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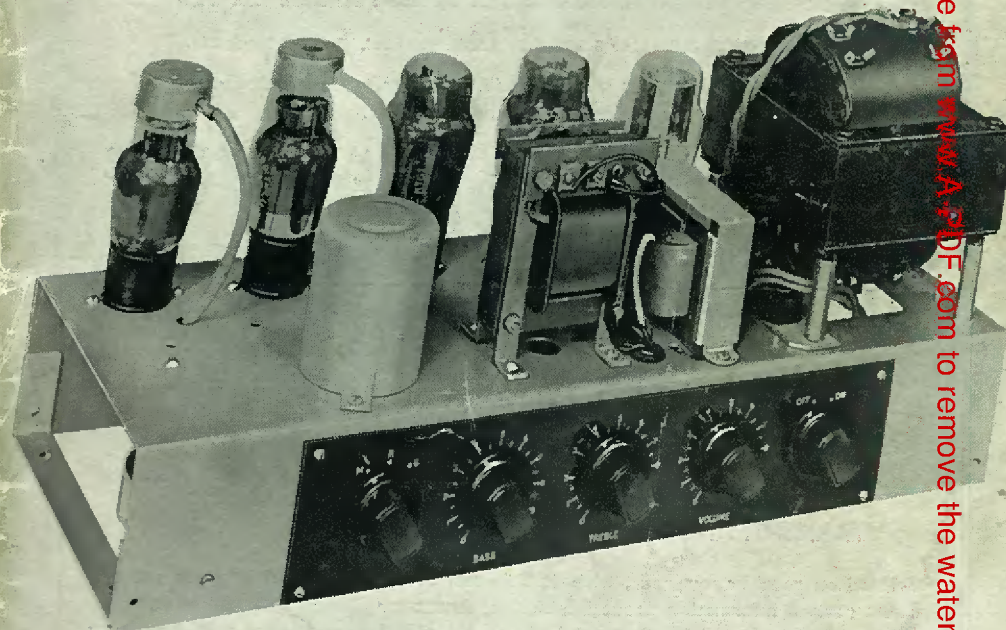
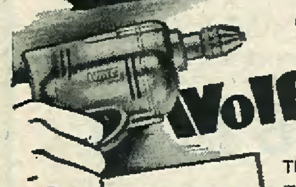
RADIO CONSTRUCTOR

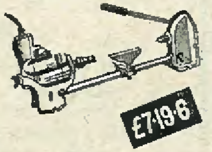
for the Radio and Television Enthusiast



IN THIS ISSUE . . .

1/3





Radio Constructor

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EDITORIAL

Your Magazine

WITH this issue, we enter into our fourth year. We can honestly say that we are pleased at the progress we have been able to make in this relatively short time, and we are not forgetting that much of this is due to the support given by our readers.

From the start, it has been our policy to make this a personal magazine. We try to avoid any tendency to dictate to our readers in any way, and instead have a standing invitation to them to write and tell us what sort of material they would like to see in these pages.

This invitation has been accepted by many of them, and as a result we have been able to include many items which otherwise might not have occurred to us. As an example, the lists of ex-R.A.F. components with values was first proposed in a letter written to us, and, through the lists subsequently submitted by readers, we have been able to make up what has proved to be a most popular series.

More than one series, and numerous articles, have been suggested to us in this way. Maybe you, yourself, have wanted to see something which has not yet appeared, or has not been covered to your satisfaction. Again, you may have a suggestion for brightening the appearance, or for something on the lines of the panel control escutcheons which we recently started (suggested by two separate readers!) If so, drop us a line about it, please, for then we shall be better able to supply what you want.

More Each Month

One concrete result of this progress is that we are now able to enlarge the magazine, and as from this issue each copy will contain an additional eight pages. With this extra space we shall be able to add a little more variety, enlarge those particular items which have suffered by being cramped, and altogether put out a better publication.

Intercoms

A new series by our popular contributor J. R. Davies commences in this issue. This time, the subject is Amplifying Inter-communication Systems, about which we have received many enquiries.

Many of our readers are perfectly at home when it comes to designing amplifiers, but with intercoms the most interesting feature is the methods by which the master station and the remote or 'slave' stations are inter-connected. The problem here is to make the system as foolproof and comprehensible as possible, with the minimum number of connecting leads. J.R.D. goes into this in his usual extensive manner and, judging by our own reaction, this is going to be yet another popular series.

G2ATV

NOTICES

THE EDITORS invite original contributions on construction of radio subjects. All material used will be paid for. Articles should be clearly written, preferably typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsman 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.

COMPONENT REVIEW. 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 Useful
SIGNAL GENERATOR

by A. R. TUNGATE, G3ELB

A SIGNAL generator is an asset to any radio enthusiast who undertakes the servicing of receivers.

Apart from simplifying faultfinding it (*a*) enables stages of a receiver to be analysed either independently or collectively (*b*) allows frequency response of AF stages to be checked (*c*) enables stage gain to be checked (*d*) allows IF transformers to be tuned to their correct operating frequency (*e*) reduces the time factor of radio servicing compared with the use of a multi-range meter only, and (*f*) allows complete alignment of a superhet receiver.

The signal generator is known under a variety of names, i.e., test oscillator, modulated oscillator or service oscillator, but whatever its name, the purpose is the same.

It is essentially a low powered transmitter, the output of which — instead of being connected to an aerial system and so radiated into space — is confined to a shielded lead, via which the signal can be injected into any required stage of a receiver.

Commercial models of signal generators, with intricate controls and various refinements, and bearing a high degree of accuracy, are indeed costly instruments, but the piece of apparatus about to be described can be constructed with ease and at a very low cost. Yet it will still give a fair performance in relation to its commercial counterpart.

Perusal of the circuit, fig. 1, shows a triode VI connected as a Hartley RF oscillator, the frequency of which is determined by L1 and TC1. To cover the range of required frequencies, plug-in coils are used. This ensures simplicity in design, layout and construction. It is worth noting here that most makes of commercial generators employ switched coils, which adds to the cost of the finished product.

The output from the Hartley oscillator is fed via C2 and developed across a potentiometer VR1. This control is referred to as the "Attenuator", and does as its name implies. A very high output is useful for lining up a receiver when its trimmers have been seriously interfered with, or when new coils or trimmers have been installed. A low output is necessary when checking sensitivity, or when the operation of trimming and padding a receiver is nearing completion.

The attenuator allows both these conditions to exist, by cutting down the output to the desired level, or giving full output, depending upon the position of the slider arm.

C1 is an isolating capacitor. Its function is that of isolating the DC voltages in the receiver under test from the circuit components of the signal generator. Breakdown of this capacitor endangers VR1 mostly, especially if the slider arm is at the low end of its traverse, leaving only a few ohms in circuit. Further, the surge of high current from the receiver power pack could be sufficient to endanger the rectifier valve and possibly the mains transformer. Thus a good quality capacitor is indicated here.

J1 is an open circuit type jack, from which the RF, or modulated RF, output is taken to the screened lead already mentioned.

L1 is mounted in a screened compartment to minimise indirect pick-up from the magnetic field around the coil. When winding L1, it must be remembered that the turns of the grid portion must be wound in the same direction as those of the anode section. Failure to do this will result in the feedback being in the incorrect phase, and the valve will be unable to sustain oscillation.

Stability of the RF stage is aided by wiring throughout with 16 swg copper wire, and keeping all leads short and direct. No trouble should be experienced in getting the Hartley oscillator to function.

C3 is a blocking capacitor, preventing the HT in the anode circuit of V1 being short circuited to chassis via L1. The RF choke

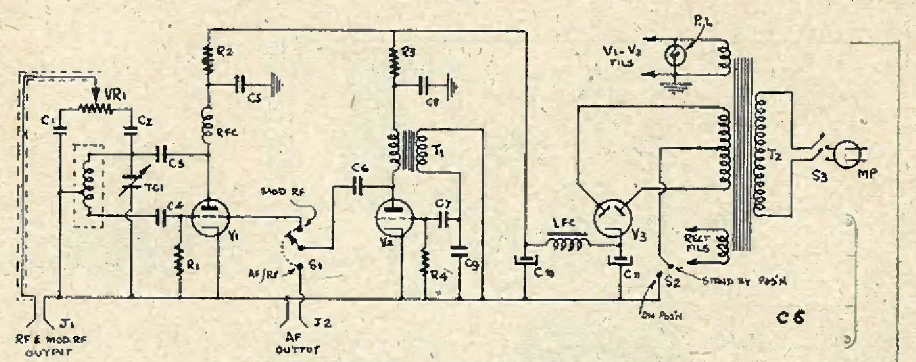


Fig. 1: Theoretical circuit of the signal generator.

COMPONENT VALUES

R1, 47 k Ω ½W.
R2, 6.8 k Ω ½W.
R3, 5 k Ω ½W.
R4, 47 k Ω ½W.
VR1, 1 M Ω pot.
J1, J2, open circuit jacks.
RFC, 2.5 mH choke.
V1, 6J5
V2, 6J5
V3, 6X5
PL, 6.3V 0.3A bulb
T1, Intervalve trans.
T2, 120—0—120V 50 mA, 6.3V, 6.3V.

C1, 0.01 μF 1 kV wkg.
C2, 0.005 μF mica
C3, 0.01 μF paper
C4, 100 pF paper
C5, 0.01 μF paper
C6, 0.002 μF mica
C7, 200 pF paper
C8, 1 μF paper
C9, 0.1 μF paper
C10, 8 μF 350V wkg.
C11, 8 μF 350V wkg.
TC1, 500 pF variable
LFC, smoothing choke
Extras: 2 crocodile clips, 4 coil formers, screened lead, mains plug, jack plug.

prevents the generated RF currents from flowing back into the HT line, and thus causing instability. Any RF that does 'creep' through the choke is dealt with by R2 and C5, which constitute the anode decoupling filter.

The triode V2 is connected up as a Meissner audio oscillator. A description of this part of the circuit is hardly necessary, as the components are few in number and are self-explanatory. The output from the AF oscillator is fed via C6 to S1. By means of this switch, the voltages can be fed either to J2, another open circuit type jack, for direct AF output (required for fault finding in the AF stages of a receiver) or to the grid of V1, thus allowing grid modulation of the Hartley oscillator. R3 and C8 constitute the decoupling system in the anode circuit of V2.

The frequency of the Meissner oscillator can be raised or lowered to suit individual tastes by changing the value of the grid capacitor between 100 pF and 0.001 μF, and/or connecting capacitors across the grid winding of T1. Suggested values for the latter are from 0.25 μF to 0.001 μF. A note of around 400 cps was obtained with the circuit constants specified in the components list.

V3, with its associated components, forms a conventional full wave rectifying circuit to provide the necessary HT for V1 and V2. The current consumption of the apparatus is very small and HT batteries could be used, but the writer prefers the mains power pack. S2, fitted in the centre tap of the HT winding, enables the unit to be switched to a "stand-by" position, in which it is inoperative but has the valve heaters kept on, a necessary arrangement when minimum frequency drift is important.

The entire unit is constructed on a standard 10″ × 6″ × 2½″ chassis, which leaves plenty of room for all components without the necessity for cramming.

The layout adopted by the writer is shown in fig. 2.

After construction, which is a simple matter owing to the small number of components, the RF stage should be checked to see that it oscillates. To test this, hold a 5 turn 2″ loop of wire, connected to a pea lamp, over L1. If the stage is oscillating, the pea lamp will glow.

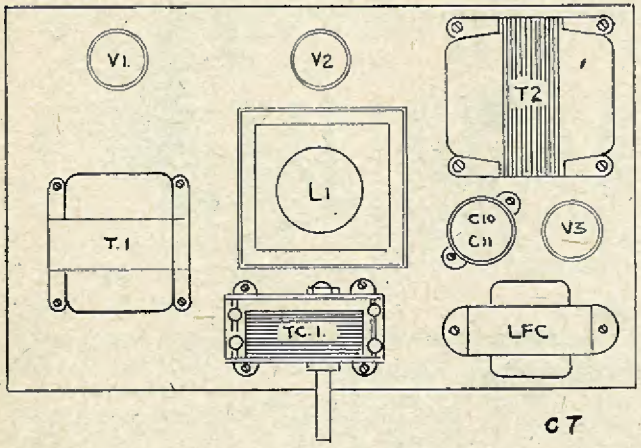


Fig 2: Chassis layout of the signal generator.

C7

Swing the capacitor TC1 from maximum to minimum capacity, and ensure that the lamp glows throughout the entire rotation of the vanes. If V1 stops oscillating, the tap on L1 should be moved towards the centre of the coil, a couple of turns at a time on the long and medium wave coils, and half a turn on short wave coils. Then make a further check for continuance of oscillation. Increasing the tapping point towards the centre of the coil increases the amount of energy fed back from the anode to the grid circuit, therefore it is necessary to find the point giving sufficient feedback to sustain oscillation throughout the entire frequency range of the coil in use.

The AF stage can be checked for oscillation by connecting a pair of headphones across the secondary winding of T1. If an audio note is not present, reverse the terminal connections to one of the windings, but not both. This ensures that feedback is in the correct phase to maintain oscillation.

Calibrating the scale can be done in one of two ways, first by the use of a heterodyne frequency meter of the BC221 class (the most accurate) or by connecting the screened lead (plugged into J1) to a broadcast receiver aerial lead, then tuning to a station of known frequency and zero beating the signal generator, with the attenuator giving a low output. The "AF-RF/Mod RF" switch should be in the "AF-RF" position. The point on the dial can then be marked, and other marker stations can be utilised in the same manner for further calibration check points on higher or lower frequencies. Although this latter method does not give complete accuracy, it will serve the purpose to which the signal generator will be put.

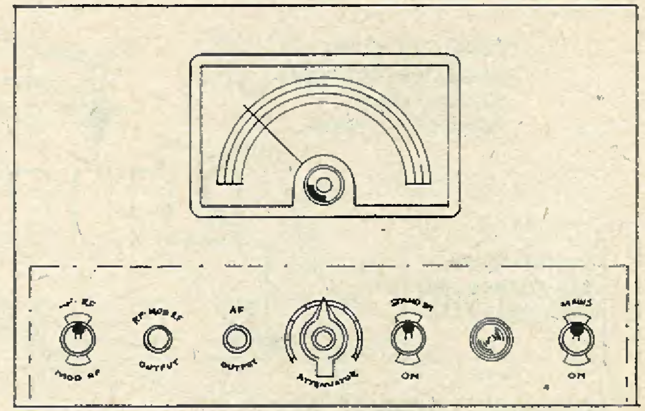
Fig. 4 shows a block schematic diagram of a superhet receiver, and it is now proposed to explain and discuss the method of employing the signal generator in servicing and checking such a receiver.

Signal continuity is tested by injecting AF, IF and modulated RF at points working back from the output to the aerial. Each stage is thus checked and made to operate in turn.

First, switch on the signal generator and allow a couple of minutes for the heaters and cathodes to settle down. Insert the screened lead into J2 (marked 'AF Output'). Switch to 'AF Output', and from 'Stand-by' to 'On'.

(1) Assuming the power supply of the receiver under test to be in order, having checked same with a multi-range meter, connect the earthy lead of the screened cable to the receiver chassis. Trace the grid pin of the output valve, and to this attach the other crocodile clip. An audio note of the same frequency as that generated by the Meissner should be heard in the receiver speaker in amplified form, if this stage is working correctly. No signal indicates (*a*) no HT on anode (*b*) no HT on screen (*c*) speaker transformer primary short-circuited (*d*) speaker

Fig. 3: Panel layout of the signal generator.

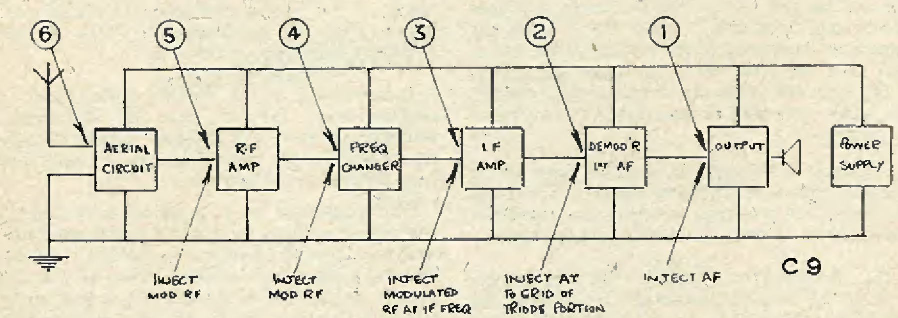


C8

transformer secondary open-circuited (*e*) output valve cathode on open circuit or (*f*) the valve itself is faulty. A check on these points will reveal the fault. Assuming the output stage is in order :—

(2) Remove the crocodile clip from the grid pin and transfer to the grid of the triode section of the demodulator, usually a double-diode-triode. Once again a note will be heard in the speaker, but at greater strength, indicating that the stage under test is functioning. Non-appearance of the note indicates a fault in the anode or cathode circuit of the triode, or in the valve itself. The coupling capacitor also becomes suspect. Here again, checking with a meter will reveal the fault.

(3) Having checked the AF stages of the receiver, it now becomes necessary to test the IF amplifier stage. To do this, a coil L1 covering the IF range must be inserted into the signal generator. The crocodile clip is transferred to the grid of the IF amplifier valve. The screened cable is inserted into J1, switch set to "Mod RF", and the attenuator set about half way round. The signal generator is next tuned to the correct intermediate frequency for the receiver under test, usually 465 kcs. If the stage is working correctly, and the demodulator is functioning, then the usual note will be heard from the speaker. This shows that the necessary rectification is taking place, and the filtering system around the detector is operating. If the audio note is not heard, check the anode and screen



C9

Fig. 4: Block diagram of a superhet receiver, indicating points of connection of signal generator. See text for step by step explanation.

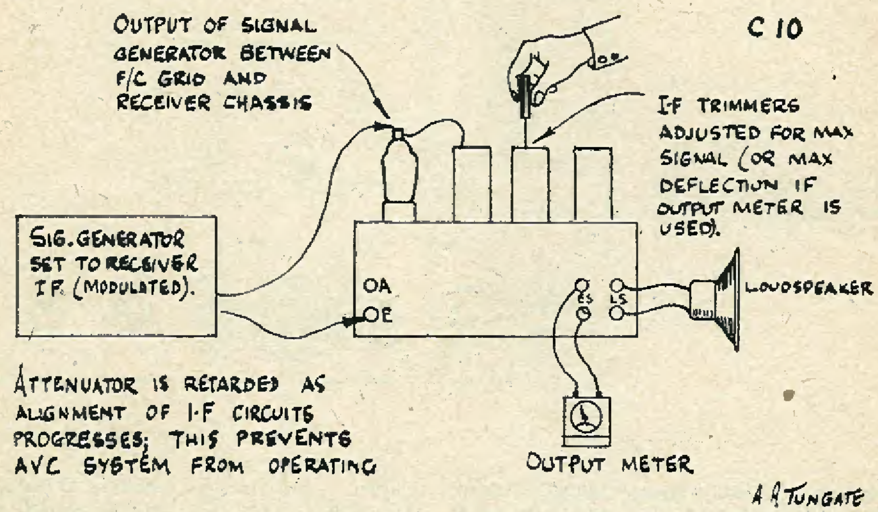


Fig. 5: Pictorial diagram showing method of using signal generator to align IF stages.

voltages of the valve, the cathode circuit, IF transformer primary and secondary, and the detector components. It should be realised that the output from the signal generator can be injected across the primary of the IF transformer in the anode circuit, thus checking both primary and secondary windings without the signal having to go through the valve.

(4) Change L1 for a coil covering one of the tuning ranges of the receiver, preferably the Medium waveband. Connect the crocodile clip to the grid pin of the frequency changer valve, still injecting "Mod RF". Set the generator frequency to the middle of the band, and tune the receiver to the same frequency. If the frequency changer is operating correctly, the audio note will be heard from the speaker as usual.

Absence of the note indicates a fault in the anode, screen or cathode circuits, the local oscillator not working, or the valve itself not serviceable. Check as before with a meter.

(5) Remove the crocodile clip, and connect it to the RF amplifier valve grid pin. Tune the receiver to the signal generator frequency and check for note in speaker.

(6) Lastly, retard the attenuator, and inject the modulated RF into the aerial socket. Failure on the part of the receiver at this point, when all other stages are known to be in order, indicates a fault in the aerial coupling circuits or in the grid tuned circuit of the RF amplifier.

Thus it can be seen that a fault can be tied down in a very short time to one specific stage of a receiver. On finding the defaulting stage, attention can be concentrated on the components in that stage and the fault quickly traced. The signal generator is therefore a handy piece of equipment to have around when servicing has to be done.

Incidentally, it is worth noting that a receiver may fail to give AC continuity, although no part of it is faulty, simply because the tuned circuits (including the IF amplifiers) may be out of adjustment.

The alignment of a superhet is practically impossible without the aid of a signal generator, and to alter the trimmers or padders without one is asking for trouble. The IF circuits should be aligned first, and the procedure to adopt is shown in fig. 5, which is self explanatory. Following IF alignment, ganging of the RF and oscillator may be necessary. The procedure for this is shown in fig. 6.

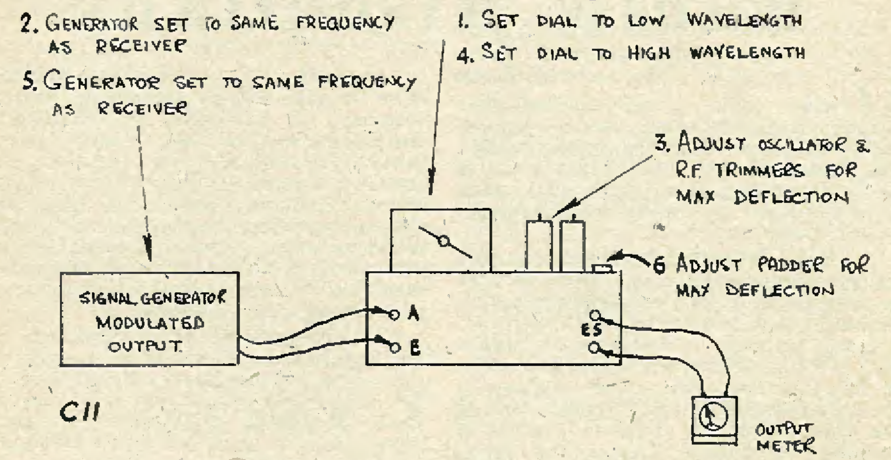


Fig. 6: Diagram summarising the complete procedure for ganging the RF and oscillator circuits of a superhet receiver.

A receiver has its own trimming and padding frequencies, which are invariably given in the maker's service sheet. If these are not available, the following chart can be followed, as these are average figures for these frequencies :—

Long Waves: Trim at 300 kcs (1,000 metres)
Pad at 157 kcs (1,805 metres)
Medium Waves: Trim at 1400 kcs (215 metres)
Pad at 600 kcs (500 metres)
Short Waves: Trim at 15 Mcs (20 metres)
Pad at 7.5 Mcs (40 metres).

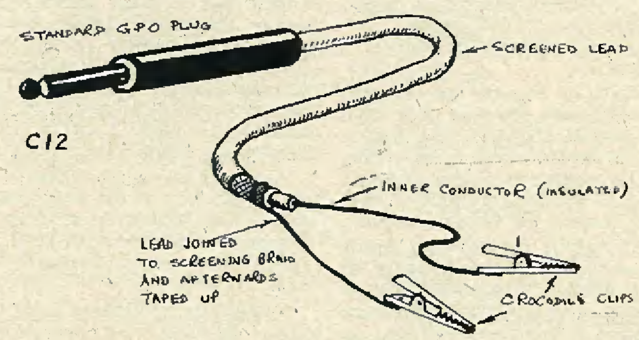


Fig. 7: Details of lead assembly.

Radio Miscellany

ONE of the regular topics over which readers have recently grown eloquent when writing, is the re-introduction of pictorial wiring diagrams for constructional articles. The pleasant feature of these letters is that all the readers concerned are quite frank about their limitations, and truthful about the length of their readership.

As I have on many occasions declared myself against point-to-point wiring plans, as both a waste of space and an expedient against the best interests of the progressive constructor, I should naturally be suspicious of anyone who in the same letter told me he is a reader of long standing. Also under suspicion is the rare reader who claims he is putting forward the views of "dozens of others" instead of speaking for himself. Anyone who knows the feelings of dozens of others must be exceptionally well placed, but to claim to know that number who all share his exact views on any controversial subject is almost an invitation for the arguments put forward to be taken with the proverbial pinch of salt. At the best he is taken to be exaggerating a little wildly, and he thus weakens the case he is putting forward.

Justification

To get back to the point, it is not simply the number of readers who have urged me to agitate in support of wiring plans, but the obvious genuineness of their wishes that moves me to re-open the matter.

Frankly I do not like pictorial diagrams for the following main reasons:—

- they waste a lot of space,
- they are liable to encourage mental laziness and "false experts"
- and, they tend to spoil the tone of a magazine.

It must, however, in fairness be admitted that there is good reason for their occasional use. They do enable the real beginner to make a quickly successful start in the hobby, and give him an opportunity to more leisurely learn something of both theory and receiver practice before tackling his second design.

For that reason alone the use of a wiring diagram for receivers intended essentially for beginners only is a fair and reasonable arrangement even at the expense of irritating the more experienced readers. As newcomers are constantly joining us this might average out to perhaps four times a year.

The great majority of readers passed through their novitiate without recourse to pictorial diagrams, but few would be unwilling to concede the need to make things as easy as possible for *some* beginners even if they feel that it is against the best interests of *most* recruits. It has been argued, with some truth, that point-to-point wiring plans actually retard the beginners' progress on the grounds that it is liable to induce him to believe that there may be something really difficult about a theoretical circuit after all.

I have no doubt that many old readers and raw beginners will want to let off steam about this. If so, will they please write to the Editor, not me. I have written only of my personal views, and unlike a few odd characters I cannot claim to speak for dozens of readers, even after a very long association with radio journalism.

Since replying personally to many readers on this subject I would like to add to E.W. of York, J.T. of Liverpool and T.W. of Bristol, all of whom wrote in the friendliest of terms, if you can borrow copies of R.C. for May, 1949, when I dealt with these points at length, I should enjoy hearing from you again.

Lingua Franca

Glancing back at that issue, just to make sure that the date is right, the following words strike me forcibly. ". . . when foreign radio books and magazines come into one's hands, how little the description matters as long as the circuits are there. Together with a photograph they will give you all the information you need."

It now occurs to me that I might also have added that a great number of component names and technical terms are English, or a near approximation of the English name. This is even more noticeable in amateur communication radio. Quite understandably when you consider that a French and a Swedish amateur, in QSO, for instance, invariably have to use English for mutual understanding.

Strangely enough, complete uniformity isn't yet found even in the English speaking countries. The Americans cling to their terms—antenna, ground, plate, tickler coil, vacuum tube, shield, dynamic speaker, etc., while we stick to our own.

English terms continue to steadily command wider acceptance in international use.

Perhaps it will eventually become the acknowledged *lingua franca* for radio in the same way that Latin has for medicine and law, Italian for music and French words for the menu and cuisine. At the moment I cannot think of any other human activity (unless it is Football) where English terms have gained universal acceptance.

Weak Points

The printed name panels, scales, etc., appearing currently in R.C. should prove of great help in cleaning up the appearance of many home-constructed receivers. Of the many little faults that mar the appearance of home-built gear, untidy printing is perhaps the most common. Oddly enough, in a recent list of common faults I put that one near the top of the list. Prominent amongst the others which I tried to list in the order of their prevalence were :

The too flimsy chassis. I suppose everyone has seen examples of chassis which bend and sag, and whenever the set is moved pulls out of alignment.

The clumsily designed. The big and awkward set which by a little planning could have easily been made neat and compact.

Bad lay-out. Invariably due to the constructor again using an old chassis and mounting the components on existing holes rather than drilling new ones.

The absence of fuses and safety devices. This seems fairly common when a constructor gets to his third set without running into trouble of any sort. He doesn't incorporate them again until he burns out a few components or valves, when he becomes a poorer but wiser man.

The amazing part of this "bad" printing is that in nearly every case the constructor had obviously gone to some pains to do it neatly, and often when the letters and figures were well formed the effect was still untidy and disjointed. By "printing", I include all forms of marking, as quite a number try their hand at engraving, die-stamping or acid etching direct on metal panels.

Spacing

One constructor, whose efforts were no better than the average, assured me he had been to considerable trouble to get the lettering evenly spaced and had actually done it by measurement.

Therein lies the trouble. The spacing between letters in a word (or between words for that matter) is only APPARENTLY EVEN, it is never EQUIDISTANT. For those, and there are a great many, who had not realised this, here are a few simple rules which will enable neat hand lettering or engraving to look as good as a professional job.

The widest spacing is that left between two straight stems such as HE or ND etc.,

A lesser space is used between a straight letter and a curved one as in the examples ON, DE etc.

A still smaller space is used between two curves—for example DO, OG, etc.

With combinations of such letters as VO and the LT (as in the word 'volt') there need be no spacing between the extreme points of the letters, particularly if the lay-out is close-spaced or condensed, but on no account should the extreme points be allowed to overlap.

Printing following these rules *appears* to be even and regular, although by measurement it is actually far from it.

Should anyone still have doubts on the point try a little hand lettering with the following examples :—

LONDON

ON-OFF

VOLUME

To get the fullest effect, print with moderately large letters—the larger the lettering the more important the spacing.

CENTRE TAP *talks about*

WIRING DIAGRAMS – TERMS – PANEL PRINTING

Acid Etching

The earlier mention of this reminds me that there may be some readers to whom this process is unfamiliar, or others who have not thought of applying it to panel marking. The markings are "cut" into the panels by nitric or other acids.

In its simplest form, the surface is first smeared with a covering of wax (or even household soap) and the lettering required scratched lightly on to it.

The acid is then applied to the lines with the tip of a feather, when it is allowed a few minutes to bite its way into the metal. The surrounding surface which is protected by the film of wax remains unaffected although, of course, if the acid is left on too long it will eat its way under it via the sides of the letters.

Only a shallow etching is necessary, and the letters are filled in with white lead or other colouring matter (white greasepaint or even enamel could also be used).

With the easily dissolved metals (copper, zinc, etc.) the scratched letter should be thinner than the final result desired. The acid will always eat into the sides of the letters as well as down into the panel.

A little preliminary experiment on a scrap piece of the same metal will soon give you a good idea of the time required to etch a given depth, but this is quite an automatic process and a matter of experience. The important thing if you want to make a professional-looking job of it, is the spacing—it is certainly no less important than nicely formed and regular letters.

Ex-W.D. COMPONENTS

We present the fifth list of ex-WD components, together with reference and values. This list is compiled from information supplied by readers.

In the list of valves given below, the first two columns give alternative Service numbers, and the third gives the equivalent commercial number. The numbers in the first column are preceded by 10E/, except where otherwise stated.

19	VU113	U17
28	VR119	DDL4
11OE/47	—	5U4G (USA)
92	VR91	EF50
95B	VR95	954
105	VR92	EA50
121	VU120	SU2150A
146	VU111	V1907
149	VR65A	SP41
159B	VR130	HL23
164	VGT121	T41
168	VT114	—
211	VU133	V960
222	VCR97	ECR60
266	VR116	V872
277	VR99	X65
278	VR100	KTW62
279	VR102	BL63
280	VR101	DL63
305	VI103	V63
346	—	6V6G
373	VU71	5U4G
386	VR136	EF54
387	VT75A	KT44
389	VR501	E1192
392	VR135	E1148
394	VR137	EC52
405	—	6K8G
446	VCR139A	ECR30
467	VI507	—
582	—	6X5G
587	VT60A	807
597	VU71	5U4G
598	—	5Z4G
603	—	6Q7
631	VR505	MH41
757	VR99A	X66
818	VCR517B	—
7312	VT25	DET25
7607	VR18	215SG
7738	VR21	210LF
7958	VR22	220PA
9600	VU39	R3
10946	VT51	PEN220A
11398	VT52	EL32
11399	VR53	EF39
11400	VR54	EB34
11401	VR55	EBC33
11402	VR56	EF36
11403	VR57	EK32
11446	VR65	SP61
11447	VR66	P61
11448	VR67	6J5G
11529	VU71	5U4
13027	VCR516	—

Amplifying Intercom Systems PART I.

by J. R. DAVIES

WE are all familiar with the Hollywood film scene in which the business tycoon, requiring his secretary, simply leans forward, presses a switch, and bawls into his little desk amplifier: to be answered by the tinny, disembodied voice of the required lady. We may also be familiar with the occasionally-met following scene which shows the secretary (who is, after all, not in charge of continuity) blithely ignoring her own amplifier and answering her employer on the telephone. That, however, is by the way.

At all events, loud-speaker intercommunication systems have been used in America for some considerable time, but it is only during the last ten years or so that they have achieved popularity in this country. Nowadays, however, we find quite a few British firms manufacturing these inter-office amplifiers.

The advantages of a loud-speaking intercommunication system are considerable. In the first place, it is not necessary to hold a handset against one's ear when talking or listening; with the result that one's hands are free to find papers, etc., whilst the conversation is going on. Secondly, there is ample volume in the system, and it may be used whilst one is at least a yard away from the speaker or microphone. Thirdly, there is no necessity to use resonances to boost up AF voltages, as is customary with usual telephone design; instead one may amplify a wide AF spectrum with little distortion, thus obtaining greater clarity of speech and fewer misunderstandings.

Basic Design

The basic design of nearly all loud-speaking intercom amplifiers relies on the fact that a small moving-coil loud-speaker also makes an excellent microphone. If we take advantage of this fact and connect up an arrangement of speakers and amplifier such as that shown in Fig. 1, then we would have the basis of a very useful intercom system. In Fig. 1 the input and output terminals of the amplifier are taken to a change-over switch which either connects the remote speaker to the input and the local speaker to the output or *vice versa.* We may call the first position of the switch the "Listen" position, the second the "Talk" position. When the local operator puts the switch to "Talk" his voice is picked up by the local speaker, amplified, and reproduced over the remote speaker. When the switch is in the "Listen" position he hears what the remote operator has to say reproduced on his own speaker. (The switch should be spring-loaded to return to the "Listen" position).

It is, of course, necessary to have a Talk/Listen switch in order to prevent the inevitable feed back that would occur were any other method attempted. If ample volume were required, it would be almost impossible to prevent the output circuit feeding back into the input, even if a separate speaker and microphone were used at each point.

Loud-speakers and Wiring

It is customary to use only loud-speakers of small dimensions for intercom systems. The reason for this is that speakers with large cones do not give good results when used as microphones, since they tend to give considerable attenuation of the higher frequencies. It is usually best to employ speakers between 4½ and 6 inches in diameter. The remote speakers may be mounted in small cabinets and should only be faced with light speaker fabric. Sufficient baffling area will be given by a small cabinet which houses the speaker comfortably, with just a little space to spare.

The speakers should be used as low-impedance units, both as microphones and reproducers, and it is therefore advisable to use fairly low resistance wire to connect them to the amplifier. Bell wire may be used for short lengths, but lighting flex (or any other similar wire which may be available) is best for runs of fifty feet or more. Using the low-impedance form of connection considerably decreases the risk of instability and hum pick-up (when the extension leads are connected to the input of the amplifier). It should usually be unnecessary to use screened leads to overcome hum pick-up, and it would certainly reduce the cost of the installation if unscreened leads could be employed. How-

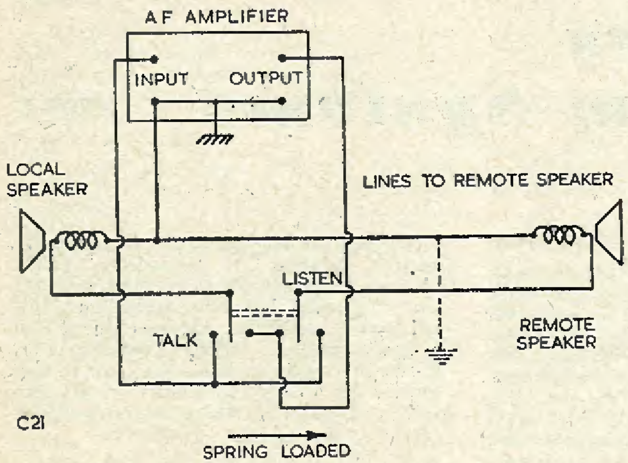


Figure 1. Showing the basic principle of an intercom system.

ever, the question of hum pick-up is dealt with later.

The Amplifier

The amplifier plays a large part in the final working of the intercom system and, as such, deserves care in its design and construction. The amount of amplification needed for most installations should be given adequately by a 3-valve mains amplifier employing a triode, pentode, and output pentode. It is advisable to use a mains transformer rather than rely on a "universal" circuit.

In fact, the only advantage obtained by using a "universal" circuit for an amplifier of this type lies in the cheapness of the original cost of construction, insofar as we save the expense of buying a mains transformer. However, the disadvantages arising from the use of a universal circuit with its consequential "live" chassis far outweigh the trifling extra cost of the transformer needed for the AC model. The main disadvantages are those of hum pick-up and risk of shock.

The question of hum pick-up deserves some consideration. If we are to use long unscreened leads connected to the input of a sensitive amplifier, (as we wish to do in this case), it is extremely advisable to keep them at chassis potential, as, otherwise, a great deal of hum may be picked up. Use at chassis potential may be ensured by connecting a centre-tap from the input transformer primary to the amplifier chassis, thereby having balanced leads, or—far easier—by simply connecting one of the pair of leads themselves to the chassis. However, the use of a universal-type chassis forces us to instal long leads which must necessarily be at mains potential, these becoming a source of danger and shock. Even if the chassis of the amplifier is connected to the "neutral" side of the mains, it only needs a blown fuse or a broken lead in the neutral connection to make the external wiring "live" *via* the dropping resistor and heaters in the amplifier. It is, therefore, far safer in the long run to use an AC amplifier instead of the universal type.

A Typical Amplifier

Fig. 2 shows an amplifier circuit which should work very well indeed in an intercom system. A high degree of amplification is obtained, which should prove to be more than sufficient for intercom purposes.

The circuit uses a triode pre-amplifier, followed by a pentode feeding into the output pentode. As the grid circuit of the first valve is extremely liable to pick up hum, the wiring to this grid, the input transformer and the valve itself are all screened. A top-grid valve should be used to prevent hum pick-up from the heater wiring, and it might prove beneficial to use a completely screened top-cap connector as well. The microphone transformer and the grid leak of V1 should be mounted in a "mu-metal" or soft iron box, or similar container. The axis of the microphone transformer should be at right angles to those of the mains transformer and smoothing choke.

It is advisable to use a proper moving-coil microphone transformer, since the use of unsuitable components may result in considerable loss of gain. The resistance of the grid leak for V1 (R_1 in Fig. 2) has some effect on the performance of the amplifier and, for this reason, no value has been given in the diagram. As this resistor represents the impedance into which the transformer feeds, it is difficult to give a figure which will hold for all cases. If no noticeable lack of volume is apparent when it is reduced to as low a resistance as, say, 100 k Ω, then it might be expedient to use this value, since it may then assist in stabilizing the grid circuit of V_1. Usually, the value of the grid leak should lie between 250 k Ω and 620 k Ω.

As it would prove fairly difficult to completely screen the volume control (R5) and its wiring, this component is not fitted in the grid circuit of V_1, but in that of V_2, where the question of hum pick-up is not so troublesome.

It may be noticed that a coupling capacitor of uncommonly low value (C_3) is used between V_2 and V_1, it being shown as having a capacitance of 500 pF. This low value is used purposely, the intention being to attenuate the lower audio frequencies. It is usually found that most loud-speakers, when used as microphones, tend to be "boomy". (In addition, it must be remembered that low frequency resonances in any particular model would be heavily accentuated if the same type of speaker

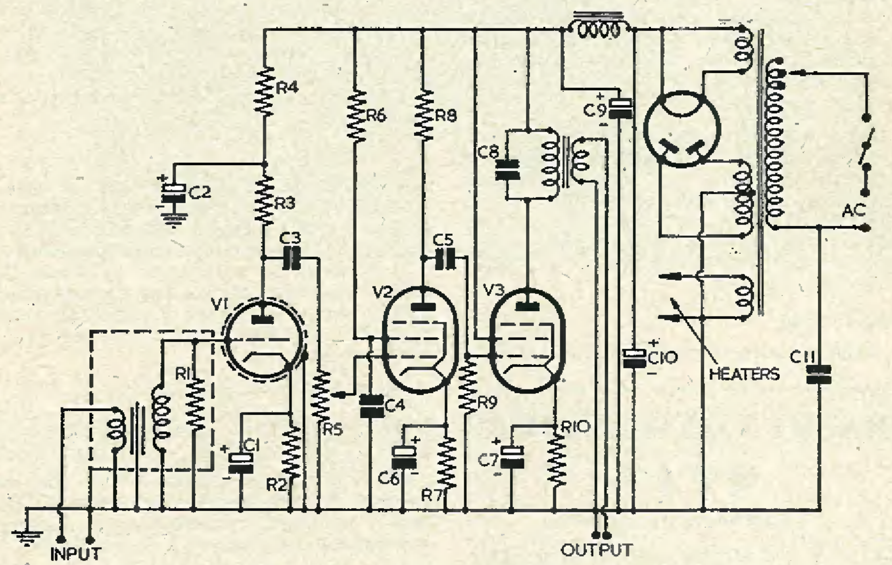


Figure 2. A typical intercom amplifier.

COMPONENT VALUES

C1,	50 μF 12V	R1,	see text
C2,	4 μF 300V	R2,	1 k Ω
C3,	500 pF	R3,	100 k Ω
C4,	0.1 μF	R4,	2 k Ω
C5,	0.01 μF	R5,	250 k Ω pot.
C6,	25 μF 25V	R6,	1 M Ω
C7,	25 μF 25V	R7,	2 k Ω
C8,	0.01 μF	R8,	100 k Ω
C9,	16 μF 300V	R9,	500 k Ω
C10,	16 μF 300V	R10,	500 Ω
C11,	0.01 μF		

Suggested valves: V1, EBC33 (diodes earthed)
V2, EF36. V3, EL32.

were used both as microphone and reproducer). The use of the low-value capacitor clears this fault, making speech very crisp and clear indeed. It also considerably reduces any hum that may be picked up in the input wiring.

There is little point in employing a large valve in the output stage of the amplifier. A small output valve will amplify just as well and consume less power. (It will also, incidentally, save ear-shattering reproduction should the system be used by an inexperienced but over-zealous person !) Such valves as the EL32 (ex-R.A.F. VT52), which can give 3 watts, are quite ample for the output stage.

The power-supply circuit is very straightforward and needs little comment. The rectified HT voltage should be between 200 and 250 volts, and, since only a small output valve is used, HT current should not be excessive. Capacitors C_9 and C_{10} provide adequate smoothing, additional decoupling for the anode circuit of V1 being supplied by R_4 and C_2.

It may be noticed that the on/off switch is separate from the volume control. This is a good p an because it will usually be found that, once set, volume need hardly ever be adjusted. It might also help if a numbered scale is fitted behind the volume control knob so that, should it be inadvertently altered, it may be easily re-set.

Hum Pick-up

Whilst we are on the subject of the amplifier and the external wiring it might be useful to devote a few lines to the question of hum pick-up.

If the intercom system is to be used in a building where unscreened mains wiring is used, hum pick-up may prove to be a major cause of trouble. However, connecting one of the two extension leads to the amplifier chassis (as is done in Figs. 1 and 2) will help to clear this snag. Connecting the amplifier chassis itself to a good earth will also help considerably. (It must be remembered that the bass attenuation in the amplifier will substantially reduce the hum level in the output).

However, should some level of hum still persist it may prove necessary to use screened leads, or at least screen the extension leads at the points where they pass close to, or alongside, existing mains wiring. The disadvantage with using screened wiring is, of course, the fact that it is more expensive than normal wire.

Next Month

In this article we have reviewed the circuit of an amplifier which is well suited for intercom work, as well as having discussed the main snags likely to occur in all intercom systems.

Next month we shall go on to discuss the various switching and calling circuits which may be used to enable the amplifier to provide intercommunication between a number of remote positions.

"RADIO CONSTRUCTOR" QUIZ

Conducted by W. Groome

(1) For an experimental hook-up, Mr. Brain needed a smoothing capacitor of approximately 4μF, but did not have one of suitable rating to hand for the 700V HT which he intended to use. He did have available a couple of 8 μF capacitors of 500V rating. Was he correct in connecting these two in series between HT+ and HT— ?

(2) What is the fluid usually recommended or cleaning switch contacts ?

(3) What causes a fold-over effect on the eft-hand side of a TV screen ?

(4) Which components should be protected from hot parts, such as power or rectifier valves and mains droppers ?

5) If you decided to modify a mains transformer, having a 4V winding in order to get 6.3V instead, how would you tackle the job ?

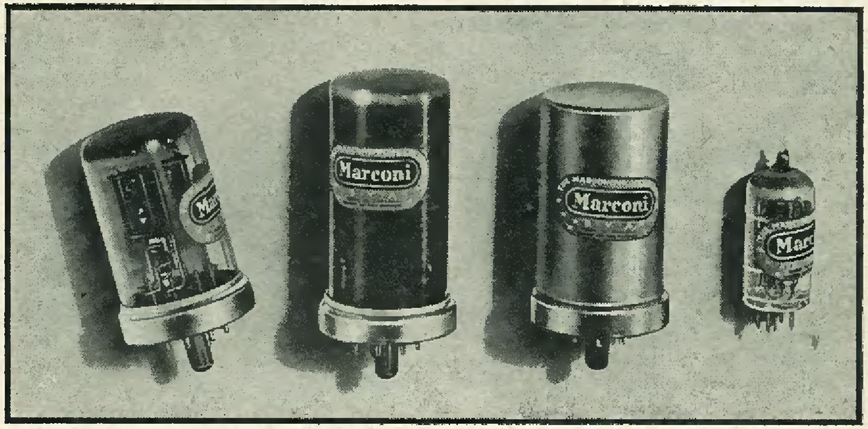
(6) The infinite-impedance or cathode-follower detector is frequently used in high-fidelity broadcast equipment. Can a similar arrangement be used for TV sound ?

● ANSWERS ON PAGE 16

The Editor Invites . .

● Constructional articles suitable for publication in this journal. Prospective writers, particularly new writers, are invited to apply for our "Guide to the writing of Constructional Articles" which will be sent on request. This guide will prove of material assistance to those who aspire to journalism and will make article writing a real pleasure!

RECENT TRENDS *in* *Radio Valve Design*



(*Photo Courtesy of The Marconiphone Co. Ltd.*)

by VALVONIC

It may be said, and one is inclined to think, fairly, that the day of the Octal valve types and their successors, the Loctal types is over. Glass based valves have come to stay and "miniaturisation" is the order of the day.

Two factors are primarily responsible for the glass based miniature valve. The first is the difficulty of finding a cement which will withstand tropical and vibratory conditions sufficiently well to prevent the bugbear of loose caps. A tremendous amount of work was done during the last war to endeavour to solve this problem, without much success. It would not be advisable to suggest a percentage of war valves, at present held in stock, which are unusable owing to loose caps. It is known to be very high.

After much development work, the Services came to the conclusion that the glass based valve was the solution to these troubles. Of course, the main difficulty in designing a glass based valve is to find a pin material of the correct co-efficient of expansion to match the glass used in any particular type. Failure in this matching technique causes undue stresses to be set up in the glass when cooling after sealing takes place, with the result that a very large proportion of glass bases crack in service or while in stock. Thanks to some clever metallurgy, the difficulty has been solved by the introduction of certain special alloys.

The second main factor concerned in the introduction of these valve types is the need for physically small valves in modern complex apparatus. This is illustrated in television sets, which employ fourteen or fifteen valves. It will be appreciated that to use Octal or even Loctal types would lead to a tremendous increase in bulk. In modern Airborne equipments, the position, but for miniatures, would be impossible. Since most manufacturers do not want to produce different types of valve for use in the service and use by set manufacturers, the recent trend has been towards the B7G and B9A (Noval) types, which are equally applicable to both users.

The practice, in general, is to use the B7G with seven pins when electrical considerations do not require a greater number of pins, but to use the B9A with its nine pins and slightly greater size of envelope when valves such as double diodes and triode hexodes are envisaged. It is also to be noted that in cases where a high dissipation is aimed at, the Noval may be employed. It is possible to get a twelve watt anode into a Noval, whereas nine watts is about the limit for the B7G type.

It may be said that, at the moment, the glass based types are more expensive to buy than the Octal types. This may be so at present, but a very large number of projected equipments is being designed around the B7G and B9A types. This will inevitably lead to the obsolescence of the older types, by an increased production of glass based valves with its consequent reduction in cost. It may be confidently said that, at no very distant date, the modern valve will become cheaper than the old types.

Hitherto, we have only considered the physical size of valves and the basing difficulties. If we are quite honest with ourselves, we must admit that, with the possible exception of the beam tetrode no very great electrical improvement has been made in valves generally since the middle or early thirties. Just now, however, there are great developments going on.

The recent work done on crystal valves has gone a long way. We know of the modern crystal of Germanium which is now being used as a diode in many applications. In certain forms, it is very useful at ultra high frequencies. A further development is now taking place in the production of crystal triodes or transistors having a performance comparable to valve-type triodes. If these developments reach maturity, then we shall see a great change in normal circuit design and the general lay out of apparatus.

Another, and most interesting, development is the introduction of secondary emission or electron multiplier valves. It is not possible to go into the design or performance of such valves at present, but in passing it may be said that slopes of 20 to 30 mA per volt are to be expected. Such valves may easily have the effect of reducing the total number of valves necessary in an equipment and, in consequence, render it cheaper and less liable to failure. Valves of this type which have so far been experimentally produced are on Noval 9-pin bases.

On looking at the whole picture of valve development to-day, it is obvious that the miniature glass-based valve is the valve of the future.

Answers to Quiz

(1) Mr. Brain was right. By connecting two similar capacitors in series, the effective voltage rating is double that of either capacitor by itself, whilst the capacitance is halved.

(2) The base is carbon tetrachloride, a fluid used industrially as a grease solvent.

(3) If the scan waveform departs from the correct sawtooth shape and curves at the point where the flyback ends and scan commences, the effect is that the flyback slows down perhaps a half inch from the edge of the raster and there takes up time which should be used for the scan. The beginning of every line as transmitted is therefore displayed on the screen back to front and then continues in the correct direction as the sawtooth straightens out. The remedy is to improve the waveform of the sawtooth generator and amplifier.

(4) Electrolytic capacitors in particular. Efforts to make a power pack of small dimensions often result in these components being placed close to the rectifier. Fixed and variable capacitors, although not so likely to break down, can cause frequency drift in RF and IF stages if their values change through thermal expansion.

(5) Make sure that the wattage to be drawn from the new secondary will not be greater than that of the existing winding. Count the number of turns on the 4V winding and divide by four, which gives the number of turns per volt. Multiply this by 6.3, and you have the number of turns required for the new secondary. Choose a gauge of wire suitable to carry the current needed. For the same wattage, this will be a smaller gauge for 6.3V than for 4V. Now remove the old secondary and wind on the correct number of turns.

(6) Yes. Use one of the special miniature triodes, such as the 955. Decouple the anode with 47 k Ω and 8 μF. Connect a 47 k Ω load from cathode to HT—, and take the output from the cathode via a 0.1 μF capacitor. No by-pass is needed, as circuit stray capacitances will earth any RF at the cathode. If an ordinary single valve audio amplifier and small speaker are to be used, one may as well stick to diode detection, but where the audio section is designed for high quality the cathode-follower detector will give reproduction of amazing realism. The writer has found the TV sound to be the best source of high-fidelity signal available, the majority of live TV broadcasts possessing quality which the best records cannot approach.

BUILDING YOUR OWN VALVE TESTER

By W. G. MORLEY

Part III

The Grid Bias Supply

The DC grid bias supply is shown in Fig. 3. An alternating source of 250 volts is applied to the cathode of a half-wave rectifier, V4, from the anode of which a negative supply is taken to a third stabilizer valve (V5). The 250 volts AC may be conveniently taken from half of the centre-tapped HT secondary of Fig. 1. The rectifier shown is a 6X5, and this may be heated from a 6.3 volt winding on that transformer. (It may be seen that the transformer which supplies the HT and GB circuits gives outputs of 250—0—250, 5 and 6.3 volts and is therefore quite a normal, easily obtained component). There is no point in keeping the 6.3 volt supply for the 6X5 at chassis potential, and it is therefore connected to the cathode via a 10 k Ω resistor R6. This will obviate the risk of breakdown between heater and cathode, whilst the presence of the 10 k Ω resistor will prevent any damage should the 6.3 volt winding on the transformer break down to earth. Before use, the mains transformer should, in any case, be checked to ensure that the 6.3 volt winding is well insulated from the transformer laminations, screen, or any other item at chassis potential.

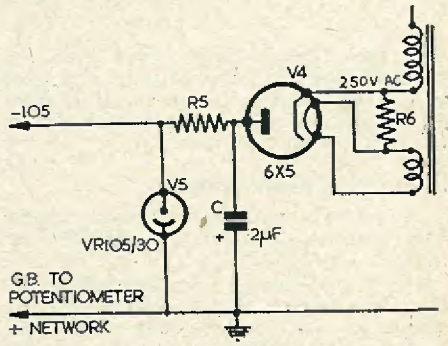
A small 2 μF reservoir capacitor is used at the anode of the GB rectifier, and, if an electrolytic component is used here, it must be remembered that the chassis connection is now positive instead of negative. The value of R5 need not be found experimentally in this case, since the currents drawn from the stabilizer are quite small.

The GB Switching Circuit

If a set of valve tables is examined, it will be found that the recommended values of grid bias for different types of valve vary between 0 and —75 volts. As the valve tester is intended to check as many different types of valve as possible, then it is necessary to provide a series of grid bias voltages extending to these limits. Fig. 4 (a) shows the circuit of the GB switching arrangements. It will be seen that this circuit allows considerable scope for the carrying out of test measurements, and it will be realised that, although a relatively large number of components is needed for its original construction, the complete versatility provided by the finished instrument will very amply repay the initial expense and trouble.

As it may prove difficult to obtain the 22 position switch shown in Fig. 4 (a), Fig. 4 (b) shows an alternative method by means of which the various GB voltages may be obtained by using two 12 — position switches.

It will be seen that a 10 M Ω resistor, (R29), is permanently connected between the arm of the GB switch and the full negative GB voltage. This resistor is fitted to ensure that the GB applied to the valve under test does not drop to zero during the time when



C30

Fig. 3 The GB power unit. The 250V AC. supply is taken from half the secondary shown in Fig. 2.

Values:

R5, 7.5 k Ω; R6, 10 k Ω; C, 2 μF.

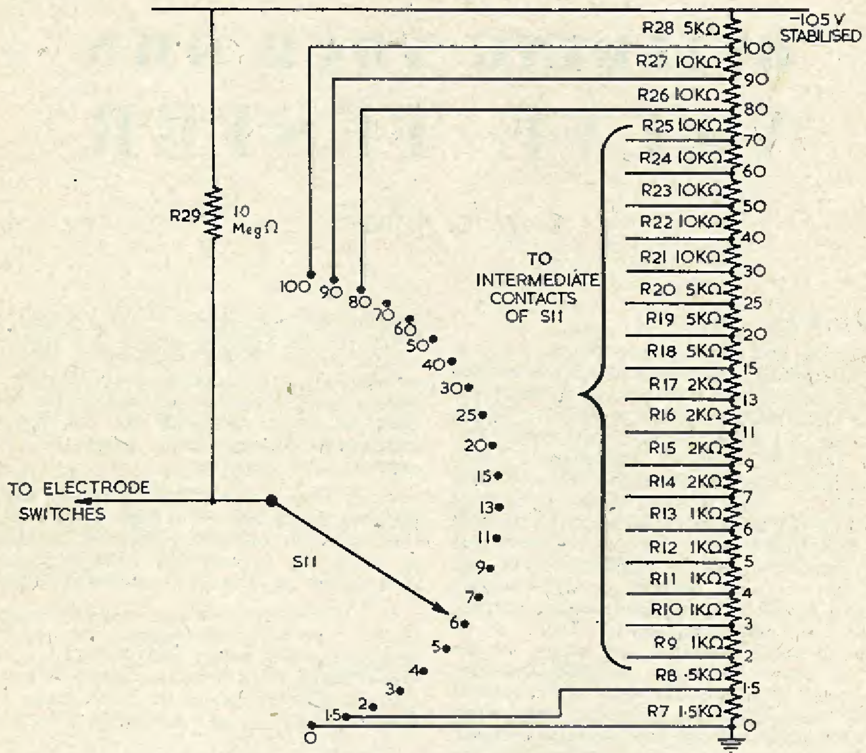


Fig. 4 (a): The GB potentiometer network.

the switch arm is being moved from one contact to the next. Owing to the high value of the resistor, it will have negligible effect on the accuracy of the voltages obtained from the potentiometer network.

Providing the Heater Supplies

The provision of the various heater supplies will necessitate the use of a specially constructed transformer.

The heater voltages of valves which will be encountered in normal service work are shown in the accompanying table. The figures in the left hand column represent the actual heater voltages of the valves. In cases where the voltage may appear unfamiliar, the name of the manufacturer (if British valves use that voltage) or of the type (if American) are appended in brackets. However, there is little point in supplying all these voltages, and the centre column shows how voltages which are nearly the same may be bracketed together in groups. The figures shown in the centre column indicate the actual voltage that should be obtained from the transformer. The right hand column shows the legend which may be indicated at each switch position.

Once again, it will be found that a 22-position switch is needed for the various heater supplies and, if this is difficult to obtain, two 12-position switches may again be used in its place, as was done for the GB supplies in Fig. 4(b).

Owing to the large range of voltages which are needed for the heater circuits, it will, of course, be necessary to wind a separate heater transformer. If the constructor is familiar with transformer winding, then he may be able to make his own bobbin, etc., and start from scratch. Otherwise it might prove easier to strip the secondaries from an ordinary transformer and wind a new, tapped, heater secondary in their place. The transformer should be capable of handling about 30 watts.

It is not necessary to use the same gauge of wire throughout the secondary winding, as the current required will decrease as the voltage obtained is increased. The use of thinner wire for the higher voltages will considerably reduce the size of the secondary, and will make winding easier. Up to the 7 volt tap, the wire used should be capable of carrying 4 amps; from 7 to 12 volts, 2 amps; from 12 to 70 volts, 0.5 amps; and from 70 to 117 volts, 0.25 amps. (14 swg wire will carry 4 amps; 16 swg 2 amps; 22 swg 0.5 amps; and 26 swg 0.25 amps).

Heater Connections

When the design of the switching circuits, which will apply the necessary voltages and testing circuits to the electrodes of the valves under test, is being considered, it is first of all necessary to spend some time in studying the base connections used for each separate type and make of valve.

The first question which needs to be solved is that of supplying the heater voltages to the appropriate pins on each particular valve base. If it is possible to connect the heater wiring permanently to each different valve base, then it will be possible to considerably simplify the switching circuits.

Examination of the different ranges of valve used nowadays show that the heater pins are, almost without exception, the same for all the valves in each particular range. For instance the heater connections on Loctal valve bases are always taken to pins 1 and 8. The same holds true for Mazda Octal. British 5 pin uses pins 4 and 5, and British 7 pin uses 3 and 4. Similarly, with American UX bases, whether 4, 5, 6 and 7 pin, the heater pins remain the same for all the valves in each individual range. It is therefore possible to connect the output of the heater voltage selector switch permanently to the particular heater pins on each different valve base.

Unfortunately, however, this standardisation of heater pins does not occur with International Octal valves. The heater connections of these valves may be taken either to pins 2 and 7, 7 and 8 or 2 and 8. At first sight it may

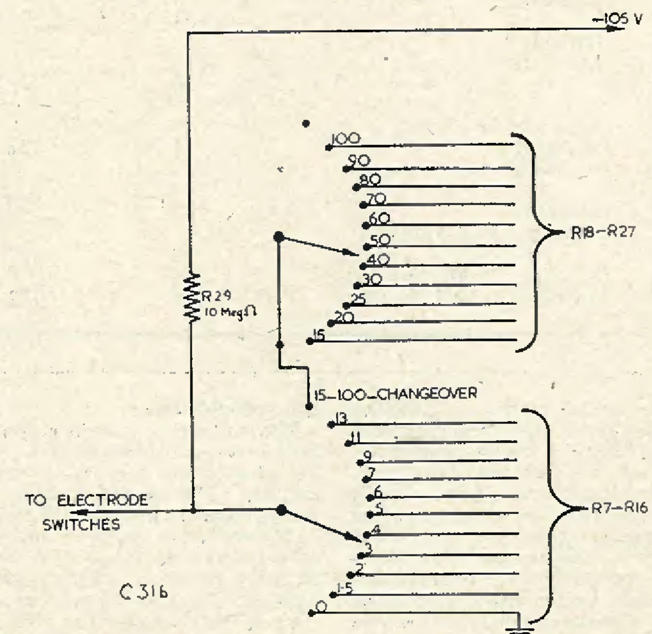


Fig. 4 (b): Showing how the 22-position switch, S11, may be split up into two 12-position switches.

TABLE OF HEATER VALVES

Valve Heater voltages (1)		Voltages supplied by Transformer (2)	Legend for each switch position (3)
0.625	(Deaf Aid)	0.625	0.625
{ 1.0	(Brimar)	1.05	1.0 and 1.1
1.1	(American Battery)		
1.25	(Deaf Aid)	1.25	1.25
1.4		1.4	1.4
2.0		2.0	2.0
{ 2.5		2.6	2.5 and 2.8
2.8			
3.3	(American 20, V99 etc.)	3.3	3.3
4.0		4.0	4.0
5.0		5.0	5.0
6.3		6.3	6.3
{ 7.0		7.2	7.0 to 7.5
7.5	(Osram—American 10, 81, etc.)		
10.0	(Osram)	10.0	10.0
{ 12.6		13	12.6 to 14.0
13	(Brimar)		
14			
{ 15	(Osram)	15	15.0 and 16.0
16	(Cossor)		
{ 20	(Mullard)	20	20 and 21
21	(American 21 A7 etc.)		
{ 24	(Mullard)	24	24 to 26
25			
26	(Osram)		
{ 29	(Mullard)	30	29 and 30
30			
{ 32.5	(American 32 L7 etc.)	33	32.5 to 35
33	(Mullard)		
35	(Mullard)		
{ 40		42	40 to 45
44	(Mullard)		
45	(American 45 Z 3 etc.)		
50		50	50
70	(American 70 A7, 70 L7, etc.)	70	70
117	(American 117 N7, etc.)	110	117

appear that the simplest method of allowing for these differences consists of supplying a switch that will alter the heater connections for particular valves under test, using only one valve holder. In practice, however, this switch would also have to make good the change in electrode connections and would become needlessly complicated. The alternative course is to supply three International Octal valve-holders on the tester, each being wired so that its heater connections use one of the three alternatives mentioned above. This is done in the tester described here.

Electrode Switching

The next item for consideration is the system used for switching the electrodes of the various test valves to their appropriate voltages or meter circuits. The method which is used in this tester is shown, in simplified form, in Fig. 5. A Mazda Octal, British 5 and British 7 pin valve-holders are shown in this diagram, all being connected to the various electrode switches. The 10 leads connected to the arms of these switches run through the entire stack of valve holders, the individual pins of the valve holders being connected to the

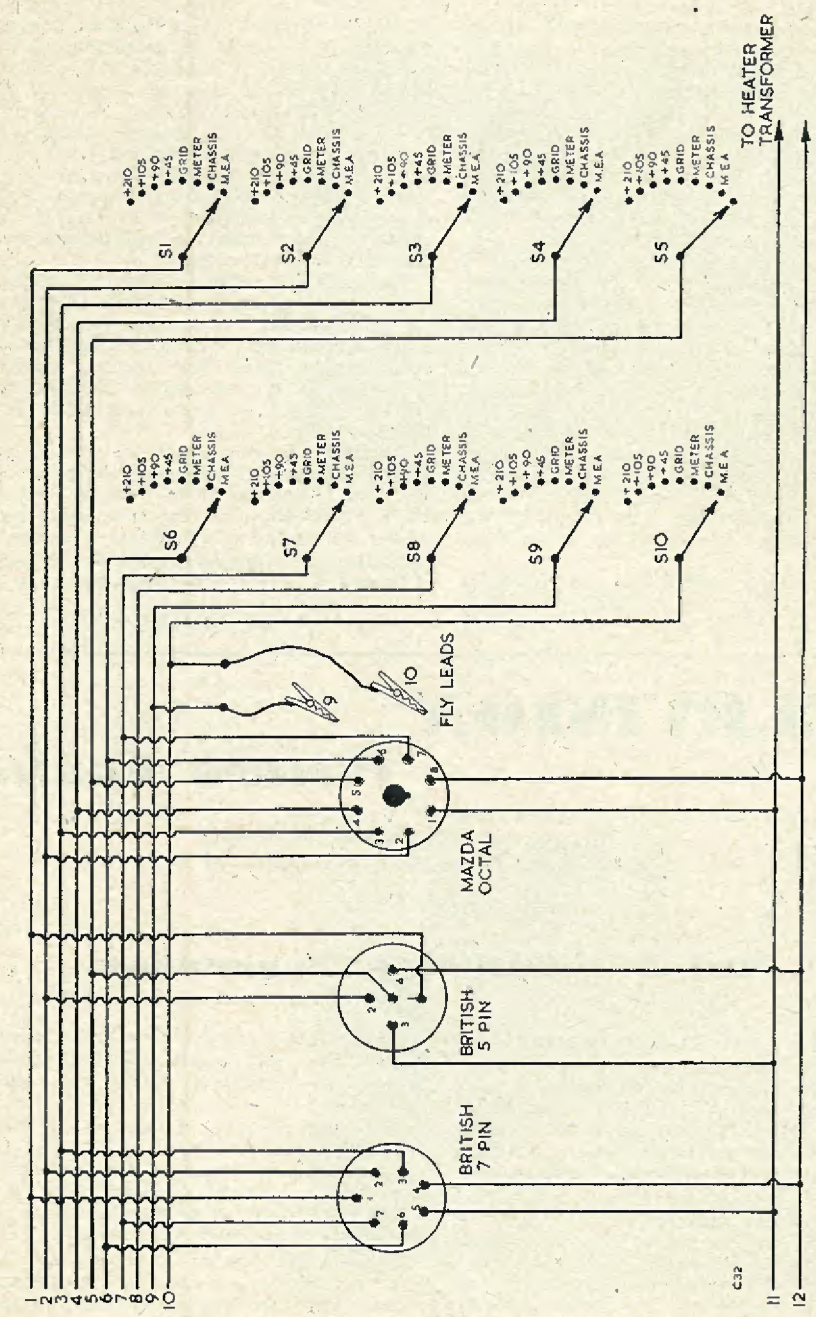


Fig. 5: Illustrating the method of connecting the individual valve holders to the electrode switches.

leads having the same number reference.

In addition to the valve holders, two fly leads for top cap connections are provided, these being clearly marked "9" and "10" to indicate to which electrode switch they are connected. (Two fly leads are necessary because some of the older types of valve have two external connections to their electrodes, one at the top and one at the side. Some modern valves also have two top connections.) The fly leads should be terminated with crocodile or miniature bulldog clips.

It will be seen that, as the heater supply is connected permanently to the heater pins on each particular valve holder, the ten leads from the electrode switches do not connect to these pins. Thus, for instance, leads 1 and 8 from the electrode switches are not connected to the Mazda Octal base. Similarly, leads Nos. 3 and 4 do not connect to the British 5 pin base. It will be appreciated that this method of connection makes interpretation from valve tables to electrode switch positions extremely simple indeed, as the electrode switches then correspond with the numbers for each electrode given in the valve tables.

Each electrode switch has eight different positions. These are marked :—" +210 ", " +105 ", " +90 ", " +45", "Grid", "Meter", "Chassis", and "Magic Eye Anode" ("MEA" for short). It is therefore possible for each electrode to be connected, *via* its switch, to any of the regulated HT voltages, to the grid voltage selection switch, to the meter, to the chassis (which is also the HT negative and the GB positive connection), or to the "Magic Eye Anode" position. This ensures, of course, that the electrodes of *any* valve may be connected to any source of supply or test circuit required, *via* its valve base connection, no matter in what manner its electrodes are connected.

The switch position marked "Meter" connects the particular electrode chosen to the meter circuits. These latter may then be adjusted to check emission, read mutual conductance, check for shorts, measure insulation, or test rectifier or diode anode current. The meter circuits are dealt with later.

The last switch position, which is designated "Magic Eye Anode", connects the particular electrode selected to the 210 volt HT supply via a 1 M Ω resistor. This connection then allows the sensitivity of Magic Eye tuning indicators to be tested (by visual indication if necessary) as in a working circuit.

TO BE CONTINUED

TELEVISION
Picture Faults

Part five of a series, illustrated by photographs from a Televisor screen by courtesy of
Mr. John Cura.

Part 5 – The Sync Separation

BETWEEN the group of signals which control the brightness of successive lines, and at the end of each complete frame, a pulse or series of pulses are given by the vision transmitter. These are accurately timed pulses of carefully controlled duration, and are provided to trigger the time bases in the receiver.

In order that these pulses may be separated from the vision signal proper, the signal is transmitted so that all picture components occur above a line which is 30 per cent. of the maximum output of the transmitter. The sync pulses extend from this line downwards, so that, in fact, no power is transmitted during pulses. In other words, the transmitter actually stops sending during sync pulse periods.

The pulses given for timing line time bases have a duration of one tenth of the time taken by one line scan. Those for timing the frame scan consist of a series of longer pulses, four tenths of a line scan in duration, and separated by periods of one tenth of a line scan.

One complete frame is made from two successive vertical scans, one being timed slightly later than the other so that the second

Fig. 1 Result of start of line time base slip. In bad cases, the whole of the picture may be affected, and the subject matter broken up completely into a complex pattern of rectangles.

(John Cura 'Tele-Snap')

set of lines forming the raster occurs between those formed previously. This is called interlace, and achieves good picture quality without flicker. One complete frame lasts for one twenty-fifth of a second.

The extraction of the synchronising pulses from the total vision signal is fairly simple because of their arrangement, and can be achieved by means of a voltage limiting device which will pass all signals which do not exceed a certain amplitude. Thus, only the sync pulses, which consist of the first 30 per cent. of the signal, will be allowed to pass, and the picture content will be cut off. The pulses can then be applied to the time bases to trigger them at the correct time to start their scans.

Probably the most common circuits used for sync pulse extraction are those which

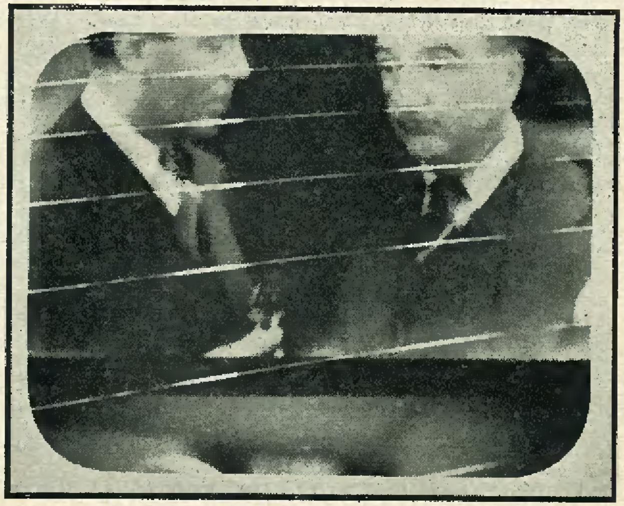


Fig. 2 Showing effect of slipping in frame time base. Arrested here by the camera, in practice the picture will be constantly in motion either upwards or downwards.

(John Cura 'Tele-Snap')

employ a pentode valve having a short grid base, that is, one where the anode current may be cut off by the application of less than about —10V grid bias. Most television type pentodes come in this category, e.g., EF50, 6AC7, SP61, etc. When this type of valve is operated with a low anode voltage and a slightly higher screen voltage, the anode current when the control grid is made positive does not increase beyond a certain amount, no matter how much positive the grid is made. This condition can be obtained by arranging that the phase of the vision signal applied to the grid is positive going. The anode current of the valve will then rise, as described above, until it reaches a maximum, and increases of vision signal at the grid will not result in any further increase of anode current. The output from the valve therefore consists of pulses of current which coincide with the sync pulses at the grid, and have no picture content. These pulses can then be applied to the time bases to synchronise them.

Typical electrode voltages for valves such as the EF50 and SP61 are 40V for the anode and 50V for the screen. Some variation may occur, however, in different versions of the circuit, depending on the methods used. The valve usually has no bias resistor, the cathode being taken direct to HT—. The grid circuit of the sync separator will often contain a series resistor between the grid leak and the grid itself. As the valve operates without bias, when the signal is applied to the grid (positive going) grid current flows and there is a voltage drop across this series resistor. This further limits the signal and provides even more effective isolation of the sync pulses from the picture part of the signal.

There are a great number of other possible circuits for sync separation, far too varied to be detailed here, but they are becoming less common and seldom figure in home constructed televisors. It should be pointed out, however, that diode or double diode valves are occasionally used in conjunction with sync separators of the type described, being arranged to isolate the feeds to the line and frame time bases in order to prevent interaction between the two.

Failure on the part of the sync separator circuits to supply the times bases with timing pulses will cause the bases to operate at incorrect and varying speeds. In the case of the frame time base, the effect is easily identified and will show as a complete picture which rolls up or down, depending on the setting of the frame hold control. If the line time base is slipping, the speed will defeat the eye and the picture will appear as a number of horizontal streaks. When there is no synchronisation whatever, the picture will be a complete jumble which will depend entirely on the settings of the controls as to its appearance.

Figs. 1 and 2 illustrate the effects of partial lack of synchronisation. Fig. 1 shows tearing of the top of the picture, the result of insufficient line sync pulse amplitude. Fig. 2 shows frame slip. The line is holding, but the complete picture (arrested here by the camera) is wandering up or down. Fly-back lines usually appear when this happens, and there is loss of interlace. The dark band between pictures is the usual period between frames.

Should there be a fault, the sync pulses may be traced through the sync circuits, and this may conveniently be done with a pair of phones in series with a 0.1 μF or similar capacitor. The signal may be traced from the video stages through to the time bases, the frame sync. pulses sounding similar to the automatic telephone dialling sound, and the line pulses with the high pitched whistle characteristic of the line frequency. They may be identified from the vision signal by the lack of change in volume when the picture changes in brilliance. It must be remembered that similar sounds to the sync pulses are made by the time base oscillators, and it may be necessary to remove the oscillator valves in order to prevent confusion.

BOOK REVIEW

RADIO SERVICING, Theory and Practice. *By Abraham Marcus.* **Pp. 775. George Allen and Unwin, Ltd., 40, Museum Street, London, W.C.1. Price 35s.**

This is a most comprehensive book, written for the reader who has some knowledge of radio, though not enough to qualify as an expert. The first chapter is therefore designed as an intense refresher course in theory.

The second chapter deals with the various types of components used in receivers, exclusive of valves. These latter are the subject of the next seven chapters, and these include *Service Notes* dealing with the various faults which may be found in valves.

Chapter 10 discusses various control circuits, and here the *Service Notes* deal with possible circuit defects. Chapter 11 is concerned with various types of receiver, including car radios and FM receivers. The defects found in each type are also listed.

Various types of power supplies, including vibrator and motor generator types, and their possible faults, are described in Chapter 12.

The next chapter introduces and discusses the various types of servicing instruments, including cathode ray oscilloscopes. Then follow a further three chapters devoted to the procedures and techniques employed in servicing.

Summing up, this is a book which should prove very useful, not only to the full or part-time serviceman, but to the constructor who is continually coming up against maintenance problems.

B.C.

Design of the SUPERHET

by R. J. CABORN

PART 10

CARRYING on in these articles with our discussion of the superhet, we shall deal, this month, with crystal filters, audio filters and the use of crystal oscillators for purposes of calibration.

Crystal Filters

Crystal filters, or *crystal gates* as they are sometimes called, are connected in the IF stages of a superhet in order to considerably increase selectivity. The selectivity offered by these filters is so high that it is not usually practicable to receive modulated signals when they are in operation, as the intelligence-conveying sidebands are rejected. Attempts have been made in the past, by employing two crystals of slightly differing frequencies, to obtain a band-pass effect for reception of modulated signals; but, although fairly successful, this type of filter does not appear to be very popular nowadays, and the modern crystal filter is used almost entirely for reception of CW. As CW signals consist mainly of transmissions on one frequency, the crystal filter may then be used for—almost literally—"single-signal" reception.

However, it is interesting to note that even CW or morse signals have sidebands. For instance, if the transmitted WPM rate were sufficiently high to cause, say, ten "dots" per second to be sent, the effect on the transmitter sidebands would be something the same as though it were modulated by a frequency of 10 cycles per second. In addition to this, the virtual modulation frequency is increased by reason of the random frequencies which must necessarily accompany the sharp-fronted wave sent from the transmitter as the key is pressed or released. It is possible in practice to make a crystal filter so selective that it cannot even respond to these small sideband frequencies, and an effect is given as though the dots and dashes in the signal were "running together". Usually, some form of control is fitted to the crystal filter circuits to enable the selectivity to be adjusted.

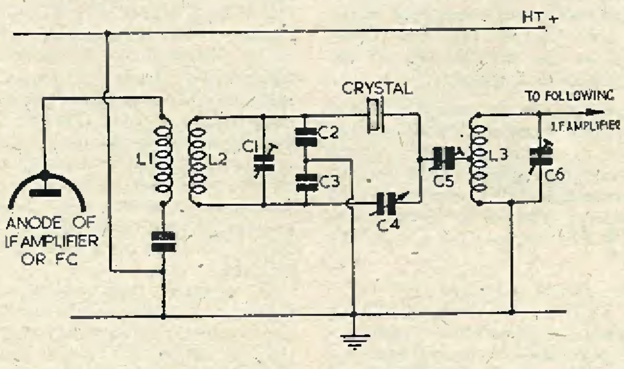


Fig 1: A typical crystal filter circuit (L2 may be centre-tapped, if desired, instead of using the capacitors C2 and C3 to balance its output).

Typical Values:

C1, 5, 50 pF   C2, 3, 100 pF   C4, 15 pF.

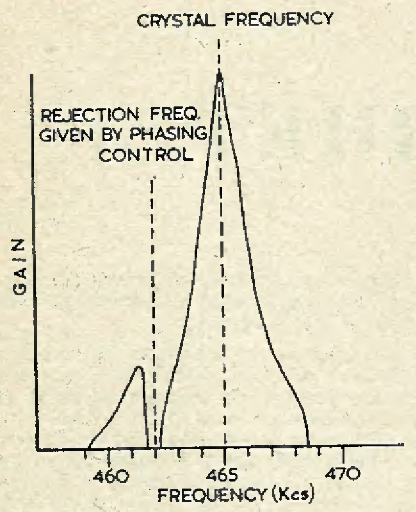


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Fig. 2: A curve which shows the effect of the crystal filter, and of the crystal phasing circuit.

Fig. 1 shows a typical crystal filter circuit. The anode of V1 feeds into the coil L1 which, for maximum interchange of energy, has a relatively high inductance. Coil L2 is tightly coupled to L1 and its inductance is such that it may be tuned to the IF by means of C_2 and C_3 in series and the trimmer C1. The output from the secondary is balanced to chassis by the potentiometer consisting of the capacitors C2 and C3, so that the signal voltages applied to the crystal and to the capacitor C4 are equal and opposite.

From this point the circuit acts in a bridge fashion. Capacitor C4 can be adjusted so that it is equal to the capacitance inherent in the crystal and its holder, with the result that, so far as signal transference by capacitance is concerned, no energy whatsoever is passed to the capacitor C5 and thence, *via* L3, to the next IF stage.

However, the crystal acts not only as a capacitor but also as a series-tuned, or "acceptor" circuit, and it therefore "accepts" any signal corresponding to its own frequency. (An acceptor circuit has a very low impedance to frequencies to which it is tuned). As the "Q" of the tuned circuit represented by the crystal is extremely high, then the selectivity offered by the crystal filter circuit is also very high as well.

Another way of looking at the circuit is to consider it as a balanced capacitance bridge. The only time that it falls out of balance is when the crystal ceases to act as a capacitor and functions as a tuned circuit. As signals will be transferred to C5 only when the bridge is out of balance, it follows that the only signals which may be passed are those whose frequency is the same as that of the crystal.

The transference of energy from the crystal circuit to the next IF stage is achieved *via* C5 and L3. The tapping into L3 is arranged to offer the correct impedance to the crystal filter.

"Crystal Phasing"

In practice, the capacitor C4 of Fig. 1 is used not only to cancel out the capacitance which is inherent in the crystal and its holder; it also carries out an operation known as "crystal phasing".

The effect of the capacitance of the crystal holder is to cause a secondary tuned circuit to be formed by the crystal. As the capacitance of the holder may be considered as being in parallel with the tuned circuit represented by the crystal itself, this secondary tuned circuit is of the parallel or "rejector" type, offering a very high impedance to signals to which it is tuned. The resonant frequency of this rejector circuit is slightly different from that of the crystal itself.

As capacitor C_4 changes the effect of the capacitance of the crystal holder, it may be used to vary the frequency of this parallel-tuned circuit, and thus offer maximum rejection of any interfering signal which has the same frequency.

Fig. 2 shows roughly the effect which may be obtained. It will be seen, in the first place, that a high degree of selectivity is obtained by means of the crystal filter, a very high peak being obtained at 465 kcs, (the presumed frequency of the crystal we are using). From this peak the curve falls away very rapidly; but, nevertheless, it is still possible for a very strong interfering signal to break through should it be removed only by several kcs from 465 kcs. By use of the phasing control it is possible to obtain an extremely high degree of rejection at any frequency near that of the crystal. In Fig. 2, this has been done for a frequency of 462 kcs.

It is fairly common practice to set the rejection frequency offered by the phasing control to give maximum attenuation of what may be called the "audio image" frequency. This may be understood more easily if we take an example. Let us imagine, for instance, that a superhet whose intermediate frequency is 465 kcs is fitted with a BFO of frequency 464 kcs, thus allowing a beat note of 1 kcs to be heard with each signal tuned in. Now, if an interfering signal happened to have a frequency such that it gave an intermediate frequency of 463 kcs after passing through the frequency-changer stage, this signal also would beat with the BFO to give a tone of 1 kcs. The phasing control of the crystal filter is then set to offer maximum rejection at 463 kcs. If the receiver is fitted with a 1 kcs audio filter in the AF stages, it will be appreciated that an enormous amount of selectivity and freedom from interference is then available.

To set the phasing control for this type of reception, the usual method consists of tuning in a strong signal with the crystal filter switched on and adjusting the BFO to give the required beat note. The receiver is then retuned to obtain the same beat note "on the other side" of the BFO frequency. The signal will probably be very weak at this position but should still be audible. The crystal phasing control is then adjusted to give maximum rejection at this frequency.

Selectivity Control

A certain amount of selectivity control is available with most crystal filter circuits. In Fig. 1 this could be achieved by adjusting the capacitor C1, which then varies the impedance of the tuned circuit, L2 C1. When C1 is adjusted to enable the coil to resonate at the same frequency as that of the crystal, the tuned circuit may then be considered as being resistive. To a certain extent, this damps the tuned circuit represented by the crystal. For this reason, the "resonant" position of C1 offers the least selectivity (although it gives the greatest signal strength).

Capacitor C_1 is usually not a panel control but is pre-set, as its adjustment needs a certain amount of care.

Using a Crystal Filter

Any amateur who has used a receiver fitted with a crystal gate will be aware of the outstanding selectivity offered by the arrangement. Once the filter has been set up correctly it is possible to tune almost literally to a "hair's breadth".

However, when a crystal filter is used it is very necessary to ensure that the frequency-changer of the receiver is working correctly. Should there be the slightest "drift" or instability in the oscillator frequency, the filter will, of course, be useless. Similarly, with the filter in circuit, it is impossible to receive any CW transmitter which is even only slightly "wandering", or which is very "chirpy".

It is possible to switch out the crystal filter by short-circuiting the crystal.

Audio Filters

Some mention was made above of audio filters, particularly with regard to CW reception. These filters are fitted occasionally in communications-type receivers to ensure that, should two stations be very close together in frequency, the AF tone produced by one is accentuated by the filter whilst the other is attenuated.

Simple L/C arrangements are usually quite sufficient for this form of filter, and a typical circuit is shown in Fig. 3. It will be seen that the switch enables the anode of the valve to be

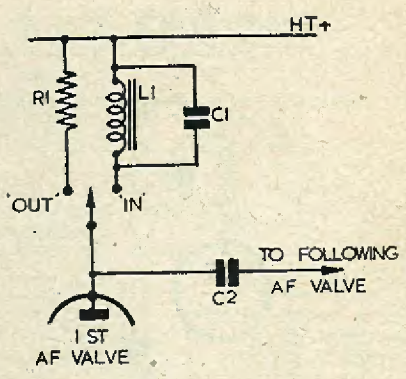

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Fig. 3: A simple audio filter.

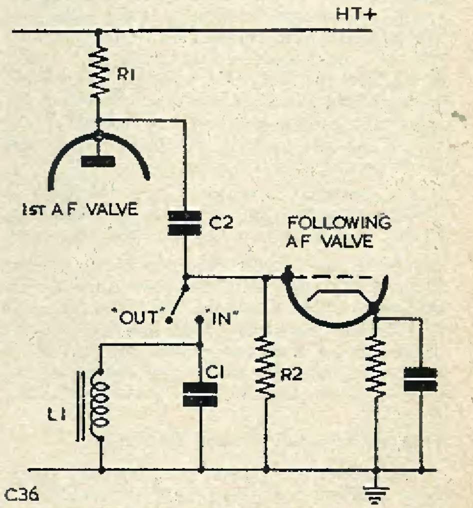

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Fig. 4: An alternative method of connecting the audio filter of Fig. 3.

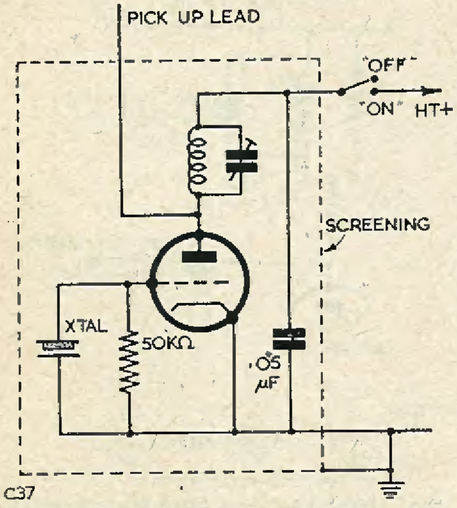


Fig. 5: A crystal oscillator which may be used for calibration purposes.

connected either to a normal anode load (R1) or to the tuned AF circuit L1 C1. The values of L1 and C1 are so chosen that they resonate at the required frequency.

In practice, it would be advisable to use as large and efficient an inductance for L1 as is possible. A larger inter-valve transformer would prove ideal, especially if the secondary and primary were connected in series. (Some of the old-fashioned transformers, manufactured in the early '30s with heavy cores and sectionalised windings, are what the writer has in mind; although good quality modern chokes would do just as well, of course, but might prove more expensive to obtain).

The parallel capacitor C1 could then be chosen experimentally, so as to cause the circuit to resonate at the required frequency.

If it is considered that the anode current flowing through L1 may be reducing the efficiency of the filter, the shunt-fed circuit of Fig. 4 could be used. This, however, has the disadvantage that the anode resistor R1 is always in parallel with the tuned circuit, causing some slight possible loss of efficiency.

Using a Separate Crystal Oscillator

Whilst on the subject of communications-type receivers, it would be interesting to devote a few paragraphs to the subject of crystal oscillators for frequency calibration.

The purpose of using crystal oscillators in this manner is to give a reliable check of frequency at all points of the dial. An oscillator is used which has a fundamental frequency of, say, 1,000 kcs: and it is then possible, by using its harmonics, to check the dial calibration of a receiver at every 1,000 kcs, therefore making it possible to identify a station, or measure its frequency, easily and reliably.

Practically any crystal oscillator circuit may be used. Fig. 5 shows the circuit of a simple tuned-anode crystal-grid oscillator which would do quite well for a job of this type. The tuned circuit should be designed so that it can resonate at a slightly higher frequency than that of the crystal. It may be adjusted by connecting a milliameter in series with the HT supply to the anode, and tuning for a "dip" in the meter.

The oscillator, whether it is an integral part of the receiver or is built separately, should be entirely screened. A lead taken from the anode of the valve, and projecting outside the screen for several inches, should be placed close to the aerial input wiring of the receiver in order to provide the necessary coupling.

Next Month

In next month's article we shall deal with the problem of maintaining frequency-changer oscillator stability.

OUR COVER PHOTOGRAPH

illustrates the E.M.I. Amplifier P.A.161, one of the items which are being made available, in limited quantities, to amateurs and experimenters, by E.M.I. Sales and Service Ltd. (Amateur Division), Sheraton Works, Hayes, Middlesex. All these items are brand new, and a complete list may be obtained from the above address.

The P.A.161 is a 12 watt amplifier, with switched input circuits for microphone, gramophone and radio. The first two are for low impedance microphones and pickups, and an input transformer is incorporated. The valve line-up is H63, KTZ63, and two KT61's in class AB1 push-pull. The HT supply is full-wave rectification using a U12, and is fully protected by fuses. A grey crackle ventilated cover, with chrome handles, is available. Input conditions are: Microphone—impedance 15 Ω, 0.1V for maximum output. Gramophone—impedance 25 Ω, 1 mV for maximum output. Radio—impedance 100 kΩ, 2V input for maximum output. Output conditions: Rated output 12W, impedance 50 or 100 Ω. Noise level is 37 db below full output. Mains input is 200-250V at 50 cps, and consumption 100W.

"from our MAILBAG"

Dear Sirs,—I have tried your new idea for soldering. It is all right, but give me the good old soldering iron any day. I suppose you would get used to it after a while, but at first I found the joint to be soldered becomes dirty with oxidisation of the metal and from the carbon bit, especially if proper contact is not made between the joint and the bit. Also, if you keep the carbon on the joint too long, the joint gets red hot and melts. You also have to be careful of arcing, when little bits of carbon spray on to the joint to be soldered.

But, if it isn't good for soldering, it certainly can unsolder joints, and quickly, and it can reach into those packed ex-Govt. surplus chassis without melting all the wax capacitors within half a mile radius.—

J. Glazer, (Westcliff-on-Sea, Essex).

High Fidelity

Dear Sir,—I wonder when the "high-fidelity" boys will begin to take a rest! Everywhere one looks in present wireless literature one sees advertisements for more and more super amplifiers, each one claiming to poke its nose higher up the frequency scale than its rivals. And, of course, loudspeakers which will give excellent reproduction—at a price.

The point is that mechanical reproduction will never give a satisfying copy of the real thing and so these ever-so-tiny excursions into better reality (!) can never be of any real use. Personally, I think that the quality offered by a three-triode amplifier is quite sufficient for all domestic purposes. The listener's ear realises that it is listening to canned music and can still appreciate it; why bother to try and deceive it?—

T. Scott (Newhaven, Sussex).

Mains/Battery Receivers

Dear Sir,—I wonder would readers be interested in a little discovery which I have recently made? I think that this is of some importance both to commercial manufacturers as wells as to amateurs, and it concerns the design of Mains/Battery receivers.

Recently, I built a Mains/Battery receiver in which, in the "Mains" position, the first three valves, 1A7, 1N5 and 1H5, were heated, in series, by the cathode current of the mains output valve, this current being approximately 50 mA. All worked well on the initial tests until I got round to lining the set up. When the note of the signal generator was heard in the speaker the three valve filaments immediately glowed more brightly. I noticed the effect because the valves concerned were in a shadow at the time being.

Thinking that the output valve was working incorrectly I checked all the components around it, but everything was serviceable. I then connected a milliameter in series with the heaters of the 1.5 volt valves. This showed approximately 48 mA. When I applied the tone again the valves once more glowed more brilliantly, but the current shown in the meter *did not change*. I finally connected a voltmeter across the valve filaments (i.e. between the cathode of the output valve and chassis). This read 4.2 volts, but when the tone was again applied this meter *also did not change*.

Unfortunately these experiments caused a failure in one of the valves and I have not been able to replace it to date and obtain any more readings. Nevertheless I think that the phenomenon is of some importance since the circuit I used is very popular in commercial receivers. I cannot as yet give any reason for the brightening of the valve filaments when the voltage across them and the current passing through them remained constant, but I hope to be able to offer some explanation in the future. If any other reader has a suggestion, or has had a similar experience, I would be very obliged if they would let me know.—W. Savage, (Kilburn, N.W.6.).

Novel Method of Soldering

Dear Sir,—The piece of apparatus described by E. Kaleveld on page 298 of the May issue, while being novel and ingenious, is I am afraid going to cause some alarming accidents, such as blindness from short circuit flash every time the clip comes in contact with the metal ferrule. On short circuit, the current from a 6V 5A transformer winding is not limited to 5A. It might be nearer 50A. Actually, it is the flash of molten metal on contact that is the most dangerous. I have had one or two short circuits in my time with 6.3V and 4V transformers. The connecting wires acted as a fuse by melting! Also, the surge of current generated in the primary blew the house fuses.

So it is essential to fit a short rubber sleeve over all but the tip of the clip, and to insulate the ferrule. Since the current is limited by the resistance of the short ½ in length of carbon rod, I should think the dimensions are important. For example, the diameter is not given and the length of carbon should be greater. It may be ground down on a hand grinder to the correct size.—

W. J. Law, (Ealing, W.5).

QUERY CORNER

A "Radio Constructor" Service for Readers

Television Pre-amplifier

Television reception in my locality is frequently lacking in contrast, due to insufficient signal strength. Can you recommend a pre-amplifier circuit that would improve the reception?
J. Ealey, Eastbourne.

A television pre-amplifier should not be regarded as a means of preventing all those picture faults which occur in fringe areas. For example, trouble is frequently encountered due to fading of the vision carrier. This is a particularly annoying effect which results in loss of contrast, together with a corresponding loss of picture synchronism. Many television receivers are designed for sale at the lowest possible price, and as a result the manufacturers have used a minimum number of valves. The outcome of this is that the type of receiver in question has a sensitivity which, although it is adequate for use in most parts of the service area, does not permit sufficient contrast to be obtained when used in fringe areas. It is in this condition that a pre-amplifier proves invaluable, as it enables that little extra gain to be obtained which makes all the difference between a weak unsteady picture and one having ample contrast and stability. The pre-amplifier which is about to be described is suitable for use with most commercial television receivers, and because of its bandwidth of over 3 Mcs. it in no way impairs the quality of the picture. It was not considered necessary to make the unit self contained, as the relatively low power required may, in most cases, be obtained from the main power pack within the receiver. The supplies to the pre-amplifier are 6.3 volts at 0.3A for the valve heating and between 200 and 250 volts at a maximum of 12mA for the HT. A gain control is provided, which enables the HT current to be reduced under conditions where the maximum gain is not required. This control may also be found useful if any overloading occurs in the receiver proper. Apart from joining up the supply leads, no modification need be made to the televisor with which the pre-amplifier is to be used. This is a particular advantage for those constructors who have spent many months in obtaining a satisfactory picture, and are now loathe to make any further modifications for fear of undoing some of the good work.

The valve which has been selected as being most suitable for use in this unit is our old friend the VR136, or EF54 to give it its civilian type number. This high slope RF pentode has a very low noise characteristic; the published equivalent noise resistance being only 700 ohms, which compares favourably with the 1,400 ohms of the EF50. This characteristic of a valve is particularly important in applications where the gain must be as high as possible but where the signal level is very low, as it is under such conditions that the valve noise may easily form an appreciable proportion of the signal voltage.

The tuning coils are wound on standard Aladdin formers (type No. F804) and are fitted with dust cores (type PP5804). The two coils should be mounted on either side of the valve holder, and a metal screen constructed to pass across the centre of the holder between the two coils. It has been found in practice that a tin-plated chassis provides very good screening properties at television frequencies, and has the great advantage that it may be soldered along the joints; also, of course, earth connections may be soldered direct onto the chassis. The table below

QUERY CORNER "Rules"

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

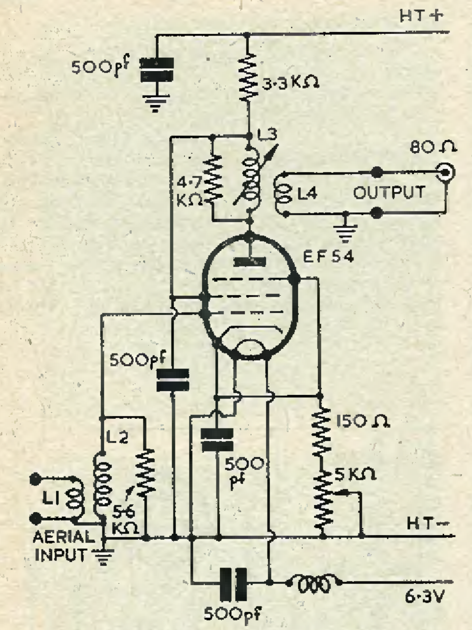
(2) Queries on any subject relating to technical radio or electrical matters will be accepted though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.

(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.



PIN No.	CONNECTIONS
1	HEATER
2	ANODE
3	SCREEN GRID
4 } 5 }	EARTH
6	CONTROL GRID
7	EARTH
8	CATHODE, SUPPRESSOR
9	HEATER

C38

Fig. 1: The circuit diagram of the TV Pre-amplifier.

indicates the number of turns required on the coils to tune to either the London or the Birmingham transmission.

TRANSMISSION	L1	L2	L3	L4
London	1½	8	8½	1½
Birmingham ..	1¼	6	6½	1¼

The coils are each wound with 32 swg enamelled copper wire, and the gap between the two windings on any one coil is 1/32 inch. The wire is held in position on the former by means of any good quality glue. The choke in the heater circuit is for the purpose of preventing any stray coupling via the heater wiring. This choke consists of 10 turns of 22 swg DSC wire wound on a ¼ inch diameter mandrel and made self supporting. This choke and its associated capacitor should be connected close to the heater pin or the valve holder. It is also important, to ensure the maximum stability of operation, that the decoupling capacitors should be of the type having mica as a dielectric.

Having assembled the preamplifier, check over the wiring, connect up to the television receiver and switch on. After allowing a few minutes to elapse for the valves and components to reach their working temperatures, turn the dust cores for maximum amplification as indicated by maximum picture brightness, or alternatively, until the amplifier becomes unstable. Then slacken off the cores, one being screwed further into the coil and the other further out of the coil. This procedure will permit a wide bandwidth to be obtained and at the same time ensure stability.

The leads between the pre-amplifier and the receiver may be of any convenient length, but the signal output lead must be of standard 80 ohm co-axial cable.

AVC Diodes

During my experimental work, I have encountered two types of AVC circuit which I believe are basically similar in operation. One has the two diodes connected together and the AVC line taken from across the load resistor, whilst the other uses the two diodes separately, one as signal rectifier and the other as AVC rectifier. Which of these two circuits is preferred for good reproduction?
T. Huxted, Louth.

The two AVC circuits in question are reproduced in figures 2 and 3. The first circuit (fig. 2) employs a single load resistor for both the diodes, and its main advantage is that it can be used when there is only one diode

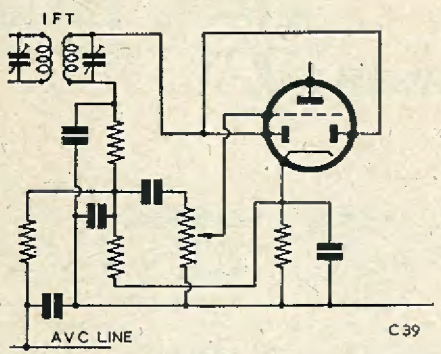


Fig 2: A single diode operating as combined signal and AVC rectifier.

available, or where it is important to conserve the number of components in the receiver. Its main disadvantage is that, as the AVC is taken directly from the diode load which is returned to the cathode of the valve, there is no AVC delay, and thus the sensitivity of the receiver is reduced on very weak signals. This disadvantage is overcome in the two-diode circuit, where the voltage at the cathode of the valve may be used as the delay voltage by returning the AVC diode load to the chassis. This arrangement is to be preferred, and is the one used in most of the better class receivers.

Fierce Reaction

The setting of the reaction control on my receiver is very critical, and at one end of the tuning range the receiver oscillates continuously. Can you recommend a cure?

L. Mead, Pinner.

The trouble here is undoubtedly due to too much feedback in the reaction circuit, and the remedy lies in either reducing the number of turns on the reaction coil or in adding some resistance in series with the coil. If the latter method is preferred, the value of the resistor will have to be determined by trial and error methods, but it should be found to be in the region of 2—20 k ohms.

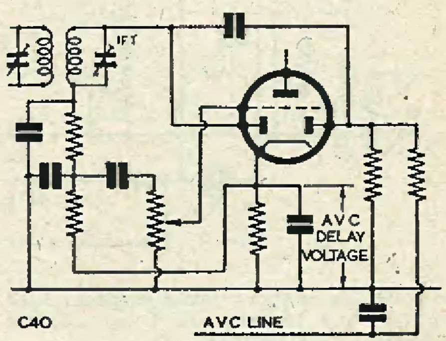


Fig. 3: A double diode arrangement operating as signal detector and AVC rectifier.

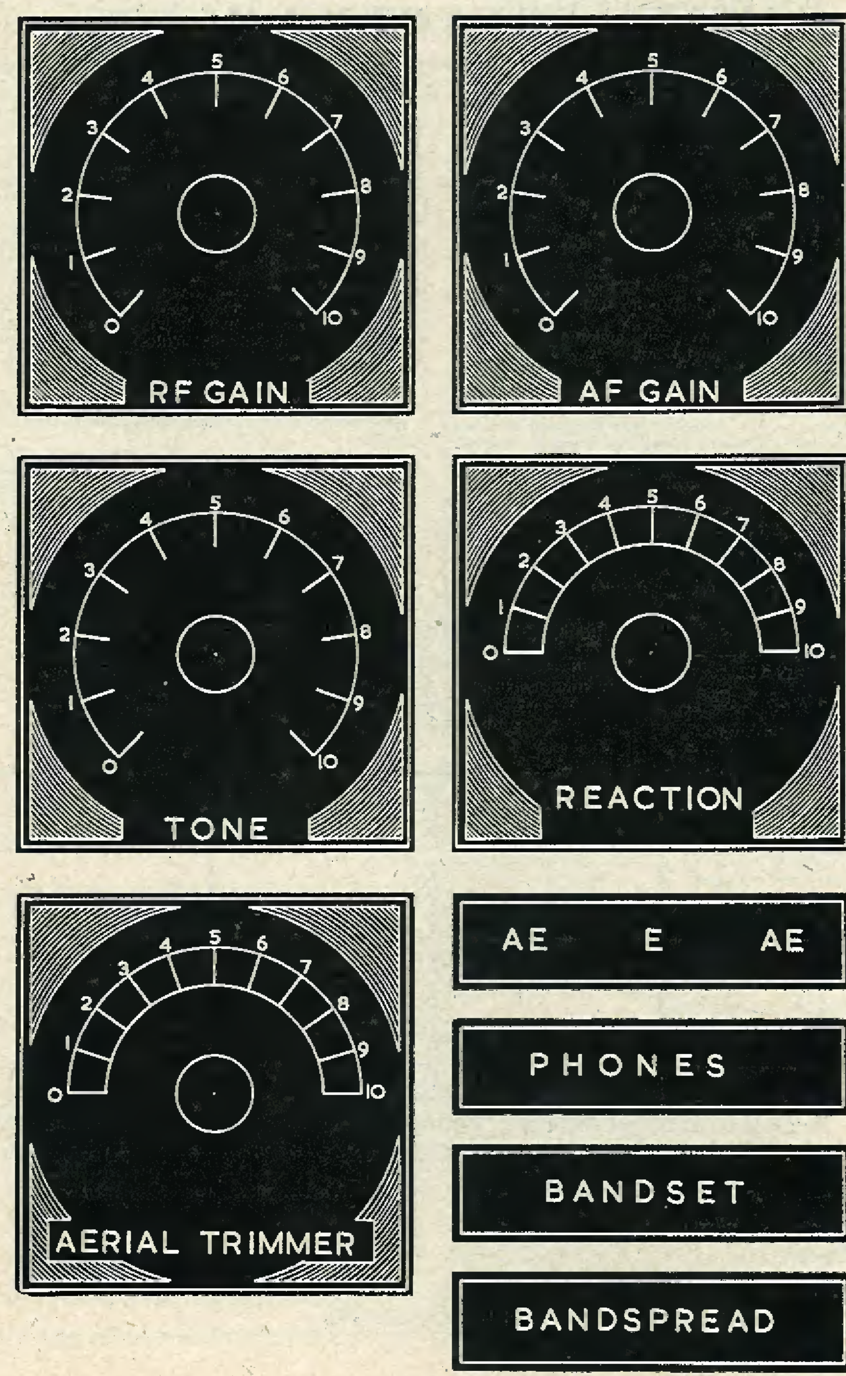
Panel Sheet No. 2

(*page* 33)

The second sheet in this series consists of a number of panel control dials and nameplates suitable for a simple superhet or straight receiver.

As suggested by Mr. Myers, of Leeds, these may be photographed and reproduced on celluloid to any required size. Alternatively, they may be cut out and pasted direct on to the panel.

In the latter case, some form of protection would be desirable. We have been experimenting on this, and the best method we found was to cover with Sellotape. This does not in any way destroy the paper or the effect, is durable, and gives a glossy finish. The outer decoration may be cut off if considered superfluous, or if a square outline is objected to, without affecting the usefulness of the dials.



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WANTED. FL8 Audio Filter. State price and condition.—Box A124.

HOSTS of valves, components, etc. for sale. Clearing out surplus wants. Send requirements for quote to R. Benyon, G3FXG, 152, Ferndale Road, Clapham, S.W.4.

WANTED. Miniature CRT and EHT transformer, suitable small 'scope.—Green, 87, Sixth Avenue, Queen's Park, London, W.10.

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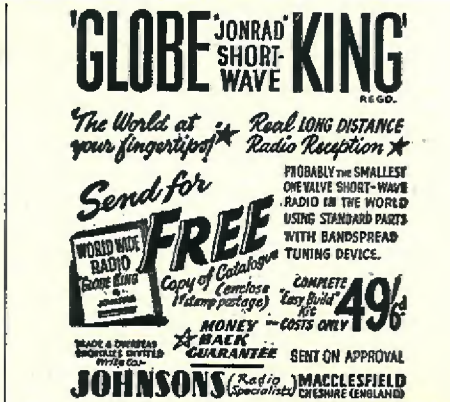

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