG. 6.

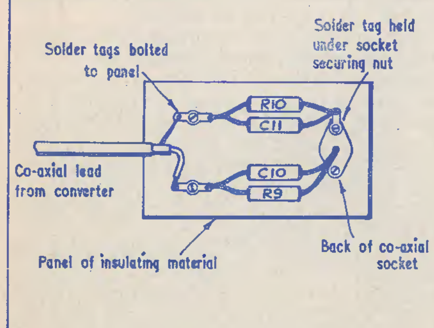


FIG. 8.

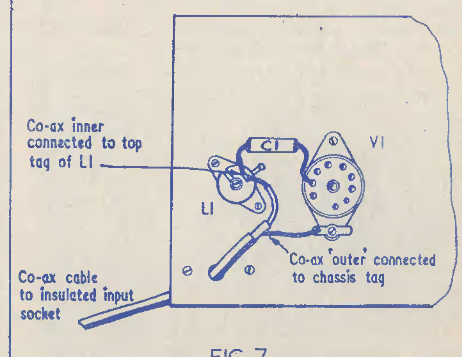


FIG. 7.

Fig. 5. Layout of the principal components below the chassis
Fig. 6. Wiring layout. All component leads must be kept short
Fig. 7. Alternative input wiring when a live chassis is employed
Fig. 8. How the isolating components shown in Fig. 3 may be fitted

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isolated from the aerial and the subsequent television receiver. The additional components required at the input circuit are illustrated in Fig. 3. It is of importance to ensure that the isolating condensers shown in this circuit, C_{10} and C_{11}, are capable of withstanding the full mains voltage without risk of breakdown. If possible, the chassis of the converter unit (assuming that this is live) should be connected such that it is always at neutral mains potential. This method of connection may sometimes help to obviate mains modulation troubles.

Construction

The layout of the completed converter, viewed from above, is illustrated in Fig. 4. This diagram shows the principal components on the chassis and will be of assistance in following the wiring instructions given below. Fig. 5 illustrates the layout below the chassis. This diagram indicates, in addition, the positions at which pins No. 1 of V_1 and V_2 should appear when they are mounted. Correct orientation of these valveholders is essential for short wiring. Power supply components are not shown in either Figs. 4 or 5.

The writer understands that, by the time this article appears in print, completely-drilled chassis will be available from advertisers. Since these will be readily and cheaply available it is not proposed to give full drilling dimensions in this particular article.

Wiring

To commence construction, all those components which are bolted to the chassis may primarily be mounted. It should be noted that solder tags are fitted to the nuts securing V_1 and V_2 valveholders. The positions of these tags are illustrated in Fig. 5. Two single-ended solder tags (or a double-ended tag) are fitted under each nut.

Fig. 6 shows the wiring layout. This is the layout employed for the transformer-isolated version. For the live chassis version the small modification given in Fig. 7 must be employed. This requires a short length of co-axial cable to be soldered direct to the top tag of L_1, and to the solder tag adjacent to V_1 valveholder. This co-axial cable then passes through the hole previously occupied by the Belling-Lee input co-axial socket. The output co-axial lead is, of course, already isolated by the separate winding fitted to T_1.

To simplify presentation, Fig. 6 shows the components slightly more spaced out than would be the case in practice. It cannot be emphasised too strongly that *short* leads are essential. It may happen that some of the condensers used have a protective enamel covering, this enamel sometimes extending from the body of the condenser along the lead-out wires. The reason for this is that the condensers are dipped in the enamel during production. If the enamel on the lead-out wires prevents a short connection being made, it may be carefully scraped off with the finger nail or melted with a *quick* application of the soldering iron.

Owing to the short connections employed, no joint should be heated for too long a period or its associated components may suffer damage. The only way to ensure a quick joint is, of course, to employ a clean, well-tinned soldering iron.

Live Version

As may have been seen from Fig. 7, the live version of the converter differs from the transformer-isolated version only insofar that the co-axial input socket is not mounted directly to the chassis. The reason for this precaution is that it prevents any mains voltage reaching the o-axial outer conductor.

To ensure isolation, the input co-axial socket should be mounted on an insulating material, such as Paxolin. A suitable method of doing this is shown in Fig. 8. It will be seen that, in this diagram, the co-axial socket is mounted on a small panel of the insulating material, together with the necessary isolating components and their solder tags. Two of these solder tags anchor the co-axial lead from the converter unit and provide a useful mounting for the isolating condensers and their parallel resistors. The insulated panel of Fig. 8 may be mounted anywhere on the converter unit chassis, or anywhere on any cabinet in which it may be housed.

Alignment

After completion, the converter should be carefully checked to ensure that all wiring is correct. It may then be aligned.

To carry out this process, the existing television receiver should be switched on and allowed to warm up such that it is receiving the normal Band I signal. The converter should be switched on also at the same time. The Band I aerial lead should next be taken out of the televisor and plugged into the input socket of the converter. The output plug of the converter is then connected to the aerial socket of the receiver.

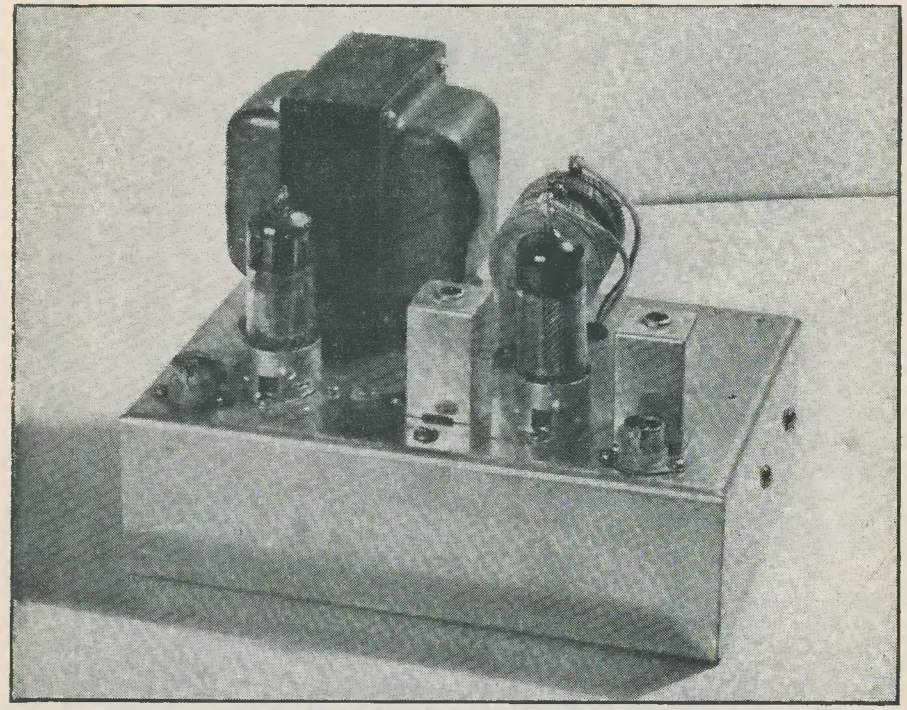
In consequence of this altered mode of connection, the Band I signal now has to pass through the converter. The contrast control of the televisor should be advanced until the Band I signal re-appears. T_1 should then be adjusted for *maximum* Band I signal. (This transformer should be adjusted both by means of its core and by means of C_6. It is possible, in some cases, that a particular combination of settings of the core and of C_6 will give optimum picture strength. This combination can easily be determined experimentally and is that which is most desirable.) L_1 is next to be adjusted. Its core should be set for *minimum* Band I signal. If necessary, the contrast control of the televisor may be further advanced during this process to ensure that the Band I picture can still be resolved. T_1 and L_1 should then be re-adjusted once more. If the ultimate setting of L_1 causes the Band I signal to disappear altogether, its final setting should be that which is mid-way between the settings at which the picture just commences to re-appear.

L_1 and T_1 are now set up and should not be touched again.

The next process consists of adjusting the oscillator circuit L_3 and C_5. For this, the Band III aerial should be plugged into the converter input socket and the televisor contrast control set to its maximum position. The core of L_3 is then *slowly* and carefully adjusted until the Band III signal appears. (It is possible that this procedure may have to be repeated several times for different settings of C_5.) Contrast on the televisor should be reduced as necessary, and L_2 next adjusted for maximum Band III signal. After this process, L_3 should be slightly re-trimmed, and L_2 finally adjusted.

The converter is then ready for use.

(To be continued)



Another version of the Teletron Converter as built by H. L. Smith & Co., Ltd. *Employing a similar layout to the original, it has a larger chassis and a self-contained power supply*

N.xt month . . . **A High Quality 10-watt Ultra-Linear Amplifier**

by L. F. SINFIELD

Query Corner

A *Radio Constructor* Service for Readers

E.H.T. Rectifier

After some two years my home-built television receiver has developed an intermittent picture fault. The defect usually occurs during the first hour of operation, and appears as a sudden collapse of the picture, accompanied by a sharp click. The picture then returns to normal almost immediately.

E. Swain, Guildford

Faults of this nature in which a sharp click or crack accompanies the sudden disappearance or dimming of the picture invariably indicates intermittent flashover in the e.h.t. circuit. The point at which the trouble occurs can usually be located by examining the suspected parts in subdued lighting. When the effect occurs it should be possible to pin-point it by the appearance of the spark. This class of fault should be corrected as soon as it develops, otherwise further damage can be done which may make the repair a costly business. It is most unlikely that once a flashover has occured the trouble will correct itself; usually the effect becomes more frequent until finally the insulation breaks down completely.

In certain of the earlier television receivers it was not unusual for the insulation between the filament winding of the e.h.t. rectifier and the core of the line transformer to become punctured. If this happens it is advisable not to try to effect a temporary cure by adding small pieces of insulating material at the point of breakdown. A good repair can only be effected by completely removing the filament winding and renewing the wire. Before disturbing the winding it is important to count the number of turns and note the positions of the lead-off wires. In most cases this winding will consist of about 4 turns, so that should the position of the lead-off wires be altered, it may easily result in a change in filament voltage. This is to be avoided, as experience has shown that e.h.t. rectifiers are particularly sensitive to differences in filament working conditions; both under-running and over-running can result in a reduction of valve life. Having removed the defective filament winding, the transformer core should be wiped to remove traces of carbon left from past arcing, and a length of p.v.c. tape wound around the core. This tape prevents any sharp edges on the core from penetrating the insulation of the new winding. A new length of polythene covered e.h.t. lead should be used when replacing the winding. Providing a wire with genuine polythene covering is obtained, no further trouble can possibly arise from sparking. When connecting up the leads, care is required to ensure that the solder flows freely round the joint and does not leave any sharp points. Corona can occur at sharp points, particularly in conditions of high humidity, and it may cause a noise pattern to appear on the screen.

If the arcing is traced to the e.h.t. rectifier and occurs on the outside of the bulb, the valve should be cleaned with a spirit-soaked pad. This usually provides a complete cure by removing all traces of semi-conducting dirt. Should the discharge occur within the valve a replacement will be required. Invariably this trouble in an e.h.t. rectifier is a sign that either the bulb has become internally blackened by a metallic deposit evaporated from the cathode assembly, or because the valve has become gassy. If a replacement valve has to be fitted there are two points worthy of careful attention. First, the lead-out wires of the "wired-in" type of rectifier must not be bent close to the glass bulb; the glass can very easily be broken by careless lead bending, and invariably this ruins the valve. A good plan is to grip the lead close to the glass with a pair of thin-nosed pliers and then bend the lead. The second precaution concerns the method of soldering the valve leads to the terminal points. One rectifier manufacturer recommends that the anode lead is not soldered closer than 10mm from the glass seal, whilst the heater leads must not be soldered closer than 5mm from the end of the bulb. This precaution is necessary to prevent thermal expansion of the lead-out wires occurring at the glass-to-metal seal, as this may easily damage the seal.

The final likely place at which e.h.t. flash-over can occur is at the tube anode connector. Arcing usually arises here because a film of dirt has collected between the anode connector and the earthed coating around the tube cone. This dirt may easily be removed with a spirit-damped pad, care being taken not to wipe off any of the external coating (aquadag). In some cases this may only form a temporary cure, and it is advisable in such circumstances to use an anode connector which is fitted with a moulded p.v.c. cap. A little silicone grease smeared around the inside of the cap before it is applied to the tube will act as an excellent barrier against moisture and prevent any further sparking. Finally, check that the earthing connection to the external coating on the tube is properly made; should the coating not be earthed it will collect a charge which may approximate to the e.h.t. voltage, and arcing between the coating and some adjacent earthed object will occur.

* * *

L.T. Drain

I have been servicing a mains/battery portable of a well-known make and have succeeded in obtaining good results. I was surprised, however, to find that when operating the set on mains there was still a small discharge from the l.t. battery. Can this be prevented?

L. Glover, Cowes

Presumably this general purpose portable is of the type in which the l.t. battery remains in circuit when the set is operated on the mains. This method of connection is quite normal, but it does mean that if the l.t. voltage derived from the mains via the rectifier is lower than it should be, the l.t. battery will endeavour to make up the difference. Check, therefore, that the receiver is being operated on the correct mains tapping and that the components in the power pack are in good order. Metal rectifiers are usually fitted in this type of set, and it may be found that the forward resistance of the rectifier has increased. This causes a larger volts drop across the rectifier and consequently reduces its output.

* * *

Query Corner
RULES

(1) A nominal fee of 2/6 will be made for each query.

(2) Queries on any subject relating to technical radio matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like. Queries relating to ex-W.D. surplus or commercial equipment cannot be accepted.

(3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct, and that the circuit is theoretically sound.

(4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.

(5) Correspondence to be addressed to "Query Corner," Radio Constructor, 57 Maida Vale, Paddington, London, W.9.

(6) A selection of those queries with a more general interest will be reproduced in these pages each month.

Picture Break-Up

I have recently purchased a secondhand television receiver made by a well-known firm. After operating satisfactorily for some time, a defect has developed causing the picture to break up into horizontal bands. There also appears to be some corona which causes a white spot pattern to appear on the image. Any suggestions for a cure?

E. Melvil, London

It sounds rather as though the receiver in question is fitted with some form of flywheel sync circuit, and that the smoothing in the line flyback e.h.t. circuit is inadequate. Smoothing is normally obtained by the capacitance between the final anode of the c.r. tube and the external coating on the tube. If the coating is not effectively earthed there will be an appreciable a.c. component on the e.h.t. line which can easily feed back into the vision channel and upset the line sync. This condition may easily cause the picture to break up into a number of horizontal bars.

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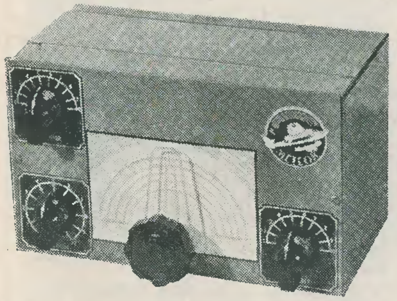
The "METEOR" MINI-RECEIVER

for the Beginner



PART 1.

by **F. A. BALDWIN,** *A.M.I.P.R.E.*

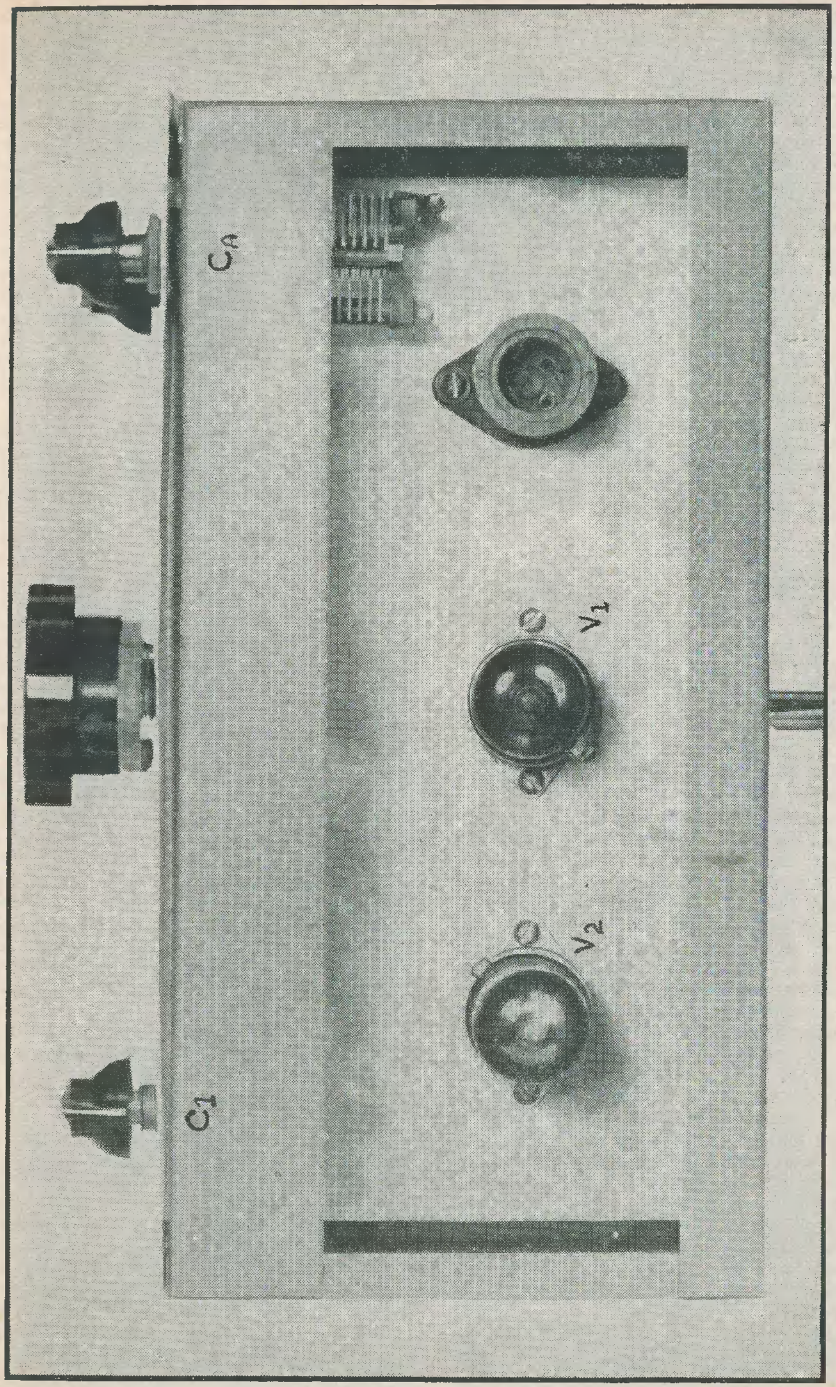
(A receiver using modern miniature components, specially designed for, and directed at, our beginner readers. In this issue the circuit and drilling details are outlined so that construction may be commenced. Part 2 will contain wiring instructions, etc.)

Every year hundreds of people become interested in radio as a hobby, and one of the first things they require, apart from the necessary interest and tools, is a simple receiver design which they can start to build with every confidence in the final outcome. To an old hand at the game this seems an easy thing to come by, with a library of radio books accumulated over the years and a vast stock of magazines to fall back on if required. To a newcomer, however, this is not possible. For them, no library exists, and they must live in the hope that sooner or later a magazine will come to their assistance by publishing such a design. One of the greatest headaches for an editor is not only the apportioning of available space between the various subjects of interest (amplifiers, receivers, etc.), but also to balance each issue between the various stages of advancement within the hobby—beginner to old-timer. Add to this the division between practical and theoretical articles and it will be understood that it is not possible to cater for beginners in all issues—or for that matter any other specialised interest.

General

Before designing this receiver we had to consider which type of circuit was most suitable. Apart from the obvious choice of a straight circuit to ensure simplicity, consideration had to be given to the availability of components easily obtained from our advertisers for the convenience of readers living far outside the main centres of the country. Also, in order to present an up-to-date design, it was considered advisable to incorporate modern miniature components, it being of little practical use to offer an out-of-date receiver using old parts to the up-and-coming enthusiasts of to-day. Miniaturisation being the order of the day, we have followed the present trend; at the same time, we have used as few components as possible in order to keep the cost to a reasonable level, and also to obviate a crowded chassis, both for practical reasons and for clarity in the layout. Similarly, we have adopted coils of the plug-in type, thus also making the receiver into an all-wave type consistent with the coil ranges. With the coils specified (see component list), a range of some 32 Mc/s to 730 kc/s can be expected, allowing for the additional capacitance of the wiring and bandspread condenser. Again, for simplicity, headphone output is employed, while other refinements such as tone controls, etc., have been omitted.

The power supply is taken from a very handy little power supply unit which may be obtained commercially either in com-



View from above with cover removed, showing easy accessibility to plug-in coil ponent form or already wired and tested. This is the R.C.S. Products power unit type PU1 which has an output of 120 volts at 20mA, and 6.3 volts at 1.5A for the valve heater supply. This is to be preferred instead of the battery supply and valves usually presented to the beginner, in that a start is made at the outset with mains valves and equipment. Later progression into the more advanced receivers and equipment will then no doubt include these valves, whereas those of the battery supply type would, more often than not, be consigned to the junk box. The power unit is small, neat, and compact, being totally enclosed in an attractive grey-sprayed metal cabinet. The overall cost of this is reasonable compared to the rather expensive continual replacement of batteries. The front cover illustration shows the receiver unit as it would appear when in actual operation. Both units are sprayed grey enamel and this, together with the use of Panel Signs transfers, presents a very attractive ensemble.

Circuit

The detector stage is built around the Mullard EF41 r.f. pentode, one of the B8A range. In the circuit diagram (Fig. 1), all the valve base connections are shown. For example, valve pin number eight is connected to chassis, which is, in effect, the earth. In Part 2 of this article, to be published next month, further details of these connections are given, so that no possible mistakes with regard to valveholder wiring are made.

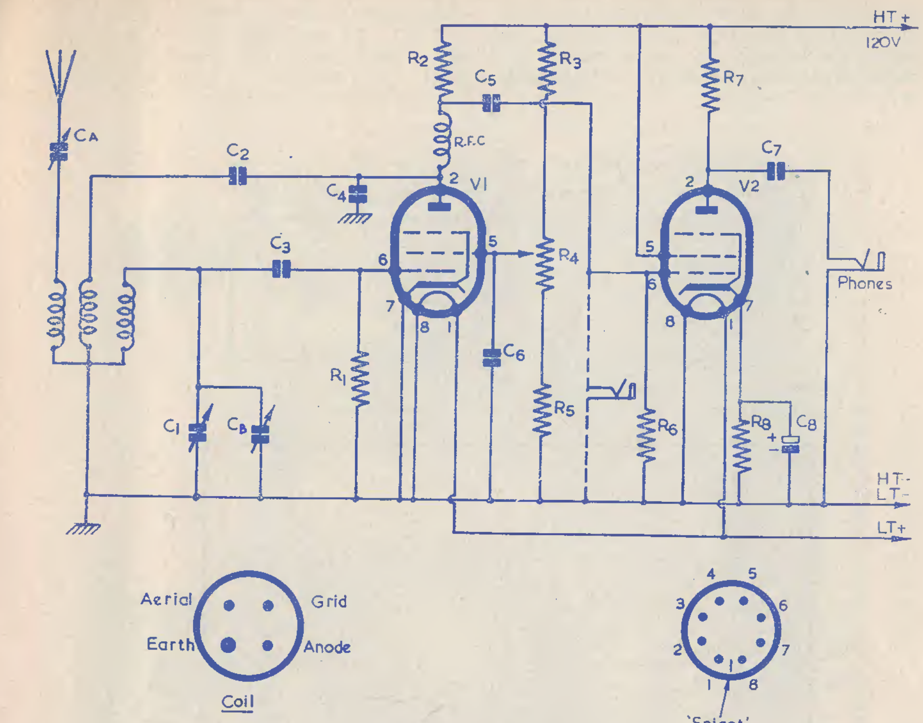
The aerial is connected to the coil primary winding via C_a, the inclusion of thisensuring smooth reaction without dead spots over the entire receiver range; for operation of this see Part 3. The feedback winding is connected to the detector anode via C_2, a 70pF silver mica condenser. The tuned winding is that connected to the grid via C_3, a 100pF ceramic condenser. C_1 is the bandset condenser while C_b is that used for bandspread. The h.t.+ supply to the anode is via R_2, a 22kΩ resistor, and the r.f. choke (Eddystone Cat. No. 737). The screen supply is via R_3, a 200Ω resistor, R_4, a 50kΩ potentiometer, and R_5, a 200Ω resistor and is bypassed to earth via C_6, a 0.1μF condenser. The variable potentiometer R_4 acts as reaction control by varying the applied voltage to the screening grid of the valve. This method of obtaining reaction is preferred in that no alteration to the receiver tuning is made by varying the voltage. Positive feedback (reaction) is obtained by the inclusion of both C_2 and C_4 in the anode feed to the reaction winding. The grid condenser and grid leak, C_3 and R_1, are of carefully chosen values in order to obtain efficient operation over the entire range of the receiver. The output of the detector stage is taken via C_5 into the grid of V_2.

For those who are rather apprehensive about trying out the receiver only when both valves are included, it is perfectly possible to complete only the detector stage as a first step, and, having connected the power supply, insert the phones between C_5 and chassis in order to obtain a signal. The phone socket, of course, will have to be wired into circuit before this can be done. This is shown in dotted line in Fig. 1, for those who wish to adopt this method and would rather advance stage by stage. The connection to the grid of V_2 and R_6 need not, of course, have to be broken if this is done.

The output stage is constructed around the Mullard EL42 Output Pentode. The circuit is perfectly straightforward and its purpose is to amplify the audio voltages arriving at the grid (pin 6), so that a much greater output is available for the headphones connected into the anode circuit. Once again the values have been carefully chosen and all are standard values easily obtainable. The resistor R_6 is the grid leak, or load across which the input voltage is built up, while the cathode bias voltage is obtained from R_8 decoupled by C_8, both connected to pin 7 of the valveholder. The anode load resistor is R_7 and the phones are connected to the anode via C_7. This last condenser must be of the 350 volts working type as a precaution against the phones becoming "live" through the possible breakdown of a lower rated component. Provided this precaution is observed there is no danger inherent in this portion of the circuit. It is recommended, of course, that this condenser should be that specified, and most certainly not one of the surplus components which quite probably has deteriorated through long, and often bad, storage conditions. So much for the circuit—we now progress to the initial stages preparatory to wiring up the actual circuit. The power unit will be described in Part 2.

Initial Practical Preparations

Obviously, the first thing is to obtain the components that are specified in the component list. For the convenience of readers, the firms concerned are stated after the individual components. For younger readers whose available cash may be limited, it should not be forgotten that this receiver is capable of being constructed in stages, i.e., as a one-valver in the first instance. Ideally, the tools required are—small pliers, screwdriver, wheelbrace complete with drills, a chassis punch complete with tommy bar



E208

Fig. 1
Circuit of the "Meteor" mini-receiver

COMPONENTS LIST

Resistors

R_1	2MΩ $\frac{1}{2}$ watt
R_2	20kΩ $\frac{1}{2}$ watt
R_3	200Ω $\frac{1}{2}$ watt
R_4	50kΩ potentiometer
R_5	200Ω $\frac{1}{2}$ watt
R_6	470kΩ $\frac{1}{2}$ watt
R_7	200Ω $\frac{1}{2}$ watt
R_8	150Ω $\frac{1}{2}$ watt

Valves

V_1	Mullard EF41
V_2	Mullard EL42

Panel, Chassis and Cabinet—R.C.S. Products (Radio) Ltd.

Headphones—(high impedance type)

R.F. Choke—Eddystone type 1022.

Power Unit type PU1—R.C.S. Products (Radio) Ltd.

Phone Jack and Plug.

Aerial Wire—14 swg enamelled copper–in 35, 50, 70, 100, 140 or 270 ft. lengths (according to individual requirements).

Condensers

C_a	100pF variable, Eddystone type 585
C_b	25pF variable, J.B. type C804
C_1	140pF variable, Eddystone type 586
C_2	70pF Silver Mica
C_3	100pF Ceramic
C_4	100pF Ceramic
C_5	0.01μF TCC type CP45W
C_6	0.1μF TCC type CP45N
C_7	0.1μF TCC type CP45N
C_8	25μF Electrolytic, Dubilier

Coils—Eddystone Miniature Plug-in types —706/LB, 706/Y, 706/R, 706/W and 706/P.

Coil Base—Eddystone type 707.

Coil Stand—Eddystone type 775.

Valveholder—B8A McMurdo

PVC Wire, Nuts, Bolts, Solder, Solder Tags, 3-way Strip, Aerial/Earth Strip, Rubber Grommet, Knobs etc.

for valveholder holes, soldering iron (preferably of the pencil bit type) and, of course, solder (Multicore). A centre punch and scriber would also be desirable if available.

front panel as shown, holes A, B, C and D. To do this correctly, lay the panel face downwards on a soft piece of paper so that the paintwork is not scratched or

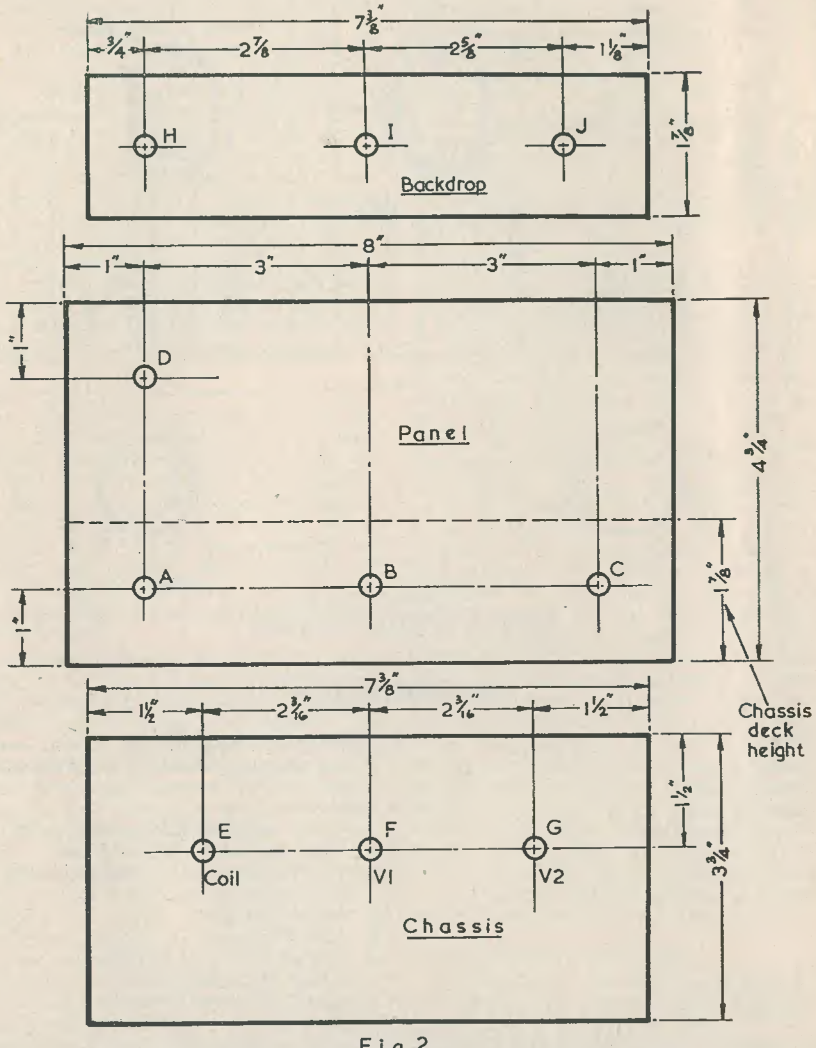
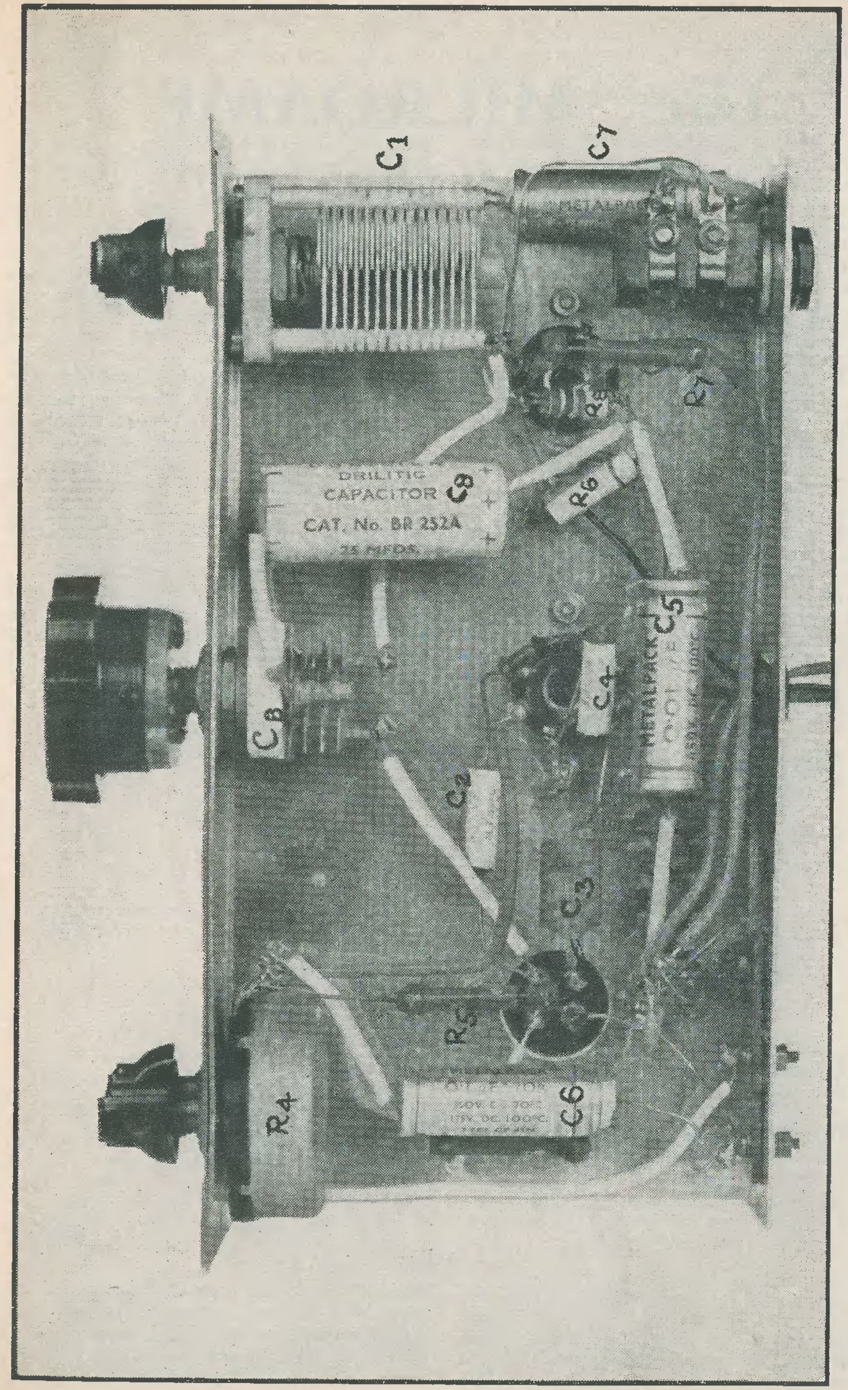


Fig. 2
Drilling dimensions of chassis panel & backdrop

From Fig. 2, all the information required regarding drilling details may be obtained. As received, the front panel and chassis, together with the cabinet, are separated, i.e., not bolted together. First, drill the

damaged. Next, measure and mark, preferably with a pencil, on the rear face of the panel. Then, after centre punching the drilling positions, drill the required holes.

(*continued on page* 110)



Under-chassis layout showing location of main components

The "MICROAMP"

A MINIATURE HIGH FIDELITY AMPLIFIER

by **O. J. RUSSELL**, *B.Sc.(Hons.)*, **G3BHJ**

THERE IS CONSIDERABLE INTEREST IN THE high fidelity reproduction of records, particularly in view of the superb quality and virtually noiseless background obtainable from long-playing records. Unfortunately, the cost of modern high fidelity equipment, particularly when preamplifiers, tone control units and equalisers, to say nothing of loudspeaker enclosures and multiple speaker systems with crossover networks are included, is high. The constructor with a modest pocket must often feel the need for a medium priced amplifier which will give good results, without costly trimmings. Unfortunately there are very few low cost amplifiers or designs available include tone correction and/or equalising facilities for optimum reproduction of records. The cost was to be as low as possible, and in fact enable the home constructor to use pieces in stock, or even in the junk box, and still obtain reasonable quality even when using, say, a small surplus speaker rather than an expensive super high fidelity model. In fact, owners of super high fidelity speakers would normally be able to afford an amplifier to suit. However, the amplifier will, of course, feed a super high fidelity speaker if one is available.

After some thought, the amplifier was reduced to the ultra-simple line-up of just two valves, a 6J7 amplifier and a 6V6 output

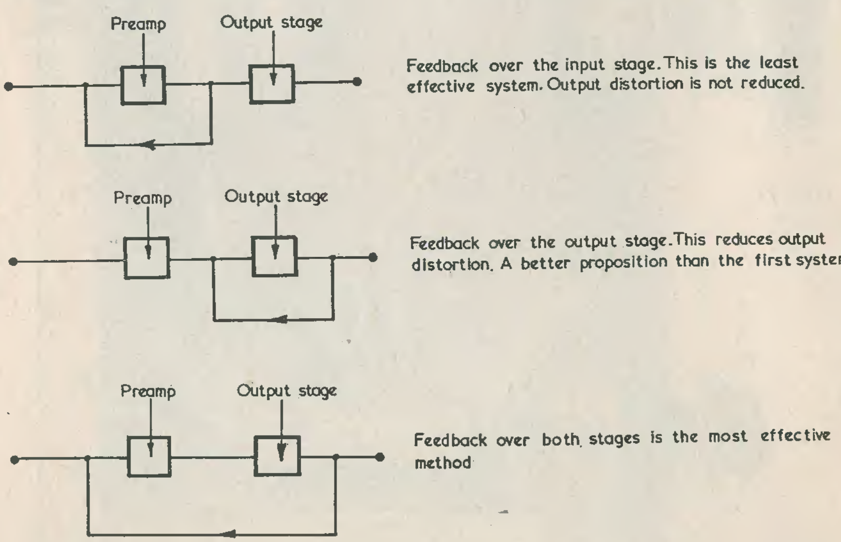


Fig. 1

The object of the "Microgram" design was to evolve the simplest amplifier which would provide negative feedback for the advantages obtainable therefrom, and also stage. If a modern crystal pick-up such as the ACOS types are used, then the stage gain of 120 obtainable with the 6J7 is some ten times more than is necessary to swing the

6V6 to full output. Accordingly negative feedback of from some ten to twenty db may be applied with a consequent reduction of distortion.

As a study of some negative feedback designs will reveal, there are considerable stumbling blocks in the way of applying feedback. Multi-stage amplifiers using a heavy degree of feedback require quite advanced design if stability is to be achieved with a wide frequency response. In fact, the application of feedback to even a two-stage amplifier can be achieved in several ways. (Fig. 1).

In other cases feedback is applied over the output stage only. This is helpful in reducing distortion. However, it is generally impossible to apply feedback from the output stage via the speaker transformer secondary. This is because, measured at the output secondary, the output stage, far from having a gain, may have a reduction in voltage as compared with the grid input, as the output transformer has a high step-down ratio. Thus with feedback over the output stage only, we must take output from the anode and not from the transformer output. However, feedback from the secondary

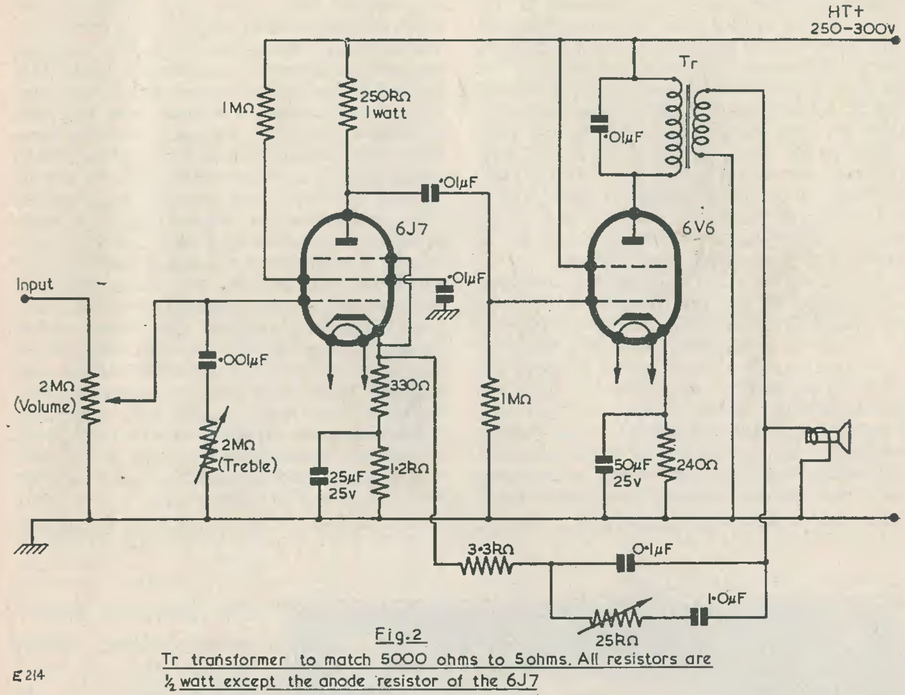


Fig. 2

Tr transformer to match 5000 ohms to 5ohms. All resistors are ½ watt except the anode resistor of the 6J7

Several two-stage amplifiers have been described in which feedback has been applied only in the pentode preamplifier. It is difficult to see the reason for this, as this is the least effective method of applying feedback. The output stage operates at high level, so distortion there is far higher than in the preamplifier, which has only to provide some ten volts or so of audio at the most. Hence the overall distortion is hardly affected in such an amplifier, where one is merely feeding slightly purer audio into a stage capable of appreciable distortion. The effect is that of a cupful of pure water in an ocean of sewage.

winding helps to reduce transformer defects, an especially important point with single-ended amplifiers.

The most satisfactory method, therefore, is to use feedback over the whole amplifier from speech coil to input. This overall feedback reduces distortion irrespective of whether it arises in the preamplifier, output valve or output transformer. It is the customary solution in complex amplifiers, but is seldom applied to simple two-stage amplifiers of the economy type. Nevertheless, it is just as advantageous.

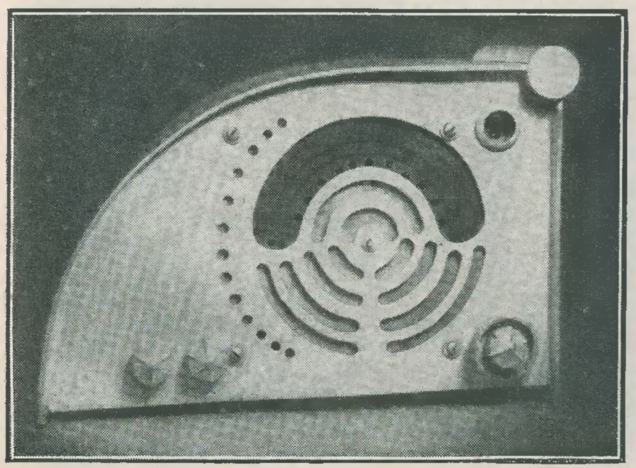
However, readers will quickly discern a snag or an apparent snag. Having thrown away surplus gain in negative feedback, we have no gain to spare for tone control circuits. As tone control circuits generally operate as attenuators of various sections of the audio spectrum, we need considerable "surplus" gain if tone control is to be achieved. However, for record reproduction, top is boosted on the record. Therefore we can safely use a top corrector of variable attenuation to give the effect of top boost, correctly equalised top, or even top cut without sacrificing gain. This effectively disposes of the problem of top correction.

For bass correction, a different solution is adopted. The bass correction progressively decreases negative feedback in the bass, so that output rises in the bass region, and bass boost is achieved without sacrificing gain. Moreover, feedback increases as the frequency rises in the bass, and so harmonic distortion products being of higher frequency than the bass fundamentals will be fed back appreciably. Thus the value of feedback in reducing distortion is not lost to any great extent. So without going to any greater complication than two valves, the above tricks enable the best possible use to be made of such a simple combination.

Fig. 2 shows the circuit of the amplifier constructed to test the overall performance of such a circuit design. It is so simple that no layout is considered necessary, provided the usual simple precaution of keeping the grid circuit of the 6J7 well away from the anode circuit of the output is observed. The pick-up leads and 6J7 grid lead should, of course, be carried out in screened cable, and short leads used in wiring up the top corrector components in the input circuit.

A simple power pack providing some 250 to 300 volts at, say, 60mA will be perfectly adequate. In the writer's case a general purpose power pack having a double 8μF condenser and smoothing choke was used, and the hum level (probably due to the hum reducing effect of feedback) was low.

No elaborate speaker system was used; in fact, a surplus 6in speaker and transformer were used in a "table top" miniature vented enclosure constructed for the occasion. The definition of both bass and treble was very satisfactory on both L.P. and 78 r.p.m. discs when using a modern crystal pick-up. The equipment was loaned to the owner of a popular three-speed playing desk, who reported that he had discovered a previously unsuspected background treble register counter-melody on a favourite record that he had never noticed previously! While no exaggerated claims are made, the writer is confident that the suggested arrangement will give about the best possible results obtainable in a two-stage amplifier. It may be that the results will be surprising to those who suppose that "high fidelity" is only possible with elaborate and costly equipments. Certainly it is a considerable improvement on the use of the usual domestic receiver for record reproduction. Owners of two-stage amplifiers not incorporating feedback may like to try modification to the Fig. 2 circuit, if they have enough gain in hand to provide adequate negative feedback, as in many cases a considerable improvement in quality may be achieved. Moreover, where a large speaker adequately baffled or housed is available, results should be correspondingly improved.



The illustration shows a modern-looking cabinet designed and built by an Indian reader, S. N. Nautiyal. The material used was hardboard bent to shape, with the side and bottom members braced with wood. The dial has been fitted so that it occupies the position usually taken by the speaker fret, and holes have been drilled so that no undue obstruction of the sound waves takes place.

Radio Miscellany

A RATHER UNSETTLED COLUMN THIS month, I'm afraid. Have not yet got over the holiday season, having just returned from Central Europe where, for part of the time, I was half-way under the Iron Curtain. In fact, for three weeks I did not hear the sound of a British voice other than three radio contacts on 20 metres. Believe it or not, one of them, a GM station, could not give me the scores in the fourth Test match without dashing into another room to find the morning paper!

Nor could I find anybody who listens to the B.B.C. European programmes. I have never yet found anyone who does, so I guess their number must equal those of British listeners to Russian propaganda programmes. Of course, during the war years, when listening in the occupied countries was forbidden (and many sets capable of getting London were confiscated), there was plenty of it. Older readers will recall that some years ago I wrote of a number of ingenious little home-made receivers made by Dutch constructors. Many of them were of miniature proportions with standard parts and sometimes with the most unlikely bits and pieces used as substitutes.

First Steps

It was on the homeward journey that the news of America's "flying saucers" broke. The real ones, I mean, announced by President Eisenhower's press secretary, the first of which is to be projected in 1957. Plenty of warning, of course. If they had been let off secretly somebody might have panicked and started "retaliation" with H-bombs. These "space ships" are scarcely twenty inches across but we must learn to crawl before we can walk, so mankind must be content to learn by mistakes on a small scale first. They will encircle the earth between 200 and 300 miles up, at a speed of some 18,000 miles per hour.

It was not exactly a coincidence that this column touched upon space travel recently. A first step on these lines has been anticipated for some time, and as soon as the announcement was made rumour had it that the Russian version was equally advanced.

Both "saucers," apparently, will start their journey by multi-stage rockets, and on reaching the intended height will be started on a parallel-to-the-earth's-surface course by side blast.

CENTRE TAP *talks about* HOLIDAYS SATELLITES CHEAP TV

Equally ingenious were the hiding places. Usually in the "smallest room" where a locked door would not arouse overmuch suspicion. No doubt many a cunningly contrived hidey-hole in the cistern or under a floor-board still remains as a reminder of those grimmer days. As, during my stay this year, the only news I heard was of the Big Four Geneva talks and the resultant high hope of a permanent peace, let's not dwell on war-time radio.

It is quite possible the first one will not even carry instruments. Even so, much can be learned from its behaviour, although we shall be denied the opportunity of listening for its radio signals. We may, at least, stand a chance of seeing it. It should be fairly easy to track with a good telescope and ought to be visible, reflecting the sun at twilight, to the naked eye.

(continued on page 102)

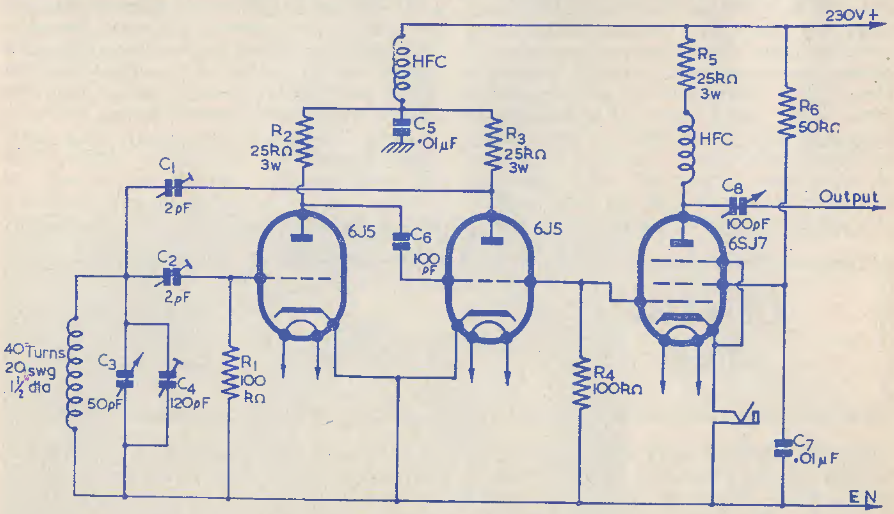
FRANKLIN VFO

FROM SURPLUS COMPONENTS

by G. A. TIEL

THE FRANKLIN OSCILLATOR IS KNOWN FOR its inherent stability and freedom from drift provided it is run in the correct manner and not overloaded; whilst the simplicity of its circuit makes it an ideal driver unit for the beginner to construct. This piece of equipment described herein has been in constant use for a period of four years driving a 160/80m transmitter, and over that period has remained completely free from trouble. The complete unit was built from surplus components out of the junk box, so its cost was practically negligible.

As this is a well-known oscillator of conventional circuit design there would appear to be no reason to detail its characteristics, other than the way to lay out and screen the components in the most suitable manner, and to adjust it for satisfactory operation.



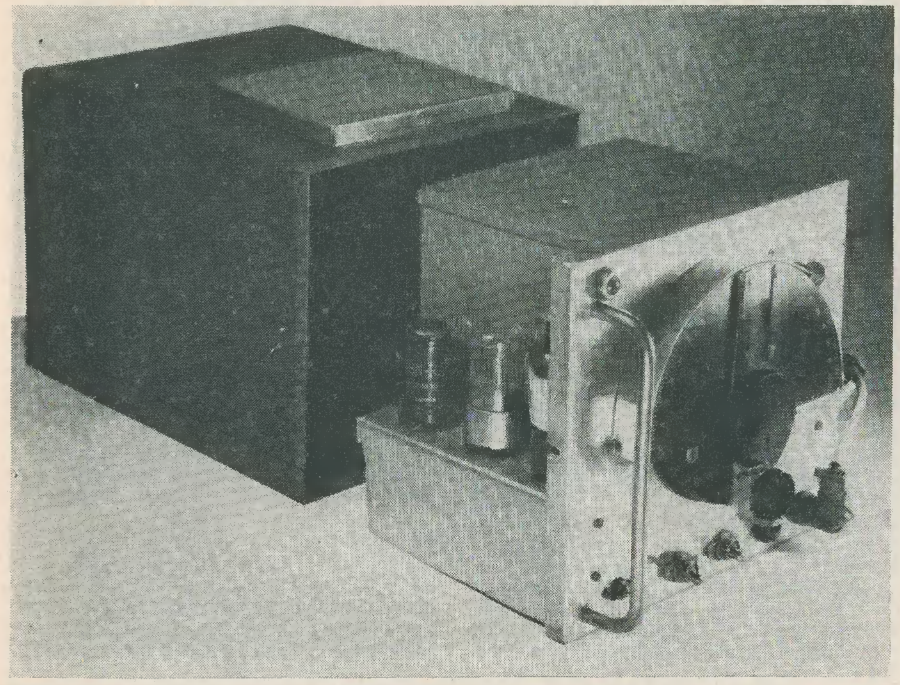
Construction

The oscillator can be built to fit any suitable box which the constructor may have available. The one described was built to fit a box 7½in. by 8½in. by 11in., which was originally used to house a piece of M.O.S. equipment. As can be seen from the photo, a second box 6½in by 5½in. by 5½in. is mounted on the chassis, this to completely screen the coil and variable condensers and to keep them at an even temperature away from the valves. This could quite satisfactorily be made smaller if desired.

The three valves are mounted along one edge of the chassis, and all components, other than the coil and condensers, are canned below it. A front aluminium panel 8½in. by 7½in. was cut out and bolted to the chassis, this carrying the slow motion dial, bandset condenser, dial lamp, h.t./l.t. switches, jack and co-axial socket. There is also a hole through which adjustment can be made to the 100pF variable condenser which couples to the next transmitter stage, so that the drive can be varied.

The excellent slow motion dial (10A/15319) is available in most surplus stores for a few shillings and is a precision piece of equipment. This is secured to the panel by two screws, and a strip of polished aluminium is swept around the circumference of the dial in order to improve its appearance and to hide the gap between the outer edge and the panel. The spindle is pinned to the dial mechanism, and the condenser, which is carried on a bracket in the box, is lined up to it. Small 0-10pF trimmers C_1, C_2 are used for producing oscillation and these are mounted in the box adjacent to the coil. This latter consists of a paxolin former 1½in. diameter on which is wound 40 turns of 20 s.w.g. enamel wire, suitably doped, the former being mounted rigidly towards the centre of the box. It should be at least one diameter away from the sides. All resistors in the h.t. line to the anodes of the valves are of the heavy duty 3 to 5 watt pattern (R_2, 3, 6), this to ensure that everything runs cool to maintain stability. These resistors are readily available for a few pence each.

When wiring the oscillator it is advisable to use 18 gauge tinned copper wire, hard drawn and cut into short lengths. This ensures that the wiring is rigid, and will not flop about if the oscillator is moved or jarred. Also pay particular attention to the soldered joints, as a dry joint can cause no end of trouble afterwards. Use if possible silver mica condensers for coupling and decoupling; these are also easily obtainable. The r.f. chokes, if supported in the wiring, should be rigid and not free to move. Where wiring carries voltage and passes through metal screens, these should be bushed or grommeted.



The completed instrument shown withdrawn from case

Calibrating and Adjustment

To adjust the oscillator, all that is required is to set C_1 and C_2 to the smallest value consistent with steady oscillation. Once this is done the frequency will remain constant provided that the temperature in the box does not vary, and that the structure and wiring of the set is rigid. The output is taken from the 6SJ7 buffer stage, via a 100pF variable condenser, fed to a co-axial socket on the front panel. For c.w. operation a jack is provided in the cathode of this latter stage. To calibrate the oscillator using a calibrated receiver, set this to the h.f. end of the band and open the bandspread condenser (main tuning dial) of the oscillator. Move the bandset condenser until the signal beats into the receiver, and lock the knob. Obviously for accurate reading it is desirable to spread the band right across the dial if possible, so next swing the receiver to the other end of the band (l.f.) and move the bandspread dial until the signal beats into the receiver. If only half of the dial is covered in this process, pull out one of the moving vanes in the condenser and repeat the check until a reasonable spread over the dial is obtained. Calibrate in the usual manner using a frequency meter, or 100 kc/s crystal, and plot a graph so that the frequency can be read off easily and quickly when required.

List of Components

R_1, R_4	100kΩ ½ watt, Dubilier
R_2, R_3	25kΩ 3-5 watt, Dubilier
R_5	25kΩ 3-5 watt, Dubilier
R_6	50kΩ 1 watt, Dubilier
C_1, C_2	2-10pF, either fixed or trimmer pattern
C_3	50pF variable air-spaced, Eddystone
C_4	120pF variable air-spaced, Eddystone
C_5, C_7	0.01μF T.C.C. 500V wkg
C_6	100pF T.C.C. Silver Mica
C_8	100pF air-spaced variable pre-set Eddystone
2	H.F. chokes, Eddystone 1010
1	Jack, Bulgin
1	Panel lamp, Bulgin
1	Slow motion dial, Eddystone
2	Single pole toggle switch, 3 Amp, Bulgin
2	6J5 Valves, Brimar
1	6SJ7 Valve, Brimar
1	Co-axial socket, Belling-Lee

For those amateurs who are short of components, the makers names of suitable types have been included in the above list.

RADIO MISCELLANY—*continued from page 99*

Old Iron

To revert to holiday talk, while I was in Styria I paid a visit (people made me feel it was almost a pilgrimage) to the Iron Mountain, Erzberg.

Everyone seemed astonished that I should want to make a trip there as part of a holiday, but I remembered learning about it at school, and I was afraid the desire to see it might become an obsession. Eventually I managed to persuade a couple of local amateurs to make the trip with me, despite their insistence that there were far better things to see with less than half the trouble. It is of no very great height as mountains go, but it is so rich in iron that it merely has to be chipped off the sides. The ore has been worked since the time of the Romans,and surface excavations have turned it into a veritable pyramid of nearly sixty steps, each some forty feet high.

I was curious to know how it would affect radio reception—it seemed on the face of it a wonderful screen. However, nobody much seems to live around there, and when I enquired about it they shrugged it off as being no worse than any other mountain.

One thing I have always noticed in mountainous regions. Everybody, from the toddlers up, can tell you the exact height above sea level of all the local high points. In Britain, unless the height a.s.l. is of any especial interest, such as being the highest point in the county, only radio amateurs trouble to find out these things. Not one in twenty, especially among town dwellers, can tell you the a.s.l. height even of his own home.

Just after the war I bought an ex-W.D. altimeter for next to nothing. It is quite good fun to carry about in a car or on a motor-bike, even in London, and watch it when travelling over higher ground such as Hampstead, Eltham or Crystal Palace.

Anti-TVI

However, I wasn't really disappointed in Erzberg. I should have been far more disappointed to have come away without seeing it, but I was easily persuaded to push on for the higher point of Schöckl, where there has long been a v.h.f. f.m. relay station. The station and the mountain top are served by a cable railway one side and a chair-lift the other, although it is a tortuous hill climb to reach the foot of either. The engineer in charge, who showed us round, does a tour of a fortnight's duty up there. In the summer visitors go up for the thrill of the ride, a drink at the top and on a clear day to look out into Hungary and Yugoslavia with a telescope. You can hire one to see if you can tell the time on a distant clocktower. The only other humans seen in winter are skiers, so what with the snow and the bitter wind a broadcasting engineer's job isn't all fun.

We watched them put the finishing touches to a t.v. aerial (on a separate tower) which was to go into service a few days later. It (*continued on page* 114)

Let's Get Started 27:
TIMEBASES

by **A. P. BLACKBURN**

In last month's article on the cathode ray tube, we arrived at the decision that a saw-tooth waveform was necessary to sweep the tube. It was mentioned that circuits which do produce this waveform are called "timebases."

Indeed, when we begin to consider circuits of this type, we leave ordinary radio circuit practice, and enter a vast field of electronic circuitry. The use of oscilloscopes in an ever-increasing range of applications has brought timebase techniques to a relatively high standard of precision. Typical uses of the oscilloscope, outside radio and electronic work, are in nuclear physics, medical research, automobile and aircraft engine testing, and a host of others.

In view of the work that has gone into timebases, and the number of types that have been developed, we can only hope to examine a few of the commoner types here.

The Neon

Just to keep in mind what we want ideally from our circuit, Fig. 1 has been included. The basis of most timebase circuits is to charge a capacitor through a resistor. Then when the capacitor has charged to some predetermined level, an automatically operated switch discharges it. Such a circuit is shown in Fig. 2*a*. Its operation is very simple.

In a previous article* it was shown that if a battery were suddenly connected to a series resistance and capacitor, the voltage across the capacitor would rise slowly. If the switch S in Fig. 2*a* were depressed, the voltage across the capacitor would slowly rise. Fig. 2*b* shows a graph of this. The switch is closed at A and the capacitor charges until it reaches B. The capacitor is actually charging up to 120V, which is the battery voltage as shown by the dotted line.

Up to the point B, the neon has had insufficient voltage across it to "strike" it, and therefore no current passes through it and it appears to be an open circuit. However, when the voltage across the capacitor reaches 80V the neon will strike and will, therefore, act as a low resistance. This will discharge the capacitor and the voltage across it will drop to C in Fig. 2*b*. At this point the voltage across the neon will be insufficient to keep it struck, and the glow discharge will be extinguished. As the neon is again open circuit the capacitor will begin to recharge toward D. The process will, therefore, repeat itself indefinitely, or, in other words, it will oscillate.

It is interesting to compare the waveform in Fig. 2*b* with Fig. 1.

Ignoring the part of 2*b* between points A and B, because that is only the switching-on condition, we can see that there are two distinct differences between Figs. 2*b* and 1. The first is that the forward stroke, (i.e., that part C to D on Fig. 2*b* and A to B on Fig. 1) is not straight in 2*b*. You may remember that linearity, as it is called, is necessary so that the spot is driven across

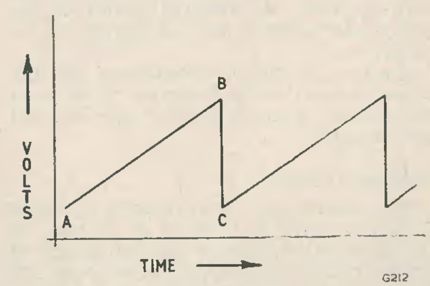


FIG. 1.

the c.r.t. at the same speed all the way across. In Fig. 1 this would be so, but in Fig. 2*b*, the non-linearity is considerable. The second comparison is that in Fig. 1 the voltage between B and C changes very quickly. This period is called the "fly-back." In Fig. 2*b*, however, the fly-back (B to C, D to E, etc.) occurs quite slowly. This brings us to an interesting point.

* Phase Shift—A. Blackburn, *The Radio Constructor*, November 1954

www.americanradiohistory.com

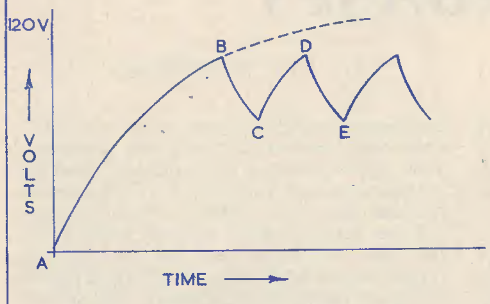


FIG. 2 (b)

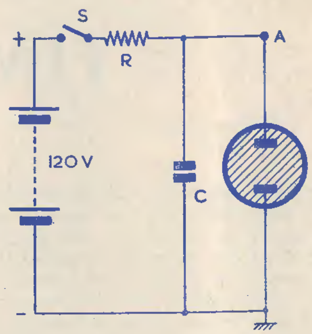


FIG. 2 (a)

G213

The spot has travelled across the screen from left to right, say, under the influence of the voltage waveform depicted in Fig. 1. When the voltage reaches point B, the spot will be at the right-hand side of the tube. From B to C, however, it will be returned very rapidly to the left-hand side. Ideally, this fly-back should be so rapid that it would not be seen. Fig. 2*b* is not, however, anywhere near ideal because the fly-back is relatively slow, so that the return of the spot would probably be slow enough to be visible.

The two points of comparison are the indications of the disadvantages of the neon type circuit. There is another that we shall mention later.

Constant Current

Non-linearity may be overcome by using a pentode valve in place of R in Fig. 2*a*. The pentode has a very interesting anode characteristic. Considerable changes in anode voltage (grid 1 and screen voltages constant) produce little change in the current flowing through the valve. The new circuit would look something like Fig. 3*a*. In this case, the capacitor will charge until the neon strikes, when it will return to its original condition, as in Fig. 2. However, the capacitor will charge through the pentode V_1. As it charges, the anode voltage of V_1 will drop, but the charging current through the valve will remain comparatively constant.

The waveform shown in Fig. 3*b* will result. This is an inverted version of Fig. 1, because the forward stroke goes negative instead of positive. This circuit provides a more linear timebase than Fig. 2, but is, of course, more complex.

In Fig. 2 the frequency of operation is controlled by making R a potentiometer. The charging time of the capacitor can, therefore, be varied. In Fig. 3*a* the charging time is varied by controlling the current through the valve by means of the screen potentiometer, R_1.

The Thyratron

A valve often used in place of the simple neon is the thyratron. This is a gas-filled triode; like the neon but with a grid interposed. It normally contains a cathode and heater whereas the neon does not. The anode would be connected to the point A in Fig. 2*a*, and the cathode to earth, and its action would be exactly the same as the neon. The grid, however, is used to "lock" the timebase to the signal to be observed on the c.r.t. A sample of this signal is fed to the grid of the thyratron so that the thyratron will strike at the same point of each successive waveform. The observed picture will therefore be steady on the screen.

Looked at another way, the signal is used to lock the timebase to the signal frequency, or some sub-multiple half-frequency, third, quarter, etc., depending upon how many cycles of the signal it is desired to see.

These two circuits are relatively elementary types, but are still used where extreme

linearity is not important, and the highest frequency required is 20–30kc/s. The types using a simple neon are not easy to synchronise to the applied signal and therefore find only a limited use.

The Miller Timebase

This type of timebase is one of the commonest in use to-day. It has good linearity, a high top frequency limit, but a poor fly-back time.

A basic form of the Miller circuit is shown in Fig. 4*a*. The suppressor grid is held at a negative potential which cuts off the current in the valve. If the suppressor were caused to rise to cathode potential, current would flow and the anode voltage would drop. This drop would be transferred to the control grid via the capacitor C. If the control grid were cut off by this voltage, current would cease in the valve, and the anode would rise. The grid, therefore, drops to a negative potential just short of cut-off and current will flow in the valve.

From this point onward, one way of describing the action is to consider the "Miller effect." This states that the capacity between anode and grid 1 is multiplied by the gain of the valve and appears as an imaginary capacitor between cathode and grid. The dotted capacitor C′ therefore has a value of approximately A × C where A is the gain of the valve. Now the grid leak R is returned to a positive potential, so C′ begins to charge toward that potential.

The anode, therefore, falls in potential because of the positive "movement" of the grid. The capacitor C′ will be charging non-linearly, but the change in voltage across it will be quite small, say four or five volts. The anode, however, will fall perhaps 200V. Such a tiny portion of the total charging excursion of C′ is actually used, however, that it is almost perfectly linear, and the anode waveform will therefore be linear also. Fig. 4*c* shows the grid excursion considerably enlarged to show the comparative linearity of the charging curve used. When the voltage has fallen to a very low value, the valve will "bottom." This means that the anode voltage has fallen to a value where the grid no longer has any control over the anode voltage.

The "run-down," as the anode voltage excursion is called, will cease and the grid will return to its normal potential, i.e., approximately at ground. If, as the instant of bottoming occurs, we cause the suppressor grid to be cut off again, the anode voltage will return to the h.t. voltage. Note that during the run-down, the real capacitor C has been discharging, and upon cessation

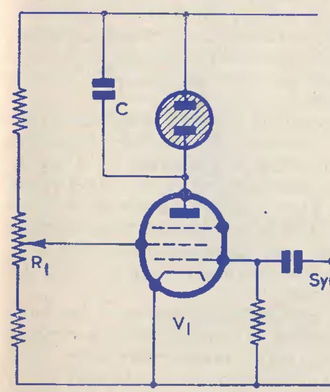


FIG. 3 (a)

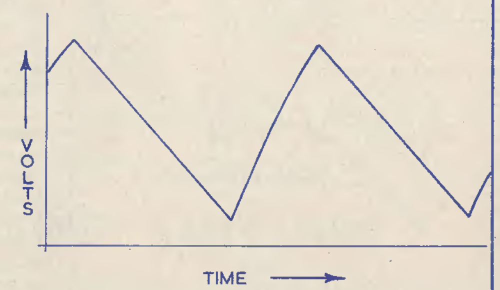


FIG. 3 (b)

G214

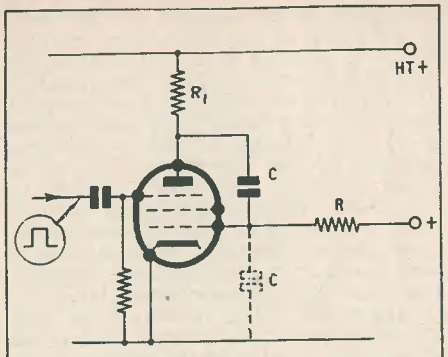


FIG. 4 (a)

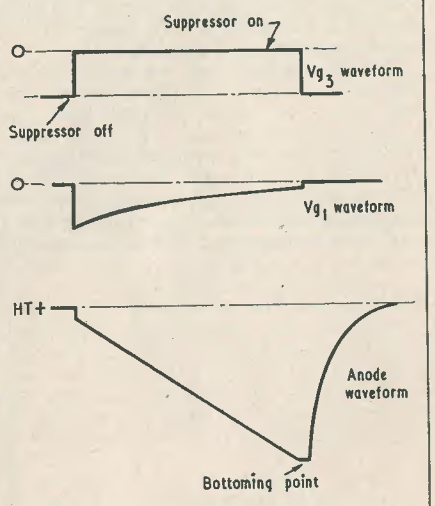


FIG. 4 (b)

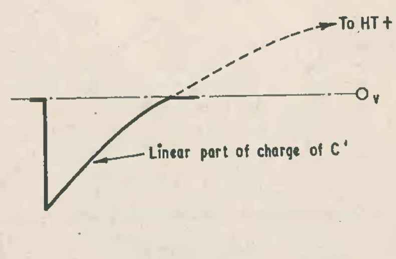


FIG. 4 (c)

of the run-down it will recharge toward h.t.+, through the anode load resistor R.

Normally, the load resistor R_1 is large so that a high gain is obtained from the valve, and R, the charging resistor, is also large in order to avoid excessive grid current.

The rate at which the anode runs down is given by:

$$\frac{V}{CR} \text{ volts/sec.}$$

where V is the potential to which the grid leak R is returned; C and R are as indicated on the circuit.

As an example, if the grid leak were returned to +250V, C were 0.01μF and R 1MΩ, the rate of the run-down would be:

$$\frac{250}{0.01 \times 1} = 25\text{kV/sec.}$$

If the total anode excursion were 200V, then the time taken to run down would be:

$$t = \frac{200}{25{,}000} = 0.008 \text{ secs.}$$

Fly-back Suppression

The fly-back time will be long because, as already mentioned, the anode load R_1 must be large to obtain high gain from the valve, but C recharges through it, ready for the next run-down. In order to overcome this difficulty, it can be arranged to switch off the current in the c.r.t. during the fly-back period.

In Fig. 4*b* the suppressor waveform is shown. This takes the form of a "square wave," that is, a sudden change from one constant voltage to another. Now if this waveform were applied to the grid of the c.r.t., it would drive it positive during the run-down and current would flow. The spot on the c.r.t. screen would, therefore, be visible. When the fly-back occurred, however, the grid would be driven negative, the current in the tube cut-off, and the spot would disappear during fly-back.

At this point, it is worth mentioning that there are two modes of timebase operation. When the circuit is operating in a freely-oscillating condition and producing a waveform as in Figs. 1 or 2, it is said to be "free-running." This is suitable for observing sine waves or any waveform where the part to be observed is comparable in duration with one complete cycle.

In some applications, however, one may wish to examine a short pulse of perhaps 1 microsecond, which only occurs every tenth of a second. The timebase would have to run at 10c/s if it were free-running, in order to observe the pulse steadily on the screen. However, if the pulse only lasts 1 microsecond and the spot moves across the tube in one-tenth of a second, the pulse will be too short to be seen. Fig. 5*a* illustrates this.

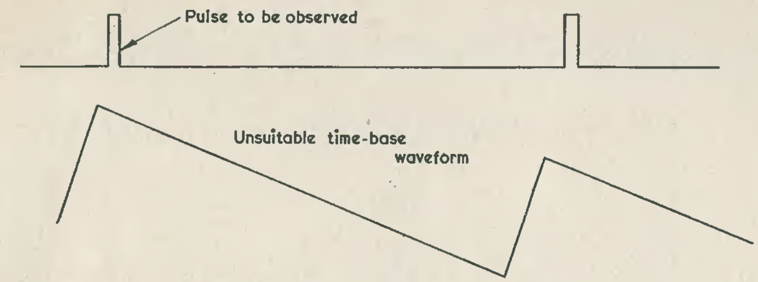


FIG. 5 (a)

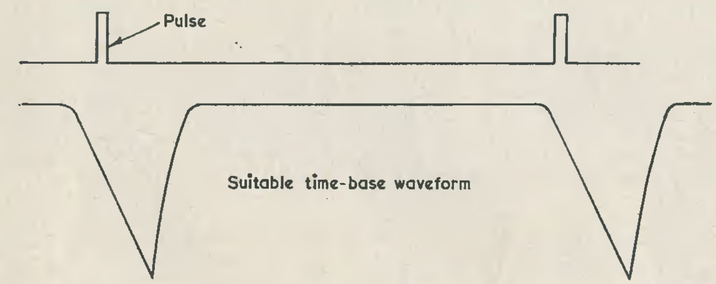


FIG. 5 (b)

In order to overcome this effect, a timebase may be used in the "triggered" or "single stroke" mode. Here the timebase is started on receipt of a "trigger" which may be the pulse to be observed. The timebase will produce one sweep, fly back and then rest until the next pulse occurs. This mode of operation can be very useful for television work, where complex waveforms have to be examined, some of which are short compared to the time in which they occur.

Fig. 5*b* shows a typical short pulse and the timebase waveform required to enable complete examination of it.

This digression on the modes of timebase operation does not, however, explain where the square wave comes from in Fig. 4*a*. There are many ways of generating square waves, but for the Miller timebase a frequently used one is the "transitron," which may use the same valve as the timebase itself. The combination of Miller and transitron produce a timebase oscillator with linear sweep for the tube, automatic fly-back suppression and quite good synchronising characteristics. The transitron may also be used as an ordinary oscillator, a frequency divider, or even a t.v. sync separator.

It is, in fact, such a useful circuit it would be worth a closer look next month.

THE "FULL-TONE" AMPLIFIER

We understand that some readers have had difficulty in obtaining the output transformer specified for the Full-Tone Amplifier. A suitable alternative transformer is the "Winrad" type OPT7, and this is available from Messrs. Home Radio of Mitcham at 17s. 6d. This alternative transformer functions as efficiently as that originally specified, but the mounting holes differ slightly.

NOTES ON RADIO CONTROL

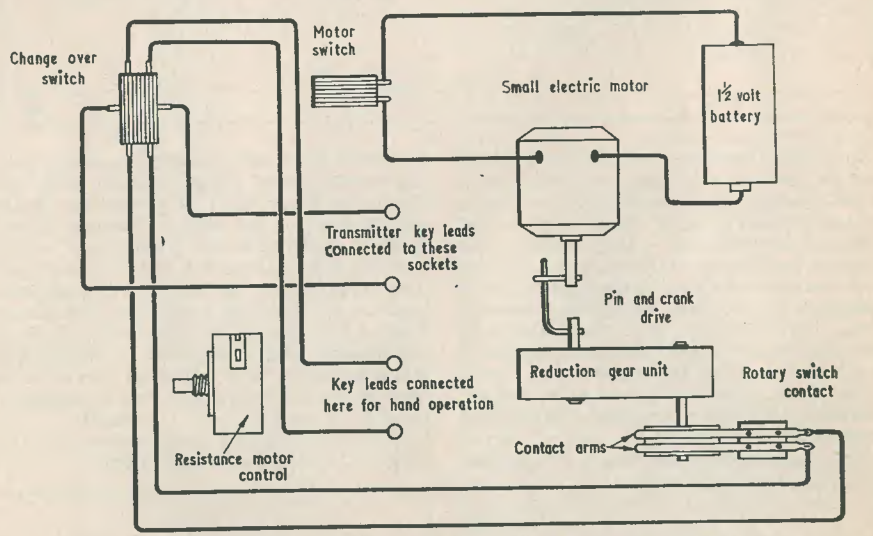
10: *An Auto-switch for the Transmitter*

by **QUENCH COIL**

MOST READERS OF THESE NOTES WHO have done much practical work will be very familiar with the awkwardness of having to get an assistant to switch the transmitter off and on whilst testing, or tuning up the receiving equipment some distance from the transmitter, and the even more annoying procedure of often having to shout directions "On" — "Off" — "On" — "Off" numerous times, over considerable distances. Quite obviously some automatic means of doing this would prove a great boon to the radio-controlled-model maker. The writer felt that the construction of an automatic switch to do this would be very well worth while. In designing it he felt that one feature must be that the time intervals of "Signal On" and "Signal Off" should be adjustable.

It is quite a simple matter to design and construct a rough-and-ready mechanism to do this switching for one, but it is worth while building the unit up nicely and incorporating one or two switching devices which will add convenience to the operation of the transmitter.

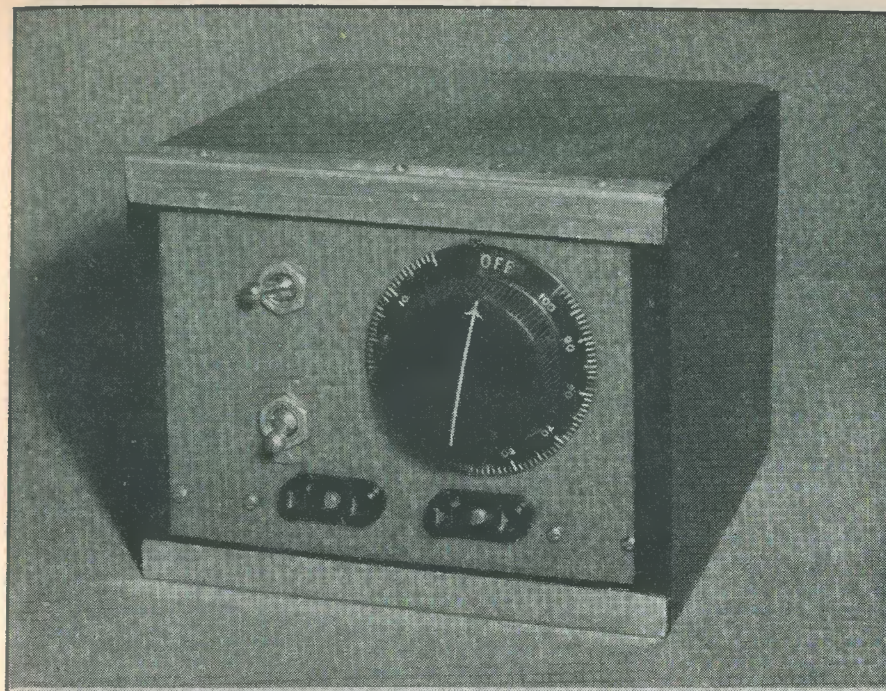
Fig. 1 shows one such unit recently built by the writer and Fig. 2 shows the "works." Two such mechanisms are illustrated in Fig. 2, that on the right being the one incorporated in the completed unit shown in Fig. 1. Fig. 3 shows the wiring diagram and general layout of the parts.



If the resistance is fitted, connect in battery supply. It should be of a type with an off position or a separate switch will be required

FIG. 3.

It will be seen that a small rotary switch is rotated by reduction gearing driven from a small electric motor. A gear reduction ratio of about 500 to one is needed if one of the



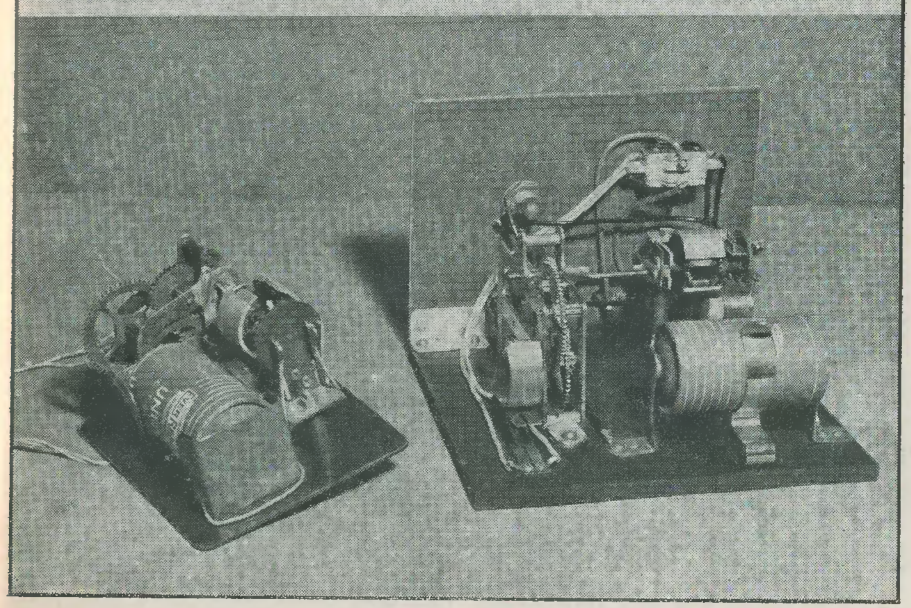


Fig. 1. Auto switch in its cabinet; note the clean lines

Fig. 2. Two types of auto transmitter switch; that on the right is fitted with a speed control

high speed miniature motors is used. These motors run quite well off flash lamp batteries and, provided the gear train runs freely, they will provide ample power.

Obtaining a suitable gear train may prove something of a difficulty, however. The writer used a set of gearing from an old gas meter indicator unit. Another possible source is from a child's clockwork train mechanism, and similarly, an old alarm clock may be located in one's own or a friend's junk box and pressed into service. Coupling between the motor and the gearing can be made via a pin and crank drive.

The rotary switch can be made up from a circular piece of wood cut from the end of a broom handle. Drill a hole squarely in the centre small enough to allow the disc of wood to be forced on to the gearing spindle from which the drive is to be taken. Cut a shallow slot across the face of the disc and force a piece of brass strip into it, bend it round half the circumference of the disc and fix the other end similarly. Arrange two arms of springy brass strip as shown to make contact with the brass contact on the wooden disc. This will make up into a perfectly satisfactory rotary switch. Speed variation is obtained by wiring a variable resistance suitable for the motor in series with it and the battery.

In the writer's unit, a two-way double-pole switch is wired up as shown in Fig. 3, so that a rapid change-over can be made from auto switch to manual as required.

THE "METEOR"—*continued from page 94*

Remembering that these holes must also coincide with the chassis front wall, carefully hold these together in the position they normally occupy when bolted together and use these holes as markers for the chassis wall. Alternatively, take the chassis wall measurements direct from Fig. 2. Having drilled both the panel and the chassis wall, these holes must now be enlarged sufficiently to take the various condensers and the potentiometer. This may be done either with a file, in which case it is apt to be rather laborious, or, better still, with a ⅜" bit fitted into a carpenter's brace—if one is available. The hole edges are then cleaned off with a small file. The chassis backdrop should next be similarly treated as shown in Fig. 2. Finally, the chassis deck itself should be marked as previously described, punched and drilled and the chassis cutter brought into operation.

Drilling etc., completed, we now proceed with bolting and fixing the various components into position. Commence with the valve and coil holders. A careful study of the photographs will reveal the manner in which this is done. Looking towards the rear of the chassis, i.e., from the front panel, the coil holder should be so placed that the white spot (not seen in the photograph), is at the left rear. Mark the fixing holes, drill and bolt into position. Valveholder number one should be so placed that the spigot guideway is at the right rear. Valve number two guideway is positioned at the left front. When bolting these two into position, two earthing tags (one for each valve), should be fixed into place on the bolt, and under the nut, nearest the coil holder. Thus, each valve has its own earthing point; for V_1—nearest the coil; and for V_2—nearest the valve V_1.

The small bandspread condenser should now be fitted to both the panel and chassis; this will hold these together while fitting the other components into position. Next, fix the potentiometer and the remaining variable condensers in position, except C_a.

With the condenser C_a, it is of the utmost importance that this should not be earthed to the panel at any point, therefore the fibre washers supplied with this (see Component list) should be placed over the spindle at both the rear and front of the panel, the small washer being, of course, in the centre of the larger two in order to ensure that no contact is made with the panel.

Turning to the backdrop (rear wall of the chassis), place in position the rubber grommet and secure the phone jack (see illustrations). The paxolin aerial and earth strip should now be placed in position so that the aerial bolt is centred within the aperture already drilled; it should *not* be touching the metal chassis otherwise all the signal will be going "down the drain," i.e., the aerial will be earthed. The outside bolts of this paxolin strip should be bolted to the chassis, the outside one (looking at the underside of the chassis) being used as an earth connection. The inner bolt is also used to hold into position a small three-way tag as the photographs show.

This, then, completes the first instalment at the stage where, the circuit having been briefly described and the drilling and assembly completed, we are now in a position to continue next month with the actual wiring-up details together with the power unit description. For those interested, Part 3 will contain details of the dial cursor, the actual operating of the receiver and some notes apertaining to aerials. Best wishes to all our beginner readers, and we trust that by next month they will be ready to go ahead with the remaining steps.

END-ON CHASSIS CONSTRUCTION

by F. C. WARREN

THIS ARTICLE DESCRIBES A TYPE OF CHASSIS construction and component layout which possesses several novel features, and which can be used with advantage in certain applications.

Probably, in nine cases out of ten, a piece of electronic apparatus, whether it be receiver, amplifier test gear or some other equipment, is built on the conventional type of chassis consisting of a horizontal platform provided with two or more sides which support the platform and enclose a space beneath it in which many of the components and much of the wiring can be accommodated. In the majority of the remaining cases, either the components are secured directly to the inside walls of a casing, and no chassis, as such, is employed; or alternatively a chassis in the form of a vertical metal plate is used. In the latter arrangement components can be mounted on both sides of the plate, which is often convenient, but it suffers from the disadvantage that valves usually have to be mounted in a horizontal position, which position is not suitable for all types of valves and furthermore is actually detrimental to many valves unless they are carefully oriented about the horizontal axis, in accordance with the makers instructions.

However, a "vertical" a rangement in which the apparatus as a whole forms a "vertical block," can prove more suitable in some cases.

For example, it is sometimes desired to fit a receiver or amplifier into a deep but narrow space in an existing cabinet—perhaps when an old radiogram is being rebuilt and modernised, or where it is desired to build a record player into a piece of furniture. Sometimes also, a particular piece of test equipment has to be housed in a narrow space in a transmitter layout or in a mobile equipment, and it is in such applications that the "end-on" construction finds favour.

A further attractive feature, from the amateur constructors point of view, is that the "end-on" chassis construction to be described can easily be made from a standard aluminium or steel chassis, and it can be easily made with only a few simple tools.

A general perspective view of an "end-on" chassis is given in Fig. 1. Basically, this consists of a conventional aluminium or steel chassis in which a three-sided cut has been made in what is normally the top of the chassis (but which now forms one side) and the piece of metal bounded by the cut has been bent outwardly to form a platform. This platform is generally used for supporting the valves of the apparatus built on the chassis which itself rests on a base formed by what is normally one of its sides.

The platform can easily be cut out with the aid of a padsaw, or one of the thin round blades which can be fitted in a hacksaw frame; a hole being drilled at one end of the line marking the path to be cut to obtain a start for the blade similar to the generally well-known method employed in fretwork.

The size of the platform will depend upon the type and number of valves which it is to support, and more about sizes will be said later on. The lines marking where to cut with the saw are best made with the aid of a scriber. After the cuts have been made the platform is bent up at right angles to the surrounding metal. The easiest way to do this is to start the bend by hand, by pushing the platform outwardly, and then continuing to bend it out by light blows with a hammer. The final bending should be done over a right-angled corner, such as the edge of a bench or table as shown in Fig. 2, so that a nice square angle can be obtained between the platform and the surrounding metal by tapping the metal with a hammer to conform to the edge of the bench or table.

After the platform has been bent up at right angles to the surface of the chassis, its sawn edges and those of the aperture which it occupied should be smoothed-off with a file. In order to support the platform and make a rigid structure, angle brackets are secured at each end between the platform and the chassis proper. These are cut from strip metal, or any scrap sheet metal available, and can be easily bent in a vice. They are fastened in position by means of nuts and bolts passed through appropriate holes drilled in the ends of the angle brackets and in the chassis. A sketch of a completed bracket is shown in Fig. 3.

Fig. 1 gives certain measurements for an "end-on" chassis made from a 9in. × 12in. aluminium chassis with 2½in. deep sides, which is amply large enough for building a 5-valve receiver or amplifier, and can easily be housed in a space some 4½in. wide by 10in. deep × 13in. long. The measurements given for the platform and its relative position on the chassis are convenient where international octal base valves of the American type "GT" series are employed, but the size and positioning of the platform will depend on the number and type of valves to be employed and on the other components of the apparatus.

As can be seen from Fig. 4, a horizontal shelf is arranged inside the chassis extending between the two ends and at a level which is substantially that of the bottom of the aperture where the platform has been bent-up. The shelf is cut from a piece of sheet metal and is provided with side flanges bent down at each end by means of which it is bolted to the sides of the chassis. This shelf serves to divide the interior of the chassis into two compartments, namely an upper and a lower compartment; the latter being conveniently employed to house the power unit components, in which case the shelf forms a useful screen in addition to supporting the components.

One or more brackets also formed from

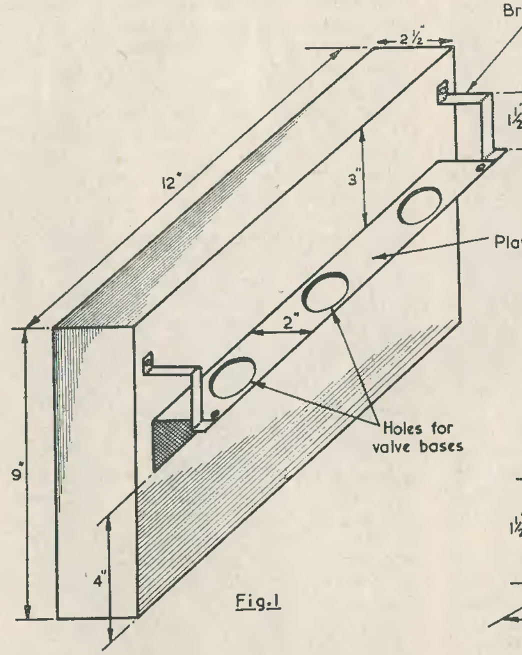


Fig.1

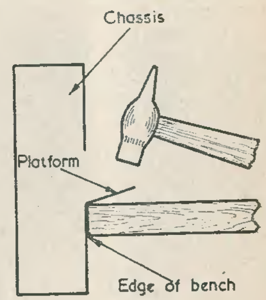


Fig.2

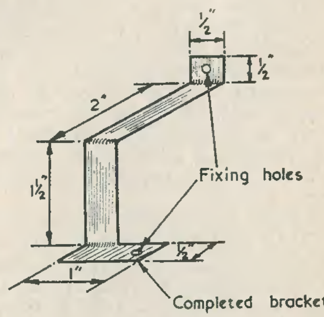


Fig.3

E200

Fig. 4 shows a rear elevational view of the chassis, illustrating further stages in construction and showing some components mounted in position. It will be appreciated that the components are shown only to give an impression of the type of layout which may be employed, and are not intended to represent a particular piece of equipment.

metal strip can be secured between the top surface of the chassis and the shelf, and these serve as a support for controls such as variable resistances—as shown in Figs. 4 and 5—in which case the spindles project horizontally. Other controls can be mounted on the top surface or on the ends of the chassis.

One advantage of the "end-on" construction is that it affords a wide variety of possible positions for locating controls, which can conveniently extend in any of the three planes of the chassis.

Fig. 5 is a vertical section through an "end-on" chassis giving another view of the relative positions of the components.

Having got so far, suitable layouts of components will be discussed. Generally

rectifier, if desired, mounted below the shelf in the lower compartment.

3. Controls mounted on the top or ends of the chassis or on brackets in the upper compartment.

Having disposed of the major components, the smaller condensers, resistors and the like can be mounted on tag panels secured to convenient points on the chassis or platform, or in the wiring below the platform and

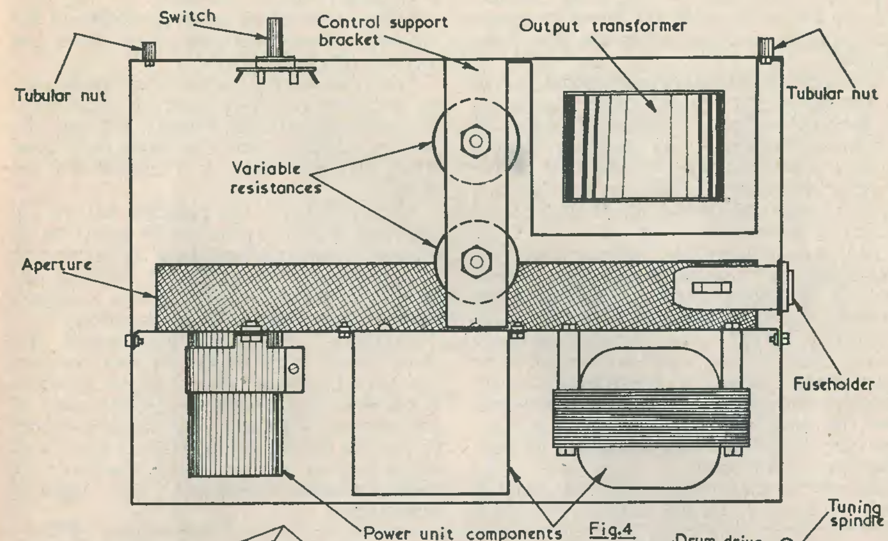


Fig.4

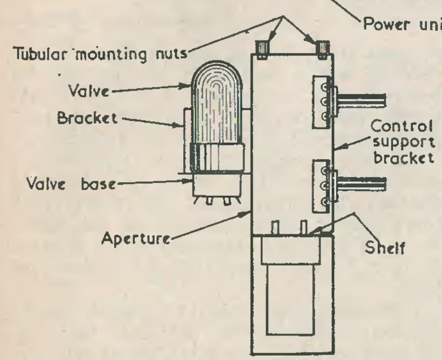


Fig.5

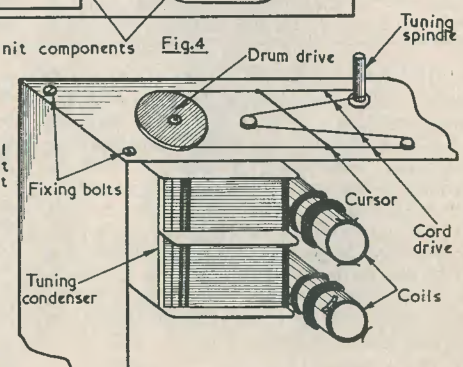


Fig.6

E201

speaking, the following disposition of the major parts will prove most suitable.

1. Valveholders mounted on the platform.
2. Power pack components—including

adjacent the valveholders. The h.t. leads will extend through the shelf or along its upper surface and will be convenient for feeding through the aperture to the valves and associated components mounted on the platform. Decoupling condensers can be mounted in clips on the upper side of the shelf.

The upper compartment can also house components such as coils, and tuning condensers in the case of a receiver, as well as intervalve and output transformers, which are bolted to the chassis and spaced so as to be near their associated valves.

Fig. 6 is a perspective view of a suggested mounting arrangement for a tuning condenser together with its associated cord drive for a horizontal cursor intended to move over an oblong dial. Tuning coils can also be seen mounted inside the upper compartment, and these are bolted to the side of the chassis.

The next point to be considered is the mounting of the chassis inside the casing or cabinet. In some instances this can be simply accomplished by securing flanges along the bottom edges of the ends of the chassis, which are drilled to take screws, by which the chassis may be secured to the casing or cabinet.

Another convenient arrangement for mounting the chassis, particularly where control spindles extend through the top surface, is shown in Figs. 4 and 5. This comprises tubular nuts mounted at each corner of the chassis, which is intended to be suspended beneath a horizontal control panel by means of bolts passing downwards into the threaded bore of the tubular nuts; the control spindles also extending through apertures in the panel.

In case some readers are not familiar with the tubular nut, this consists of a short metal tube tapped at both ends to take a bolt. Thus the nut can be bolted to a chassis by means of a bolt at one end and at the same time serve as a threaded metal socket to receive a fastening bolt at its other end for fastening the chassis in position. If these nuts cannot readily be bought, they can easily be made by tapping duralumin or brass tube of the appropriate bore to take the desired size of bolt. A 4BA bolt is a convenient size, as the overall outside diameter of the tube is then about $\frac{1}{4}$ inch. The nuts may be made about $\frac{3}{4}$ inch overall length, so that they will comfortably accommodate $\frac{3}{8}$ inch of threaded bolt in each end.

Various modifications are possible to the "end-on" chassis both as to its shape and method of construction.

For example, the ends of the chassis may be omitted, in which case bracing struts may extend vertically between the top and bottom adjacent their free edges, and these struts may also serve as a support for the shelf.

Also, if desired, the platform can be cut right out from the chassis and bolted on by means of angle brackets along the upper edge of the aperture. This avoids bending and may be easier to do, though it is a slightly more lengthy method of construction.

Doubtless, individual constructors will think up all sorts of further modifications and variations which automatically spring to mind when designing a particular piece of equipment. The aim of this article has been to give the broad idea of this very useful and novel type of chassis layout, together with some practical examples and working instructions.

RADIO MISCELLANY—*contd. from p. 102*

was at this odd moment that one of the amateurs (who spoke only QSO English) asked me why all the British amateurs he contacted were using a pair of 807's in *parallel* in the P.A. Apparently it seemed a shocking waste to him, when one can get so much more out of them in push-pull. I managed to make him understand that when one in three Styrian families looked-in to the signals from this very aerial, it would be a safe bet that he himself would be using 807's in parallel.

TV On a Shoe-String

On my return an acquaintance welcomed me more cordially than I would have expected. "I am glad you are back," he admitted, "there's something I want to ask you." (It is quite time I started to charge a consultation fee. After all, it is not fair to undercut Query Corner, and the clients never want anything to do with you until they are in trouble!)

Apparently he had bought an old t.v. receiver which had been out of use for several years on account of a c.r.t. breakdown. He bought it cheap and managed to scrounge a tube with a scorch mark.

To his delight it worked perfectly—except for one thing. When he adjusted it so that the picture filled the picture area there was a certain amount of distortion. Would I look at it. Softened up by a bit of flattery, I weakly promised I would—some time.

Fortunately my brain (? dulled by the holiday) recovered by the next morning. As soon as I began to think the answer was obvious. As it was an old set it obviously had the old aspect ratio. He was trying to fit a four-by-three transmission into it! Now he's looking round for a cheap mask (current pattern).

P.S.—It seems to have cost him next to nothing so far. I'll bet he feels it would be a shame to have to pay out good money for a licence!

VIBRATOR DATA

PART 2.

Compiled by E. G. BULLEY

Radiart	ATR	Turner	Delco	Electronics	James	Mallory	Meissner	National Union	Utah	Oak	Wearite	Volts	Max. load (amps)	Frequency c/s	Remarks
4258-12	—	—	—	—	—	—	—	—	—	—	—	12	6	115	S
4258-32	—	—	—	—	—	—	—	—	—	—	—	32	2.5	115	S
4260	340	T15S	8542	2605	PJ18	866	495	406	NP485	V5745	NSB6	6	6	115	NS
4301	324	TU3S	5043025	—	PJ12	825	403	—	NP489	—	NSB6	6	6	115	NS
4306	—	—	—	—	—	—	—	—	—	—	—	6	5	180	S
4306-12	—	—	—	—	—	—	—	—	—	—	—	12	3	180	S
4306-24	—	—	—	—	—	—	—	—	—	—	—	24	2	180	S
4313	324	TU3S	5052378	—	PJ12	825	403	—	NP489	—	NSB6	6	6	115	NS
4314	—	—	—	—	—	—	—	—	—	—	—	32	1.4	115	NS
4318	—	—	—	—	—	—	—	—	—	—	—	6	6	115	NS
4319	—	—	—	—	—	—	—	—	—	—	—	32	1.4	115	NS
4320	325	T19S	5052374	—	PJ19	296	452	—	NP65	W5495	—	6	6	115	NS
4332	—	—	—	—	—	—	—	—	—	—	—	32	1.5	180	S
4402	520	T61	8610	2688	PJ61	245	715	—	SP5	—	QL6	6	6	115	S
4403	520A	—	8611	—	—	245A	787	—	SP56	—	QL6	6	6	115	S
4404	2401	32T59	1208920	—	—	F247	561	—	—	—	—	32	1.4	115	S
4414	525	T63	8268	2687	PJ57	249	719	—	SP72	—	QD6	6	6	115	S
4415	—	—	—	—	—	—	—	—	—	—	—	6	6	115	S
4415-12	—	—	—	—	—	—	—	—	—	—	—	12	4	115	S
4416	522	—	8634	2089	PJ58	246	712	600	SP66	V6270	QE6	6	4	115	S
4417	541A	—	8752	—	—	W245A	800	—	4SP56	—	—	4	6	115	S
4500	—	—	—	—	—	—	—	—	—	—	—	6	6	115	S
4501	524	T65	8616	2107	PJ65	248	723	602	SP63	—	—	6	6	115	S
4502	503	T55	8619	—	PJ55	270B	705	—	SP50	—	—	6	6	115	S
4504	507	T62	8622	—	PJ62	273D	718	—	SP52	—	—	6	6	115	S
4505	506	—	8620	—	—	271HD	—	—	—	—	—	6	6	115	S
4607	—	—	—	—	—	—	—	—	—	—	—	6	4	115	S
4608	—	—	—	—	—	—	—	—	—	—	—	6	4	115	S
4610	—	—	—	—	—	—	—	—	—	—	—	6	4	115	S
4611	507	T62	8622	—	PJ62	273D	718	—	SP52	—	—	6	6	115	S
4612	522	—	8613	2089	PJ58	246	712	—	SP66	V6270	QE6	6	4	115	S
4613	508	T54	8621	2682	PJ54	273C	704	—	SP51	—	—	6	6	115	S
4614	508	T54	8621	2682	PJ54	273C	704	—	SP51	—	—	6	6	115	S
5300	340	—	8540	1703	—	859	495	404	NP484	V5745	NSB6	6	6	115	NS
5300-12	—	—	—	—	—	—	—	—	—	—	NSB12	12	6	115	NS
5300-32	2324	32T3S	8704	—	32PJ3S	F294	554	—	32NP42	—	—	32	1.4	115	NS
5301	340	—	8540	2605	—	859	495	404	NP485	V5745	NSB6	6	6	115	NS
5303	335	T9	8528	—	PJ9	852	435	—	NP480	—	—	6	6	115	NS

Radiart	ATR	Turner	Delco	Elec- tronics	James	Mallory	Meissner	National Union	Utah	Oak	Wearite	Volts	Max. load (amps)	Frequency c/s	Remarks
5304	—	—	—	—	—	—	—	—	—	—	—	6	6	115	NS
5304-32	—	—	—	—	—	—	—	—	—	—	—	32	1.4	115	NS
5305	340	—	8540	2605	—	859	495	406	NP485	V5745	NSB6	6	6	115	NS
5306	325	T4S	8511	—	PJ6	298	442	—	NP61	V5495	—	6	6	115	NS
5307	—	—	—	—	—	—	—	—	—	—	—	6	6	150	NS
5308	347	—	8539	—	—	839	—	—	—	—	NSB6	6	6	115	NS
5309	328	T8S	8510	2090	PJ18	854	440	408	NP43	V5770	—	6	6	115	NS
5310	340	T15S	7239124	2605	PJ18	903M	454	406	NP485	V5641	NSB6	6	6	115	NS
5312	325	T14S	5052374	—	PJ14S	299	452	—	NP65	V5495	—	6	6	115	NS
5313	324	T12	5052378	—	PJ12	294	403	—	NP489	—	NSB6	6	9	115	NS
5314	350	—	8543	2041	—	1100	—	400	NP490	—	NSB6	6	6	115	NS
5320	324B	—	5042703	2685	J15ST	505P	464	—	NP64	—	NSB6	6	6	115	NS
5321	340	T15S	7239124	2605	PJ18	902M	495	406	NP485	V5745	NSB6	6	6	115	NS
5322P	340	T15S	7239124	2605	PJ18	902M	495	406	NP485	V5745	NSB6	6	6	115	NS
5323	340	T15S	7239124	2605	PJ18	902M	495	406	NP485	V5745	NSB6	6	6	115	NS
5324P	337	—	—	—	J16	506P	—	—	—	—	—	6	6	115	NS
5325P	340	T15S	7239124	2605	PJ18	902M	495	406	NP485	V5745	NSB6	6	5	115	NS
5326P	340	T15S	7239124	2605	PJ18	902M	495	406	NP485	V5745	NSB6	6	6	115	NS
5327P	340	T15S	7239124	2605	PJ18	902M	495	406	NP485	V5745	NSB6	6	3	115	NS
5328-32	—	—	—	—	—	—	—	—	—	—	—	32	1.4	115	NS
5330	340	T15S	7239124	2605	PJ18	902M	495	406	NP485	V5745	NSB6	6	6	115	NS
5331	328	T8S	8510	2090	PJ8	294SW	440	408	NP43	ZW37216	—	6	6	115	NS
5333	338	—	7237666	2689	J9S	860	—	—	—	—	—	6	6	115	NS
5334	345	T9S	7238685	2088	PJ7	870	436	402	NP487	—	—	6	6	115	NS
5335	345	T9S	7238685	2088	PJ7	870	436	402	NP487	—	—	6	6	115	NS
5339	345	T9S	7238685	2088	PJ7	870	436	402	NP487	—	—	6	6	115	NS
5340M	340	T15S	7239124	2605	PJ18	903M	495	406	NP485	V5745	NSB6	6	6	115	NS
5341M	340	T15S	7239124	2605	PJ18	903M	495	406	NP485	V5745	NSB6	6	6	115	NS
5342	340	T15S	7239124	2605	PJ18	903M	495	406	NP485	V5745	NSB6	6	6	115	NS
5343M	324	TU3S	5052378	—	PJ12	825	409	—	NP489	—	—	6	6	115	NS
5363	303	T1A	5053699	—	J1A	503	400	—	NL3	—	—	6	4	115	NS
5365	325	T19S	5052374	—	PJ14S	299	452	—	NP65	V5495	—	6	6	115	NS
5366	325	T19S	5052374	—	PJ14S	299	452	—	NP65	V5495	—	6	6	115	NS
5367-32	—	—	—	—	—	—	—	—	—	—	—	32	1.4	115	NS
5400	524	T65	5053501	2107	PJ65	287M	723	602	SP62	—	—	6	6	115	S
5404	540	T69	8637	—	PJ69	954	734	—	SP633	—	—	6	6	130	S
5405	521	T60	5053181	—	PJ60	245C	714	—	SP55	—	—	6	6	115	S
5406	525	T63	5053183	2687	PJ57	289Y	781	—	SP72	—	QD6	6	6	115	S
5406-12	1548	—	8757	—	12J63	G249	310	—	—	—	QD12	12	6	115	S
5407	545	—	8636	—	—	953W	—	—	SP641	—	—	6	5	180	S
5408	564	—	—	—	—	748	—	—	—	—	—	6	6	140	S
5409	520	T61	5053185	2688	PJ61	245	715	—	SP57	—	QL6	6	6	115	S

*S=synchronous. NS=Non synchronous. *(to be continued)*

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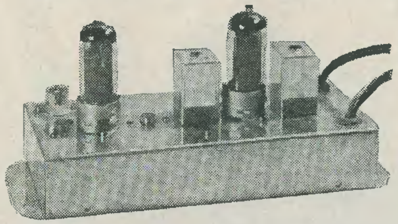

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Hardware bag (Nuts, Bolts, Tags)		1	6
Solder			6
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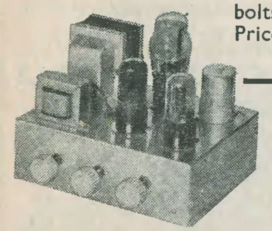

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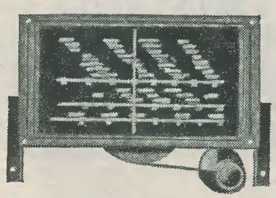

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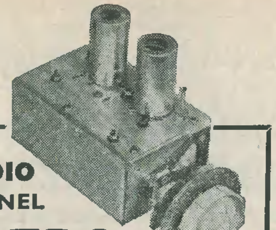

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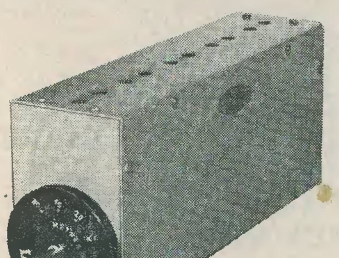

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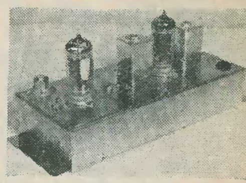

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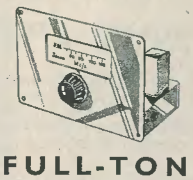

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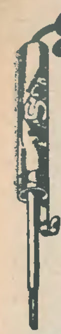

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[*continued on page 127*

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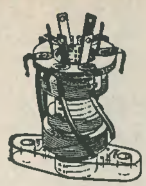

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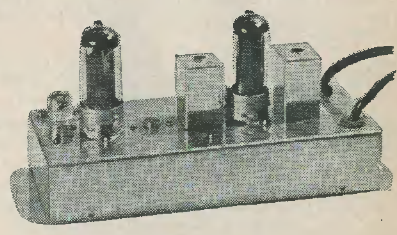

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continued from page 125]

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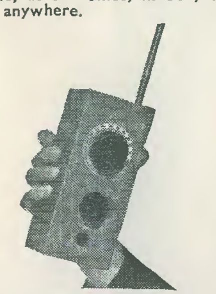

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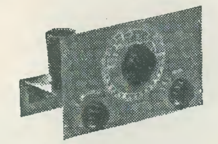

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