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The RADIO CONSTRUCTOR

for the Radio and Television Enthusiast

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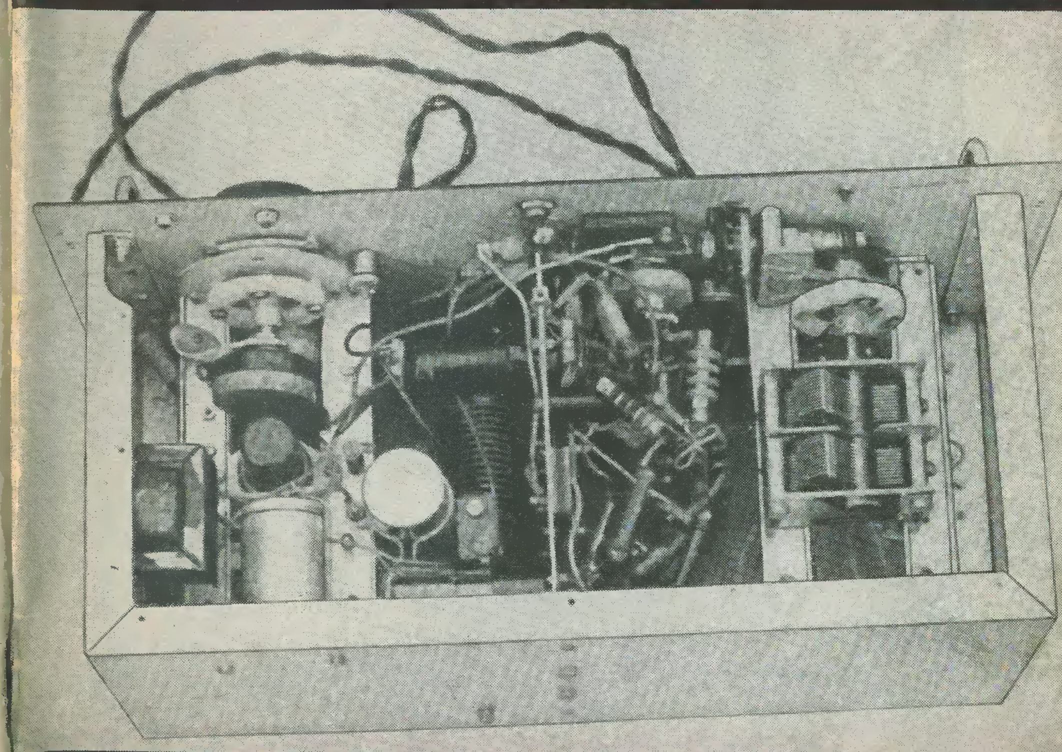

IN THIS ISSUE . . .

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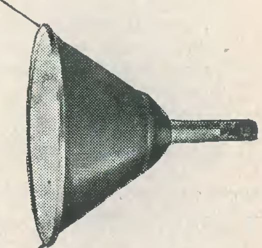
The wide viewing angle is one of many reasons why 'ENGLISH ELECTRIC' metal C.R. tubes are chosen for the 'Tele-King', 'Magnaview', 'View-Master' and other home constructor circuits today



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'ENGLISH ELECTRIC'

Metal C.R. Tube

The Radio Constructor

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Edited by C. W. C. OVERLAND, G2ATV

CONTENTS

NOTICES

THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should 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 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 *Radio Constructor*, 57, Maida Vale, Paddington, London, W.9. Telephone CUN. 6518.

A Companion Journal to THE RADIO AMATEUR

Suggested Circuits for the Experimenter

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

No. 24: A Local Station Fidelity Switch

Although it is often necessary to employ a superhet receiver for normal medium and long wave reception, such a receiver has disadvantages when high-fidelity reproduction is required. Because of its relatively high selectivity, some constructors do not use the superhet at all for local station reception; employing a TRF tuner unit in its stead. This month's circuit illustrates a switching arrangement which may be fitted to nearly all superhets employing the conventional single valve IF amplifier. When the circuit is switched to the "Sharp" position the receiver operates in its normal manner. When switched to "Broad," the selectivity response of the receiver is made considerably wider and approximates to that given by a TRF unit.

Operation

The switching circuit is wired around the second IF transformer in the receiver. When the two-position switch, S1, S2, is set to "Sharp," the IF transformer functions in the normal fashion, R1 and C1 acting as an HT decoupling circuit for the primary. The diode detects the voltage appearing across the transformer secondary, the resultant AF being built up across R3. The filter R2, C2 and C3 is conventional, except for the fact that C2 is returned to chassis via C1 and not by a direct connection. AVC is obtained from R3.

When S1, S2 is set to "Broad," this state of affairs is altered. S1 breaks the connection to C1 and, instead, short-circuits the primary of the IF transformer. In addition, S2 short-circuits the secondary. The coupling between the IF amplifying valve and the diode now becomes aperiodic, R1 being the anode resistor and C2 the coupling capacitor.

In the "Broad" position the selectivity of the receiver is that offered by the first IF transformer alone, together with the signal tuned circuits fitted before the frequency changer.

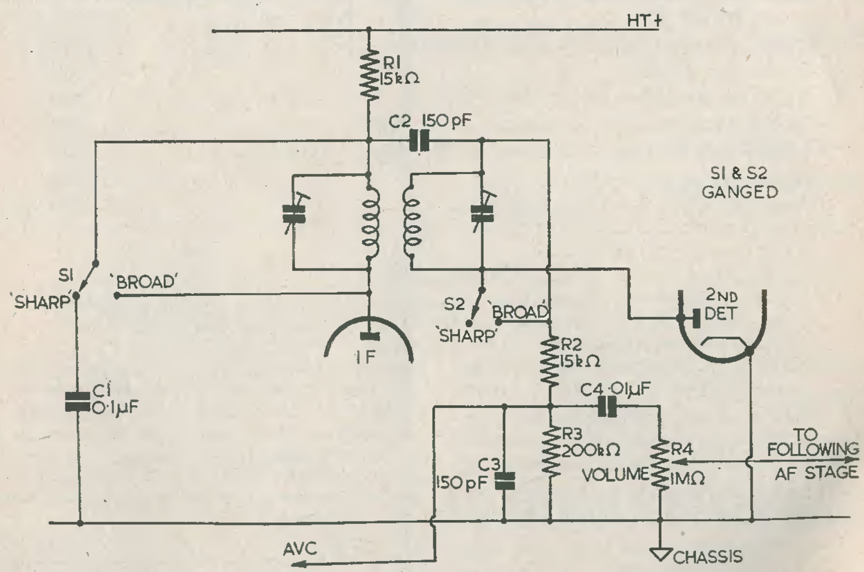
In Practice

Due to the simple nature of the switching, it should not be very difficult to add this circuit to a finished receiver or to one whose construction is being contemplated. Connecting leads must, of course, be kept short.

There will be a noticeable drop in sensitivity when the receiver is switched from "Sharp" to "Broad." If the switch is operated when local stations are being received (as is intended) much of the sensitivity drop will be taken up by the AVC circuits. AVC is operative in the "Broad" position as well as in the "Sharp" position.

It will sometimes be found possible to improve results by varying the value of R1. The value given in the circuit diagram is fairly low, and greater sensitivity might be obtained if it were increased. Should it be made too large, however, instability may result.

A final point lies in the fact that the diode may be part of a double-diode-triode operating with cathode bias. In this case R3 should be returned to the cathode of this valve instead of to chassis. (It should be remembered that this will give the AVC line a permanent positive bias equal to the cathode bias of the double-diode-triode).



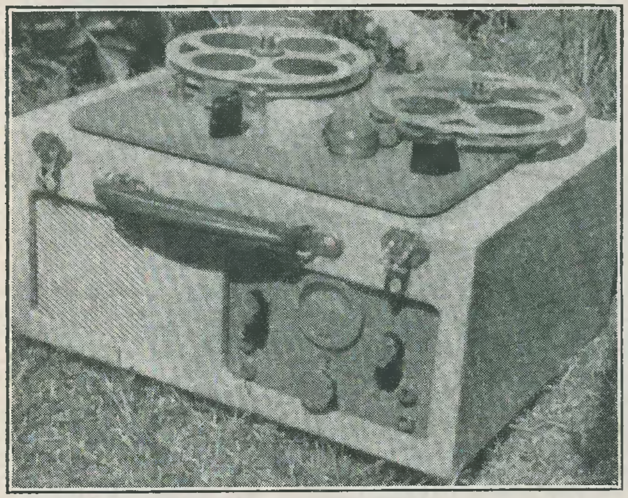
RC5

THE RADIO AMATEUR

The November issue of our companion journal contains the first of a series entitled "Model Aerials" by F. C. Judd, G2BCX, and a 2-Metre Converter by J. N. Walker, G5JU. An unusal item is a medium Wave Converter by W. Cameron, which will be of interest to many readers who use an ex-WD receiver. Other items of interest are a Simple Negative Feedback Device by F. L. Bayliss, A.M.I.E.T., and part 4 of the series "The Design of Mains Transformers." The usual regular features "Amateur Bands Commentary," "Broadcast Bands Review" and "On Higher Frequencies" are also carried.

INDEX TO
Vol. 5. 1951-1952

A four-page index covering the issues Aug. 1951 to Aug. 1952 is available free of charge. Just send in a stamped, addressed envelope of suitable size, to "Index RC" A.S.W.P. 57 Maida Vale London W.9



A MAGNETIC TAPE RECORDER

By L. F. SINFIELD, A.M.I.P.R.E.

FURTHER NOTES AND MODIFICATIONS

Revisions and Alterations

Since the original circuit of the recorder was developed, the whole unit has undergone constant changes to achieve the maximum versatility and the best all-round frequency response.

Basically, these have not drastically changed the circuit, and the alterations can be easily carried out.

The new circuit is shown together with a revised list of component values. These have been selected as optimum after exhaustive tests with audio oscillator and oscilloscope, and after considerable operational use under widely varying conditions.

The Deck

I had mistakenly assumed that Electronic Service (Hallamshire) Ltd., 93-95 Button Lane, Sheffield, had dropped production of their "Qualtape" deck on the introduction of the "Principle" model. I am informed that both types are still in production. The "Principle" is slightly more expensive, but has an improved mechanism, and requires no tape threading or reel clamp adjustment. The reel spacing is slightly greater, so that it may be advisable to make the recorder some ½″ or so longer. The height of the deck is also more, and an additional ½″ or so may be required for the lid. Different shelf dimensions and fixing bush fittings will be needed.

The Head

On the original "Qualtape" deck it was found that when the chromium case around the head was clamped tightly, the case clamping bolt and the case itself formed a complete single short-circuited turn around each pole piece.

This gave very heavy damping on the head at all times, lowered the impedance, and reduced the frequency response and output.

A simple modification to these type heads will cure this fault.

(a) Remove head and unscrew the bottom cover locking nut.

(b) Remove bottom cover plate, taking care not to disturb the head wiring.

(c) Open out the hole for the clamping bolt in the bottom cover to ¼″ diam.

(d) Re-assemble with a small fibre washer on the bolt on either side of the bottom cover plate, so that both the bolt and the securing nut are insulated from the centre of the bottom cover plate.

This alteration removes the shorted turn effect and gives much improved performance, although it is probable that later designs of head, as in the case of the new "Principle" deck, will be free from this defect. In any case, the modification is so simple that it is well worth while to check the head and alter if necessary, but take care not to disturb the pole pieces, their coils and their gaps.

As the heavy internal damping has now been removed, the loading resistor R1 on the input transformer T1 secondary has more effect and this has now been increased to 220 kΩ to obtain the maximum improvement.

On the "Principle" deck the head is uncased, so this modification is not required. It is also identical electrically, so no amplifier alterations are needed.

Monitoring Facilities

There are several instances when it is desirable to monitor the recording while it is being made, and when the programme material is not directly audible. These occur when an electrical input is used, such as a gramophone pick-up when transferring disc recordings to tape or when a radio tuner input is employed (a suitable crystal radio designed for the recorder will be described in a later issue). Another instance occurs if the mike is being used at a considerable distance so that the sound input cannot be heard directly.

In these cases there is no danger of acoustic feedback, so that the internal speaker may be used for monitoring. Therefore, two recording positions are now provided:—

(a) with the internal speaker monitoring the recording

(b) with the speaker off, when the microphone is used near the recorder and acoustic feedback would result from the speaker, if used.

To reduce loading and mismatch, the speaker is operated at lowered volume, whilst monitoring, by means of a series resistor R33. An additional three-way switch is required for speaker switching, but as the other switches are spread over three wafers there will most probably be plenty of spare sections which can be utilised.

Although the "high gain amplifier" position of the original circuit no longer applies, there is adequate gain for normal amplifier purposes by switching to either of the "record" positions and plugging a separate speaker into the external speaker socket. A certain amount of treble boost occurs when doing this, but it is not objectionable.

The addition of the monitoring facilities has been found far more useful than the original arrangement.

General Circuit Changes

From the point of view of hum, it has been found only necessary to use co-axial type lead for the low impedance *input* circuits, between the head and the input transformer. The only earth point on this co-axial wiring is to a tag under one of the bolts fixing the co-axial socket for the head lead. Care must be taken to prevent the co-axial screening touching the chassis at any other point. The output circuits have such a high signal strength compared with hum pick-up that screened cable is unnecessary, and it is required only to well space the input and output circuits and well screen the input circuits. As before, all the metal cased condensers, even the ones on the tag panel, have their cases bonded to chassis, so that they act as screens between stages.

As a pentode or beam tetrode valve has such a high impedance, it is usually better to add some form of tone corrector, although the negative feedback via R19 removes almost all of the distortion caused by using such an output valve. The resistor R32 and condenser C11 give some measure of tone correction. On some output transformers, however, their addition causes oscillation; if so, they can be omitted.

As the altered head is more efficient, it has been found better to use a lower recording level, so R25 has been increased and the meter has been made more sensitive by reducing R26 slightly. A quarter-full-scale deflection gives adequate level. To obtain more accurate compensation of frequency response it has been found helpful to tune the head to 7-8 kc/s during "record." C20 series tunes the head at this point and gives peak boost at this frequency, and on the original modified head worked out at 0.25 μF, but this value will change with other types of head. The resistor R34 limits the peak boost and prevents too sharp a peak which would give "ringing" on transients.

The choke L3 is as before, but is now made into a parallel tuned bias rejector by the addition of C21 (approx. 0.03 μF) which tunes it to 45 kc/s.

To obtain a wider range of bias control, the resistor R35 has been added and R30 reduced to 10 kΩ. If the head alteration is carried out, check that C13 is still the correct value to series tune the head to 45 kc/s.

The condenser C22 can be added for additional peak boost at 7-8 kc/s during playback. This will be of much lower capacitance than C20, as the effect of the input transformer must now be taken into account. 0.1 μF was used on the writer's recorder, but its inclusion is optional.

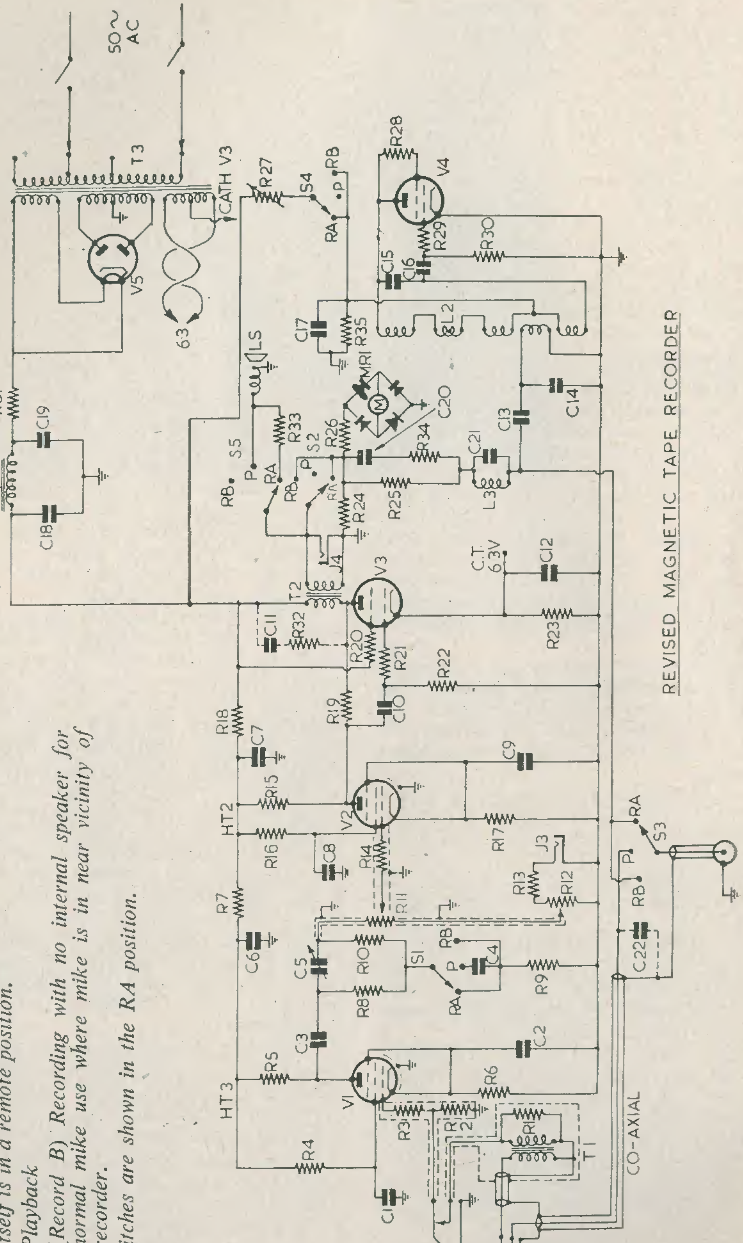
SWITCH FUNCTIONS

RA (Record A) Recording with speaker working at low volume for radio or gram input or for mike when mike itself is in a remote position.

P Playback

RB (Record B) Recording with no internal speaker for normal mike use where mike is in near vicinity of recorder.

All switches are shown in the RA position.



REVISED MAGNETIC TAPE RECORDER

RC8

REVISED COMPONENT LIST

R1*	220 kΩ ½W Erie type 9
R2	3.3 MΩ ½W Erie type 9
R3	15 kΩ ½W Erie type 9
R4	470 kΩ ½W Erie type 9
R5	100 kΩ 1W Erie type 8
R6	1 kΩ ½W Erie type 9
R7	20 kΩ ½W Erie type 9
R8	100 kΩ ½W Erie type 9
R9	15 kΩ ½W Erie type 9
R10	100 kΩ ½W Erie type 9
R11	1 MΩ pot., carbon
R12	50 kΩ pot., carbon
R13	220 kΩ ½W Erie type 9
R14	15 kΩ ½W Erie type 9
R15*	100 kΩ 1W Erie type 8
R16	470 Ω ½W Erie type 9
R17	1 kΩ ½W Erie type 9
R18	10 kΩ ½W Erie type 9
R19*	2.2 MΩ ½W Erie type 9
R20	100 Ω ½W Erie type 9
R21	1 kΩ ½W Erie type 9
R22	470 kΩ ½W Erie type 9
R23	300Ω 1W Erie type 8
R24	3 Ω 3W wire-wound
R25*	100 Ω 2W Erie
R26*	1.2 kΩ ½W Erie type 9
R27	25 kΩ 4W pot., wire-wound
R28	100 Ω ½W Erie type 9
R29	1 kΩ ½W Erie type 9
R30*	10 kΩ ½W Erie type 9
R31	50 Ω 2W
R32*	4.7 kΩ ½W (see text)
R33*	12 Ω 1W
R34*	100 Ω ½W Erie type 9
R35*	27 kΩ 3W
C1	0.1 μF TCC CP45N
C2	50 μF 12V elect.
C3	0.1 μF TCC CP45N
C4*	0.01 μF TCC CP32N
C5	60 μF max. trimmer
C6, 7	16+8 μF metal can plain foil elect. 450V DC
C8	0.1 μF TCC CP45N
C9	25 μF 25V elect.
C10	0.01 μF TCC CP45W
C11*	0.005 μF mica—see text
C12	25 μF 25V elect.
C13	0.03 μF
C14	0.1 μF TCC CP45N
C15	0.002—0.005 μF (tunes osc. to 45 kc/s)
C16	0.002 μF mica
C17	0.25 μF TCC CP48N
C18, 19	16+8 μF metal can plain foil elect. 450V DC
C20*	0.25 μF approx. see text
C21*	0.03 μF approx. (Tunes L3 to 45 kc/s—see text)
C22*	0.1 μF TCC CP45N optional, see text
V1	6J7 metal
V2	6SH7 metal
V3	6V6GT glass
V4	6V6GT glass
V5	5Y3GT glass
T1	Shielded input transformer, mu-metal core, ratio 45:1—100:1
T2	Output transformer, 6V6 to 2½ Ω, ratio 45:1
T3	Mains transformer, drop-through type with shroud, 250—0—250V 100 mA, 6.3V CT 4A, 5V 3A
L1	10H 100 mA
L2	Ocs. coil, as before
L3	RF choke, as before
MR1	1 mA meter rectifier
M	500 μA meter
LS	Internal 6½″ 2½ Ω speaker, PM
J1, 2, 3, 4	Igranic type jack sockets, rear contacts break on plug entry
S1, 2, 3, 4, 5	Ganged switches, 5 pole 3 way on 3 wafers.

* *Indicates Revised Value*

Layout Changes

The bias potentiometer has been moved to a bracket on top and at the rear of the chassis, so as to be more readily accessible.

The switch S3 is now moved to the front wafer, opposite S1. The head socket has been moved nearer the front also, so that the input leads are now further away from the mains transformer field. The reduction in hum due to this has made the hum-bucking loop unnecessary. No trouble should be experienced with feedback between S1 and S3, but a small earthed screen may be mounted on the wafer if desired.

Front wafer.........:S1 and S3
Middle wafer..............S5
Rear wafer..........S2 and S4

(S2, S4 and S5 may be interchanged in position if more convenient).

R26 and the meter rectifier MR1 are mounted on a paxolin strip on the rear of the level meter M.

The notes regarding layout given for the previous circuit apply equally to the revised version.

Accessories

Headphones can be plugged into the external speaker socket for monitoring in either "record" positions. Moving coil type phones of about 60 Ω impedance are used as these have a very good frequency response. To limit the volume, a small ½W series resistor is mounted in the phones. The value should be around 500-1,000 Ω, but will vary according to individual preference.

The recorder has been found capable of much better response than that given by the average crystal and moving coil microphone, and it is the microphone that forms the weak link. Many have been tried, and the most natural reproduction so far has been obtained from S.T.C. "ball and biscuit" and various ribbon mikes. Although these have low output, the recorder gain has been found adequate for general use. Unfortunately, this type of microphone is very expensive, but a ribbon microphone has been constructed which gives results almost indistinguishable from the very best commercial types, and far better than the average ones. (It is hoped to describe this in a later article).

The ribbon type is probably better for general amateur use, as most recordings are seldom done against a quiet background, and the directional properties of the ribbon gives better discrimination against background noises. A cardioid response would be better, but such microphones are beyond the financial reach of the amateur.

RADIO MISCELLANY

CENTRE TAP talks about

RADIO SHOPS - - - THE VHF BANDS

A provincial reader unexpectedly turned up at a local London club meeting, and he was, of course, made very welcome. It so happened that the evening had been reserved for a General Discussion and oddly enough it was the question which he came to ask that provided the chief topic for the night. It appears he was on a visit to London, where he was a stranger, so before his departure he had made a note of the addresses of one or two firms advertising attractive lines in current periodicals, and was hoping to get a look at them. To his dismay, he found the first two he called upon had virtually no window display and only small retail counters.

Had he enquired about this beforehand, he would have discovered that not only these, but some other prominent advertisers, are from a shop-window-gazing point of view most disappointing. They depend almost entirely upon mail order business.

It took only a few minutes for the members to tell him just where he could get a good look-see first. The accompanying comments, however, did provide a revealing insight into the "character" of many of London's radio bargain centres, with graphic descriptions of each shop's "atmosphere." The uniformity of general opinion regarding the better known shops, and some of the lesser known, was most marked.

One particular shop (a favourite of mine) was warmly described as being the friendliest, well stocked with bargains and widely praised for helpfulness. Others, too, were highly commended, but the visitor was warned to avoid one or two of them like the plague. Instances of bad faith, defective valves and parts sold as being in good order, and rude refusals to test in the presence of the buyer, were quoted.

Both praise and censure appeared to be handed out fairly, untinged with individual prejudices, and no doubt many constructors are influenced by reputation when buying untested gear or by post. I half-expected someone to start classifying the shops on the lines of the Motoring Associations' hotel guides. Two stars for "Good" and five stars for "Super." It would be quite an experience to see a sign "This is a 5-Star Junk Store."

Still Going Strong

For me, the discussion revived memories of the early days of broadcasting when the sale of components was Big Business. In those days 'wireless parts' could be bought in almost any district where there was a handful of shops. Even Chemists and Pawnbrokers stocked them as a side-line.

Many of London's radio shops have longish histories. Old Timers will remember the long-since-gone "Ma" Raymond's in Lisle Street, right in on the ground floor of component price cutting. It was generally believed that one might get an even bigger price cut by haggling. Others said that by such a procedure one stood an equally good chance of being treated to a stream of eloquence which literally took one's breath away.

Nowadays many of the real old original firms are, due to the blitz, expanding or diminishing trade, on different premises. One started as a cycle shop and they so concentrated on radio that the bicycle sales dropped to nothing, so they became all-radio. Another sold amateur engineering requisites and they also gradually became exclusively radio. A third started as an ex-W.D. dump, selling the bits and pieces left over from the 1914-18 War. There was no radio stuff then, of course, although there might have been a bit of "wireless telegraphy apparatus" which I failed to recognise. All my fading memory recalls seems to be miles of barbed wire, field telephones, cooking pans and khaki webbing.

Where these shops have been continuously under single ownership down the years, their history might prove an interesting sidelight on the growth of our hobby.

The Charm of Two

While the VHF bands have been attracting an increasing number of transmitting adherents in recent months, it is pleasantly surprising to find that so many listeners and constructors are taking much more than a passing interest in them. The absence of TVI troubles accounts for much of the early interest of the transmitting fraternity, and the fascination of 144 Mc/s and 70 cms. quickly fires their enthusiasm.

Listener interest is not quite so easy to account for, unless it is that the new and more precise technique (it is almost like starting in radio all over again) constitutes a sort of challenge. For the flat-dweller and others who are only able to use tiny aerials, if they are at all interested in aerial design both bands have much to offer. Quite apart from the amateur bands, there is a wide variety of interesting transmissions to be heard on adjacent bands.

In recent weeks I have seen several VHF receivers (not mere converters) specially built by listeners, and in the eighteen months or so during which I have been working on two, more listeners' reports have been received than I have ever had on other bands. Generally speaking these reports have been intelligently compiled—most of mine have been—and are often really helpful and are warmly welcomed by 2-metre amateurs. There is certainly plenty of scope for keen SWL's who have a taste for this side of the hobby.

Making a Start

From the constructional angle, the simplest approach is a converter. First-class results can be obtained with one of comparatively simple and inexpensive construction, although of course, a stabilizer is a "must." The wide range of suitable valves still available on the ex-W.D. market also helps to make the prospect extremely attractive.

The value of carefully planned layouts is brought home to one most forcibly when the saving of a ½", or even a ¼", in one or two of the leads may make a big difference in efficiency. In tuned circuits it may result in a difference of several Megacycles !

The VHF newcomer's difficulties do not end with the completion of the converter. The problem then becomes one of finding the band he wants. One occasionally hears of short cuts in achieving this, but they all seem to pre-suppose some special knowledge, such as market points, etc.

The shortest cut I know is to borrow a pal's grid dip oscillator ! Failing that, a good plan is to get advance details of local amateurs' operating times. Otherwise the listener has to fall back on finding out the frequencies of Police, Fire Service, Car Hire Services, etc., that he happens to stumble across. Then one either shortens the coil or opens out the turns (or vice versa) and hopes for the best. Of course, one can always build a G.D.O. first, but we were talking about the quick and cheap way of getting there.

Hand to Hand

A number of designs for VHF converters have been published—some very good, others not so good. Oddly enough, one of the most successful designs I have seen recently has not, as far as I can trace, been published. It seems to have passed from hand to hand as satisfied constructors have recommended it to each other, or else a copy has been made of it when VHF enthusiasts have visited one another. No doubt there have been minor modifications to it as the circuit has gone on its rounds. I made a half-hearted attempt to trace it back to the originator, but gave it up after four or five stages. It simply led me in a circle. Strangely enough, this is the first time I have heard of this sort of thing happening on this scale, and my experience goes back to pre-broadcasting days.

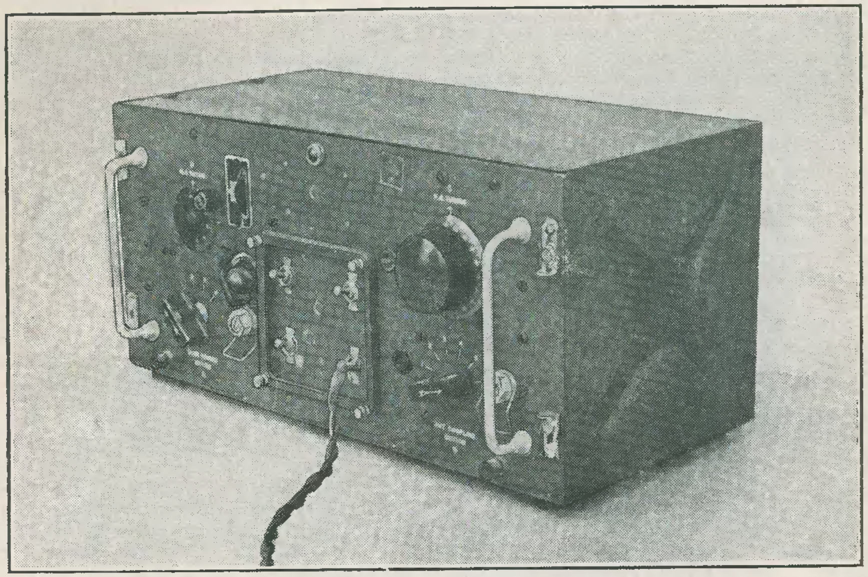
It probably came from a foreign magazine if it has been published, although of course the valves and design are sufficiently conventional for the prototype to have been made by many a knowledgeable amateur. A hand-to-hand career is much more likely with a VHF circuit, as no doubt each constructor was able to help the next man with the all important question of getting it on the band.

Plain Clothes Men ?

Members of the Clifton Amateur Radio Society seen using their formidable looking DF gear during a recent Field Day, somewhere in Kent, were mistaken by local inhabitants for Post Office engineers hot on the trail of TV pirates.

The story, however, that they caused a bigger stampede of licence applicants at local Post Offices than the much-publicised detector vans is somewhat exaggerated. Nor is there any truth in the story that the PMG is sharing part of the rake-off with the Club funds !

A SIGNAL GENERATOR



An accurate "all-wave" oscillator

By C. B. RAITHBY (G8GI)

The signal generator to be described should prove very useful to many readers with widely different radio interests. For the serviceman it provides all the facilities of the usual commercial signal generator, for the pure experimenter it will provide a reliable signal for miscellaneous tests.

Facilities

A controllable source of RF is available from approximately 150 kc/s to 25 Mc/s in five ranges (see table 1). A further low frequency range can be added if desired, and this modification is described later. The RF can be modulated if required and is available through a suitable attenuator. The audio voltage which is used for modulation is also available externally for appropriate tests.

Besides the RF oscillator a crystal oscillator of 500 kc/s is available. This can be used for frequency checking the variable oscillator or, with its harmonics, be used for checking other oscillators (including VFO's on, say, 3500 kc/s) and receivers.

The inclusion of the crystal check oscillator enables the frequency of the variable oscillator to be obtained to a considerably higher degree of accuracy than the usual ± 1 per cent. of the average commercial unit without this facility.

General Circuitry

The valves used are a 6K8M (V3), see Fig. 1, in which the triode section is used as the variable oscillator. The 500 kc/s crystal oscillator is one half of a 6SN7 (V2). The output from this is injected into the signal grid of the 6K8, which can also be grid modulated at an audio frequency if desired. The audio oscillator is the other half of the 6SN7 (V1) and operates on approximately 1000 c/s.

The RF, modulated if desired, is fed to a

triode-connected 6AC7 (V4) in a cathode follower circuit, the output of which is fed to the attenuator. Besides providing a convenient means of impedance stepdown to feed the attenuator, this stage also further isolates the oscillator from variations in the output load.

Special Circuit considerations

If a reasonably good waveform is required from the audio oscillator V1, some care is needed. The transformer T1 used in the circuit is out of an old RAF Tester R/T Type 1, Ref.105/35, and has a tertiary winding. A number of audio oscillator circuits, and many types of transformers, were used before a satisfactory, reasonably pure, audio frequency voltage was obtained. An oscilloscope is essential if it is desired to obtain anything like pure waveform from the audio oscillator. Waveform shapes, obtainable from oscillators using iron cored inductances in which the operating conditions are incorrect, have to be seen to be believed! Resistor R25 and condenser C1 serve to improve the waveform and may or may not be required. If difficulty is experienced in obtaining a transformer like T1 with a tertiary winding, it is suggested that the circuit of Fig. 3 is tried. Again careful experiment with both C and R will probably be necessary. The AF output is available at a Pye socket (Type 10H/528) and its level controllable by potentiometer R3. C23, only 500pF, is to avoid RF leakage at this point.

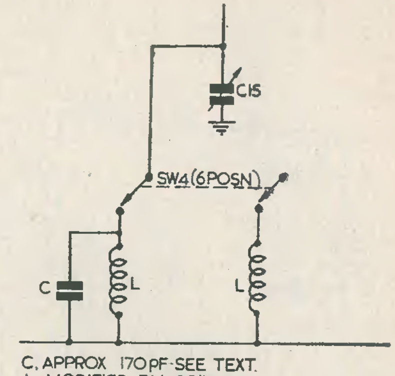
It should be pointed out that it is, of course, not essential that the audio waveform should be pure. For most tests it is not essential, and any audio that sounds satisfactory in the phones (via socket 1) will be satisfactory.

The RF oscillator (triode portion of V3) is quite orthodox and requires little comment. The tuned circuits L1 to L5 are in the grid circuit, with untuned feedback windings L6 to L10 in the anode circuit, "parallel fed." Note that the grid leak R11 must be returned to cathode and not earth. Switch SW3 controls the oscillator HT supply.

The 500 kc/s crystal oscillator V2 is in the now well known modified Colpitts circuit. This is a very useful CO circuit, especially as no tuned inductance is required. No difficulty should be experienced in getting the crystal to oscillate. The CO RF output is taken from the cathode via C8.

The cathode follower circuit of V4 is quite orthodox.

It will be noted that HF chokes (RFC1, RFC2) only are used for mains filtering. Bypass condensers at the point where the mains leads leave the case were tried (0.01μF 1000V DC working each) and these are definitely beneficial in reducing stray radiation. But in some applications the small earth currents of AC thereby produced caused difficulties, so these bypass condensers were discarded and are not shown in the circuit diagram.



C, APPROX 170PF-SEE TEXT.
L, MODIFIED PA1 COIL.

FIG. 2
CIRCUIT SHOWING EXTRA LF RANGE

C773

Construction

After careful consideration it was decided, in view of the difficulties involved, particularly in obtaining the degree of accuracy desired, not to attempt a directly calibrated dial. For radio servicing it is surprising how few "spot frequencies" are required and these, frequencies like 465 kc/s, 1600 kc/s, 665 kc/s, 1500 kc/s, etc., can be made out on a chart giving the switch position and dial reading. Other frequencies are obtained from graphs. The graph for Range 3 is given in Fig. 4.

The obvious choice of a unit in which to build the generator was the ubiquitous TU5B unit (or any other of the series). The excellent slow motion dial and the partial double screening make it ideal. All components were removed from the TU5B unit except the slow motion dials (leaving the flexible couplings *in situ*) and the right hand switch. The centre screen was also removed, but is later replaced.

TABLE 1

Range 1	.. ..	150-410 kc/s
Range 2	.. ..	410-1220 kc/s
Range 3	.. ..	1180-4000 kc/s
Range 4	.. ..	3.4-10 Mc/s
Range 5	.. ..	8.8-25 Mc/s

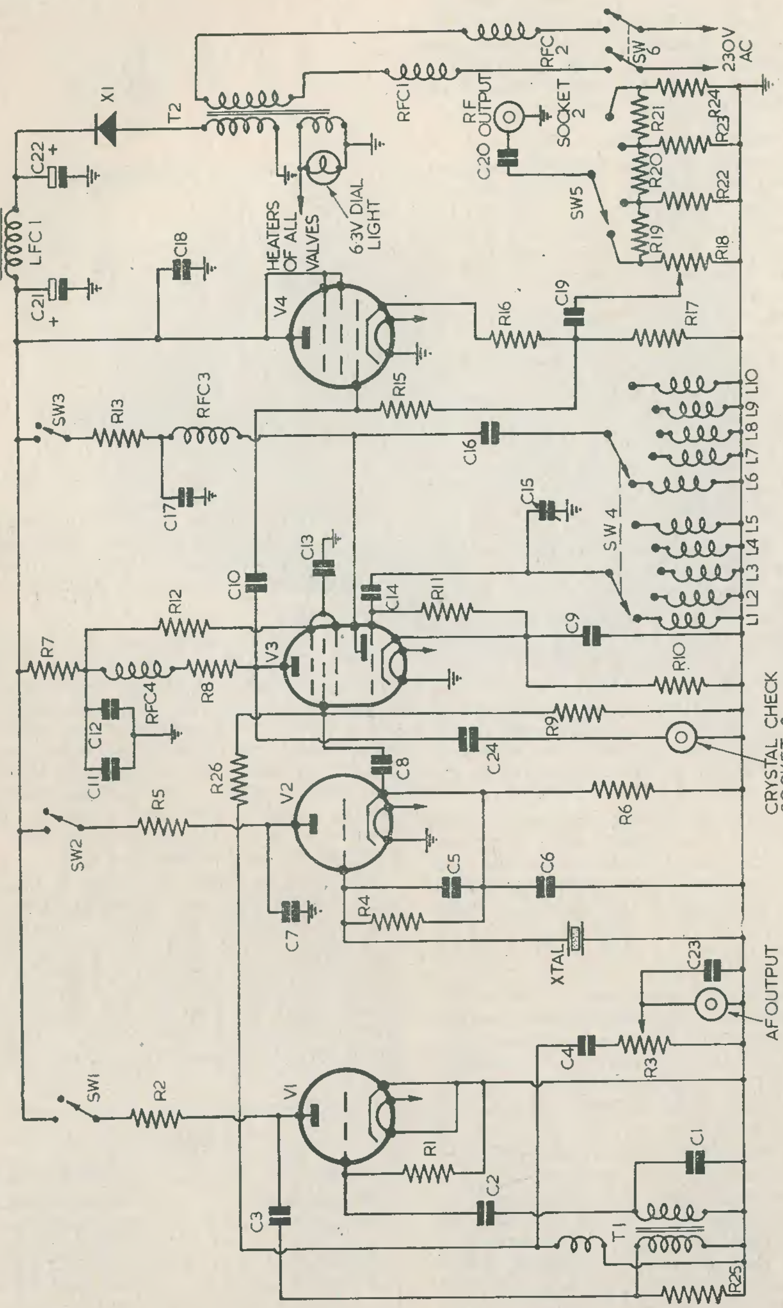


FIG. 1
CIRCUIT OF SIGNAL GENERATOR

C772

COMPONENT LIST

C1	see text
C2, 3, 4, 6, 9, 10, 13, 14, 16, 17, 18, 19	0.005 µF
C20, 24	0.05 µF
C5	70 pF
C7, 8	150 pF
C11	0.1 µF
C12	100 pF
C91, 22	8 µF electrolytic
C23	500 pF
C15	500 pF variable
All above 350V DC wkg.	
R1, 6, 12	10kΩ
R2	100 kΩ
R3	500 kΩ pot.
R4	500 kΩ
R7, 8, 17	4.7 kΩ
R9	250 kΩ
R10	200 Ω
R11	47 kΩ
R13	20 kΩ
R15	1 MΩ
R16	220 Ω
R18	500 Ω pot.
R19, 20, 21	220 Ω
R22, 23, 24	10 Ω
R5	1 kΩ
R25	see text
R26	150 kΩ
T1	see text
T2	Primary as required: Secondaries 250V 20 mA, 6.3V 1.5A
X1	250V 30 or more mA selenium half-wave rectifier
SW1, 2, 3	On-off toggle switches
SW4	2-pole 5-way, see text
SW5	see text, re L1-L10
SW6	2-pole 230V wkg. toggle
RFC1, 2,	2.5 mH HF chokes, 250 mA rating
RFC3, 4	2.5 mH HF chokes, receiving type
Crystal, 500 kc/s	
V1, 2	6SN7 (one only)
V3	6K8
V4	6AC7

Incidentally it was found that a dose of penetrating oil, though not the correct solvent, helped to allow an Allen key to loosen the grub screws.

Valves V1, V2 and V3 are mounted horizontally on the centre screen so that they project into the right hand compartment (see Fig. 5). This arrangement keeps all the heat away from the left hand compartment in which the oscillator components, RF, AF and crystal are all mounted. The crystal has been removed from its outer case and is bolted to the centre screen between two strips of paxolin. There is, however, room to instal a normally mounted plug-in crystal.

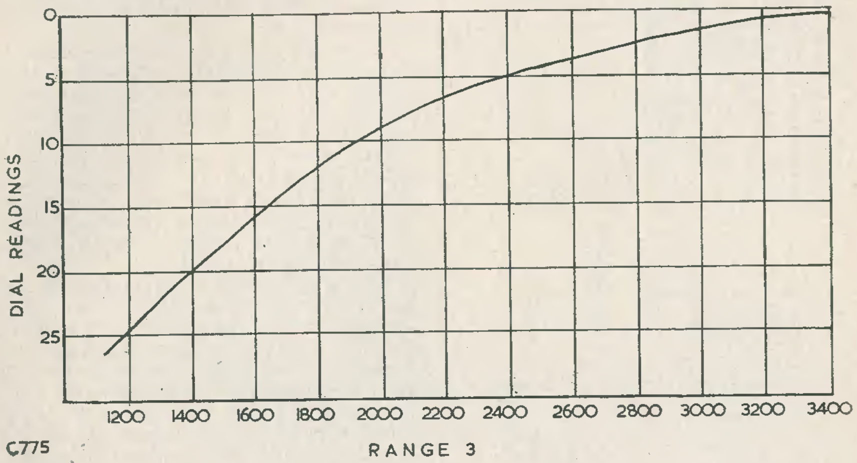
Efforts were made to obtain a small straight line frequency condenser for the variable oscillator circuit, but a small one could not be located. One section, therefore, of a miniature two-gang variable 500pF per section was used. This condenser is rigidly mounted on the horizontal brackets from which the original tuning condenser was removed. It is, of course, driven by the ceramic coupler, from the left hand side slow-motion dial which gives 2,500 divisions for 180° of turn of the condenser.

A set of Wearite "P" coils, types PA1, PA4, PA5, PA6, PA7, are used in the variable oscillator (L1-L10, Fig. 1), the coupling winding after modification being used for the feedback winding. These five coils cover the ranges given in Table 1. If the extra LF range already mentioned is required, then two type PA1 will be needed and switch SW4 will have to have six positions. If approximately 170pF is placed across the second PA1 (to make the extra range) then it will be found that the oscillator will cover 100 kc/s and lower on this range. Fig. 2 shows this modification. This range would provide 110 kc/s for alignment of old type superhets and certain modern "double superhets." At 100 kc/s, checked against the 500 kc/s crystal standard, it would be valuable for receiver calibration, particularly on the amateur bands.

The wavechange switch SW4, a 2-pole 5-way type, should be a good quality one. The coils are mounted underneath the variable condenser C15 and behind S5 on the brackets. Range 5 coil, L5-L10, *must* be located in the best position for short leads to the switch.

The majority of the oscillator components, including T1 and the crystal, are located on the central screen and are rigidly bolted in position before the screen is replaced. A certain amount of ingenuity and care is necessary in this part of the construction or it will be found that the screen cannot be replaced! Anchoring pillars, obtained from the TU5B unit, are used wherever helpful. Incidentally, in replacing the centre screen, the

Specimen Calibration Chart.

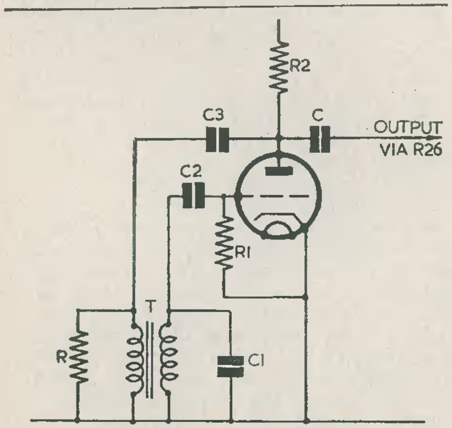


C775

fixing nuts can be mounted on the outside for convenience.

V4 is located, mounted vertically, in the right hand compartment immediately behind the fine attenuator control R18. R18 is fitted to the right hand slow motion dial via the ceramic coupler.

The original switch (SW5) is used for the coarse attenuator. It is desirable to screen between R19-24 of the attenuator.



C, 0·1μF, R, C1 SEE TEXT
T, INTERVALVE AUDIO TRANSFORMER
FIG. 3
ALTERNATIVE AUDIO OSCILLATOR
CIRCUIT FOR V1

C774

It is necessary to modify the "P" coils before use. Considering coils PA1, PA5, PA6, PA7 (Ranges 1 to 4) it is necessary to remove approximately two thirds of the coupling (feedback) winding in each case. If this is not done it will be found that the frequency coverage, as given, will not be possible. It will be satisfactory to continue to remove turns until the frequency coverage is approximately that given in Table 1. It is suggested that the coils are mounted last and each one adjusted by this method. In the case of Range 5 (L5, L10) it is necessary to remove the whole feedback winding (the thin wire) and replace it by 4½ turns interwound from the "earthy" end. It is emphasised that the leads to PA4 (L5, L10) must be short. But provided the oscillator voltage is about 150, no trouble should be experienced in getting satisfactory oscillation on this range.

Operation—initial checking

This should be done before the perforated plates are replaced and before the chassis is placed in the cabinet. Check the mains voltage tapping and connect the unit to an appropriate supply. Close SW6, whereupon the dial light should illuminate. Measure the DC voltage across C21, which should be about 280V on no load. Connect the audio output socket via a suitable connector (10H/3911) to a pair of phones. Close SW1, check the audio and operation of R3. Switch off audio. Plug in phones (normal phone plug) in the checking socket. Set the Range Switch SW4 to range 3, say, close SW3 and SW2. Tune over the range; audio whistles will indicate both the variable and crystal oscillators are functioning. Finally inject a modulated signal into a receiver and check the correct operation of the coarse (SW5) and fine (R18) attenuators.

Calibration

Considerable calibration can be done using the internal crystal alone, especially on the higher frequency ranges. Remember that on the LF ranges it is the harmonics of the variable oscillator which give audible (and zero) beats with the crystal, *e.g.*, 250, 166.6 kc/s, etc. Above 500 kc/s a calibration point is given every 500 kc/s by crystal harmonics. These are scarcely sufficient for proper calibration, and three other suggestions are made:—

1. Use a calibrated receiver, first checking its frequency against the crystal.
2. Use an "all-wave" receiver and a crystal calibrator giving outputs on, say, 100, 200, 500, 1000, 10,000 kc/s.
3. Use an accurately calibrated second variable oscillator.

Fig. 4 shows the calibration graph obtained on Range 3.

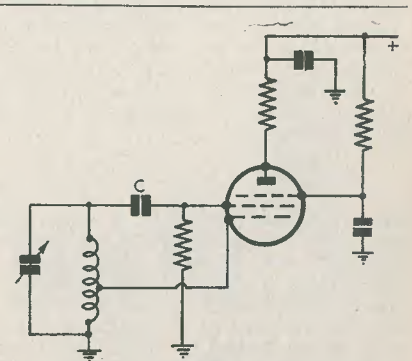
Mainly for the Beginner . . .

HIGH FREQUENCY OSCILLATORS

by H. E. SMITH G6UH

The oscillator section of a superheterodyne receiver is quite often the cause of unsatisfactory performance and failure to hear weak signals, because of insufficient care having been taken in the layout or the design. One bad fault which exists quite commonly (even in some commercial receivers) is 'drift.' By 'drift,' we do not refer to the initial warming-up drift which occurs on all types, but a tendency for the frequency to move up and down a few kc/s now and again. Nothing can be more annoying than having to adjust the tuning control every minute or so in order to keep that weak DX station tuned in. Another fault due to the oscillator is inability to hear weak signals at all, or hearing many weak carriers on the band with no modulation on them. This latter fault may quickly be checked by removing the aerial, and noting whether the carriers are still audible. If they are, the fault is almost certain to be due to the oscillator valve "squegging." This is a nasty fault, and in the case of a badly screened receiver may cause radiation to take place and seriously interfere with neighbouring receivers.

Many home constructors use the ECO (electron coupled oscillator) or "cathode tap" circuit, and although this is a simple circuit to construct and usually oscillates first time, there are a few precautions which should be taken when testing the circuit for oscillation. Firstly, the cathode tap should not be attached any higher up the coil than is necessary to maintain oscillations over the required band. A few quick checks will show where the oscillation ceases, then the connection should be made to a point *one turn* higher up the coil. There is no point whatever in trying to obtain more output from the oscillator by raising the tap, as the circuit will then most likely produce many other frequencies as well as the one required. In any case, the output from this type of oscillator is usually more than sufficient for the needs of any type of mixer. The ECO circuit is shown in Fig. 1. The coupling capacitor to the mixer stage is usually connected to the



RC12

FIG. 1
ELECTRON COUPLED OSCILLATOR

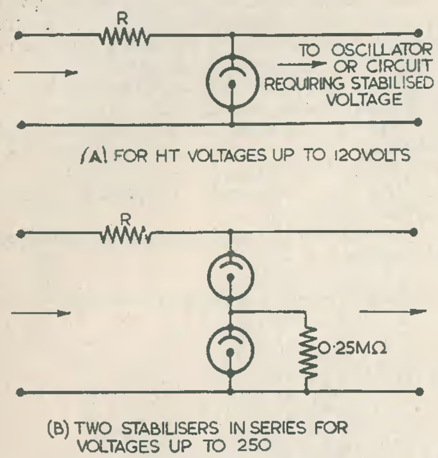


FIG. 2
VOLTAGE STABILISING
RC13

grid, but quite often sufficient voltage is obtained by coupling it to the cathode, which also ensures less pulling effect from the mixer circuit. It is a good plan to use a " negative co-efficient " type of capacitor for " C," as this will assist in reducing the amount of drift due to heat.

The main requirement, however, in all oscillator circuits is to ensure that a steady value of HT is applied at all times. This can be accomplished by the use of a voltage stabiliser (or Stab). The voltage stabiliser should always be connected via a suitable resistor, as shown in Fig. 2. Voltage stabilisers have a maximum current rating, and this resistor is to prevent excessive current being drawn and at the same time allow the output voltage to be regulated by the characteristics of the regulator. The value of the series resistor can be calculated quite easily from the following:-

$$R = \frac{E - E2}{I}$$

where E is input voltage, E2 is output voltage, and I is the rated maximum current for the stabiliser. An example, therefore, is the VS110 or S130 which have a 40 mA maximum rating. If the input voltage is 250 and 150 volts are required on the oscillator, the value of R is 100 divided by 40=2.5 (2500 ohms). Larger values of R may be used until the current through the stabiliser reaches the minimum rating, in this case 20 mA. Do not forget that the wattage rating of the resistor should be suitable for the needs of the stabiliser plus the current to be drawn by the oscillator stage.

Stabilisers are not very efficient when currents *below* the rated minimum are being passed, and it will be as well to check up on this point when you make your final tests. Do not attempt to feed more than one valve from the stabiliser, and make sure that no electrolytic capacitors are in circuit on the *oscillator side* of the stabiliser, as these will destroy the action and no voltage regulation will take place.

Stabilisers cannot be used in battery receivers, of course, neither is their use necessary, because the battery receiver is not affected by changes in the mains supply or by poor regulation. In fact, the battery powered oscillator is a far more stable affair than a mains operated one (while the batteries are comparatively fresh, at any rate). There are, of course, many other types of oscillators, including the Hartley, Reinartz, and Colpitts. The ECO is recommended as being the most stable type for use on the broadcast and short wave bands, but for VHF operation it is often quite difficult to obtain satisfactory oscillation, and the Colpitts or a modified version of the Colpitts is nearly always used on these frequencies. This circuit (Fig. 3) is once again quite simple to build, and no difficulty should be found in getting it to oscillate.

Remember that on the VHF bands stabilising the HT voltage is not enough. Mechanical considerations now play an even larger part. Everything must be rigid and all leads must be as short as possible. The tuning capacitor must be of the double ended type and the dial free from backlash. With the Colpitts circuit it is not so easy to go wrong as with any of the other types, provided a proved circuit is followed, and the component values as specified are used. An important point to remember is this; For any frequency above, say, 80 Mc/s, use a valve suited to the frequency, and never attempt to use anything else. Valves such as the Z77, L77, EC91, 6J6, 6AK5, 9001/2, to name but a few, all make excellent oscillators for frequencies in the 100–150 Mc/s region.

For efficient mixing, the right amount of oscillator voltage must be injected into the mixer valve. Most valve manufacturers will supply data on the amount of oscillator voltage required for any particular mixer. More voltage than necessary will not improve the signal strength and will worsen the signal to noise ratio. If the information cannot be obtained, it is always a good plan to experiment with various values of injection

voltage and note the effect on weak signals. In the case of the ECO, the coupling capacitor may be left at, say, 5 pF, and the tap position on the coil altered. With the Colpitts, various values of coupling capacitor from 0.5 pF to 5 pF may be tried. It is not possible to give any hard and fast figures, as the total amount of oscillator voltage available will depend upon the type of circuit, valve, and HT voltage used.

It must be stressed that the oscillators referred to above are really suitable only for the purpose of local oscillators in receivers or wavemeters, and are not recommended for use as the VFO for driving a transmitter. The frequency stability is nothing like good enough. Oscillators such as the Franklin or the Clapp, both using more than one valve, are much better for this purpose, and even they must be calibrated to very close limits.

The beginner transmitter is strongly advised to start with crystal control and to ignore those who say that DX cannot be worked unless you have a VFO. It *can* and still *is* being done by many stations, and *not* by using high power either.

Finally, a word about heterodyne wavemeters. The heterodyne wavemeter is only useful if it is accurately calibrated, and has some form of crystal check incorporated. If built on the lines of the well-known BC221, a meter of this type will be found invaluable, especially to the SW listener. It will enable checks to be made on the drift of the receiver as well as measuring the frequency of received

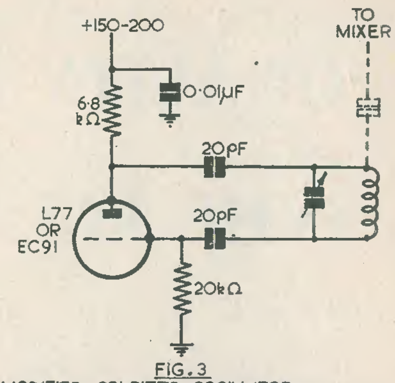
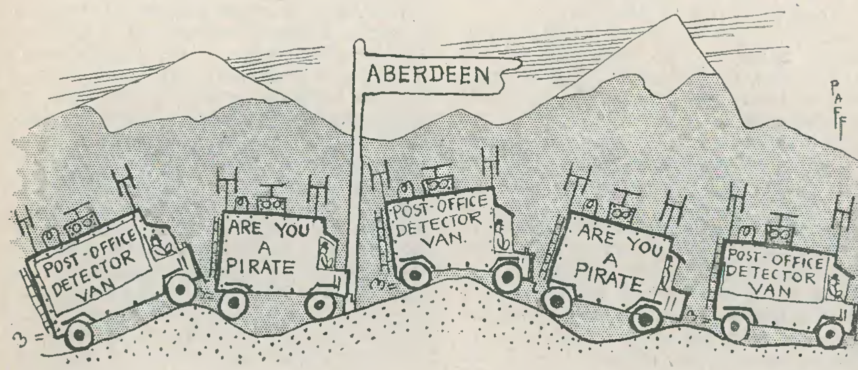


FIG. 3
MODIFIED COLPITTS OSCILLATOR
Rs & Cs = VALUES RECOMMENDED FOR
90–150 Mc/s OPERATION
RC14

signals. So if contemplating building one of these items, build it with great care and make it to last. Otherwise, it will just be another piece of junk which makes chirps on your receiver when it is switched on, but serves no useful purpose. When making frequency checks with a heterodyne wavemeter, switch the BFO off and bring the wavemeter to zero beat with the signal. If the BFO is left on, you may easily be several kc/s out in your measurement.



QUALITY FEEDER UNIT *for the* VHF FM PROGRAMME

PART 2

by G. BLUNDELL

Although the limiter valve does limit the gain of the set, there is always a danger that earlier valves may also start limiting on very large signals and cause detuning of the IF circuits. A sensitivity control is therefore added to prevent this happening. If only one IF stage is used, this control should be transferred to V4 cathode. Automatic control of sensitivity can be effected by using the limiter grid voltage to control earlier stages, but this results in extra components in sensitive circuits. Also, interference pulses may be large enough to cause grid current to flow in one of the stages. If this grid current is sufficiently heavy, a charge may build up on these extra condensers which will cause the valve to be biased off until the charge leaks away through the associated resistances. The signal may, therefore, be affected for a much longer period than the interference lasts. There is, therefore, the danger with the normal automatic gain controlling circuits of making any interference more troublesome than it need be.

If required, an AM signal can be taken from the limiter valve, and R32 and C26 will be required to act as an IF filter. The grid circuit of the limiter valve V5 behaves like the diode in a normal receiver.

The discriminator L7 is of the Foster-Seeley type, and a brief description will be given as it is the major point of difference from the normal set.

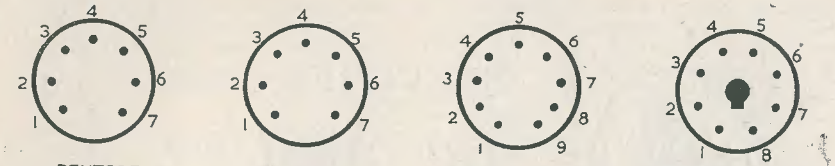
Use is made of the fact that a phase difference exists between the voltage and current in the anode circuit L7A, except at resonance. The frequency range over which this change is useful is controlled by the Q of the circuit, and R24 is required to damp the circuit suitably. The anode voltage is fed through TC7 to the centre of L7B, and this voltage appears at both diode anodes. As well as this voltage, another one appears at the diode anodes caused by the inductive coupling between the coils. At one diode anode the voltage is in phase with the current in L7A, and at the other it is in the opposite sense. The voltage/current phases do not vary as the frequency changes. At resonance the diodes produce equal and opposite voltage across the diode load R26 and R27, and the resultant voltage is 0. When the frequency changes, different combination voltages appear at the diode anodes due to change in phase in the primary winding L7A, and so the frequency changes are converted into low frequency changes; in other words the FM is converted into an audio signal.

Alignment

This is best done with the help of a signal generator. If a generator is not available, your local service dealer should be able to line the IF up for you to the following instructions.

In the event of real difficulty, Radius Radio will be pleased to help you.

To align with the generator, connect the output into the mixer grid of V2 (across L2). Connect damping resistors of 47 kΩ across L4A and B and L5A and B. A microammeter is needed in series with R17 at the earthy end to read the grid current of the limiter valve, and a bypass condenser of 1000 pF should be connected across it. There is an ex-government indicator available with a double movement which is very sensitive (about 80 μA) and one half of this meter can be used. Alternatively, a valve can be used as shown in Fig. 6. This reading will be backwards, *i.e.*, increasing input into the set from the generator will reduce current in the meter and 0 volts will be indicated by a ½-scale reading. A rising current will indicate a positive voltage at the grid and at falling current a negative one. The important thing, of course, in this measurement is not to affect the conditions in the limiter grid circuit. Care must also be taken that no circuits are overloading, *i.e.*, increasing the output of the



Valve Base Connections.

generator should always show an equivalent change in the reading. If this does not happen, the input must be reduced until it does.

Having connected the generator, increase the output until a reading is obtained. Adjust 6A and B to give a balanced curve around the centre frequency.

Disconnect damping resistors from L5A and B and adjust this circuit again to give a balanced curve. Reconnect these resistors, and disconnect resistors across L4A and B and tune this circuit. Disconnect all damping resistors.

To align the discriminator, connect generator to V5 grid or, if sufficient output to give a good reading is not obtained, to V4 grid. Connect microammeter in series with an 0.5 MΩ resistor to the junction of R26-R28-C19. Adjust L7A to give maximum change of reading from ½-scale or maximum reading on the microammeter. It may be necessary to change over the connections of the meter. Adjust L7B and check that the reading on the meter will adjust through the 0 position (½-scale) or will go through 0 when using the microammeter. Set L7B slightly off-tune so that a reading is obtained, and again adjust L7A to a maximum, then set L7B to zero. At this point, when using the valve-voltmeter short the 0.5 MΩ resistor to ground and check that the 0 position is still correctly set at ½-scale.

To check that the discriminator is working correctly, change the frequency of the generator. At 250 kc/s higher in frequency the output voltage should rise to a maximum in one direction, and at 250 kc/s lower in frequency the output voltage should rise to a maximum in the other direction. When the generator is disconnected the output reading should be 0.

To test the frequency changer, connect the microammeter in series with R6 or the valve-voltmeter resistor R33 and check that there is approximately 2 volts negative at this grid. If the valve is not oscillating there will be no reading.

Connect the audio amplifier to the output of the set. A rushing noise should be heard which is caused by the high amplification of the set, and this will indicate that the IF part of the set is OK. Connect the aerial and rotate the tuning condenser until a station is heard. Connect the meter back to the limiter grid, and adjust the aerial coil to give a maximum reading. Adjust also L2 by slightly parting the turns with an insulated screwdriver. (A knitting needle filed to shape will do; this sort of tool should be used also for the IF alignment). L3 should also be

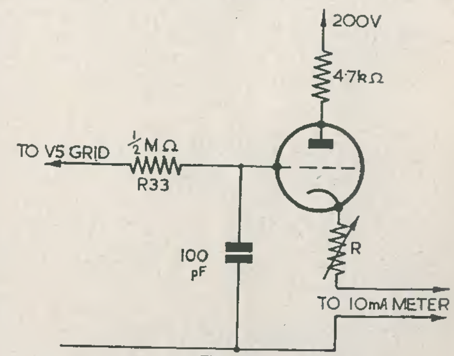


FIG. 6
VALVE TYPE EF91-6V6G-6SN7 ETC. ADJUST R TO GIVE ½SCALE READING WITH ½MΩ SHORTED TO GROUND
C796

adjusted to make the FM programme tune in at about 65 on the dial.

If the set is working correctly when the FM programme is tuned in, the background rushing noise should completely vanish together with most of the interference. When the AM programme is tuned in at about 70 on the dial, both interference and programme should vanish when the set is correctly tuned as indicated on the magic eye. Various police and fire service calls may be heard from 70 to 75. Taxi service may be from 40–60, and the approximate calibration will be as follows:— 0 on dial, 65 Mc/s; 40, 80 Mc/s; 65, 90 Mc/s; 100, 105 Mc/s.

The tuning indicator is more necessary than in a normal AM set, because once the set is somewhat near in tune there is no way of telling on low passages whether or not the set is tuned. If the set is not correctly tuned there will be distortion on loud passages and the interference will not balance correctly. As this tuning can be rather difficult to do, a way has been chosen using a magic eye which is simple and effective. However, if a microammeter movement is available this is best of all. The meter movement is set so that its zero is in the middle of the scale, and when the needle comes back to zero the set is correctly in tune. The same method is used with the magic eye. R22 is chosen to make the magic eye close approximately halfway, and then the set is tuned until the pattern again half closes. The push button is then used to short the control grid of the magic eye to ground, and the pattern should not change if the set was correctly tuned.

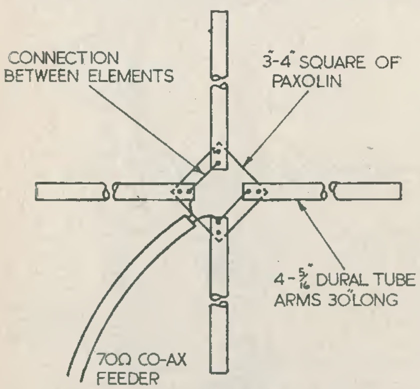


FIG.7
COMBINED HORIZONTAL & VERTICAL AERIAL

C798

The Receiving Aerial

To tune to Wrotham, the aerial should be a dipole similar to a television aerial, with a co-ax feeder from the centre. The main differences are that the aerial is much shorter, and that it should be mounted horizontally. The length of the aerial should be a total of 5 feet ½ inch, with a ¼″ spacing at the centre. The aerial must be mounted broadside on to the station. The direction of the signal can be accurately found by rotating the aerial until the signal disappears. The tip of the aerial will then be pointing in the direction of the station. A combined horizontal and vertical aerial can be made as shown in Fig. 7.

"THE MAGNA-VIEW"

The Radio Constructor's 16 inch Televisor

PART 10

The English Electric Co. have very kindly forwarded to us minor modification details which they recommend for use with the "Magna-View."

The first deals with the reservoir condenser in the power supply unit. When used with a metal rectifier, the value should be raised to 60 μF. This results in a negligible increase of voltage, but a much greater decrease (sounds Irish !) in ripple is attained. Furthermore, the resultant increased suppression when using the 60 μF condenser will greatly enhance the life of the condenser in this position in the circuit. A suitable component is the TCC type CE37L, rated 550 mA ripple working at 350V DC.

Regarding the second point, readers should make reference to the tube biasing arrangements shown in Fig. 14, p. 403, June issue. A considerable improvement here has been effected by the English Electric Co. to obviate the residual EHT being seen on the screen when switching off. The new arrangement completely eliminates this spot, which might in time stain the screen.

The required modifications are quite simple. R9 is increased in value to 220 kΩ, and is taken to Pin 7 on the Line Output Transformer instead of the HT+B as previously. It will be clearly seen that, when switching off, the associated supplies to the tube will collapse simultaneously, thus effectively cancelling out the concentration of light in the centre of the screen.

Test Report 1

A considerable number of enquiries have been received by us regarding the use of permanent magnet focusing devices. In association with the manufacturers of Elac components, tests have now been carried out by us in the "Magna-View."

The most important consideration is substitution of the focus coil by an LF choke of approximately 300 Ω DC resistance, or alternatively a resistor of this value. The rating must, of course, be high enough to safely carry the required current. The focus coil in the "Magna-View," apart from its natural function, is an important part of the smoothing system and voltage requirements throughout the circuit.

Slightly higher stability is obtainable with the permanent magnet system and constructors may, with the introduction of suitable components by Elac, wish to instal this type.

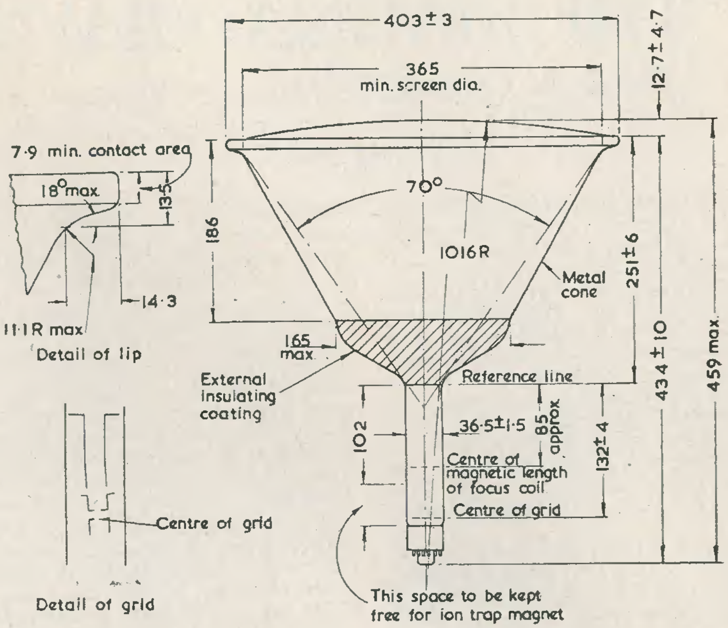
The list appended clearly defines the correct component for tubes likely to be used, and also the ion trap magnets recommended.

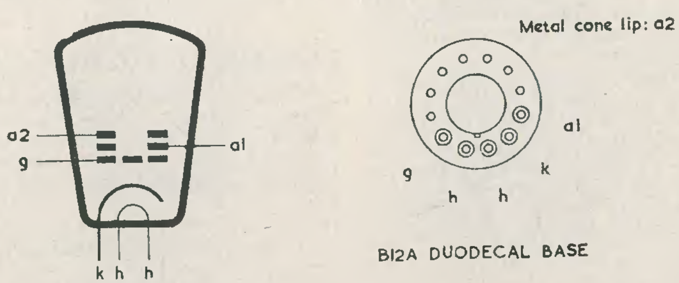
PERMANENT MAGNET FOCUS UNITS
W20/IJ .. for Tetrodes at low EHT
W22/IJ .. for Tetrodes at high EHT
W25/J .. for CRT types T901, C17BM, 6901A, TR14/2
ION TRAP MAGNETS
IT9 .... for Mullard MW41-1
IT8...... for English Electric T901

MW41-1

TELEVISION TUBE

Direct viewing television tube with 16-in. diameter screen. It has a metal cone envelope and incorporates an ion trap.





B12A DUODECAL BASE

All dimensions in mm

742

Test Report 2

The Mullard MW41-1 Metal Cone 16″ CRT

Although in appearance similar to the English Electric T901, the Mullard tube was found to require different treatment when installing into the " Magna-View."

However, the constructional procedure outlined in the Feb/Mar issue is ideal, and, by utilising the improved design of focus board described last month, the electrical and mechanical requirements were easily met. A considerable advantage was found in the use of the **Denco** stand-off insulators which have been made available specially for this design.

The draughtsman's version of the tube is shown in the sketch, and typical operating data is as follows:—

EHT—12 kV. Anode 1—300V. Heater—6.3V.

These conditions are ideally found in the " Magna-View."

The heater current of 0.3A is so low that this may conveniently be taken from the normal 6.3V supply in the receiver. It is still highly recommended, however, that a separate transformer winding be employed, if possible. The most likely failure in the greatest percentage of tubes is cathode/heater short, and a separate heater supply in a grid modulated design represents the best method of minimising the effects arising from such insulation failures.

The most important factor is the siting of the ion trap magnet, and this component and its use should be carefully studied. Considerable space has already been devoted to this subject (May issue) and a comprehensive brochure is available from Mullard, Ltd.

In the case of the MW41-1 on test by *The Radio Constructor*, a completely different location to that shown in the official brochure was required for the magnet. This is, no doubt, due to the influence of the scanning and focusing equipment differing to that in use by the manufacturers.

Reference to the draughtsman's outline will show the space recommended for location of the ion trap magnet. Your writer found in practice the best spot was two inches up the neck from the base (*i.e.*, where the pins actually enter the base).

There are two positions, magnetically. The arrow on the magnet may point towards the screen, and in this position should be on the neck side which is provided with a red line for this purpose.

Alternatively, the arrow may point towards the base; in this position the magnet should be diametrically opposite the red location line. The final test is, of course, the brilliance.

The Elac IT9 is the approved ion trap magnet for this tube, and no other type should be employed.

Further consideration should be given to the focusing coil. It may be necessary to rotate this component, and, where excessive shading occurs, to reverse the leads.

At all times the brilliance control should be reduced during the setting-up procedure to avoid internal damage to the tube.

With care, and with the components previously specified for the " Magna-View," it became possible to resolve a fully defined picture on the MW41-1, which was brilliantly clear in daylight.

This tube is very sensitive, and even with a greatly attenuated signal full modulation and contrast is achieved. In consequence, when installing this tube care must be taken to prevent overloading. Readers unfamiliar with this symptom will recognise it as a greyish, flat picture, similar in appearance to that obtained on a very old tube.

The Editor Invites

articles from readers, of a nature suitable for inclusion in this magazine. Articles submitted for publication should preferably be typewritten, but ordinary writing is acceptable if clearly legible In any case, double spacing should be used, to allow room for any necessary corrections. Drawings need not be elaborately finished, as they will usually be redrawn by our draughtsmen, but details should be clear. Photographs should preferably be large (half-plate) but in any case the focus must be good. Much useful advice to prospective writers is given in our "Hints for Article Writers," which will be sent free on request.

A 10-VALVE RADIOGRAM

by J. R. DAVIES

—oOo—

When a series of articles under the above title was originally envisaged by the writer, he had intended to give a full description of the circuit followed by detailed instructions on the layout and construction of its chassis. This he later found to be impracticable as it would be impossible to compress the amount of detail required into sufficiently small space for it to be printed in monthly form. He decided, therefore, to reduce the space devoted to the constructional side and to concentrate mainly on the circuit. This is quite permissible because the circuit is, in itself, inherently stable and, provided that the constructor follows the usual common-sense rules of layout and screening, it should be possible to reproduce it in working form quite easily. The first two articles in the series are devoted to a description of the circuit, whilst the third article gives details of the methods used by the writer in building his own particular model.

The Circuit

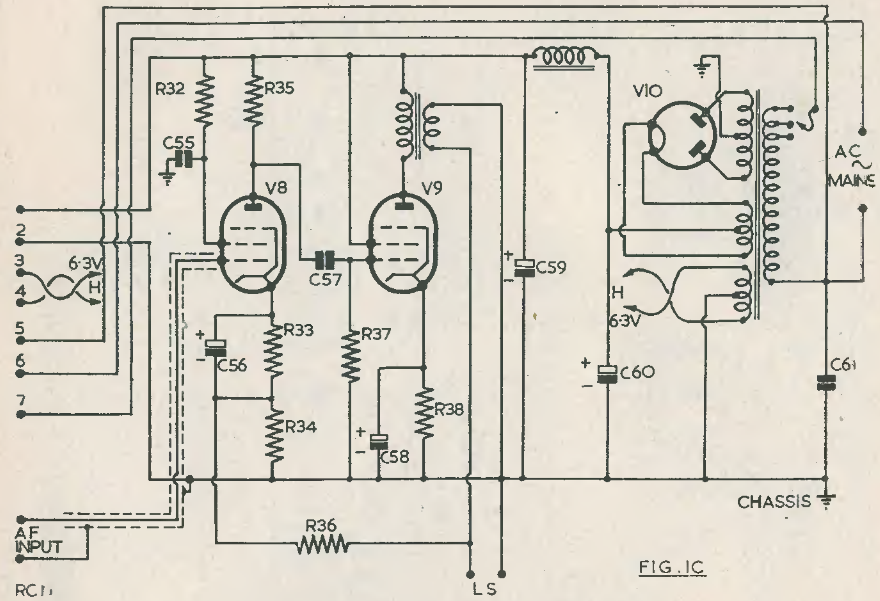
A full circuit diagram of the 10-valve radiogram is given in Fig. 1a, 1b and 1c. From these diagrams it may be seen that the set is really divided into two parts; the power pack and AF amplifier, and the radio section which is fitted with the various controls. This method of construction was adopted in order to simplify the building and to prevent having a single chassis which would be too heavy and cumbersome. It also allows the use of a larger and more efficient AF amplifier than that shown in the circuit. Indeed, the radio chassis proper could be used with any high-fidelity amplifier which the constructor may have on hand or wishes to build or purchase, so long as the latter can supply the various LT and HT voltages needed. The AF output from the radio section has an impedance of 450 kΩ at a level which is approximately one-third lower than that present across the detector load and it could therefore be connected successfully to almost any desired AF amplifier.

The stage line-up, considered briefly, is as follows:—

V1 is the RF amplifier working on long, medium and short waves, and it feeds into the frequency-changer, V2. V3 is a separate oscillator used on the short-wave band only, its anode circuit being broken when the "medium," "long" and "gram" positions of the wave-change switch are selected. V4 is the IF amplifier which, in its turn, feeds into the second detector, V5; the latter being a diode which provides both AVC and AF detection. V5 is followed by V6, a cathode follower which is used to provide a high input impedance to the diode DC load as well as acting as a buffer between the diode circuit and the tone control circuits, to which it has the further advantage of offering a fairly low output impedance. The AF from the receiver chassis is then applied to the amplifier *via* a length of special low-capacitance screened cable (the writer used coaxial cable) arriving at a separate pair of terminals and thence to the grid of V8. V9 is the output valve and negative feedback is applied to the cathode of V8 from the output transformer secondary using a conventional circuit. V10 is the usual full-wave rectifier and it is fed by a 250V–0–250V mains transformer. Returning to the receiver chassis again, V7, the tuning indicator, is operated in the normal manner from the AVC line.

Variable Selectivity

Variable selectivity is provided, and is carried out by a four-pole three-way switch, (S9 to S12 inclusive) which offers three positions of selectivity—"Sharp," "Staggered" and "Local." On the "Sharp" position



POWER SUPPLY AND AUDIO STAGES

(*See p. 193 for values*)

he two IF transformers are tuned to a peak, and selectivity is similar to that offered by the conventional peaked-transformer superhet. In the "Staggered" position the IF's are stagger-tuned, resulting in less selectivity but far greater fidelity. When switched to "Local," the IF transformers are heavily damped by resistors, resulting in the optimum fidelity of reproduction but (as the name implies) only sufficient sensitivity and selectivity for the reception of the more powerful transmitters. An important advantage of this particular circuit is given by the fact that the intermediate frequency does not alter for different degrees of selectivity, an attribute not always evident with some variable selectivity devices.

Gram Switching

Wave-change switching is effected by switches S1 to S8 inclusive, of which S7 and S8 are used for switching the pick-up circuits only. It will be seen that, when S8 is set to the "Gram" position, the pick-up (*via* its filter) is connected directly across the volume control, R23. However, this method of connection could only be permissible if the diode (V5) is taken out of circuit, as it would otherwise short-circuit, *via* R21 and the IF transformer secondary, the positive half-cycles present in the output of the pick-up. This point is taken care of by S7, which applies a heavy positive delay (R19 and R20) to the diode cathode on the "Gram" position, thus effectively isolating it from the pick-up circuit altogether. When the delay is removed from the diode for radio reception, the cathode circuit to chassis is completed by R19, C37 and the electrolytic capacitor, C36. This last capacitor was found to be necessary in practice in order to reduce hum and to provide an adequate path for AF; but it should be remembered that it is only operative for radio reception when no energising (or at best, only a very small positive energising voltage given by the process of signal rectification) is available to enable it to "form." Nevertheless, the capacitor provides an adequate by-pass for hum voltages; and several components of different manufacture functioned equally well in this position when they were connected experimentally in order to test the circuit. To make doubly certain, further checks were made to ensure that the connection

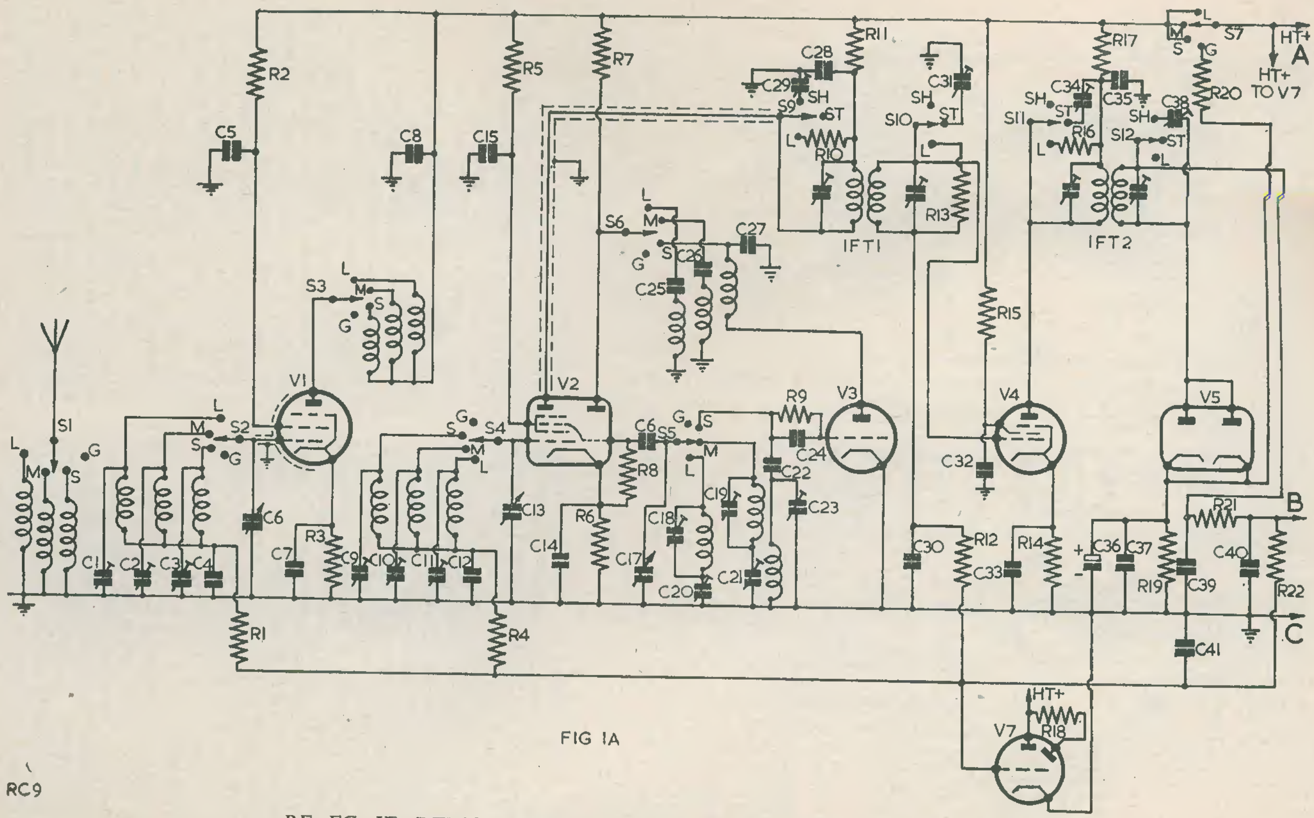


FIG 1A

RC9

RF, FC, IF, DEMODULATOR, AVC & TUNING INDICATOR STAGES

Component Values for Fig. 1

C1, 2 — 50 pF; Trimmer
C3 — 20 pF; Trimmer
C4, 5 — 0.05 μF
C6 — 500 pF; Part of 3-gang capacitor
C7 — 0.05 μF
C8 — 0.1 μF
C9 — 20 pF; Trimmer
C10, 11 — 50 pF; Trimmer
C12 — 0.05 μF
C13 — 500 pF; Part of 3-gang capacitor
C14, 15 — 0.05 μF
C16 — 150 pF
C17 — 500 pF; Part of 3-gang capacitor
C18, 19 — 50 pF; Trimmer
C20 — Long-Wave Padder
C21 — Medium-Wave Padder
C22 — Short-Wave Padder (Fixed)
C23 — 20 pF; Trimmer
C24 — 100 pF
C25, 26 — 0.01 μF
C27, 28 — 0.05 μF
C29 — 20 pF; Trimmer
C30 — 0.05 μF
C31 — 20 pF; Trimmer
C32, 33 — 0.05 μF
C34 — 20 pF; Trimmer
C35 — 0.05 μF
C36 — 25 μF, 25V wkg.; Electrolytic
C37 — 0.25 μF
C38 — 20 pF; Trimmer
C39, 40 — 100 pF
C41 — 0.01 μF
C42 — 300 pF
C43 — 0.05 μF
C44 — 8 μF; Electrolytic
C45 — 0.1 μF
C46 — 0.05 μF
C47 — 0.01 μF
C48, 49 — 0.002 μF
C50 — 500 pF
C51 — 0.003 μF
C52 — 0.001 μF
C53 — 300 pF
C54 — 8 μF; Electrolytic
C55 — 0.25 μF
C56 — 25 μF, 25V wkg.; Electrolytic
C57 — 0.05 μF
C58 — 25 μF, 25V wkg.; Electrolytic
C59 — 8 μF; Electrolytic
C60 — 16 μF; Electrolytic
C61 — 0.01 μF, 750V wkg.

Resistors

(All half-watt unless otherwise stated)

R1 — 500 kΩ
R2 — 30 kΩ
R3 — 420 Ω
R4 — 1 MΩ
R5 — 15 kΩ (1 watt)
R6 — 420 Ω
R7 — 30 kΩ
R8 — 60 kΩ
R9 — 20 kΩ
R10 — 100 kΩ
R11 — 4 kΩ
R12 — 1 MΩ
R13 — 25 kΩ
R14 — 1.2 kΩ
R15 — 40 kΩ
R16 — 100 kΩ
R17 — 2 kΩ
R18 — 1 MΩ
R19 — 10 kΩ
R20 — 100 kΩ
R21 — 10 kΩ
R22 — 1 MΩ
R23 — 500 kΩ (Potentiometer)
R24 — 30 kΩ
R25 — 500 kΩ
R26 — 1 MΩ
R27 — 1.2 kΩ
R28 — 82 kΩ
R29 — 100 kΩ
R30 — 200 kΩ
R31 — 450 kΩ
R32 — 500 kΩ
R33 — 1.2 kΩ
R34 — 47 Ω
R35 — 160 kΩ
R36 — 2.2 kΩ
R37 — 500 kΩ
R38 — 500 Ω (may vary for different output valves)

Valves

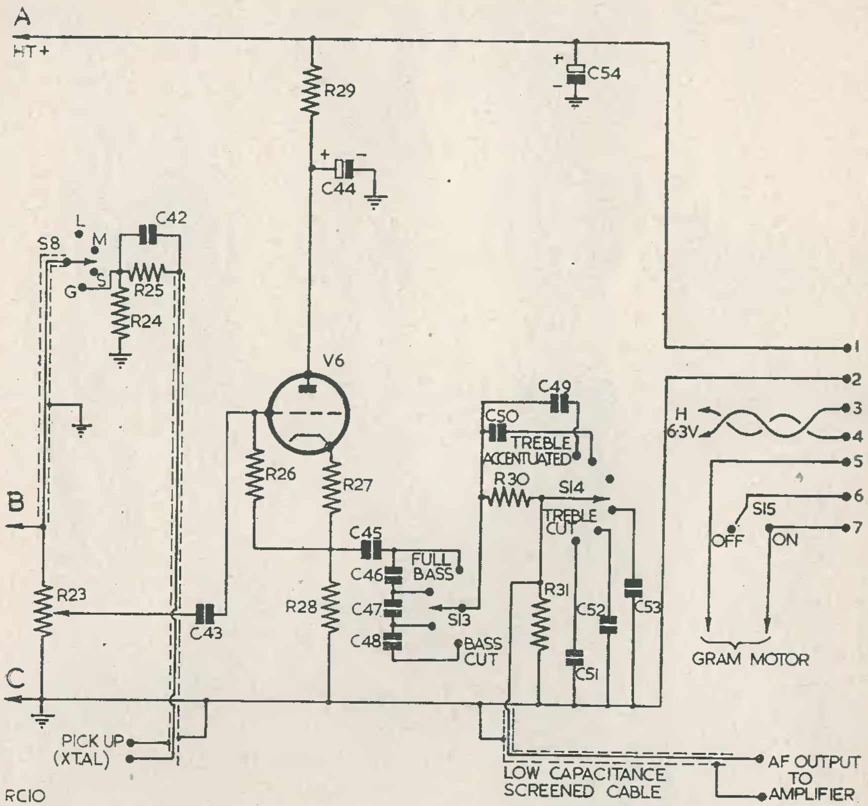
V1 — Variable-μ RF Pentode (6K7, etc.)
V2 — Triode-Hexode Frequency-changer (6K8, etc.)
V3 — Triode (6J5)
V4 — As for V1
V5 — Double-diode (6H6, etc.)
V6 — Triode. (Possibly part of double-diode-triode; top-cap grid essential)
V7 — Tuning Indicator
V8 — "Straight" AF Pentode (EF36, etc.)
V9 — Output Pentode (6F6, etc.)
V10 — Rectifier (5Y3, etc.)

Switches

S1 to S8 — Wave Change Switch, (References "L," "M," "S," and "G," stand for "Long," "Medium," "Short," and "Gram" respectively)
S9 to S12 — Variable Selectivity Switch. (References "SH," "ST," and "L" stand for "Sharp" "Staggered" and "Local" respectively)
S13 — Bass Tone Control Switch
S14 — Treble Tone Control Switch
S15 — Mains On-Off Switch (Together with R23)

IF Transformers

456 kc/s. — Any reputable make, but must be capacitor-trimmed.



CATHODE FOLLOWER WITH TONE CONTROLS

(*For values see p. 193*)

of the diode cathode to R19, C36 and C37 instead of to chassis did not introduce any distortion; and it was found that no difference whatsoever was noticeable when R19 was short-circuited, whether receiving either weak or strong signals. S7, in addition to providing the diode delay, also breaks the HT circuit to the RF and IF valves in the "Gram" position.

The AVC in the receiver is taken directly from the diode load (i.e., from the volume control, R23), and is not delayed. It was found that there was no advantage in having delayed AVC so far as sensitivity was concerned, whilst the use of a separate AVC detector circuit caused the tuning indicator to give slightly erratic results when the IF transformers were staggered. It was decided, therefore, to use simple AVC as shown in Fig. 1 and so allow the tuning indicator to give a "true picture" of the rectified voltage formed across the diode load.

(*To be continued*)

IN YOUR WORKSHOP

In which J. R. D. discusses Problems and Points of Interest connected with the Workshop side of our Hobby, based on Letters from Readers and his own experience

We reviewed recently the procedure usually employed to repair a receiver which suffers from tuning capacitor howl. The cures we discussed consisted mainly of checking the mountings of the tuning capacitor and of removing any excessive "peakiness" that may occur in the IF stages.

These measures do not always, however, effect a cure; and the serviceman is often driven to the more desperate procedure of fitting additional floating mountings to the capacitor or, as a last resort, of completely replacing the tuning capacitor itself.

Now, when all other possible faults have been investigated, the process of replacing the tuning capacitor with a new model nearly always results in a cure, but the reason for this is not always immediately apparent. One expects a few teething troubles in a newly completed home-made receiver; but it is a little difficult to understand why a tuning capacitor which has been giving good service for years should suddenly become microphonic. The old capacitor appears to be just as strong and sturdy as it always has been. Why should it, then, "go bad?"

As with everything else in radio, however, there is a reason; and it is this reason which we shall now discuss.

Varying Capacitances

Let us begin by imagining that we have two similarly shaped plates of a capacitor as shown, end-on, in Fig. 1. The dielectric is air. Plate A in this diagram is fixed, but plate B is capable of vibration; this being caused conceivably by sound waves.

Our reference books tell us that the capacitance existing between these two plates is governed by the formula:

$$C = \frac{0.0855 \times KS}{t}$$

where C is capacitance in pF, K is dielectric constant, S is area of each plate in sq. cms., and t is distance between plates in cms.

What we want to do here is to investigate the effect upon C of varying t; and it will help if we prune the formula down a little.

In the case of our two plates in Fig. 1, K and S are constants. We do not wish to change the area of either of the plates, nor will we be altering our dielectric. As K and S are constant we can now replace the cumbersome expression above the line on the right hand side by a single letter: say, a. So we can now write:

$$C = \frac{a}{t}$$

where a, for our purposes here, is a constant.

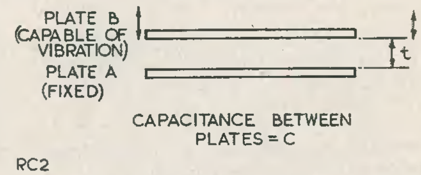


Fig. 1: Two plates of a capacitor viewed end-on. The dielectric is air.

When plate B of Fig. 1 vibrates, it is obvious that the vibrations vary the value of t. Let us now see how these variations in t affect C. This is most easily done by differentiation; and we obtain:

$$\frac{dC}{dt} = -\frac{a}{t^2}$$

The minus sign merely means that a decrease in t causes an increase in C, (and vice versa) which is what we would expect.

If t is equal to 1 cm., we find that:

$$\frac{dC}{dt} = -a$$

When t equals $\frac{1}{2}$ cm., we find:

$$\frac{dC}{dt} = \frac{a}{(\frac{1}{2})^2} = -4a$$

Going a stage further, when t equals $\frac{1}{4}$ cm., we obtain:

$$\frac{dC}{dt} = \frac{-a}{(\frac{1}{4})^2} = -16a$$

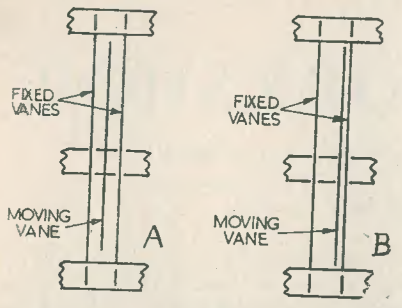


Fig. 2 (a): One moving and two fixed vanes of a standard tuning capacitor.

Fig. 2 (b): How the moving vane of (a) may fall out of its central position between the fixed vanes. A tuning capacitor whose vanes are like this is very liable to become microphonic.

These three examples are sufficient to show that the effect upon C of variations in t increases as the inverse square of the reduction of t. When t is halved, the effect upon C of variations in t is four times greater; when t is reduced to a quarter, the effect upon C is sixteen times greater, and so on.

(Almost the same figures will be obtained, without differentiation, if the changes in C are worked out for values of t between 1.01 and 0.99; 0.51 and 0.49; and 0.26 and 0.24 cms.; using the original formula $C = \frac{a}{t}$. These figures represent a variation in t of 0.02 cms. at 1, ½ and ¼ cms. respectively).

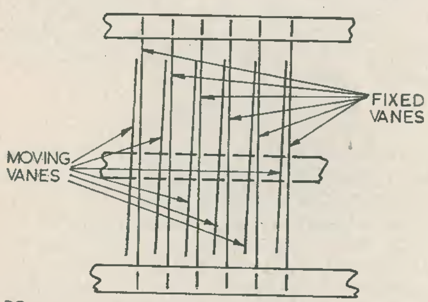


Fig. 3: In practice, the moving vanes of a tuning capacitor sometimes become distorted in the manner shown (somewhat exaggerated) here, where they closely approach the right hand fixed vanes at one end and the left hand fixed vanes at the other. When a capacitor like this becomes microphonic it usually has to be replaced.

Results

What does all this tell us ? Referring to Fig. 1 again, it tells us that the vibrations in plate B cause capacitance changes which increase at a considerable rate when B approaches A. (We get, incidentally, something of the same effect with a trimmer of the "postage-stamp" type. When the leaves of such a trimmer are well apart, a half-turn of the adjusting screw has little effect. When, however, the leaves are tight together, a half-turn of the adjusting screw causes a very much larger change in capacitance).

In the ideal case of t being equal to zero, $\frac{dC}{dt}$ would equal infinity. If t were equal to zero the plates would, of course, be touching; but this ideal consideration gives a startling idea of what is possible when the plates are very nearly touching.

Tuning Capacitors

Fig. 2 (a) shows one moving and two fixed vanes of a tuning capacitor. The moving vane is mounted centrally between the two fixed vanes. In nearly all tuning capacitors the fixed vanes are mounted more rigidly than are the moving vanes. Thus, when the tuning capacitor is affected by sound waves, it is safe to assume that the moving vanes vibrate more than do the fixed vanes. Vibration (of the type induced by sound waves) of the moving vane of Fig. 2 (a) should cause only small variations in capacitance.

In Fig. 2 (b) the moving vane has become displaced and is now much closer to the right hand fixed vane than it was previously. The result of this displacement is that the variations in capacitance caused by vibrations in the moving vane now become considerably higher than they were before.

From our findings we can now sum up and state that, when the moving vanes of a tuning capacitor become displaced from their central position and closely approach the fixed vanes, the tuning capacitor affected is very liable to become sufficiently microphonic to allow feedback to occur. This, in effect, is what occurs in very many cases when a tuning capacitor—to use our earlier phrase—"goes bad."

In Practice

Bearing this potential fault in mind, our investigation of a receiver suffering from tuning

capacitor howl becomes much simpler. We start, as before, by checking that the floating mountings of the tuning capacitor are in good order. Our next task now consists of ensuring that the moving vanes of the oscillator gang (which is the only part of the capacitor which concerns us) are correctly centralised. Only after we have done this is it necessary to start looking for bad response curves in the IF amplifier and so on.

Fortune does not always smile too sweetly upon the poor serviceman, however, and whilst, in many cases, it may be possible to centralise the oscillator moving vanes by a simple adjustment of the end-bearing screw, in others it may be found that the vanes are too badly distorted for such a cure to be effective.

Fig. 3 shows an example of how moving vanes can become distorted by time or by careless handling. It is, of course, obviously impossible to do anything for a capacitor as bad as this, and the only solution (apart from judicious bending by hand which may do more harm than good) is replacement.

It is worth-while, in addition, keeping an eye open for split end-vanes which have been bent inwards too closely. And, finally, it should be pointed out that, when a tuning capacitor has been cleared of microphony by adjustment, it will of course be necessary to re-trim the receiver.

VALVES AND THEIR POWER SUPPLIES

Part 1

By F. L. BAYLISS, A.M.I.E.T.

—oOo—

A Thousand Odd "-Odes"

Despite the large measure of standardisation which has been adopted in respect of types of valve bases, methods of using valves, and the apparent stability of modern circuit designs —especially receivers—the variety of types of valves and the limitations of their usage must be confusing to all but the circuit-steeped, lifework professional.

Certainly, the beginner could be excused bewilderment when confronted with the fact of the existence of more than twenty types of commonly used British bases, each base serving any number of valves, in its type series, from a solitary one to more than a hundred.

Moreover, although several excellent handbooks are available, in which operating data and characteristics are given clearly and concisely (the *World Radio Valve Handbook* is an excellent example), to the tyro such books are not necessarily good primers. *His* need is more for an introduction to *them*, an introduction which is a guiding and explanatory aunt to point out exactly how this and that are done, and why this and that are necessary.

This short series of articles, then, is intended as just such a guide—a thesis and grouping of all the popular modern types of valves, together with explanatory circuits on the important aspect of supplying them with the correct voltages and currents, *i.e.*, their associated power packs.

The signal circuits associated with the valves are not intended to be discussed. These may vary from design to design and, in any case, are often given in full in the valve manufacturers' handbooks.

The correct supply of power to the valve will be the focal point of the discussion, and guidance will be given in this matter from the points of view of preference, adaptability and suitability for particular cases.

AC-Only Circuits (4 volts)

Early British type mains valves were of the AC type, having 4 volt heaters, usually no cathode as such, and were a direct development of 2 or 4 volt battery types.

Very rapidly, however, these gave place to the 4 volt types, both directly and indirectly heated, some of which are obtainable even today, whilst others may be regarded as earlier developments of the modern 4 volt series often met with in 15 year old receivers.

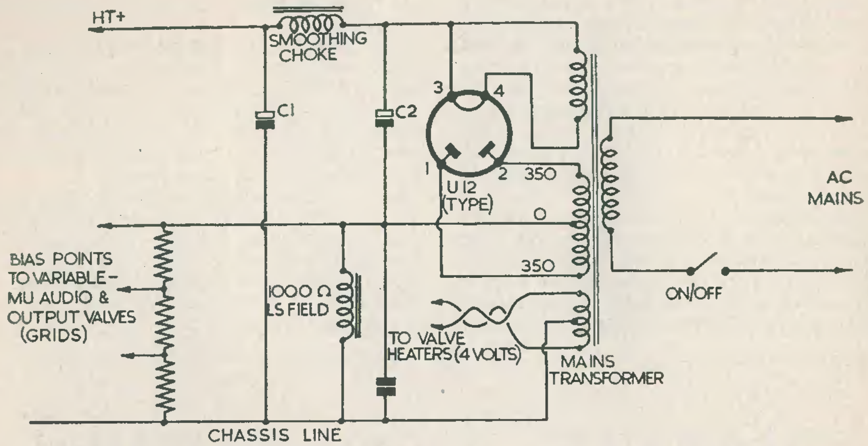


FIG. 1

RC15

These valves are the original British types and, despite their antiquity compared to, say, an EF50 or an ECH35, remarkably good they are.

However, since most of them, today, are made simply as replacements and are rarely used in current commercial designs, the only circuit features worth mentioning here are those popular some 15 or 20 years ago—for after all, there are still thousands of such receivers in use and they must still be serviced.

If at any time you have to look into such a set, then, look out for the following points:

(*a*) The cathodes were often strapped to the chassis, and bias for the audio valves obtained either from a bias resistor or a loudspeaker field connected in the power pack HT– lead. Sometimes more than one resistor was used to give various bias tappings.

(*b*) A mains transformer is almost invariably used, and the heater windings nearly always centre-tapped.

(*c*) The RF valve top caps were anode connections—not grid—so, beware shocks !

A typical power supply arrangement in such a set is shown in Fig. 1.

It is perhaps worthy of note that receivers such as these are prone to audio instability, caused either by feedback over the bias circuits, low values of C1 and C2—often these were Mansbridge paper condensers—or by a combination of these two deficiencies.

A low burbling hum is the usual symptom, and an improvement can sometimes be made by adopting cathode bias, with appropriate bypass electrolytics, and dispensing with the existing bias scheme, though leaving the loudspeaker field *in situ*. C1 and C2, if 2 or 4 μF paper, may with advantage be replaced by a 16+16 μF electrolytic rated at 450V working.

Before leaving the subject of old 4 volt AC valves, it may be mentioned that *all* had 4, 5 or 7 pin British type bases and that rarely, even with RF valves, was the heater current rated at less than 1 ampere.

Other 4 Volt AC Types

As with most things, however, there are exceptions to the foregoing generalities.

Whilst Mullards list but a bare half-dozen, and these only as maintenance types, and with the Marconi-Osram PX4 now definitely obsolete, on the other hand Mazda have introduced only comparatively recently a range of 4 volt valves classified as current types, and all fitted with Mazda octal bases.

Moreover, though sometimes similar in characteristics, these cannot be said merely to be the older types with newer bases. The PEN46, in fact, has been developed especially as a television line output valve.

These Mazda octal bases, whilst very similar to the international octal, have two important but discernible differences: the Mazda spigot has a greater diameter and the pin spacing is greater, *i.e.*, the periphery around the eight pins is longer.

A Mazda octal valveholder of the Amphenol type is usually distinguishable by having a tiny " pip " raised on the top surface between pins 1 and 8. They are *not* inter-changeable with the international octal type.

Lastly, one 4 volt diode, the Mazda D1, is a 3 pin valve, fitting a B3G valveholder.

It is interesting to note that the anode of these miniature all-glass valves is the top cap, whilst the two outer base pins are the heater and the centre pin is the cathode. Interesting, because the anode, which may have an HT+ potential, has been kept well away from the heater pins. This is good and thoughtful practice, and this principle can with every advantage be extended to other valves.

The Risky Test Prod

Consider the first valve base shown in Fig. 2. This is a connection diagram of the Mazda 4 volt triode-hexode frequency changer TH41, a valve classed as a current type.

The heater is brought out to pins 1 and 8. However, whereas pin 1 is adjacent to the comparatively low voltage cathode (pin 2), pin 8 has the screen grid, pin 7, as its neighbour.

The risk of a short circuit between pins 7 and 8 is too great to be ignored. A loose blob of solder, a chance jab with a test prod, a bare wire end, may all cause disaster by connecting the screen's 100V to the " live " side of the heater wiring.

The wise constructor will watch this point and connect pin 8 to chassis, reserving pin 1 as the 4V heater supply point.

As for the TH41, so with the 6SH7 and any other valve in which heater and high voltage points are adjacent.

The 6SH7 connections are shown in the second diagram of Fig. 2, and in this case the position is even worse. Whilst pin 2 is sandwiched between the harmless metallising and cathode, pin 7 has the anode and screen grid one on either side. These are a formidable pair, and to connect a 6.3V heater supply between them is to court disaster. Connect the heater supply voltage to pin 2, then, and strap pin 7 to chassis.

Although the foregoing may be taken as a general rule to apply to *all* mains valves, it cannot, however, apply equally to battery valves. The suppressor grid, the metallising, or both, may be internally connected to the negative filament pin, and the maker's recommendations should be strictly adhered to when making connections. (See also " Earthing Filaments " in *Query Corner*, last issue.—Ed.)

Care in soldering, however, should certainly be exercised, and the insulation of the wiring to the filament and adjacent valveholder tags taken right up to the tags, leaving no bare wire at or near them. Reference to these latter

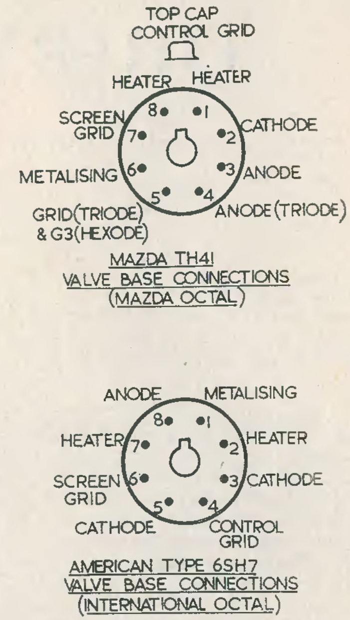


FIG 2

RC16

points will again be made when battery valves are fully dealt with later in this series.

Before concluding this part, the writer would like to allay any misunderstanding that may arise out of the reference to the top cap of B3G miniature valves. The reason for the segregation of anode and cathode connections was that with these valves, being diode demodulators, interaction between modulated and demodulated signals was to be avoided.

However, the top cap *could* have been the cathode, and the centre pin the anode, next to the heater pins. The fact that this is not so is much more probably purposeful than accidental.

(*To be continued*)

ERRATUM

There is a small error in Fig. 6 of the article " Design for an 'Economy' Mains Receiver " which was published in the October issue. The designation of the valve heaters in the diagram are interchanged, that is to say it is the heater of the 12SK7 which should be connected to chassis, and the 12A6 which should be fed from resistor R10.

QUERY CORNER

A "Radio Constructor" Service for Readers

Image Converters

I have seen recently a number of references to image converters. Can you tell me briefly what they are and their purpose ?

E. Smythe, Chiswick

In its best known form the image converter is a device to convert infra red radiation into visible light. Infra-red radiation has a wavelength of 0.01 millimeters which is just above the visible spectrum, but if present in a large enough concentration it can be detected as heat. The image converter is cylindrical in shape and has a screen on each of its circular flat ends. One screen is sensitive to infra-red and emits electrons under its influence. These electrons are focused, as in a cathode ray tube, onto the viewing screen on the other end of the tube. This screen is similar to those used in cathode ray tubes and emits light under electron bombardment, thus reproducing a visible image of the infra pattern on the other end of the tube. To accelerate the electron from one end of the tube to the other, a potential of several kilovolts is applied to a cylindrical anode located within the tube.

The Germans were beginning to use infra-red equipment towards the latter part of the last war to enable cars to be driven through complete darkness without revealing their position. Infra-red lamps were located on the front of the vehicle and the road ahead was viewed by the driver through an image converter. Other applications included the use of the equipment with machine guns and rifles to enable a target to be located in the dark without revealing the position of the gun. In the post war years the converters have found many uses, one of the most important being as a high speed shutter for photographing transient phenomena of very short duration. For such applications the tubes are pulsed, so that the image only appears on the viewing screen during the exposure period.

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 or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.
(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.

Resistance of Lamps

I have measured the resistance of a 25 watt 230 volt lamp and found it to be 150 ohms. But by Ohms Law I calculate that a lamp of this resistance would pass 1.5 amps at 230 volts which is about 350 watts. Can you please point out the error in my calculations?

F.J.J., N. Wales

A tungsten filament lamp has a positive temperature co-efficient; this is another way of saying that its resistance will increase as the temperature of the filament wire increases. Thus although the lamp has only a resistance of 150 ohms when cold, this will rapidly rise to around 2300 ohms when the lamp is switched on and reaches its working temperature This does, of course, mean that at the instant of switching on the lamp will pass a current which is much in excess of its working value, and it is this sudden surge which sometimes accounts for a broken filament when the lamp has seen a long period of service.

Working Voltage of Capacitors

Should the working voltage of a screen grid decoupling capacitor equal the working voltage of the grid to which it is connected, or should it equal the HT voltage ?

G. Paishley, Watford

In order to make this problem clear to readers, let us consider the circuit shown in Fig. 1. Here, the screen grid of a pentode is fed via a dropping resistor R1 from the HT line and decoupled by the capacitor C1. Now the voltage applied to the capacitor is normally the working voltage of the screen grid, but should the valve be removed for any reason the voltage across the capacitor will rise to the HT voltage. Also, this condition may exist immediately after the set is switched on as the rectifier probably warms much quicker than the valve, hence the HT voltage is present across the capacitor before the pentode has warmed up.

This line of thought can be carried a stage further if we consider what happens to the HT voltage should a very quick heating rectifier, such as one having a directly heated filament or a metal rectifier, be employed. In this case, the HT is applied to the receiver upon first switching on, before the valves have a chance to pass any current, and the HT load is therefore negligible. During the warming up period the HT voltage may therefore rise to the peak of the rectifier anode voltage (i.e., 1.4 times rectifier anode voltage). This voltage is applied to the decoupling capacitor shown in Fig. 1, which must consequently be capable of withstanding it.

Most capacitors are fairly conservatively rated as regards their stated working voltages, but as amateur equipment is usually built to last some years with the minimum of servicing it has always been the writer's policy to rate decoupling capacitors at a working voltage which is at least equal to the HT voltage when an indirectly heated rectifier is employed. In equipment using a directly heated or metal type rectifier, the working voltage of such capacitors is chosen to be at least equal to 1.4 times the rectifiers' AC input voltage.

Similar remarks also apply to signal coupling capacitors, as reference to Fig. 2 will indicate. In this case the coupling capacitor will charge up to the full HT voltage via R1 and R2, if the valve V1 is removed, or during the warming up period. Providing the constructor is aware of these possible ways of overloading capacitors, it is but a moment's work to check that the working voltage of each component is adequate before it is actually connected in circuit. This small additional effort is well repaid by the reduced servicing which carefully designed equipment requires.

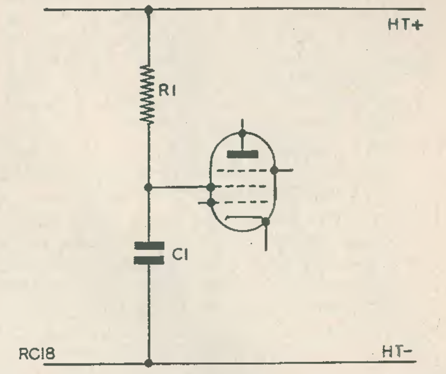


FIG. 1
SCREEN GRID DECOUPLING CAPACITOR

Poor C.R. Tube Focus

I have purchased a 12 inch television tube second-hand and find it impossible to obtain a good focus. Can this be a fault within the tube ?

W. Shiels, Andover

The main causes of an evenly poor focus in a magnetic tube may be listed as follows:

(1) Incorrect value of focusing field. In

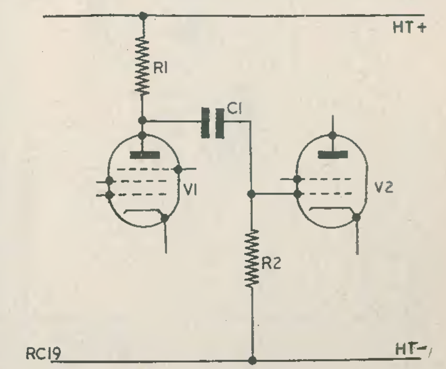


FIG. 2
SIGNAL FEED CAPACITOR

this respect, it is worth remembering that the centre of the field should be approximately in line with the end of the electrode gun assembly nearest the screen. Also bear in mind that a triode tube (single anode) requires a larger field than a tetrode tube (two anodes).

(2) EHT voltage too low. This defect will also result in raster overscanning and a weak picture having poor highlights.

(3) Defective tube. The most likely defect which would cause a uniformly poor focus is a bad vacuum within the tube. Tubes which suffer from this trouble are usually referred to as being gassy, a fault which is difficult to establish without special gear. If this trouble is suspected, it is best to test the tubeby running it in a televisor which is known to be in good working order. The assistance of a local radio dealer can sometimes be enlisted to check a tube in this manner.

The above list of possible faults which can impair the focus of a televisor tube assume that the focus is uniformly poor: tubes which exhibit a poor focus over only part of the raster indicate an entirely different set of fault conditions which will be made the subject of a separate article at some future date.

from our Mailbag

WARNING

Dear Sir,

The circuit of the "Single-Valve Signal Generator" (Jan. '52 issue, p.227) contains a potential fatal accident.

The output potentiometer has been returned to HT– so that in its minimum position the output is connected direct to one side of the mains, possibly the live side.

This can be avoided by returning the potentiometer to the chassis instead of HT– (as shown dotted in the accompanying diagram)

D. THORNTON (Ewell, Surrey).

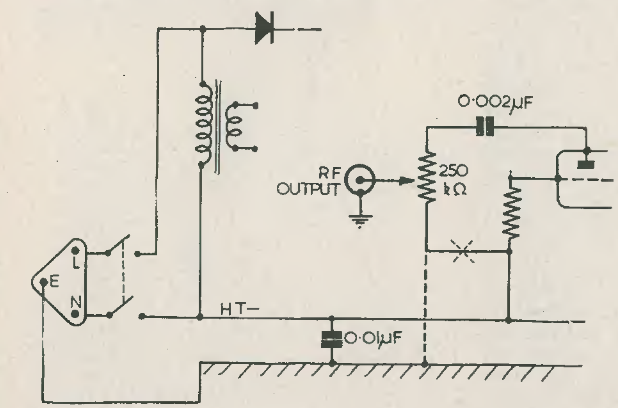
(We apologise for such a late reference to this matter, which has only just been brought to our attention. We should also like to point out that the 0.002 *μF condenser should be of good quality, and have a minimum rating of 750V wkg.—Ed.).*

EFFECTIVE

Dear Sir,

I thought I would write and inform you how effective my advertisement was in the Sept. issue of *Radio Constructor*. Although the total cost (equipment offered) was £50, the instruments and parts were sold by the 5th Sept., and I have had to write to many of your readers who sent telegrams and letters, informing them the goods were sold.—

J. LOWE (Richmond, Surrey).



ATTENUATOR CONNECTIONS FOR SINGLE VALVE SIGNAL GENERATOR

RC6

HELP NEEDED

Dear Sirs,

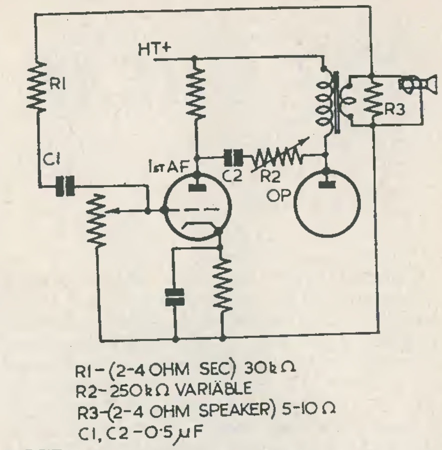
Please can you tell me if there is any information available on the Army 21 Transmitter, or of any possible way I may be able to get such information. I have one of these transmitters and I am trying to find the frequency ranges covered by some of the inter-stage tuned circuits.—

J. W. TRESADERN, G3HOT, 63 St. Mary's Road, Plaistow, London, E.13.

Dear Sir,

I am wondering if any of your readers can supply a circuit diagram of the No. 2 Performance Meter AP.53874, and has anyone converted it to any practical use? Could it be easily converted to a signal tracer using the Y63 Magic Eye for detection?—

C. V. HAWES, 24 Wannock Road, Eastbourne, Sussex.



RC17

NFB COMPENSATING VOLUME CONTROL

Dear Sir,

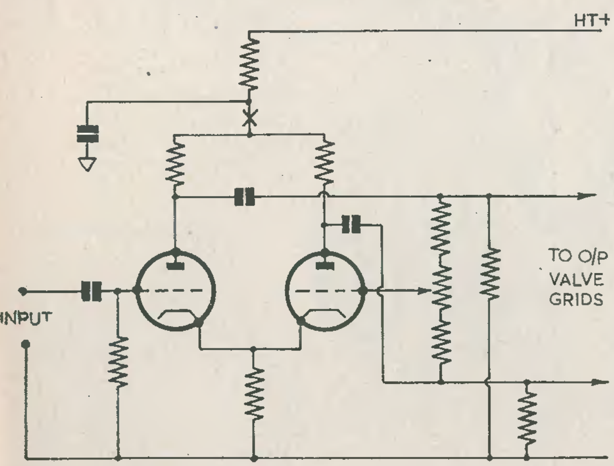
I always look forward to reading Mr. French's article, but really must take exception to this month's (Sept. issue) on variable feed back. Audio distortion increasing with the output demanded from the valve, the suggested circuit giving minimum NFB at maximum input, would appear to be somewhat topsy-turvy!

I enclose sketch of my favourite hook-up for doctoring commercial 4+1 valve superhets, which does really seem to work and make even a brass band worth listening to!

The tone control and all tone correcting components are first removed, and the tone control switch used to switch off NFB when maximum sensitivity is required. The resistor across the speaker is optional—it helps to flatten out variations in speaker impedance and response at different audio frequencies and improves damping.

Finally—a warning. If the set is of the AC/DC variety, connecting the output transformer secondary in the NFB circuit makes the speaker "live" and an external speaker should not be connected. —

S. DALTON, LL.B., (London, E.C.2.).



RC17A

PHASE-SPLITTERS

Dear Sir,

In your answer to a correspondent who asked for a phase-splitting circuit for driving a push-pull stage I was pleased to see that you recommended the See-Saw (or Paraphase) circuit. I have always felt that the merits of this arrangement have never received the recognition which it deserves.

There is an alternative arrangement of this circuit which has some advantages, the chief one being the elimination of the RC coupling to the phase reversing valve. It is shown here and may be of interest to your correspondent.—H. READING (Woodford Green, Essex).

A CHEAP RECTIFIER

by R. W. HILL

A prowl round the junk shops recently brought to light the existence of another rather awkward valve type which was being sold very cheaply. This was a 2C34/RK34, a most impressive looking bottle with two anode caps and a 7-pin UX base, and it looked worth every penny of one of my hard-earned half-crowns. The next step was, of course, to spend about a week finding some useful purpose for the thing. To the uninitiated this expenditure of time may seem uneconomic, but the inveterate Surplus man will agree with me that this is more than offset by the thrill of the chase and the eventual triumph of making something for half of what it should have cost. Actually this valve is a twin triode class C amplifier/oscillator with the following specification:— Heater 6.3V–0.8A, anodes 300V–80mA, 10.W dissipation, bias –36V, μ13 and max. grid current 20mA. These figures are for the two triodes together. Fig. 1 gives the base connections. My immediate requirement was for a rectifier for a small receiver under construction, and I had been looking askance at the current prices, which seem to be on the increase, but I now look no more, for the RK34 works admirably as a full-wave rectifier and henceforward will be incorporated in many other pieces of apparatus with small power requirements.

The best connection is shown in Fig. 2. Grids are clearly not the things to have in a rectifier, and I tried leaving them loose and connected to cathode, but the voltage output was low; finally with some trepidation I hooked them on to their respective anodes.

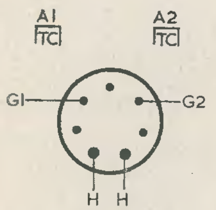


FIG. 1

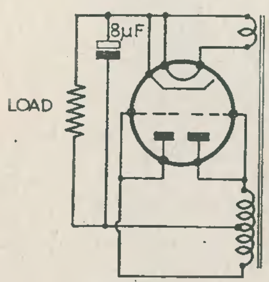


FIG. 2

C757

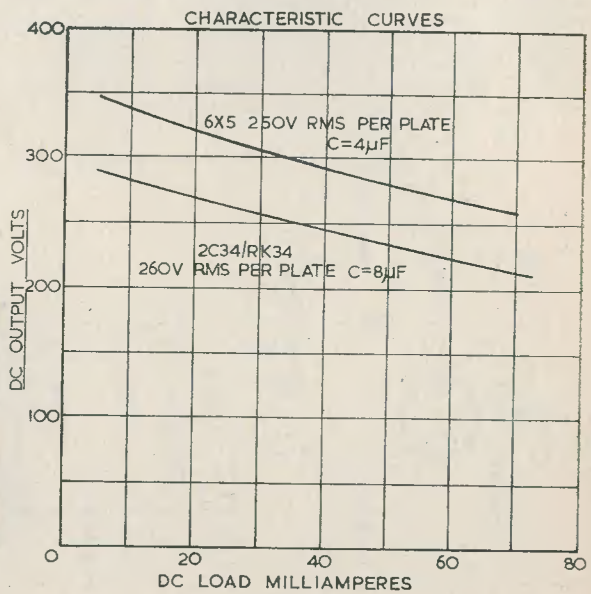


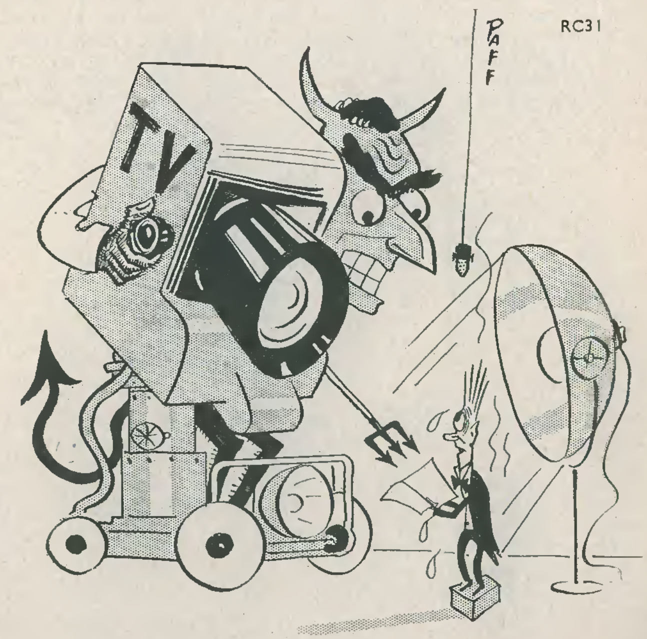
FIG. 3

The results were good, but I spent a few anxious minutes peering inside expecting to find the poor grids doing an imitation of a neon sign, but all was well, and a meter check showed that the grid current was slightly over a quarter the anode current, which agreed well with the valve ratings.

The next worry was regulation, for this type of valve has a much higher impedance than a properly designed rectifier, where the anode-cathode spacing is made small to give the least voltage drop. A series of checks with varying loads gave the curve in Fig. 3, which includes for comparison the regulation curve of a 6X5. The output voltage is lower, as was expected, but the curves have identical slopes, which is most satisfactory.

Owing to the short-sightedness of the manufacturers in not supplying the data for the use of this valve as a rectifier, the maximum working ratings must be more or less guessed at. The total anode and grid current is 100mA, so this is obviously the limit, and due to the different working conditions a lower current would be safer and lead to longer valve life. I have used one at 50mA for some time and it gives no sign of stress at all. The AC input is probably safe at 250V, which covers most normal requirements. The 6.3V heater supply may be difficult for some, although there are numbers of transformers with suitable windings available. If all else fails the RK34 could be run from the common 6V heater supply in a similar way to the 6X5. This would cause any self-respecting valve maker's hair to stand straight on end, but it is quite likely that the heater-cathode insulation is a bit thicker than usual in this type of valve, and I can only say that I have tried it, and it works !

There are many other applications of the RK34 which spring to mind, such as an AF amplifier or, more particularly, an output valve. but at the moment I am well satisfied with its use as a cheap and efficient rectifier.



"I told you it was different to Sound Radio!"

USEFUL MARKING-OUT DEVICE

By P. J. ELLIS

With the longer nights already set in, the writer, in common with other radio enthusiasts, has embarked on an ambitious scheme of building new test gear and receivers, and of modifying present equipment. The greatest difficulty encountered so far has been in the marking out—particularly of valveholder positions. At first, the writer used the old method of setting out by compasses and rule, centre-punching and finally drilling.

This took quite a time for each valveholder, and generally produced both unsightly and inaccurate work. Also, some of these valveholders had to be added to sets already constructed. It was found impossible, in some cases, to get either compasses or rule in between the existing components.

In order to surmount this difficulty, and also to quicken up a generally uninteresting job, the writer accordingly designed the marking-out punch shown in the diagrams. This tool, with a slight tap from a hammer, punches three centre-pops on the chassis, the centre one of which marks out the centre of the valveholder, and the other two the positions of the fixing screws.

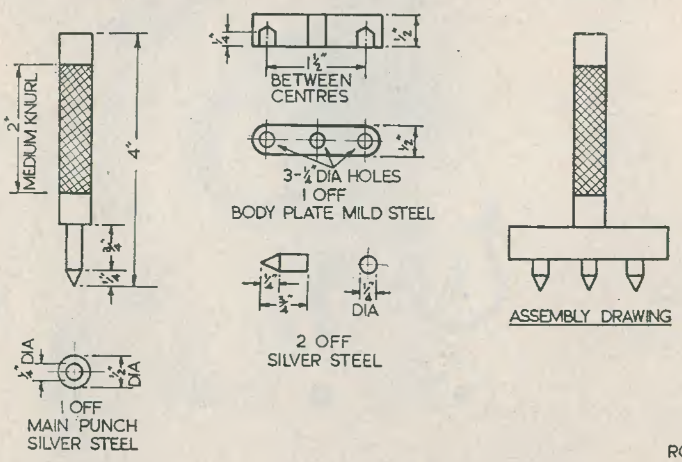
The device is made of mild and silver steel, both cheap and readily available. The body plate is made of ½″ square mild steel bar, with three ¼″ diam. holes drilled accurately in it. The outer, blind holes should be drilled slightly under size, by "stoning" the tips of the drill, so that they are a tight fit to the ¼″ silver steel points. The centre hole should be reamed so that the main punch is a good removable fit; this will enable one punch to be used with a number of body plates, if required, and also to be used for ordinary punching.

The main punch is made from a piece of 4″ long × ½″ diam. silver steel rod turned down at one end to ¼″ diam. for 1″ and pointed. The handle may be knurled, if facilities are available, to give a professional appearance.

The outer two points are made from ¼″ diam. silver steel rod pointed at one end like the main punch.

All the silver steel points are hardened by heating until they are cherry red and then quenching rapidly in cold water. After this they are tempered by first polishing bright with emery cloth, carefully heating in a low flame and quenching rapidly in cold water when the points become a light straw colour.

The distance between the two outer points varies with different holders, and in this instance dimensions are given to suit the standard octal base holder. Some thought was given to making the points adjustable for distance, but in view of the time needed to set up, the chances of error in setting, and the fact that a body of sufficient length for a large holder might prove too large when working, say, on a cramped chassis with B7G bases, it was decided to make up separate body plates for all the commonly used valveholders.



RC7

USEFUL MARKING-OUT DEVICE

A QRP RECEIVER for 144 Mc/s.

By H. NUNN, ISWL/G167

This simple receiver came into being through the writer attending a lecture at a local club. I made up my mind to get going on the band as soon as possible with the least expense.

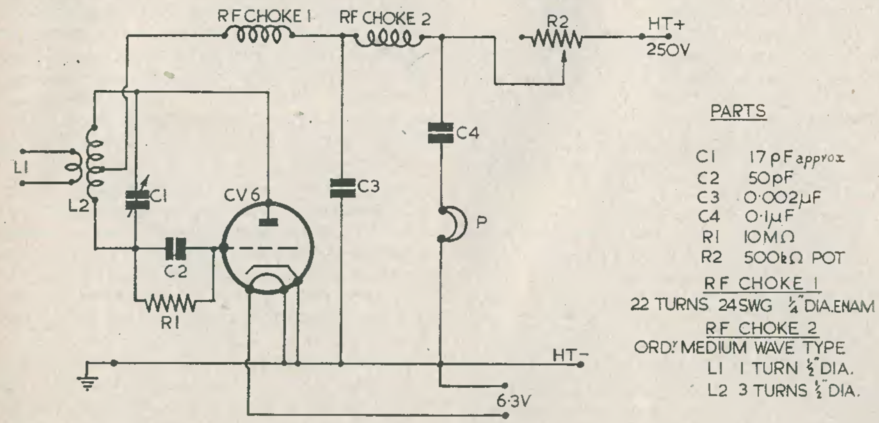
I decided on a Super-Regen circuit, and various types of valves were tried, but the CV6 proved to be the best; also, it is very cheap and easy to obtain. The receiver was built on a piece of very thick aluminium 7″ × 6″, in the centre of which the tuning capacitor was mounted on a piece of ¼ inch perspex; this was fixed to the chassis by a small "L" shaped bracket made from thick brass.

The tuning capacitor consists of a surplus item stripped down and reassembled to three fixed and two moving vanes, double spaced. The tuning coil of 16 swg enamelled wire is wound three turns on a ½″ diam. former, which is then removed and the coil allowed to spring off. It is then soldered direct on to the tuning capacitor.

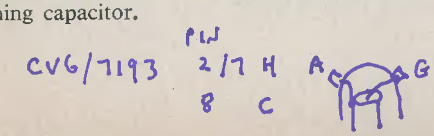
The coupling coil consists of a single turn loop of thick wire enclosed in plastic sleeving. This is fixed to two large stand-off insulators and placed as near as possible to the grid end of the tuning coil. The best position will be found when a loud hiss is heard all round the dial without dead spots. An insulated strip at the rear takes the 0·5 MΩ pot and headphone sockets.

Keep everything rigid, especially the tuning capacitor and coil. All components and wiring are on top of the chassis except heater leads. The valve holder is raised ½″ to clear the chassis, and all earthing is to one solder tag. No trouble was encountered from hand capacity or hum; a normal power pack was used.

Results to date consist of local amateurs ten miles away, also aircraft signals. Considering the height of the aerial, 14-ft., and the fact that this is only a simple beam similar to one described in *Short Wave News* (now *The Radio Amateur*), I think this quite good.



RC1



Trade Reviews

LABGEAR 5-STAGE WIDE-BAND MULTIPLIER

The almost complete coverage of Great Britain by TV, and the expansion of programme time—particularly at week-ends and in the evenings, important times as far as the majority of amateur transmitters are concerned—means that TVI is a problem which *must* take priority in the shack. Otherwise, there will be a tendency for activity on the LF bands to become progressively lower and lower, and we shall be in some danger of losing them altogether.

With this in mind, the introduction by Labgear (Cambridge) Ltd., Willow Place, Cambridge, of a completely switched wide-band multiplier unit, built to give maximum attenuation of harmonic radiation such as will cause interference with TV reception, is a most welcome step.

The unit, which is completely wired up and tested at the factory, consists of a number of wide-band couplers, a band-switch of the wafer type, and the necessary bypass and trimmer condensers. It is so arranged that, when mounted on the main chassis, each stage is completely screened from the others. Fixing is by four 6BA screws, and a drilling template is supplied.

It is quite small, so that a compact 5-band Tx may be readily built. The chassis space occupied is $9\frac{1}{8}''$ long by $2\frac{7}{16}''$ wide, and the maximum height above chassis is $3\frac{3}{4}''$. The switch spindle projects at the rear, and is suitable for coupling to a Labgear turret in the PA or buffer stage, thus simplifying band changing.

Output is obtainable at 3.5–3.8 Mc/s, 7.0–7.3 Mc/s, 14.0–14.35 Mc/s, 21.0–21.45 Mc/s and 28.0–29.0 Mc/s (or to 29.7 Mc/s with slightly reduced drive) simply by setting the switch to the appropriate range as indicated on the escutcheon. Input may be from either a 3.5 Mc/s or 1.7 Mc/s VFO.

The associated valve line-up can be really flexible, and in a simple rig may actually consist of double triodes. Three such valves would even allow for the VFO. EF50, EF54, EF91, Z77, 6AQ5, 6AC7, 6AG7, QVO4-7, 6V6, EF55, 6J6, 6C4, EC91, 12AU7, 12AT7, ECC81, etc., are all suitable. The makers suggest that multi-electrode valves should be triode connected, as this gives a flatter response and greater drive to the PA, as well as making for greater simplicity in the construction of the multiplier stages. Two line-ups have been found exceptionally satisfactory by Labgear Ltd. The first should be employed when it is found necessary to construct a miniature exciter using the very minimum number of valves and to keep the cost as low as possible. It consists of an EF80 Clapp master oscillator, followed by two 12AU7's associated with the multiplier proper. This will provide approximately 2 mA drive for an 807, which should not be exceeded if low harmonic content is to be maintained. The second line-up, for use where rather greater drive is required, such as for a pair of 807's in parallel, consists of four EF80's in place of the 12AU7's. The EF80's should be triode connected, and some 5-6 mA drive will be available on all bands.

THE "MAXIMITE"

We have received for review from the Radio Servicing Co., 444 Wandsworth Road, London, S.W.8., a copy of a publication which they are distributing, and which gives constructional details of a receiver called the "Maximite."

This is a miniature AC/DC Transportable superhet, for 100–250V mains, and with a measurement of only 6″ long, $3\frac{3}{4}''$ high and $2\frac{3}{4}''$ wide. Full size construction and point-to-point wiring diagrams are given as well as the usual theoretical circuit, so that there should be no difficulty with the building.

Adequate sensitivity is ensured by the use of a superhet circuit and modern components. Despite the small size, a $3\frac{1}{2}''$ moving coil speaker is incorporated, so that reasonable quality should be obtained. A frame aerial is used, with a throwout length for weak stations, feeding into a UCH42 frequency changer. This is followed by a UAF42 IF amplifier and diode detector, which also furnishes AVC. The output stage is a UL41. The half-wave rectifier is a UY41.

Constructional notes are given for a suitable cabinet, which should be very easy to make. If the receiver is not required to be so small, a Weyrad HA2 coil may be substituted for the frame aerial, and advantage taken of a larger cabinet to install a bigger speaker.

The publication may be obtained from the above address at 1s. 0d.

SIXTH R.S.G.B. AMATEUR RADIO EXHIBITION

November 26th-29th, 1952.

The Sixth Annual Amateur Radio Exhibition organised by the Incorporated Radio Society of Great Britain will he held at the Royal Hotel, Woburn Place, London, W.C.1, from Wednesday, November 26th to Saturday, November 29th, 1952. The Exhibition will be opened at 12 noon on the 26th by Col. Sir Ian Fraser, C.B.E., M.P., a Past President of the Society.

As in past years the Exhibition will be supported by a number of companies who specialise in the provision of valves, apparatus, equipment and publications, for the radio amateur. In addition the War Office, Air Ministry and Post Office will be represented. The sponsoring organisations will exhibit apparatus and equipment constructed by members including a "live" amateur transmitting station. The British Amateur Television Club will demonstrate amateur television equipment.

The following have reserved space:—

Air Ministry, Automatic Coil Winder and Electrical Equipment Co. Ltd., Cosmocord Ltd., E.M.I. Sales and Service Ltd., Esibind Ltd., English Electric Co. Ltd., General Electric Co. Ltd., General Post Office, George Newnes and Co. Ltd., Goodmans Industries Ltd., Iliffe and Sons Ltd., Panda Radio Co., Philpotts Metalworks Ltd., Salford Electrical Instruments Ltd., Siemens Electric Lamps and Supplies Ltd., Taylor Electrical Instrument Co. Ltd., War Office, Westinghouse Brake and Signal Co. Ltd.

Why Go Hi-Fi?

By K. R. PIPER

From the very beginning of sound reproduction, there has always been the quality enthusiast, and, thank goodness, there looks like being a band of high fidelity seekers for evermore.

As one who has been in the search for "1 kc/s more on top and 10 c/s less on the bottom," I feel it my duty to warn off anyone who has just caught the bug, or is in danger of catching it—"Brother, you're in for a lot of headaches!"

Long ago, well before the war, there appeared an advertisement for a loudspeaker which was "guaranteed to reproduce 30 c/s." Do I hear a titter? Well, it's a fact. Actually, if the darned thing reproduced 100 c/s in any quantity, it was doing extremely well.

But people believed it, and they laid out their money to prove it, and honestly believed that they could hear 30 c/s on it.

A certain cathedral installed a new organ which had a pipe giving 2 c/s, yes TWO. How many people actually "heard" that note, I don't know, but I was one of them, until I found out that the 2 c/s note was produced by two pipes, one at 80 c/s and one at 82 c/s, beating together. A certain quality enthusiast assures me that he can get 20 kc/s on his broad band TRF quality amplifier rig, yet I am assured that the BBC do not put out audio frequencies anywhere near this figure; 9 kc/s yes, 20 kc/s NO.

What I'm getting at, is this. Quality is largely a comparative thing; by all means get the best you can, but when you start chasing those few extra cycles either way, especially when they aren't there in the first place, then give it up chum, or you'll find that instead of listening to a piece of music, you are listening to a set of frequencies, and no more.

Now medical evidence shows that the extreme range of audibility is from 15 c/s to 25 kc/s, and that a person who can hear that lot is a rarity indeed. I assure you that if you listened to an amplifier having a flat response over that band you would not find it easy to tell the difference from one covering from, say, 30 c/s to 15 kc/s, unless, of course, you have got hifi fever to the extent that the mind becomes virtually an oscilloscope, analysing each waveform and note.

Far more important than extreme frequency range is a balance of top and bottom. What I mean is this, if an amplifier is too boomy don't fly off in search of more HF; far better to wittle away some of the bass. I am assuming, of course, that the amplifier has a reasonable top response of 10 to 15 kc/s; the reverse case applies also.

An extreme case in point—two very good friends of mine run amateur transmitters, and both are quality enthusiasts. Listening to them both I can detect very, very little difference in modulation quality, although one transmits the full band of audio and the other only from 300 c/s up to 3 kc/s. But because they both have well balanced amplifiers, the quality is good. True, this is only on speech, and on music a wider range would be needed, but both are recognisable and sound quite natural.

There is a difference, though, and it is this. Whereas the man using cut-off below 300 c/s and above 3 kc/s can maintain an average of 80 per cent. or more modulation, the other chap can only maintain an average of 50 per cent. or less. Why? Well, the answer is not too difficult; the greater the band of frequencies to be accommodated the greater the percentage of power which must be held in reserve to cope with the peaks of signal, that is why one very rarely sees a quality amplifier below 10 or 12 watts.

The average output of these will only be about 3–4 watts, with the rest held in reserve for the odd peak which would otherwise overload the rig. 12 watts for 4, that's certainly not very good economics, whatever else it may be.

Let's stop worrying about frequencies and get down to music. If a piece of recorded music can be made to appear natural with a top limit of 12 kc/s, let's have that and let a 4 watt amplifier give 4 watts, not 1, and let's admit that we can't get perfection. There are several reasons why; the obvious ones are that the mechanical agencies cannot be perfected, and that includes the microphone, loudspeaker, the pick-up head, the recording head, the record itself and our old chum the output transformer.

Just as we can never reproduce a perfect square waveform, so we can never "can" the quality of the Albert Hall.

It is hoped in a later article or articles to give circuits which will give quite satisfactory quality, whilst not claiming to go from "0 to 30 kc/s flat."

A reasonable scheme is to restrict the top response of the amplifier so that record hiss is just lost, then slice away the bass response until the piece sounds natural and balance is restored.

This way you won't hear a 20 kc/s note, but you will have a satisfying natural-sounding reproduction.

Small Advertisements

Reader's small advertisements will be accepted at 3d. per word, minimum charge 3/-. Trade advertisements will be accepted at 6d. per word, minimum charge 6/-. If a Box number is required, an additional charge of 1/- will be made. Terms: Cash with order. All copy must be in hand by the 12th of the month for insertion in the following month's issue.

PRIVATE

FOR SALE MCR1 receiver, 15–2000 metres, complete, £8 or offers. Brooks, 19 Loretto Gardens, Kenton, Middlesex.

FOR SALE Rotary Converter, 230/50 volt DC/AC, recently re-wound and overhauled, black crackle cabinet, £8. Drury, HILlside 4814.

FOR SALE Pair of Burgoyne tape heads, screened oscillator coil and circuit, all unused, 57/6d. Box B214.

FOR SALE BC348 Manual 5/–. Valve Tester Transformer 12/–. By Ghiradi "Trouble Shooters Handbook" 15/–, "Modern Radio Servicing" 10/–, "Basic Maths for Radio Students" 4/–. Witts "Radio Upkeep and Repairs" 3/–. Dowset and Walker Handbook 7/–. Box No. B215.

TUITION Expert private tuition given (in London) in Radio, Technical Electricity and Mathematics. Terms Moderate. Box No. B186.

FOR SALE Premier 6″ TV in case, working but experimenter might improve, seen Brighton, spare tube, £19. Offers for combined EHT-HT-Heaters transformer giving all supplies for VCR97 TV. Offers BC454. Sellwood, 15 Park Road, Hoddesden, Herts.

FOR SALE Home Lab signal generator Type 5. Range 100 kcs–130 mcs with calibrated chart. In new condition. Little used. Pesterfield, Church Green Lane, Fishtoft, Boston, Lincs.

WANTED Radio Constructor Vol. 2, Nos. 10 to Vol. 3, No. 7 inclusive. Trevor Woods, 12 Lansdowne Road, Southport, Lancs.

INTERESTED ? Clearing out surplus receivers, power packs, wavemeter, components and valves of all types. Over 500 items. SAE for list. G. Bellamy, 506 Loughborough Road, Birstall, Leicester.

OSCILLOSCOPE for sale £12-10-0d. Further details from Roberts, 26 Tile Kiln Lane, Bexley, Kent.

EXCHANGE R107 for Signal Generator or £12. Box No. B213.

WANTED Radio Constructors Vol. 3, Nos. 1 to 6 inclusive, also Vol. 1 and 2 complete. W. Mitchell, 3 Town Hall Street, Grimsby, Lincs.

(Continued on page 215)

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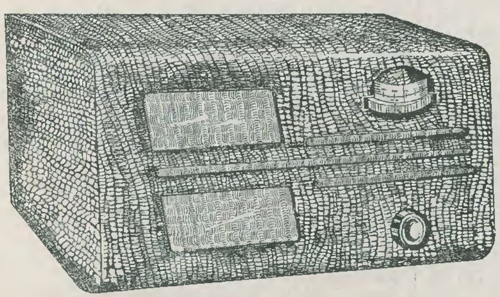

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(*Continued from page 213*)

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(*Continued on page 216*)

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(*Continued from page 215*)

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