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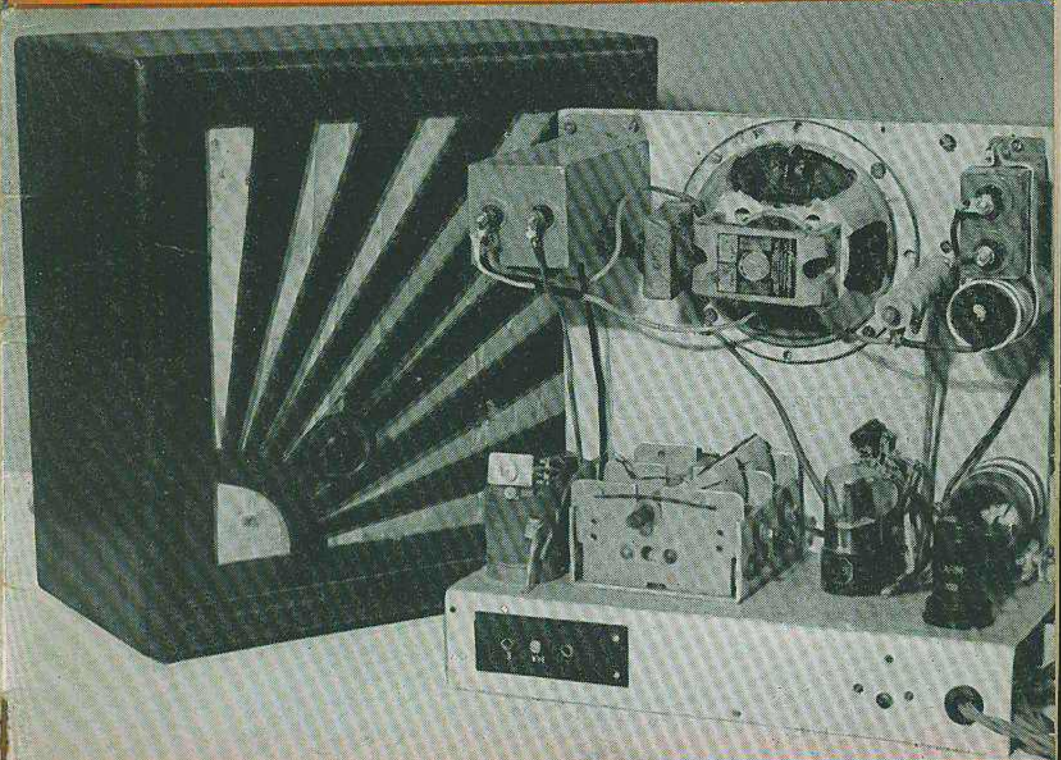
RADIO CONSTRUCTOR

for the Radio and Television Enthusiast



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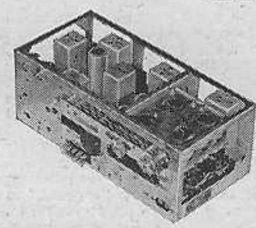
CLYDESDALE

Bargains in Ex-Services Radio and Electronic Equipment

CQ DX 2 — TRANSATLANTIC ON 2 METRES — CQ DX 2



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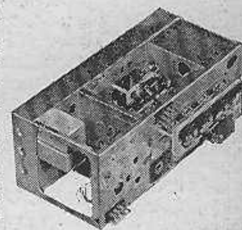

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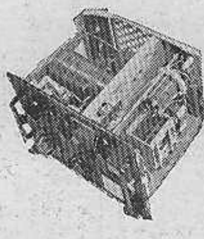

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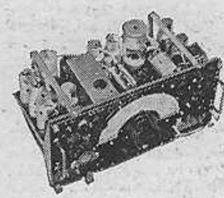

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Short Wave News

is a monthly journal which deals with all aspects of short wave radio. The constructional side describes short wave receivers, transmitting equipment, aerials, test apparatus, etc. The amateur and broadcast bands are covered in separate articles, each contributed by an enthusiast in each sphere, and there is usually an illustrated description of an amateur or commercial station. International Short Wave League activities are exclusively recorded in this magazine, and a number of competitions are run for the benefit of readers. Now in its fifth volume, Short Wave News is obtainable from local booksellers at **1/3**, or may be subscribed for at **16/-** annually.

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Radio Constructor

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EDITORIAL

Thanks

VERY many thanks to the numerous readers who have welcomed the increased size of this magazine, and have commented favourably on the new cover. We would reiterate that the improvement is due mainly to the continued support given us by the readers themselves, and to the useful suggestions sent in by them.

Aerials

It is surprising the neglect given by followers of this hobby to a most important item, the aerial. This is probably due, in large measure, to the fact that receivers today are far more sensitive, on the average, than those built in "the good old days". Consequently, signals can be received on almost any old piece of wire. But it is still true that, the better the input to a receiver, the better will be the results obtained. We ourselves have been guilty in that, during its existence, this magazine has not published any aerial articles. This is now being rectified; in this issue appears part one of a series entitled "Practical Aerials", written by a well-known transmitting amateur under the pseudonym 'Aetherium'.

With modern valves, the noise background generated in the receiver itself can now be made very low. The readability of signals then becomes determined by the noise background received via the aerial, consisting of such items as static, interference from car ignition, electrical appliances, and such things. Much of this can be eliminated, or greatly reduced, by the use of a well designed aerial, and we hope that readers will derive material benefit from a close study of these articles.

Unusual

We are sure that some of our readers must have built or experimented with apparatus which is something out of the usual run. We should be particularly glad to receive articles on subjects of this nature, and also on such items as radio control systems, magnetic and tape recording, and apparatus using miniature valves and components.

Left Out

Our apologies for the slip-up last month on the Indicator 246 Unit. This was given on the cover as being included in that issue, but was in fact left over owing to lack of room, and the cover announcement was overlooked. The article will be found on page 49 of this issue.

G2ATV.

NOTICES

THE EDITOR invites 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 draughtsmen will redraw in most cases, but relevant information should be included. All Mss must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

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 LIGHTWEIGHT MAINS TRANSPORTABLE

by T. HATTON

THE home of many a radio enthusiast contains a number of extension loudspeakers, all of which are operated from one main receiver. This gives a very poor choice of programme, and is, generally speaking, rather inconvenient. The easiest way of overcoming this difficulty is to build a complete receiver into one or more of the extension speaker cabinets.

This, if the speaker happens to be a large antiquated model, is not too difficult. In this respect, it is unfortunate that the general trend of modern design is towards smaller and more compact apparatus. Extension speakers are normally quite small affairs — certainly less than a foot square and 6″ deep, and this makes the inclusion of a receiver rather a difficult matter.

Most constructors avoid any such attempt because of the difficulty of fitting the requisite number of components into the relatively small space available round the speaker. The only answer to this problem — short of midget components — is to remove the original speaker and fit a smaller one. The average size of extension speaker cabinet is about 11 × 11 × 5 inches, and it houses a ten inch speaker. However, the six or eight watts that such a model can handle is much more than that required for normal room listening. Few commercial receivers use a speaker as large as this, and many only use six inch types. In this modification, a five inch mains energised speaker was easily fitted into the space available, and by such a choice, the weight has been kept down to very reasonable proportions. The final weight, using several ancient components (the tuning capacitor weighed nearly 2 lbs. !), was less than 10 lbs.

No mains transformer was used, the heaters being supplied via a series capacitor from the mains. The mains energised speaker may be replaced with a permanent magnet speaker and a separate LF choke, rated at 35 mA, 8 or more henries. It is preferable to use the former, since the total weight is less than if the two separate components are used. The valves used are cheap, and easily obtainable at present.

Circuit

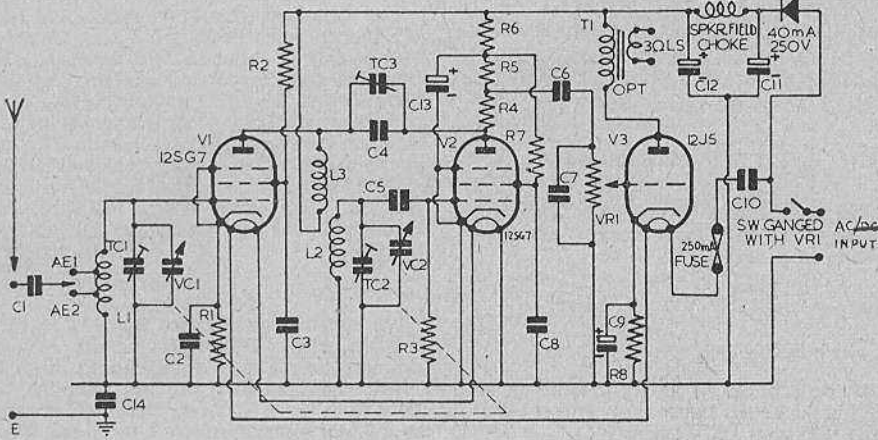
The circuit used is shown in figure 1. Two alternative tappings are necessary on the aerial coil, to suit different aerials. A long aerial is liable to cause the Home Service to break through into the Light Programme unless it is used on the lower tapping. Incidentally, it is not permissible to omit C1 or C14, since this would not conform with the condition on the back of the wireless licence referring to 'a direct connection between the aerial and the mains supply'.

V1, the RF amplifier, is tuned by VC1, which is ganged to VC2, with parallel trimmers TC1 and TC2.

The RF amplifier is transformer coupled to the tuned circuit feeding the leaky-grid detector. A semi-variable amount of regeneration is supplied by means of the reaction trimmer TC3, via the coupling transformer. The detector is resistance/capacity coupled to the output triode, via a conventional volume control (VR1.). The leads hereabouts should be kept as short as possible, since they are capable of introducing considerable hum into the output. The bias decoupling capacitor C9 should be made 50 or 75 μF if this is available,

The cover illustration

shows the Mains Transportable Receiver, alongside the Cabinet, as constructed by the writer of this Article.



C38

Fig: 1: Theoretical circuit of the transportable receiver.

List of Components:

R1, 200 Ω $\frac{1}{4}$W
R2, 25 k Ω $\frac{1}{2}$W
R3, 1 M Ω $\frac{1}{4}$W
R4, 6, 25 k Ω $\frac{1}{4}$W
R5, 82 k Ω $\frac{1}{2}$W
R7, 250 k Ω, $\frac{1}{2}$W
R8, 500 Ω $\frac{1}{2}$W
VR1, 1 M Ω pot with switch
C1, 0.01 μF 350V
C2, 0.1 μF 150V
C3, 8, 0.1 μF 350V
250 mA fuse and holder
5″ mains energised speaker
250V 40 mA HT Rectifier

C4, 100 pF 500V
C5, 300 pF 350V
C6, 0.1 μF 500V
C7, 500 pF 350V
C9, 25 μF 25V elect.
C10, 2 μF 600V paper
C11, 8 μF 450V elect.
C12, 24 μF 350V elect.
C13, 16 μF 350V elect.
C14, 0.01 μF 500V paper
TC1, 2, 3, 70—100 pF trimmer
VC1, 2, 2—gang 500 pF
80 : 1 Output transformer
V1, 2, 12SG7
V3, 12J5

as the degeneration attendant on the use of automatic bias will then be reduced.

The output valve used is a 12J5, which is the 12 volt equivalent of the 6J5. Admittedly, this is intended to work as an LF amplifier, not as an output valve, but the results obtained fully justify its use. The most suitable value of output transformer appears to be about 80 : 1. This is not a critical match, and may be varied if it is inconvenient.

Heaters

The heater arrangement is a method becoming increasingly popular today. Rather than use a series resistor to drop the mains voltage to a suitable value to heat the valves at the current required, the necessary voltage drop is obtained by an impedance. This takes a leading current from the AC supply, and the average product of the current and voltage is — in the perfect case — zero. That is, although there is a PD across the terminals of the capacitor, and a current is flowing through it, no power is being used up. In the case of the capacitor shown in series with the valve heaters in the circuit diagram (C 10), the power consumed is merely the power required to heat the valves in the normal way. In this case, this is about 6 watts, and no power is wasted in the voltage dropping, as compared with 40 watts dissipated in the heater chain of a similar AC/DC set.

The calculation to determine the value of C10 may be made in the following manner :—

Let V_s be the supply mains voltage at 50 cps.

V_v be the total heater voltage required.

and I_h be the heater current. This must be the same for all the valves used. Then,

$$C = \frac{3{,}180 \quad I_h}{\sqrt[2]{V_s{}^2 - V_v{}^2}} \text{ (microfarads).}$$

In the present case, V_s is 230 volts, V_v is 39 (12.6 volts for each valve heater), and I_h is 0.15 amperes.

$$\text{then } C = \frac{3{,}180 \times .15}{\sqrt{230^2 - 39^2}} = 2.1\ \mu F$$

which is approximately 2 μF.

Such capacitors can never be electrolytics. They should be the paper type, and rated at, at least, 600 volts DC working.

A breakdown in this component may damage the valves, so it is advisable to use the best obtainable. As will be seen from Fig. 1, it is advisable to include a 250 mA fuse in the circuit to safeguard the valves in the event of accidents.

The HT is supplied by means of a metal rectifier, rated at 250 volts, 40 mA. This may easily be bought as government surplus at present, for a few shillings, and may be recognised by its absence of cooling fins. It is usually painted grey.

Coils

The coils used were home made, and tune, in conjunction with a 500 pF 2-gang capacitor, a wave-range of about 220 to 510 metres. The individual inductances required are: L_1—130 microhenries, L_2—120 microhenries, L_3—30 microhenries. The winding details are as shown in the sketch (Figure 2), using 24 gauge wire, preferably double silk, or silk and enamel, covered, although any normal type of insulation will be satisfactory. When finished, the windings should be varnished to hold them in place.

Construction

The speaker cabinet used was 11¼″ square, and 5½″ deep. This seems to be a fairly common size, and the dimensions may be varied within an inch or two, although the depth must be at least five inches. These are the internal measurements of the case. Once these internal measurements have been made, a piece of wood about ¼″ thick must be cut to the dimensions of figure three. This also indicates the positions of the larger components on the panel, which is formed by the piece of wood cut for figure 3. It also shows the positions of the holes required to bolt the receiver chassis on to it, and the hole for the loudspeaker. This must be marked out on the centre shown for it with a pair of compasses; radius=2 3/16″.

The small receiver chassis fixed to the bottom of the wooden panel accommodates the valves,

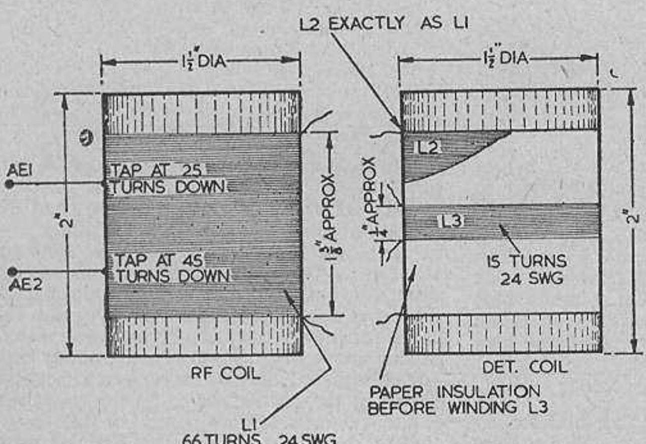


Fig. 2: Details of coil construction

C39

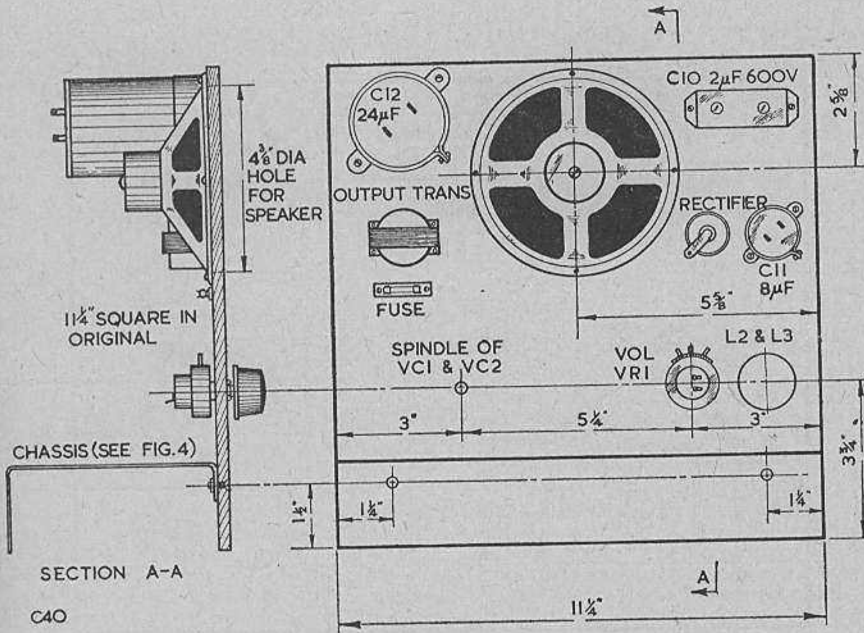


Fig. 3: Alternative Panel Layout to that shown on Cover.

tuning capacitor and all the other components except those of the power pack, which are built round the loudspeaker on the upper portion of the panel.

This chassis is constructed from 18 swg sheet aluminium, which should be cut and drilled before the two sides are bent down.

The sides which are bent down, as shown in figure 4 by the dotted lines, comprise the front and back. The smaller side is bolted on to the wooden panel with two 4 BA countersunk bolts, with the nuts on the metal side of the joint.

With regard to the actual wiring up, it is only necessary to ensure that the leads to the volume control are as short as is possible, and screened. The mains input lead should be passed through the hole provided for it, and wound round with insulating tape to increase its diameter, and prevent any internal connections taking the strain of the inevitable pulls and jerks on the flex. Leaving a short length of slack, one lead should be soldered to a solder tag bolted to the chassis, and the other passed through a grommet lined hole in the chassis, to the switch on the back of the volume control. It is usual, where one side of the mains is connected to the chassis, to provide a double pole on/off switch to guard against shocks.

However, since there are no external metal pieces on this set (even the knobs had deeply sunk grub screws) a single pole switch was used. It is only necessary to handle the receiver with due respect when it is out of its cabinet, as is necessary when working on any AC/DC type of set.

Alignment

When the set has been checked for possible mistakes in the wiring, it should be switched on, and a station tuned in. This should be possible, provided that the volume control is at maximum, even if the reaction is in the wrong direction, and tending to weaken the signal. If the set cannot be persuaded to oscillate, note whether an increase in the capacity of TC3 increases the volume of the signal, or decreases it. If the volume is decreased, then the connections to L_3 must be reversed.

When this has been done, it should be possible to make the receiver oscillate. If not,

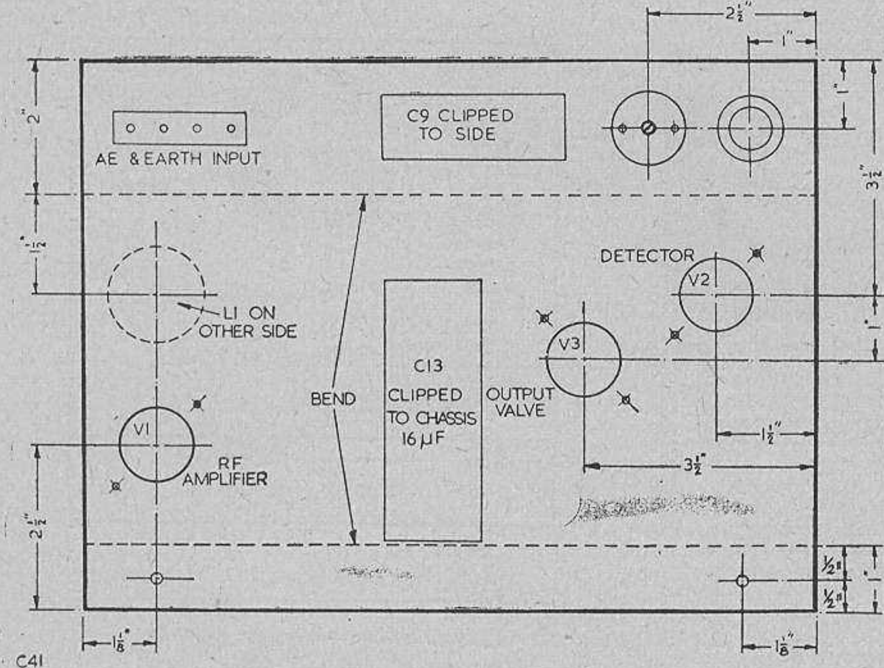


Fig. 4: Details of chassis layout

four or five extra turns should be added to L3. If too much reaction is present, and the set howls steadily, four or five turns should be removed. If this still does not cure the trouble, the lead from TC3 and C4 should be tapped halfway down L3.

Assuming that a station has been tuned in, it is then necessary to trim TC2 and TC1. On the Light Programme, the tuning control should be adjusted in conjunction with TC2 for the loudest result, with the reaction control well advanced, but out of oscillation. The reaction control (TC3) should be adjusted just out of oscillation at the high frequency end of the waveband — i.e., the tuning capacitor vanes out of mesh.

Then the trimmer TC1 should be adjusted for maximum response in conjunction with the tuning capacitor, on the 464 metre channel of the Third programme (not for aesthetic reasons, but because it happens to be a suitable frequency for the trimming).

Alignment of this receiver presents no difficulties to the beginner, and the original was adjusted and stowed into its cabinet within twenty minutes of completion. It is advisable, since no reduction drive was used for the main tuning capacitor control, to use a fairly large diameter knob for the two panel controls, of about two inches diameter. The tuning is quite sharp, and becomes difficult if the knob is too small.

Normally, the receiver is used in a bedroom, where low to medium volumes are usually needed, although it has served a period of use in a living room, where everyone talks at once, with the wireless supplying a noisy background.

The set works with adequate gain on an aerial nine feet long, but on large aerials, it will be found necessary to use the AE2 terminal, since the Home Service breaks through into the other programmes slightly. The power consumption is far better than most receivers, being approximately 13 watts.

A Theoretical and Experimental Study of

SILICON DETECTORS

(Reprinted by kind permission from the l'Union Belge des Amateurs-emetteurs journal "QSO" March, 1950).
Translation by P.F.S.

At high frequencies, electronic valves present a great problem and inconvenience, due to two major factors. Firstly, the capacity between cathode and anode, which becomes troublesome from about 100 Mcs. upwards, and secondly the electron transit time, which, upon reaching the maximum frequency, annuls the valve's effect as a detector. These difficulties disappear with the Silicon detector, and the contact between the Silicon and tungsten assures a satisfactory stability for a long period. The author's information is obtained from the study of American and German Silicon detectors. It may be demonstrated by means of the Oscilloscope that the characteristic of the crystal, being represented by an 'angular trace' with a long side for positive polarisation and a short side for negative polarisation, has a resistance in the forward direction of from 15 to 40 Ω and for the 'long side' (or reverse direction) 500 to 100,000 Ω, the point of intersection on the axis of the abscissae being of the order of 0.15 to 0.35 volts. The age of a crystal can be observed by a falling off in the reverse resistance. Good specimens may last for several years.

The impedance of the crystal can be represented, to a few Mcs. by a resistance shunted by capacity.

Actual impedance measurements are made "*in situ*" by the method of substitution and injecting an alternative signal of several millivolts. The self capacity of 1 to 3 pF gradually diminishes as the negative polarisation is increased. The characteristics of detection may be restored by the use of a high frequency generator of 30—100 Mcs. The 'goodness' of a crystal is checked by reference to a suitable standard crystal, which has previously been chosen for its high efficiency.

The properties do not vary appreciably between 30 and 100 Mcs. To measure the impedance of the crystal at 3,000 Mcs. (radar frequency) a co-axial line with a resonant cavity is used, fed by a generator across an attenuator. The detector is placed at the termination, while the line is short circuited. A separate measurement is made of the impedance of the contact and support of the detector, then the capacity and inductance of the cartridge, with the crystal removed. The resistance is measured to ± 2 Ω.

The output is deducted from the power measured with a bolometer (with an accuracy of ± 1.5 dB) and the corrected power is measured with an RF Wattmeter, an absorption Wattmeter, or a Bolometer. The output ranges from 3.5 to 5 volts for a normal crystal and in most cases the measured output is found to be higher than the calculated output.

A new theory has been developed, giving the crystal a more detailed representation figure, where the resistance is replaced by a complex quantity. From the table of measured values, it is found that when the ratio of the impedance varies from infinity to 0.2, and the ratio of the input from 100 to 20%, the output diminishes from 100 to 1.2%. The complex impedance is then represented by a circle. In order to obtain a similar output from an electronic valve, a spacing between anode and cathode of about 0.1 mm. would be necessary! In actual fact, on a frequency of 104 Mcs. for an efficiency of 10%, the spacing would be less than 0.1 mm. Such diodes would be far more expensive and more cumbersome than the crystal. Crystal triodes have recently become available under the name of 'transitor' or 'transistron'. These elements are thought by many to be of some use at VHF but, actually, they only function from 10 to 100 Mcs.

Among the disadvantages of the crystal triodes it is necessary to note their fragility, and their liability to deteriorate if too high an input is applied to them; also, the output varies with the ambient temperature.

The greatest disadvantage of all is the noise level, which is far higher than that of a good electronic diode.

Amplifying Intercom Systems PART 2.

by J. R. DAVIES

LAST month we dealt in some detail with the principle of modern intercom systems and considered the workings of a typical amplifier which could be used for this sort of work. This month we shall discuss and examine the pros and cons of the various switching and calling circuits which may be employed.

Simple Switching Circuits

Fig. 1 shows a very simple switching circuit for use with one master unit and five remote stations. (For convenience we shall often refer to the remote loud-speaker units as "stations", and their users as "operators", for the remainder of these articles). It will be seen that, although simple, the circuit is quite practicable. The facilities offered are similar to those found in some commercial models.

When he requires anyone, all that the operator at the master station needs to do is to switch in whichever remote station he wants and call the operator by putting his Talk/Listen switch to "Talk" and speaking into his own loud-speaker. More than one station may be called at the same time, if desired. It will be seen that the various stations all have a common lead—that connected to the amplifier chassis—and that all switching is carried out in the other lead alone.

Fig. 1 shows the simplest circuit possible for a loud-speaking intercom. It suffers, however, from one disadvantage. Owing to the fact that their speakers cannot be switched off by the remote operators it is possible for the master station operator to switch on any speaker he wishes and listen to any private conversation that may be taking place near that particular station without the persons conversing being aware of the fact. It is therefore sometimes advantageous, in the interests of privacy, to fit on/off switches to the remote stations.

When, however, the remote speakers are

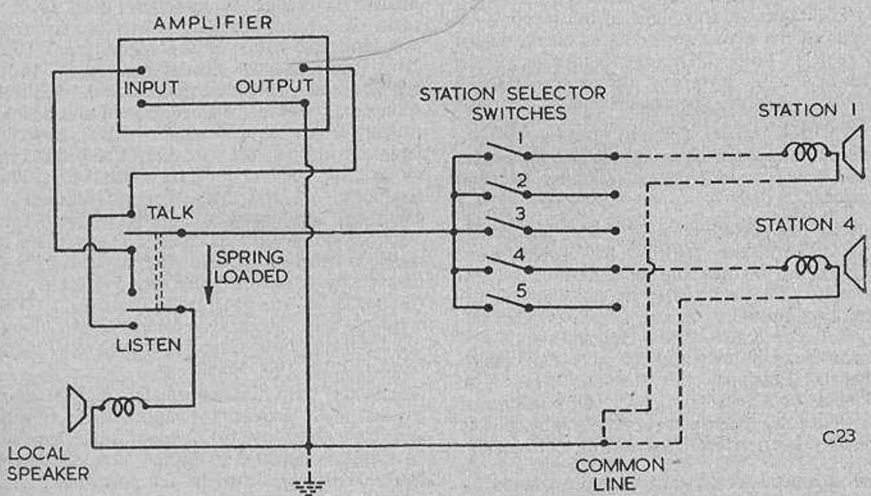


Figure 1. *A very simple switching system. Stations* 1 *and* 4 *are shown connected to the master unit.*

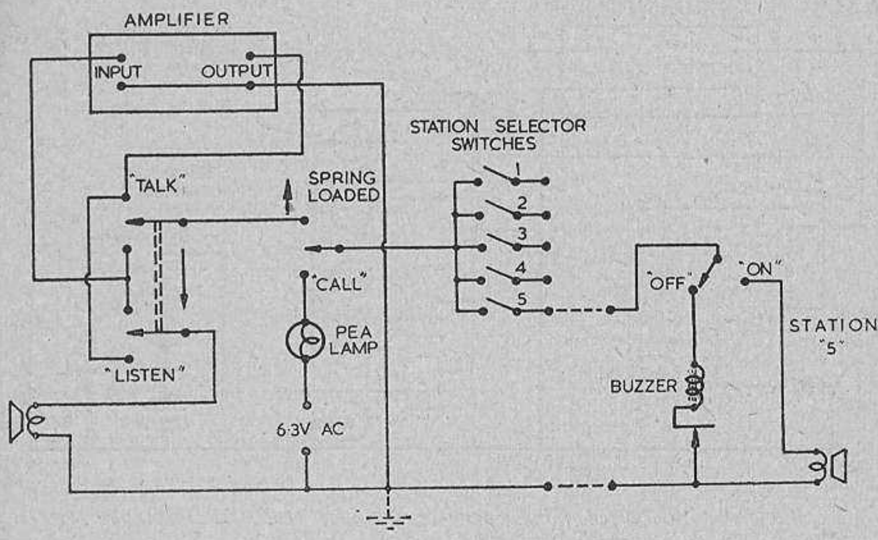


Figure 2. An improvement on Fig. 1 in which it is possible for the remote stations to switch off their speakers.

switched off, it then becomes necessary to incorporate into the circuit some method of warning (such as a buzzer, bell or lamp) to indicate to a particular operator that he is required.

Fig. 2 shows how this facility may be provided without entailing any additional wiring between the remote stations and the master unit. At each station an on/off switch is provided which, in the "off" position, connects the lines to a warning device (in this case, a buzzer). In the master station a second spring-loaded switch is provided which, when pressed, operates the calling device on the particular station chosen by the Station Selector Switches. When the spring-loaded switch is put to the "Call" position, the remote station is disconnected from the Talk/Listen switch circuit and connected, in series with a pea lamp, to a source of low voltage supply, thus operating the buzzer. The source of supply could very conveniently be the 6.3 volt heater supply in the amplifier itself. The pea lamp is put in circuit to limit the current and prevent any damage to the remote loud-speaker should this be switched on when the "Call" signal is being sent. To check that the current is limited sufficiently to avoid damage to the remote loud-speaker it is advisable to check the DC resistance of the voice coil (which, at 50 cps, will be only slightly smaller than the impedance) and work out the power that would be developed across it by the calling signal. To take an example, should the DC resistance of the coil be 3 ohms, then a pea lamp which limited the current to 0.3 amps., would allow a power of only about 1/3 of a watt to be developed. The risk of damage to the speaker would then be negligible. If it is so desired, the pea lamp may be mounted on the panel of the main amplifier unit. As it will usually brighten when the remote speaker is switched on it may give a visual indication that the remote station is operative. Usually, however, it should be sufficient to give the remote station a couple of buzzes whereupon he will switch on and answer normally.

The circuit of Fig. 2 should prove quite useful for most cases. However, in certain installations it may be necessary for the remote stations to call the master unit as well. This facility is not provided in the circuit of Fig. 2. The additional calling circuit could be added by installing an extra lead between each remote station and the master unit. The additional circuit could then be powered by the 6.3 volt heater supply previously used.

However, if it is possible to use the existing two leads, this extra wire is wasteful. Fig. 3 shows a better alternative. In this diagram,

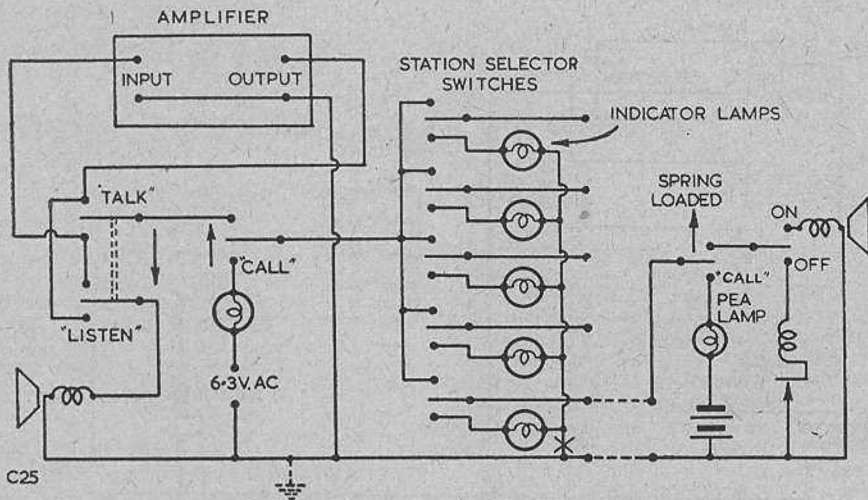


Figure 3. Showing how the remote stations may "call" the master unit.

each remote station has, in addition to its on/off switch, a spring-loaded "Call" switch which, when pressed, connects a battery, in series with a pea lamp (again for limiting the current) to the external leads travelling to the master unit. An additional contact has now been added to the Station Selector Switches so that, when they are switched off, they connect the remote leads to indicator lamps. Thus, pressing the "Call" switch at a remote station causes a corresponding lamp to glow at the master unit. The pea lamp in series with the battery is necessary to limit the current which would flow if the Station Selector Switch were put "on" whilst the call button is being pressed: otherwise an excessive current might be passed through the microphone transformer primary. The batteries in the remote stations should last for a considerable length of time since they will only be used for short periods of time. They may, of course, be replaced by bell-transformers, or by some similar trouble-free source of voltage, if desired.

Should it be desired to have an audible warning in the master control unit, a buzzer may be connected into the circuit at the point marked X on Fig. 3.

On examining the warning systems mentioned above it may be seen that the warning buzzers (or bells) have to work from fairly low voltages. However, a good quality buzzer will operate quite well from a pressure of about 2 volts or so; although this may be beyond the capabilities of a cheap or poorly-made model. This point should be borne in mind when the intercom system is being constructed.

More Complicated Systems

Up to now we have considered the simpler methods of providing amplified intercom between various stations. These are well suited to meet most requirements and, indeed, those of Figs. 2 and 3 provide facilities not always encountered in some of the commercial models.

However, the demands of certain installations will necessitate the construction of more versatile and complicated systems. In many cases, in particular, it would be extremely useful if it were possible for any station to call another station without using a master unit at all. That is to say, every station would be provided with a set of selector switches by means of which he could call any other station he required and hold an amplified conversation with him.

A simple way of doing this is to provide an amplifier at every station. (This is, admittedly an expensive course but it is, nevertheless, worthy of a small amount of attention). Each station is then fitted up as a master station, such as is shown in Fig. 2, the only alteration being that, when a station is called, an additional Normal/Receive switch is put to "Receive", thereby connecting the loudspeaker of that station across the particular line which is calling. The calling station then uses his amplifier and his Talk/Listen switch whilst the receiving station simply talks or listens without touching anything. Fig. 4 shows the general idea for a system with five stations.

It will be seen that the connecting lines between the stations consist of five leads plus the common "earthy" line. If we assume that the station shown is Station No. 2, there the Normal/Receive switch is connected to line No. 2 only. Only four selector switches will be needed, these being connected to lines 1, 3, 4 and 5. The working of the system may be understood if it is appreciated that, should Station No. 2 wish to speak to Stations 1, 3, 4 or 5, he switches on to their particular line. If they wish to speak to him they connect up to line No. 2. When the conversation is completed the Normal/Receive switch on the station which was called should be returned to "Normal".

A buzzer warning for calling purposes is also incorporated. When the Normal/Receive switch is in the "Normal" position, a buzzer is connected across the appropriate lines (as was done in the remote station of Fig. 2). On putting the switch to "Receive" the buzzer is disconnected and the speaker connected in its place. The speaker is also, by this operation, disconnected from its own amplifier. Should the switch be inadvertently left in the "Receive" position it will, of course, still be possible to call the required station by speaking to him over his loudspeaker. The Normal/Receive switch carries out more or less the same job as the On/Off switch on the remote station in Fig. 2.

Using One Amplifier

However, it will prove very expensive to provide an amplifier at every intercom station, and it would be extremely advantageous if one amplifier could be used for the whole system.

Fig. 5 shows one way of doing this. The input and output leads of the amplifier are run through the entire installation. As they run alongside each other the input lead must be screened to prevent feed back.

The principle of the system is extremely simple. Two stations (No. 5 and No. 2) are shown in Fig. 5. If Station 5 should require Station 2 he presses the No. 2 call button. (The call wiring is an entirely separate circuit to the speaker wiring). On hearing his buzzer No. 2 puts his switch to "Talk", thereupon connecting his speaker to the amplifier input. No. 5 then replies and conversation is established.

There are several snags to this arrangement. In the first place, there is no privacy on the line since anyone may switch on and listen to the conversation. Secondly, the necessity of using a screened lead puts up the cost of the installation. Thirdly, and most important of all, it is necessary for both No. 5 and No. 2 to operate their Talk/Listen switches together; that is to say, when No. 5 wishes to speak to No. 2 his switch must be at "Talk" whilst that of No. 2 must be at "Listen"; when No. 2 wants to reply both he and No. 5 must change

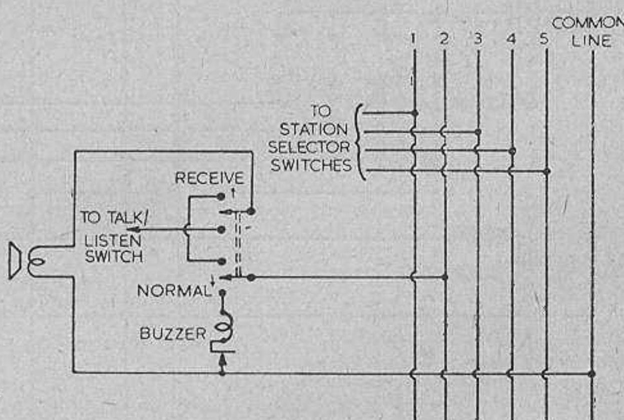


Fig. 4: A system whereby any station may call another. Station No. 2 *is shown in the diagram.*

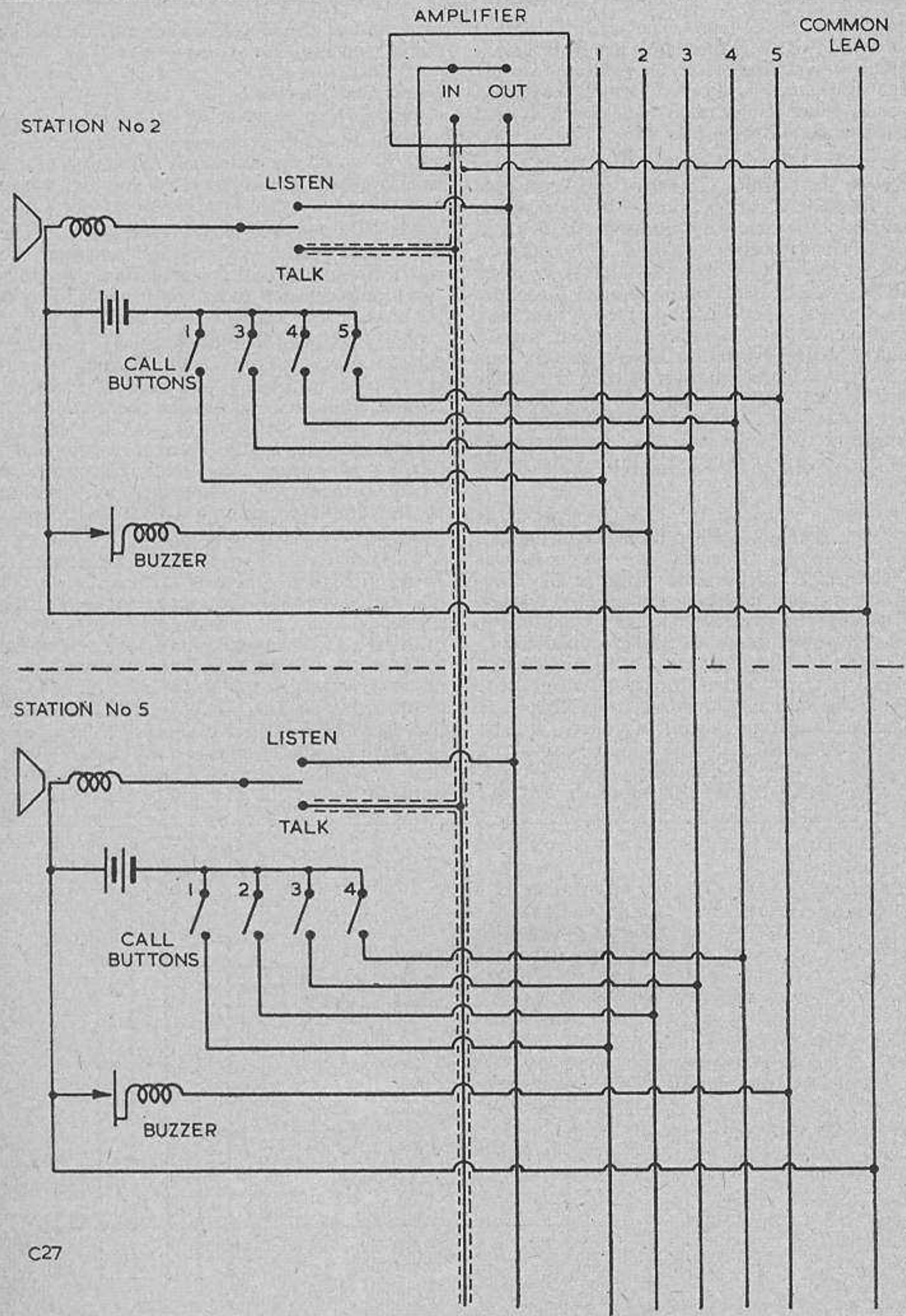


Figure 5. A system in which any station may call another, and using only one amplifier.

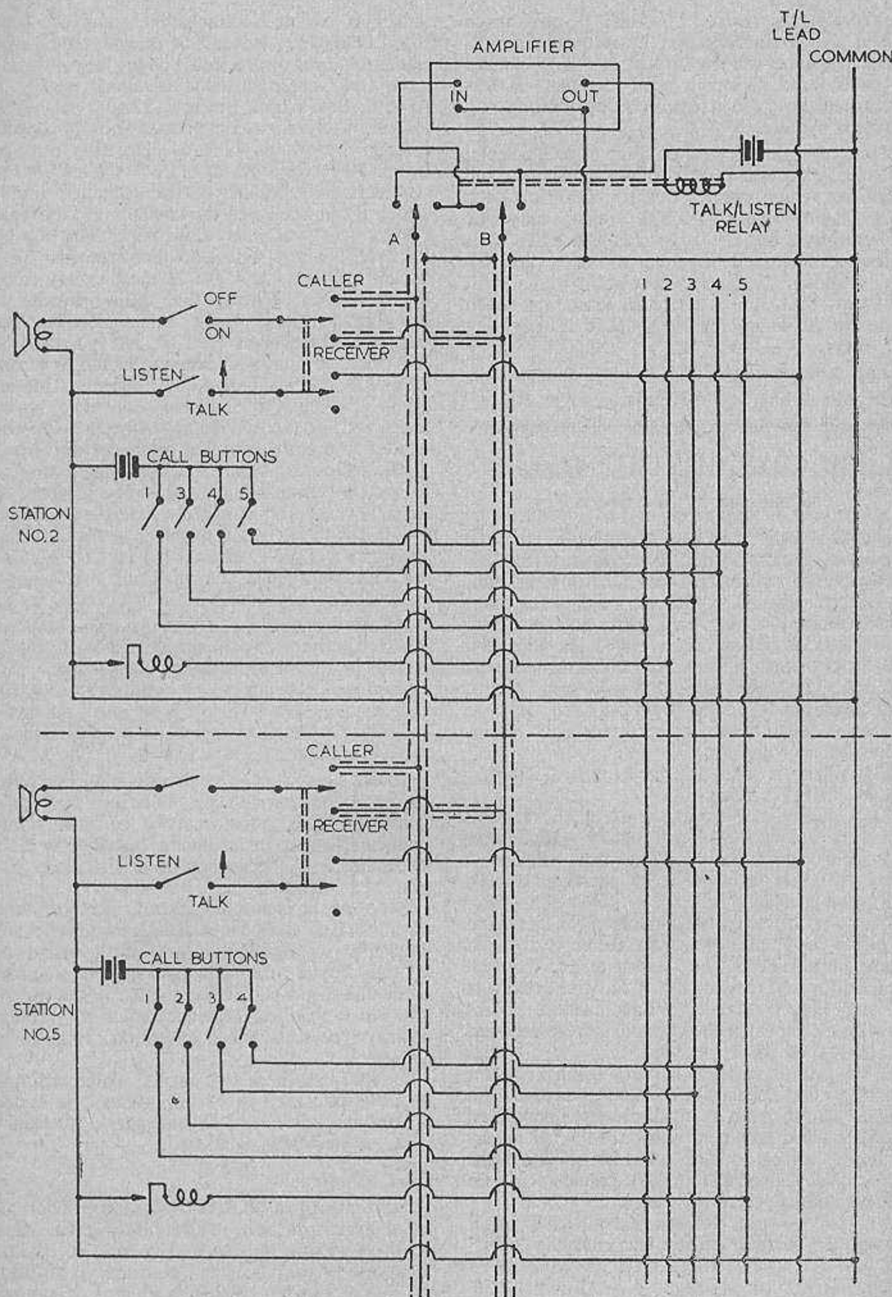


Figure 6. An improved version of Fig. 5.

their switches over. This last disadvantage would make conversation extremely difficult, and for this reason the circuit of Fig. 5 cannot be considered as being really useful. It has nevertheless served its purpose by introducing the next system.

To make the circuit of Fig. 5 practicable, all that is needed is to provide a relay at the amplifier which carries out the function of a Talk/Listen switch. (The relay may be powered by a battery or by rectified AC. This point is discussed in next month's article). Fig. 6 shows the improved circuit and it will be seen that an additional lead has been added to the wiring for the purpose of operating the relay.

The calling circuits in Fig. 6 are the same as those of Fig. 5. However, insofar as the amplifier circuit is concerned, there are some slight changes. Instead of one screened input lead and one unscreened output lead, we now have two screened leads labelled, in Fig. 6, A and B. When Station 5 now wishes to call Station 2 he again presses the appropriate calling button, as before. He also puts his Caller/Receiver switch to "Caller". This connects his speaker to the screened line A which is connected to the contacts on the Talk/Listen relay at the amplifier. The Caller/Receiver switch will also connect his Talk/Listen switch to Talk/Listen relay coil. When Station 2 hears the calling buzzer he switches on and puts his Caller/Receiver switch to "Receiver"; (if it isn't already in this position). He is then connected to screened line B, but his Talk/Listen switch is inoperative. When the Talk/Listen relay is not energized, its contacts allow line B to be connected to the input of the amplifier and line A to the output. Station 5 is therefore connected to the output and Station 2 to the input of the amplifier. No. 5 can then listen to whatever No. 2 has to say, and, when he wishes to speak he puts his Talk/Listen switch to "Talk", himself, thus energizing the relay and reversing the connections to lines A and B.

Apart from the fairly high initial cost of installing the two screened leads, the circuit shown in Fig. 6 represents a very useful intercommunication system capable of giving excellent results. However, it is by no means entirely perfect and it might be advisable to study the defects in its working.

In the first place, any station may listen to a conversation carried on between two other stations. This point will be of little consequence in most installations but it may be of importance if the intercom is fitted up in a place of business.

Secondly it is not foolproof. In the hands of a hurried man or a flustered female who used the wrong switch on being called up, it might waste time or tempers. For instance, if the called-up station operator, say, accidentally put his Caller/Receiver switch to "Caller" it would be impossible to contact him on his speaker.

Apart from these two faults, which will only be of importance in certain cases, the system is very workable and should prove invaluable when it has been installed.

Next Month

Next month we shall consider a more complicated system which, while offering the same facilities as that shown in Fig. 6, also ensures complete privacy between stations, in addition to being entirely foolproof and extremely simple to operate.

RADIO CONSTRUCTOR '*Quiz*'

Conducted by W. Groome

(1) By very careful adjustment of the frequency control, Mr. Brain found that his TV picture, which had been rolling up and down the screen, could be held stationary. Unfortunately, it was then split; the "bottom" two-thirds of the picture were at the top, and the "top" portion was at the bottom of the screen. The shift control would not cure it, and attempts to re-set the frequency or hold controls caused the picture to roll again. What was wrong?

(2) What is the action of the "Ringing Choke" EHT circuit?

(3) Usually, the tuning coils of short wave receivers are wound with heavy gauge wire in order to achieve maximum efficiency. Why, then, are the coils of TV receivers wound with fine gauge wire?

(4) A commonly used method of applying negative feedback to an amplifier is to feed from the anode of the output stage, through a capacitor and resistor network, to the cathode of an earlier stage. What audible effect would you expeet if the capacitor were reduced to about 0.05 μF.?

(5) A circuit which was very popular a few years ago was the cathode follower as an audio output stage, and it undoubtedly produced excellent results when compared with many ordinary anode-loaded circuits. What are the disadvantages which have caused it to be less popular in recent years?

(6) If you use an earthed-positive EHT supply, the rectifier anode becomes the "hot" end and it is from there that the voltage is taken. Right or wrong? *Answers P.50*

SURPLUS RADIO EQUIPMENT

DESCRIBED BY B. CARTER

In this series of articles it is intended to describe units that have (a) immediate application, after some modification perhaps, in the amateur world, and (b) to list the contents of those units that can best become sources of valuable components. This month's unit comes under category "B".

INDICATOR UNIT TYPE 246 (10QB/6322)

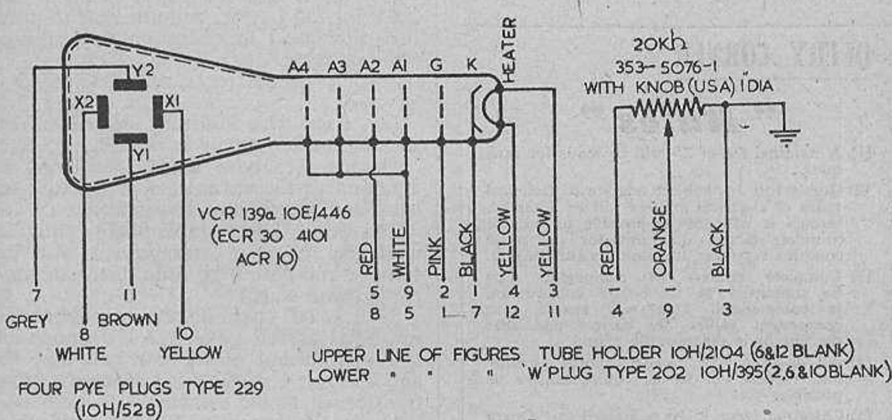
This unit consists of a small "extension" cathode ray tube which enables the business end of a remotely positioned indicator unit to be brought close to the operator with the minimum amount of space consumption.

The large size indicator unit is modified by removal of the CRT and masking the tube hole with a plate. To the latter is fitted a "W" plug similar to that fitted to this unit, and the plate may also carry the corresponding four Pye plugs if the supplies they carry originate in the large unit. A 12-way connector and four separate coaxial cables then connect the units. The screen graticule is for range work, and is similar to that used on the 1D15/APA—1 indicator.

To remove the tube, take off the top and sloping back, which are in one piece, then press and twist the cowl—which is fixed bayonet fashion—and ease off. Next, gently force the spigot of the tube base out of the holder whilst supporting the tube face with one hand. The service instruction of "gently rotating and pulling the tube" usually results in the glassware coming away from the base, through age.

To replace the tube, it has been found beneficial to dampen the inside of the rubber rim before placing the tube into the cowl.

The tube socket rotates slightly, so that the deflection electrodes may be aligned in relation to the horizontal and vertical axes.



CIRCUIT DIAGRAM—INDICATOR UNIT TYPE 246
10 QB/6322

TRADE REVIEW

FLEXIBLE DIPOLE INDOOR TELEVISION AERIAL

The latest Television Aerial to be marketed by E.M.I. Sales and Service, Ltd., is the Flexible Dipole, an indoor Aerial possessing many features of special interest.

EFFICIENT RECEPTION. The Flexible Dipole is a full sized Television Aerial and when used in areas of good field strength will give results comparable with those obtainable with a standard aerial. Flat flexible conductors with polythene insulation form the elements of the Dipole.

ADAPTABILITY. The majority of Television Receivers work equally well with this Aerial. Coaxial feeder cable is used to couple the Dipole to the Receiver via a specially designed transformer rejector, incorporated to provide correct coupling of the Aerial to the feeder, thus ensuring stability and freedom from reflections.

EASE OF INSTALLATION. An outstanding advantage of this Aerial is the ease with which it may be installed as the special fixing tacks supplied enable it to be fitted to a window or door frame in a matter of minutes.

INCONSPICUOUS APPEARANCE. The novel construction of the E.M.I. Flexible Dipole enables it to be readily concealed by curtains, carpets, etc.

LOW PRICE. The price is 25/- complete with 24 feet of coaxial feeder.

The Flexible Dipole is available in two versions:—
Model T.1091 for the London frequency;
Model T.1092 for the Midlands frequency.

Query Corner

Owing to circumstances beyond our control, this feature has had to be omitted this month, but will be resuming in the next issue.

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.

Answers to Quiz

(1) "Sync" was feeble or missing entirely. Mains "hum" was getting to the time base and applied a weak hold when the frequency control was set critically at 50 cps., but as it was not in phase with the picture the frame began and ended either too soon or too late. The sync. separator should be improved. In a fair reception area, both line and frame should hold over a quarter turn of the frequency controls (assuming the usual 2 Meg Ω transitron control).

(2) An output tetrode, loaded with a choke of suitable design in its anode circuit, is "switched" by a positive-going sawtooth pulse derived from the line time base, which is applied to the grid. During the positive-going stroke, the valve conducts and the current in the choke rises, but at the end of the stroke the grid becomes suddenly negative. The sharp cut-off causes the anode circuit to oscillate, and a high alternating voltage is generated. This is rectified by a small valve which obtains its heater supply from a winding coupled to the choke.

(3) In TV receivers, losses have to be deliberately (but carefully) introduced into the tuned stages in order to obtain the required bandwidth. The use of fine gauge wire contributes towards this necessary damping.

(4) Increased bass, due to reduction of feedback at low frequencies through the use of such a low capacitance.

(5) (a) It requires a grid swing of about 200V for full output, and attempts to provide this often lead to distortion from the penultimate stage.
(b) Only triodes (or strapped tetrodes) can be used.
(c) Even with indirectly heated valves, a separate heater supply is needed.

Despite the above snags, the circuit drew attention to the advantages of negative feedback and low output resistance.

The writer (an incurable fidelity enthusiast) used the following arrangement with great success, and with very little distortion in the penultimate stage:

SP41 as RF stage, infinite impedance detector, SP41 as AF stage, (33 k Ω anode load, 100 k Ω screen) giving low gain but large anode swing, and PEN44 as triode with output transformer in the cathode.

Improved techniques which permit heavy feedback from the speaker to the amplifier input now give superior results, and the faithful "follower" has now fallen by the wayside.

(6) Right.

BUILDING YOUR OWN VALVE TESTER

By W. G. MORLEY

Part IV

The Meter Switching Circuits

The Meter is used to measure every function offered by the tester. It should have a full scale deflection of 1 mA and, in addition, it is extremely desirable to choose an instrument with a large, easily-read face. The circuits associated with the meter are shown in Fig. 6.

Referring to this diagram, it will be seen that a switch, S14, is used to connect various shunts across the meter. This allows it to read currents up to 1 mA, 10 mA and 50 mA.

The next switch to consider is S15, the Meter Selector Switch. Fig. 6 shows that one side of the meter circuit is connected to the electrode of the valve under test whilst the other side of the circuit is connected to the arm of S15. This switch then allows the meter to be connected to any source of HT potential which may be necessary to supply the correct voltage to the particular electrode selected. It also, in the "Rectifier Test" position, connects the meter to the 105 volt positive supply via a limiting resistor of 3,500 ohms (R32). This resistor keeps the current in the circuit below 30 mA, and the meter is then used to test rectifiers by measuring the current passed by their anodes. This also gives an indication of the plate impedance of the rectifier under test. The same method is used to test detector diodes at the next position—"Diode Test"—only in this case the current is limited to 1 mA by the 105,000 ohm series resistor, R33.

In the final switch position, "Insulation Test", the meter is connected, again *via* a 105,000 ohm resistor (R34) to the 105 volt *negative* supply. This switch position is used to check the insulation between cathode and heater of any particular valve. It may also be used to test for shorts or leaks between any one of the electrodes and its neighbours. A negative supply is used for this test to ensure that no false readings are obtained owing to electron emission, as would otherwise happen were electrodes checked against the cathode. (Occasionally, too, a heater may radiate electrons to its cathode, a state of affairs which, whilst not exactly constituting a fault, would certainly cause ambiguous insulation readings if the cathode were positive with respect to the heater).

Owing to the fact that the voltage utilized for the insulation checks is of opposite polarity to that used for all the other tests, the meter connections have, in this case, to be reversed. This is done by switch S16. When an insulation test is taken, this switch is put to the "Insulation" position. Otherwise, it is set to "Normal".

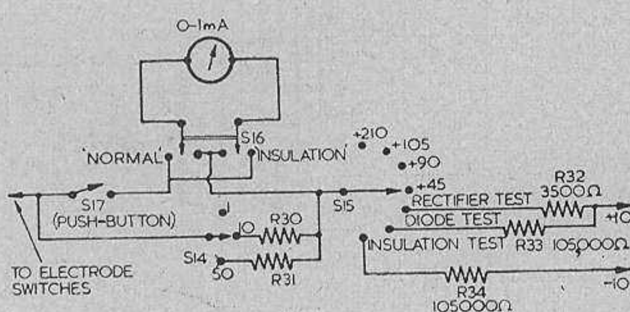
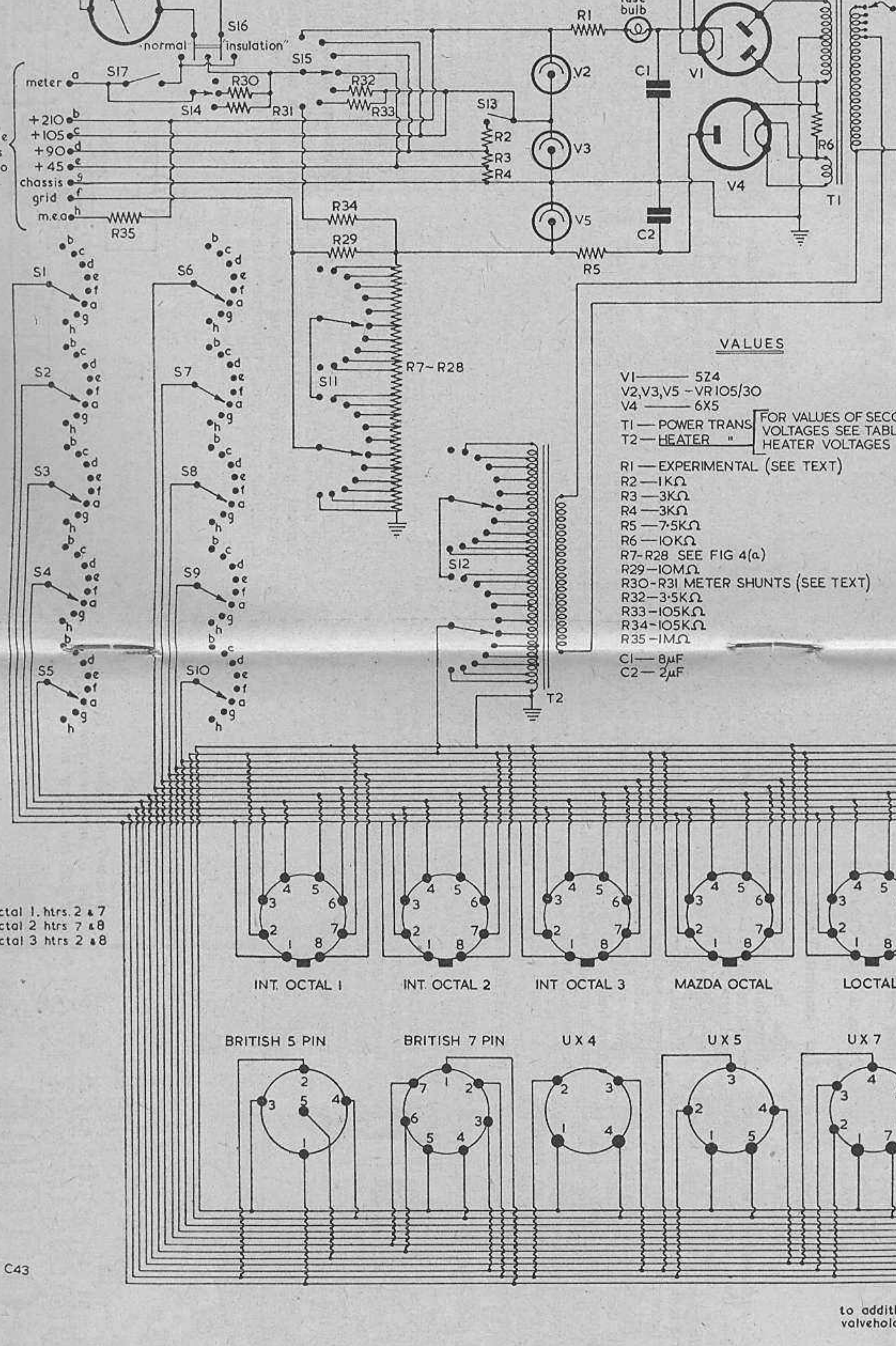


Fig. 6: The meter switching circuit

C42


S16
"normal"
"insulation"
fuse bulb
R1
meter a
S17
S15
S14
R30
R31
R32
R33
S13
R2
R3
R4
+210 b
+105 c
+90 d
+45 e
chassis g
grid f
m.e.a h
R35
R34
R29
R5
V1
V2
V3
V4
V5
C1
C2
R6
T1
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
R7~R28
S12
T2
VALUES
V1 — 5Z4
V2,V3,V5 - VR105/30
V4 — 6X5
T1 — POWER TRANS
T2 — HEATER "
FOR VALUES OF SECO
VOLTAGES SEE TABL
HEATER VOLTAGES
R1 — EXPERIMENTAL (SEE TEXT)
R2 — 1KΩ
R3 — 3KΩ
R4 — 3KΩ
R5 — 7·5KΩ
R6 — 10KΩ
R7-R28 SEE FIG 4(a)
R29 — 10MΩ
R30-R31 METER SHUNTS (SEE TEXT)
R32 — 3·5KΩ
R33 — 105KΩ
R34 — 105KΩ
R35 — 1MΩ
C1 — 8μF
C2 — 2μF
ctal 1, htrs. 2 & 7
ctal 2 htrs 7 & 8
ctal 3 htrs 2 & 8
INT. OCTAL 1
INT. OCTAL 2
INT OCTAL 3
MAZDA OCTAL
LOCTAL
BRITISH 5 PIN
BRITISH 7 PIN
UX 4
UX 5
UX 7
C43
to additi
valvehold

Insulation tests are carried out with the meter connected to read 1 mA full-scale deflection. For different values of resistance the meter readings will be as follows :—

Insulation	*Meter Reading*
Short Circuit	1 mA,
0.25 M,	0.30 mA,
0.5 M,	0.16 mA,
1 M,	0.10 mA,
2 M,	0.05 mA,
4 M.	0.026 mA.

If desired, additional markings may be made on the meter scale, these showing the various resistance readings. Alternatively, the scale can be left untouched and, instead, a card showing the various figures could be mounted in a prominent place on the front panel.

As a safety precaution a fourth switch, S17, is fitted to the meter circuit. This is really a push-button, and ensures that the meter is only in circuit when the button is pressed. This helps to eliminate possible damage to the meter should an incorrect current be supplied to it owing to, say, the switches being improperly set.

The Meter Shunts

In the majority of cases it will prove necessary to have the meter shunts (R30 and R31) home-made, and the values of these shunts will have to be worked out from the resistance of the movement itself. (The resistance of the meter movement is nearly always given on the dial of the instrument).

In this particular circuit, the value of each shunt will be equal to the resistance of the meter divided by the current in mAs which the shunt has to carry. Thus the 10 mA shunt should have a resistance of $\frac{X}{9}$ ohms; and the 50 mA shunt one of $\frac{X}{49}$ ohms; where X is equal to the resistance of the meter movement in ohms.

The Complete Tester

The full circuit of the complete tester is shown in Fig. 7. A fair selection of commonly-met valve bases is shown in the valve holder panel, but it is possible, of course, to fit many more types.

Should more valve holders be fitted, the wiring procedure consists of connecting leads Nos. 11 and 12 to the heater tags used normally by that range of valves, whilst the remaining valve holder terminals are connected to the leads from the electrode switches with corresponding numbers.

As mentioned previously, it is necessary to fit three International Octal sockets because of the three different types of heater connection.

It may be noticed that no input tappings are available on the heater transformer, the primary of this component being connected across the 0—210 volt terminals of the power unit transformer T1. This is done to simplify adjusting the mains tappings for different voltages, as all that is then necessary is to adjust the input tappings on the power unit transformer alone, the heater transformer

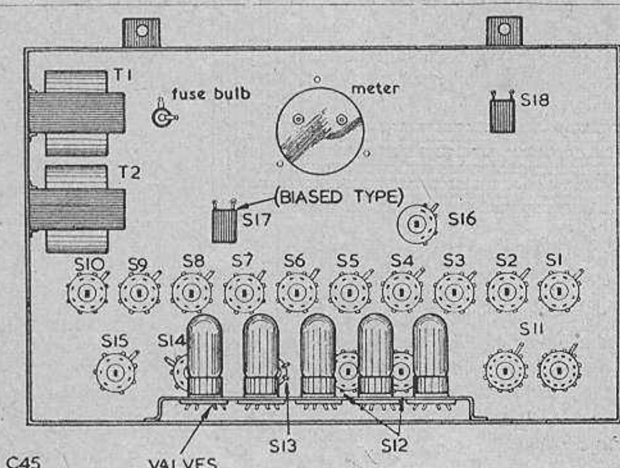


Fig. 9:

Internal view, showing layout of main components inside the upper unit

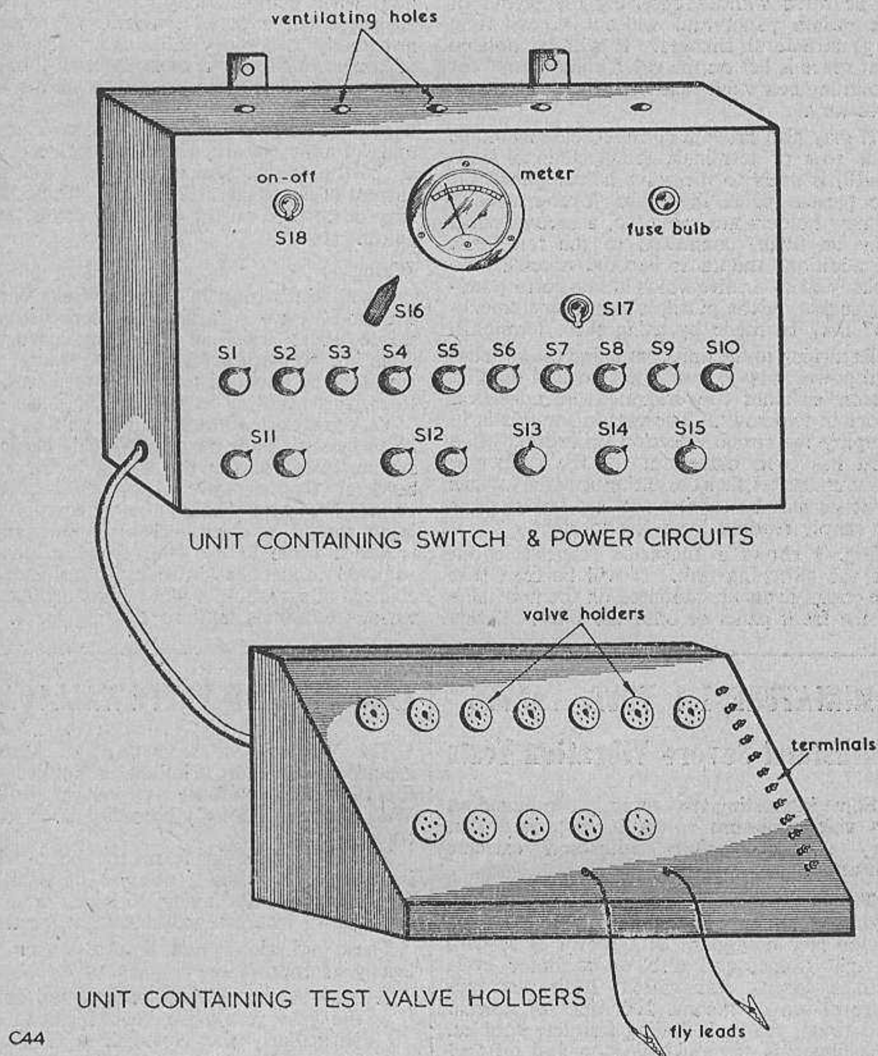


Fig. 8: Suggested layout for the valve tester.

being always connected to a source of supply of approximately 210 volts.

Layout

A very good layout for the tester is shown in Fig. 8. It will be seen that the instrument has been divided into two units: one of which contains all the power and switching circuits, the other holding all the valve holders. It is suggested that the first unit be mounted on the wall at about shoulder height, the second unit then being accommodated on a shelf or table at waist level.

Apart from easier construction, separating the two parts of the tester has the great advantage that it enables new valve holders to be fitted without upsetting the layout of the switch panel and without necessitating large structural changes. It will be noticed that space is left on the valve holder panel for mounting new valve holders, should this prove necessary.

It may also prove a considerable advantage if a row of terminals (connected to leads 1—10) is fitted to the valve holder panel. If the present panel then gets "over-crowded" as new holders are mounted, a second panel may be fitted, connected to the terminals. In addition, should it become necessary to quickly check a valve which has no corresponding socket on the panel, a temporary "mock-up" may be made by using these terminals.

Returning to the unit containing the switches and power supply, it will be seen that the first fifteen switches are mounted in numerical order in two rows. The reason for this is to simplify the circuit selection procedure. If a card has been made out for the particular value under test, then the setting up of the various switches may be carried out in a few seconds by simply reading from left to right.

Fig. 9 shows a suggested internal layout for the switching unit. It will be seen that the components are mounted on the underside of the front panel or onto the sides. If this unit, when completed, is mounted to a wall as suggested, a panel to cover the back is not really necessary; although this would, of course, make for a more finished job.

There is little need to worry about heat dissipation inside the switch unit, since it will hardly be used continuously. However, to make doubly certain, airholes may be drilled at the top and bottom of the case to allow a current of air to pass through it. These holes may be covered on the inside by coarse mesh gauze.

Wiring

As all the wiring in the two units carries DC or 50 cycle AC, there is no necessity to utilise short leads or pay any particular attention to wiring layout. The leads may therefore be bunched together into a harness-form, this resulting in neat wiring.

Very great attention should be paid to insulation between leads, particularly in the electrode switch section and in the wiring to the valve holders. Rubber covered or PVC covered connecting wire should be adequate. All joints should be clean and serviceable, and it is worth while to use resin-cored solder for soldered connections in order to decrease the chances of spreading a film of flux around the various terminals, and so causing leaks.

MINIATURE 1.4 VOLT. VALVES

Withstand Severe Vibration Tests

Some interesting tests recently conducted on 1.4 volt miniature valves have proved that they can successfully withstand extreme vibration.

The valves were mounted in standard communication equipment fixed to the back of the rear mudguard of a motor cycle with a rigid frame, and also on a motor cycle with a sprung rear wheel. Both machines were driven over some 200 miles of normal and rough roads, including tramline cobbles. The filaments were switched on and off and at the end of the trials the valves were found to be unimpaired.

Twelve Osram type N17 1.4 volt miniature valves were used for these tests, which have demonstrated that this class of valve is fully capable of standing up to the worst conditions of usage likely to arise with any domestic portable battery receiver and also to the more severe conditions which arise in connection with mobile receivers for essential communications.

1950 MULLARD VALVE WALL CHART

The Valve Sales Department of Mullard Electronic Products Limited, announce that the 1950 edition of the well-known Mullard Wall Chart has recently been circulated to the trade.

This is similar in form to the previous issue, but embodies a number of additions and improvements, many of which were the outcome of recommendations from the trade.

These additions and improvements are briefly as follows:—

1. New valves which have appeared during the past year have been included and particularly the Noval base range.
2. The Screen Grid Current for each valve has been included for the first time and this, it is considered, will be of particular value to Service Engineers.
3. A list of photocells and flash tubes is included with typical operating conditions.
4. All the base diagrams have been re-drawn in such a way as to facilitate reference.
5. The Equivalent and Substitution lists have been considerably enlarged.

PRACTICAL AERIALS

by "AETHERIUM"

Introduction

Frequency/Distance

Radiation Angles

Receiving Aerials

Part I

Introduction

In this series, it is intended to present in a straight-forward manner the functions and applications of various types of aerials.

It is hoped that the beginner will find something to assist in his own particular problem, and that the more advanced amateur may derive some useful information therefrom.

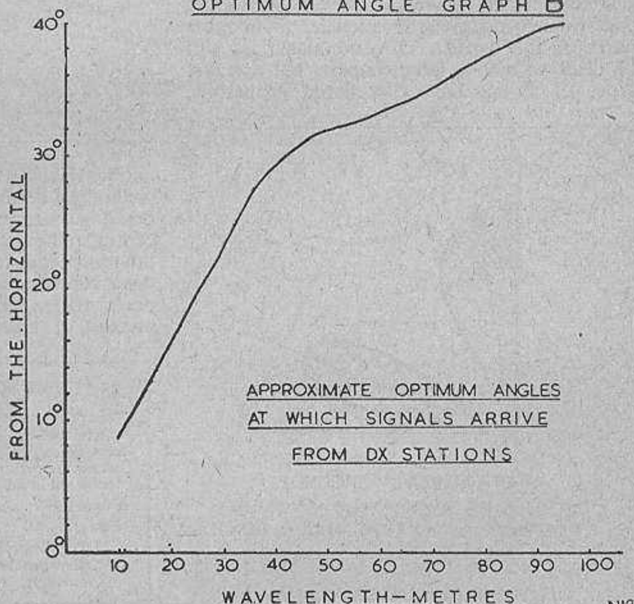
Theoretical figures will be avoided as far as possible, and the relative gain quoted for any particular type of aerial will normally be the result of actual measurement under working conditions. Most of the aerials described will be suitable for erection in the average garden or roof space, and will not require large fields or 100ft. masts to accommodate them.

Frequency/Distance

It is well known that certain frequencies are used by amateur and SW broadcast stations according to the time of day or night and the distance it is desired to cover. It would take pages to go into the question of reflection, ionisation and refraction, and in any case this field is adequately covered in most text books.

The graph 'A' shows the average maximum distance we can expect to cover at frequencies between 3 and 30 Mcs during daylight and darkness. The various frequencies (or wave-lengths) are reflected back to earth at certain angles. By comparing the optimum angle graph 'B' with the various polar diagrams it is therefore possible to assess the merit of any particular type of aerial for any given frequency within the range shown. For convenience, the Optimum Angle Graph is calibrated in wavelengths.

OPTIMUM ANGLE GRAPH B



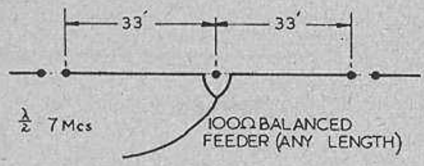


Fig. 1: Half-wave 7 Mcs. Aerial (Low impedance feed).

Dealing with the simple types of aerial in the first case, we shall progressively deal with most of the types of aerials encountered in amateur practice.

Receiving Aerials

The first important point to remember regarding an aerial, is that it is a tuned circuit in itself. One often encounters the enthusiast who, having purchased an expensive receiver, connects to it any odd length of wire, and expects maximum performance. This, of course, is all wrong, and as much care should be taken in the choice and erection of an efficient aerial, as in the choice of a receiver. A point to remember is that Short Wave Relay Stations usually have a system of different aerials which are selected by suitable switching arrangements, to give optimum performance on given frequencies from most parts of the world. Directional aerials will be dealt with in a later chapter, but as most types of aerials have directional properties, it is as well to touch upon this fact. The most commonly used type of aerial is the "long wire" or "single wire". For good average results this usually consists of a length of wire some 40 to 50 feet long and 30 feet or so high.

The keen Dx listener, however, must instal something a little more ambitious if he is expecting to get maximum results.

A careful study of the "Polar Diagram" of each type of aerial is the best method of choosing which to use.

A good all-round aerial for reception is shown in Fig. 1. This is approximately one half wavelength at 7 Mcs and works reasonably well on all bands. The low-impedance feeder, being non-resonant, is inefficient at intercepting signals, and will therefore not pick up much interference or cause serious losses when running close to walls etc. For optimum performance, an aerial such as this should be erected at least 35 feet above ground and

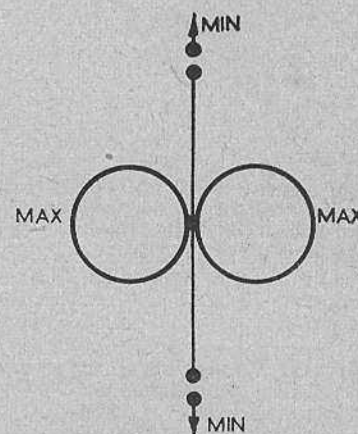


Fig. 1(a): Polar Diagram.

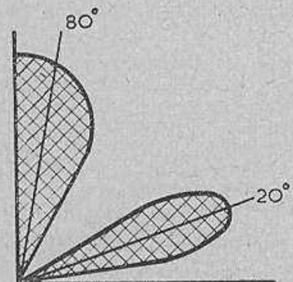


Fig. 1(b): Vertical Directivity.

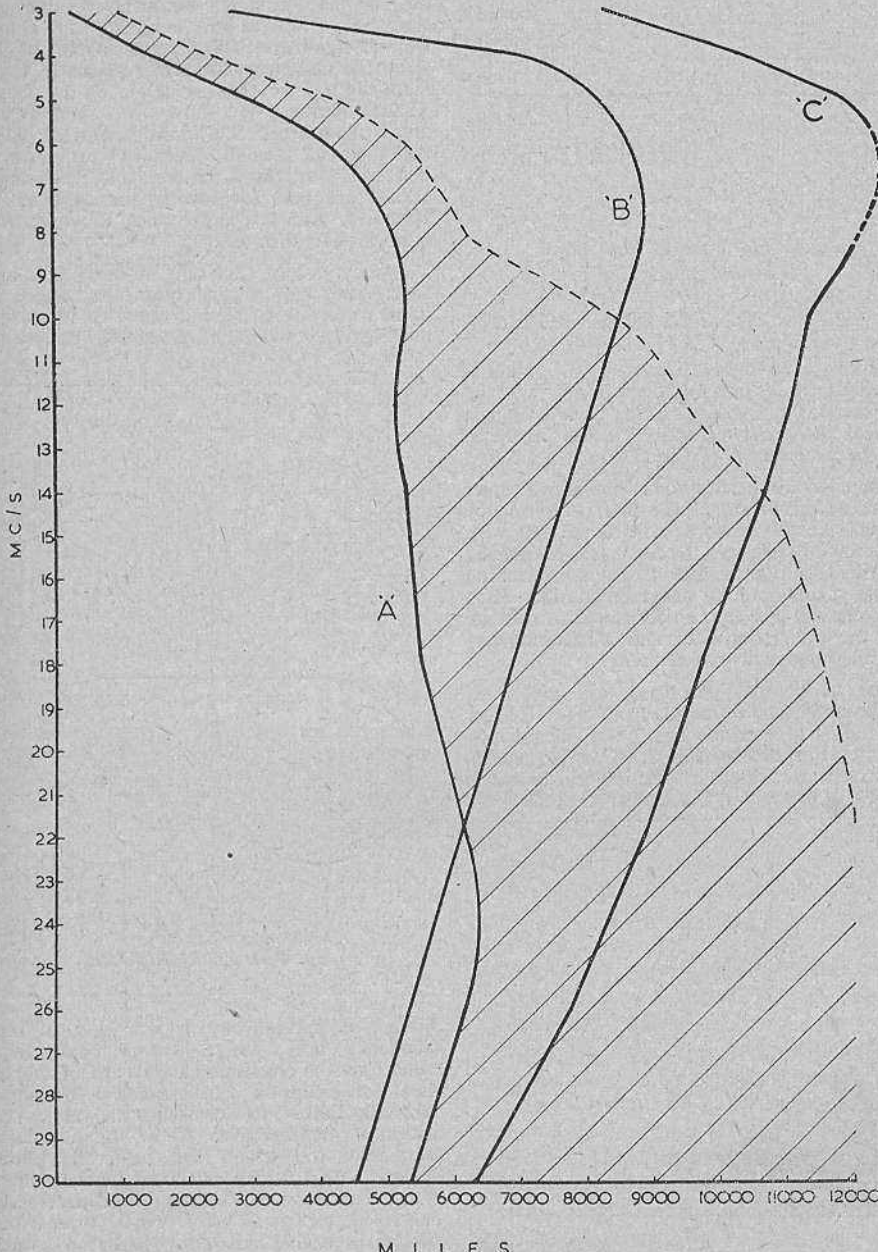
FREQUENCY/DISTANCE GRAPH
(SEE OPPOSITE PAGE)

Curve "A" . . . Average maximum distances to be expected when whole of path is in daylight (shaded portion indicates wide variations that occue when half or more of path is in darkness.)

Curve "B" . . . Summer night distances.

Curve "C" . . . Winter night distances.

These curves are approximate, and wide divergencies may be experienced due to sunspot activity and other phenomena



FREQUENCY/DISTANCE GRAPH ("A")

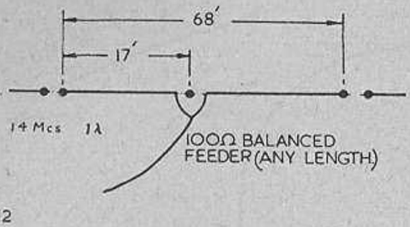


Fig. 2: Full wave 14 Mcs Aerial (Low impedance feed).

preferably even higher, because as the height is increased, the "horizontal pattern" will be reinforced, i.e. signals arriving at low angles, such as those between 14 Mcs and 30 Mcs, will be received at greater strength.

The even more ambitious listener will erect several aerials for use on the different frequency bands. These, perhaps, will all be fed with the low-impedance feeder as previously described, and plug and socket or switching arrangements made at the receiver end. Such a system will give him an enormous advantage over the 'one aerial' man, and the accompanying diagrams will explain why.

The aerial just described will give him maximum results on bands from 5 to 10 Mcs. For the 14 Mcs bands Fig. 2 is switched into circuit. For 28 Mcs Fig. 3. For frequencies between those stated, a selection can be made

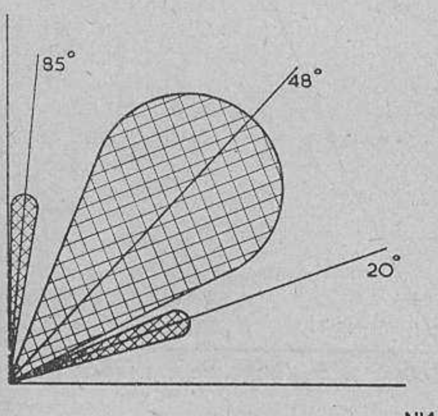


Fig. 2(b): Vertical Directivity.

of the aerials, dependent upon the time of day or night and the frequency in use. It may be as well at this stage to explain the Polar Diagrams. The Diagrams marked 'A' show the maximum lobes of reception viewed from the top, or 'looking down' on the aerial. Those marked 'B' show the approximate angle of reception, i.e. looking straight along the wire from one end. A point worth remembering is that, as a general rule, high-angle aerials are best for low frequencies (up to 10 Mcs), and low-angle ones for high frequencies (10 Mcs and up).

It may not be generally realised that any aerial used for transmitting also makes a good receiving aerial, but many of the transmitting types would be unsuitable unless the

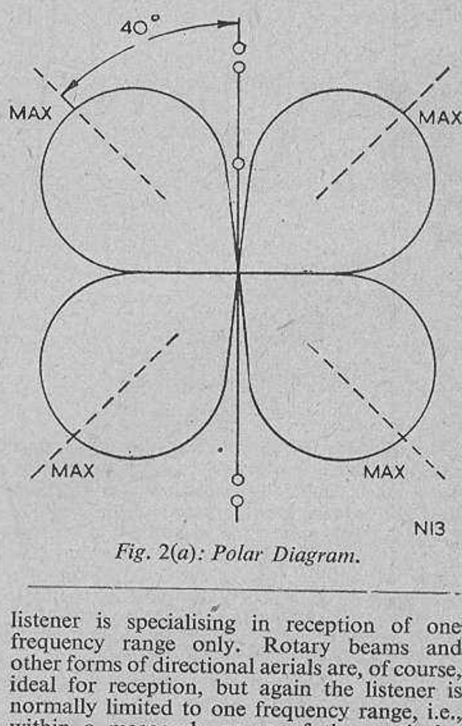
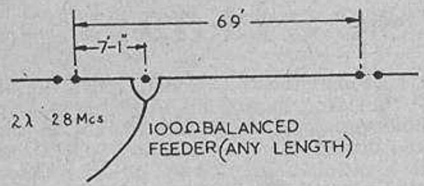


Fig. 2(a): Polar Diagram.

listener is specialising in reception of one frequency range only. Rotary beams and other forms of directional aerials are, of course, ideal for reception, but again the listener is normally limited to one frequency range, i.e., within a megacycle or so of the particular frequency for which the beam has been designed. So for the all-band listener, there is no alternative to the 'long wire' previously described, except to erect two or three types of aerials to give maximum results on several of the frequency bands. Vertical aerials are usually impracticable to erect, except for



N15
Fig. 3: Two Wave 28 Mcs Aerial (Low impedance feed).

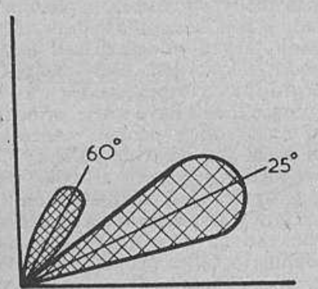
frequencies above 40 Mcs, and unless the aerial is made a full half-wavelength long at the lowest frequency it is desired to operate on, it is normally not so efficient as the horizontal wire.

Insulation

Insulation of aerials is a point which cannot be stressed too strongly, even from the point of view of the receiving station only.

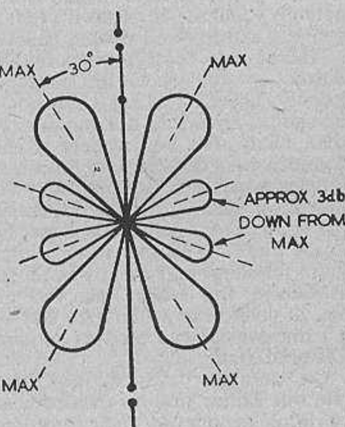
Never rely on the rubber and braiding of VIR wires to provide the necessary insulation, and never use ordinary twisted lighting flex for outdoor feeders. The RF insulation value of such covering is negligible; there is no point in using covered wire for aerials, and it only adds unnecessary weight.

A good quality hard-drawn enamelled copper wire of 7/22 or single 14 swg will be quite efficient, with at least two good quality insulators at each end (Pyrex for preference).



N17
Fig. 3(b): Vertical Directivity.

If soft-drawn wire is used, it should be stretched well before being measured and installed, as a length of 60 ft. or so can increase by over 18″ in a few months if this precaution is not taken. Soft-drawn wire can always be recognised by its pliability in the hands, and the extreme ease with which a bend can be made in a short length.



N16
Fig. 3(a): Polar diagram.

The Editor Invites

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

Radio Miscellany

I HEAR that a South London amateur has locally been "discovered" to be the chap who writes as Centre Tap. His friends won't accept his innocence, but they have at least been good enough to assure him "it's nothing to be ashamed of". I feel flattered.

Conversely, in North London, someone actually 'lets it be known' that he is the genuine article—and people believe him!

There may be a few more Centre Taps dotted up and down the country for all I know. There is, in any case, no reason why he should always be a Londoner. It is more than likely that any readers in the northern counties who think my technical and general articles have merit, will probably not consider they have been written by a mere Southerner.

I was once solemnly assured by a "man in the trade" (a partner in a nationally-known radio retailers) that there was no such person as Centre Tap really. He was able to tell me, in confidence of course, that it was only a name which was used as required for the Editorial staff.

On another occasion, a Club Secretary told our Editor that his members wasted over an hour at one of their meetings arguing over my identity. Apparently they blamed one poor inoffensive fellow for a variety of reasons—his writing was similar to my signature, he possessed gear such as I have described, he participated in some incident I have recounted, or held views similar to those I've put forward, etc.

The only thing that worries me is that, if it goes on much longer, I may not know who I am, myself. Some practical joker might easily start off a rumour amongst his fellow Clubmen. A few words, in the approved confidential manner, such as "You know So-and-so. Well, keep it under your hat, but he's the chap who writes as Centre Tap". As likely as not, in the course of a week or two, he will be rewarded by the creation of the comic situation of seeing his poor victim modestly accepting the doubtful honour. Or more likely, threatening all his pals with libel suits!

The Next Best Thing

Talking of practical jokes reminds me of a trick I saw successfully played several times in the Army. The joker, carrying a reel of field telephone wire, would stop a "rookie" as he was walking through camp, and, handing him the end of the cable, would ask him to hold it, while he measured out a length for a field line over to a building across the way.

The joker, leaving his unsuspicious helper holding the end, would start carefully unreeling and disappear around a corner. Once there, he would cut off the end and present it to some other innocent, telling him a similar story. Then, from a concealed position, he would watch the two mugs hold their respective ends until an eventual suspicion dawned on their guiless minds.

It is surprising how easily people will fall for that sort of stuff. In the old days, it was a case of sending someone to whitewash the last post or to fetch some red oil for a black lamp, but practical jokes, like everything else, move with the times. In training camps during the War it was a popular pastime among straight-faced Storemen to send rookies back with apologies for being temporarily out of stock of 250 mA. fuses. The nearest they could offer was a quarter-amp fuse, and perhaps they had better go back and find out if it would suit, first! The victims didn't easily forget how many milliamps make a quarter-amp after that.

Voice Reproduction

Those readers who have had experience in making recordings will know the awful sensation upon hearing for the first time a playback of their own voices. The first recording I heard of my voice was one I made myself. I immediately started looking for faults in the amplifier or the cutting head! I simply could not bring myself to believe that the raucous sound emanating from the speaker was really *my* voice. Ever since, as a small lad, I had been allowed to sing solo in the choir, I had prided myself that mine was a good voice. Yet everyone else, when they heard the recording, said it was truly lifelike!

Since then I have made, or heard, recordings of many other peoples' voices. Nine-tenths of them can scarcely believe it, and quite a proportion want to disown the voice that falls so strangely on their ears.

Until you have heard a recording of yourself, you can have no idea just how your voice sounds to other people. Having experienced it, many people have been jolted into an endeavour to improve their speech or voice production. One demonstration with a transcription of their speech is enough.

It seems that few of us acquire good delivery without conscious effort and the prolonged ironing out of faults, and unfortunately there are many, both radio and political speakers,

CENTRE TAP *talks about*

HIMSELF – PRACTICAL JOKES – VOICE REPRODUCTION

who left the study of their voices too late. One of the latter variety with a particularly loud and harsh voice was, within the household, dubbed with the nickname, "Thunderguts" when he first broadcast. Others are stilted, strident, or flat and expressionless, and I have often wondered what their reactions were when they first heard a re-broadcast of themselves. I expect they blamed the chap who made the recording, until their best friends told them !

The Eternal Woman

A careful study of radio speakers suggests that about a third of the males have good and pleasing voices. Those with a good microphone manner are somewhat rarer.

With women the proportion is deplorably low—unless I am hyper-critical. The number of women whose microphone voices and manner register pleasurably to my ear would not take long to count. The vast majority jar and jangle, and I am still uncertain which irritates me most, the shrill or the affected.

Whenever I hear a pleasing or musical feminine voice on the air, I find myself rushing for the RADIO TIMES to see if there is a picture of her. Quite why, I don't know. I am old enough in the tooth to realise that radio artistes, like film stars, never hand out photographs taken less than ten years ago.

Deceptive

Microphone experience helps the speaker a lot. It is not simply a matter of having the confidence which comes to the old hand. The desire to speak intelligibly, with expression enough to add force to one's words, quickly produces an instinctive improvement. Listen on the amateur bands, and you will agree that quite a goodly number of amateurs sound well over the air. With many of them, one almost starts building up a personality behind the voice and forming a mental picture of their appearance.

Of course, they never look anything like what you imagine. I remember one instance of an amateur I met after many pleasing contacts. I was quite sure he was a tall, well-built chap, gay and dashing. He turned out to be short and stout, with thick spectacles, and as bald as a coot ! It is rather like hearing a lovely voice singing off-stage—and then a fat prima donna with at least four chins waddles on to the stage to shatter the illusion.

The moral is, I suppose, if we can't all look the part we can, with patient effort, sound it.

The Gift to Gie Us—

In an attempt to analyse why many amateurs' voices sound well over the air, I decided that the following were among the chief reasons:—

With his first 'phone QSOs he found himself out of breath and consciously, or unconsciously, he started long deep breathing at regular intervals.

He imitates the style of delivery and the effectual use of pauses of the more experienced amateurs and mike users.

He lowers the pitch of his voice, and, unless his voice is unusually deep, he discovers the tonal quality improves a 100 per cent.

With a slightly lower-than-natural pitch, a steadier speed and improved enunciation follows automatically.

These points soon come by habit and not by conscious effort. This leaves his mind free, which enables him to express his thoughts more fluently and to use vocal nflection effectively.

This accounts only for those amateurs who use the microphone well, although probably the majority embraced these points without being aware that they were doing so. There are, of course, a good sprinkling of those who babble, and pause for breath in the middle of sentences interspersed with copious 'ers' and 'ahs'. The greatest kindness their friends could do them would be, as I have already said, to let them hear a playback of themselves.

TELEVISION

Picture Faults

Part six of a series, illustrated by photographs from a Televisor screen by courtesy of

Mr. John Cura.

Part 6 – Sync Separation, contd.

THE general principles of separation of the "synchronising" signals from the "picture" signals has been dealt with in the previous article. The following faults and remedies given here will conclude our remarks on this particular subject.

When sync separation is carried out in two or more stages, a fault may arise which will cause the locking of the line time base in the middle of the line period. This gives the effect of a picture split in two, with a dark vertical band down the centre of the image. The two halves of the picture will face outwards, and if two people should be facing each other in the original subject, they will be facing away from each other in the received picture. The line time base may hold steadily when this occurs, and the line hold control may not be at all critical. The effect is most likely due to synchronisation from a random source, with a delay causing the incorrect timing. It will probably be found that the synchronisation of the line time base is not carried out through the correct channel, and that the line sync separator is not operating at all. The line time base may be operating on radiated pulses from the video circuits. The effect is more likely to occur when the time base is of the Miller transitron type than of any other. This type is easily synchronised by pulses of small amplitude, and may not be critical as to whether these pulses are negative or positive going. The line sync separator circuits should be checked to see that the correct supply voltages are available, and that the valves and values in question are satisfactory. The sync pulses may be traced as suggested in Part 5 of this series.

A similar effect could be produced by the frame time base if a serious hum voltage appeared in this part of the circuit. There would be a tendency for the frame time base to synchronise on some part of the hum waveform rather than on the correct sync signals. This would be very likely if the fault also reduced the sync pulse input to the frame time base. Smoothing and decoupling circuits should be checked, and the grid circuits of the sync separator valves should be examined for open-circuits. Unsatisfactory earthing of valve pins, a common impedance in a heater/cathode earthing wire or a heater/cathode short in a valve may also be responsible.

Pulling on line, or displacement of horizontal sections of the picture, according to the make-up of the leading edge of the picture, is most likely due to unsatisfactory operation of the line sync separator—see Fig. 1. The cause may be complex, and depends to a very great extent on the type of sync separator used. It is fairly certain, however, to be due to incomplete limiting by the line sync circuits. This will allow variations depending on the brightness of the picture at the beginning of the lines which are displaced. The effect may be clearly noticed on the test card transmissions or at the start of the programme, when the castellation at the edge of the picture causes a displacement right across. Verticals in the picture will appear sympathetically displaced. Due to movement, the fault may be less noticeable on programme images.

The earthing of all points in the line sync separator and that of the line oscillator should be carefully checked. Leads from valve pins to earth should be earthed directly and not taken around the valve holder to other pins. Faulty coupling capacitors should be looked for, and grid circuits and DC restoration checked. An incorrect time constant may also be responsible, as some sync separators produce their own DC restoration, without the use of diodes, by allowing grid current to flow at some part of the picture cycle.

Lack of interlace and pairing of lines is caused by incorrect timing of the frame time base — see Fig. 2. Each complete picture occupies one twenty-fifth of a second, and the frame scans twice during this period. Due to a slight difference in timing of successive frame scans, the horizontal lines formed in one scan should come midway between the

Fig. 1: Pulling on lines, due to faulty line sync separator. Note vertical lines, which should be perfectly straight, are kinked towards the right near the top of the picture.
(*John Cura 'Tele-Snap'*)

lines formed by the previous scan. An error in timing of the frame time base will thus allow one set of lines to fall on top of, or near to, the set previously formed. If the pairing of the lines over a period is consistent, it is most likely that the wrong component values have been used in the integrating circuits previous to the frame time base. These may be in the form of R-C circuits in the sync separator, or as the coupling components between the sync separator and the frame time base. Their values should be carefully checked, if working from an original design, and varied between small limits if working on one's own. Variation of component values within their normal tolerances may cause unforseen effects, particularly where timing circuits are concerned.

Wandering of the interlace lines, causing a variation of picture quality, can be very difficult to cure. It can be caused by noise,

Continued on page 70

Fig. 2: Loss of interlace. The raster lines show clearly when one frame scan is superimposed on the next, as here.
(*John Cura 'Tele-Snap'*)

Design of the SUPERHET

by R. J. CABORN

PART II

WE have already, in an earlier article, dealt with the theory and practice of frequency-changing in the modern superhet. However, we then dealt only with the broader aspects of the subject and paid little attention to the more advanced designs which are used in present-day communications receivers, etc., and where complications arise which are not usually met in the more normal "domestic" type of receiver. It is proposed in this, the last article of the series, to deal with these points and thus make our approach to the design of the superhet complete.

Separate Oscillators

It is common practice, when short-wave supherhets are being designed, to use two separate valves for the frequency changer stage. One valve functions as the oscillator, the other as the mixer. This is done mainly to ensure that the oscillator circuit is kept as free from unwanted couplings with the signal frequency section as is possible, thereupon ensuring greater freedom from frequency "pulling".

FIG I

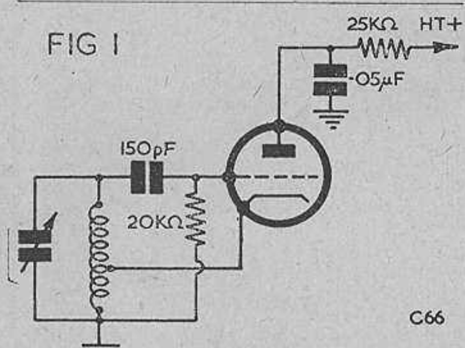


Fig. 1: An electron coupled oscillator. This type of oscillator is capable of providing excellent frequency stability.

In addition, the use of two separate valves enables the oscillator circuits to be more efficiently designed with respect to layout, so that wiring is shorter and components better positioned. A further advantage is given by the fact that the separate oscillator may be worked at a low anode voltage with consequently less heating of the electrodes (and therefore less thermal capacitance changes), whilst at the same time obviating the fault which occurs when oscillator and mixer valves are combined in one envelope and the physical proximity of the mixer section causes an increase in the temperature of the oscillator electrodes.

The oscillator circuit used should, of course, be chosen for frequency stability. For instance, Fig. 1 gives the circuit of an electron coupled oscillator which should give rise to hardly any drift at all. The coupling for the mixer is taken from the grid of the valve. However, with this circuit there is a possibility at the higher frequencies that the cathode, which is not connected to chassis, may pick up hum from the heater. If hum pick-up should occur, it may be minimised by connecting two RF chokes in series with the heater supply. The chokes should be mounted close to the valve base. As the frequencies at which the hum may occur are relatively high, the chokes need possess only a small amount of inductance. In practice, thirty or forty turns of DCC or DSC wire solenoid-wound on a half-inch former should be quite adequate for each choke. The wire used should, of course, be capable of carrying the heater current.

An alternative circuit, which has the advantage that the cathode is connected to chassis, is shown in Fig. 2. This is, of course, a normal tuned-grid oscillator and needs little comment. Once again, the coupling to the mixer is taken from the grid of the valve. However, the frequency stability of this circuit is not always so good as that of the electron coupled oscillator of Fig. 1.

Oscillator Stability

Apart from the initial question of choosing the circuit which is to be used, the problem of maintaining oscillator stability resolves itself also to considerations of mechanical rigidity, dissipation of heat and regulation of the voltage supplies.

The question of mechanical rigidity has considerable importance, and should be given due prominence when the receiver is being originally designed and built. The first essential is a really rigid and well-made chassis. The components in the oscillator circuit should be mounted securely, and long connecting wires should be avoided as they are liable to move out of position or vibrate. And, of course, all the components used in this particular circuit should be of good quality and reliable manufacture.

Heat dissipation is a factor that should also be kept in mind when the receiver is being originally made. As it is usually necessary to rely on convection currents to keep most of the components cool, it is advisable to use a well-laid out chassis instead of attempting a cramped design. Any components which are liable to radiate heat (such as high-wattage resistors, valves, etc.) should be kept well away from the oscillator circuits. The use of ceramic insulation, wherever possible, also helps to reduce changes in capacitance due to alterations in temperature.

If voltage regulation is desired, it may be obtained by the use of a stabilizer valve in the HT circuit. It is often well worth while applying a stabilized supply to the mixer valve as well, since this will obviate changes in capacitance in that valve which may be caused by alterations in its space charge, and which could affect the oscillator tuned circuit *via* the coupling capacitor.

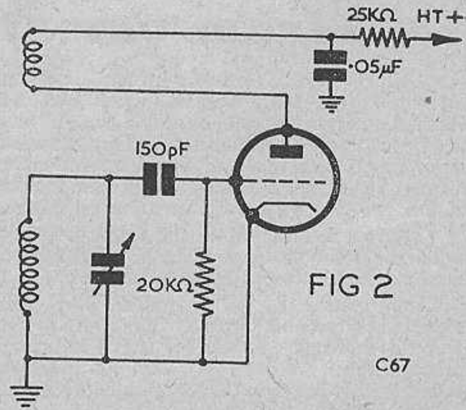


Fig. 2: A simple tuned grid oscillator which, when well designed, can offer very good stability for frequency changing purposes.

The Mixer

Probably the best type of mixer for use with a separate oscillator is afforded by the pentagrid. Owing to its construction, this valve

Continued on page 70

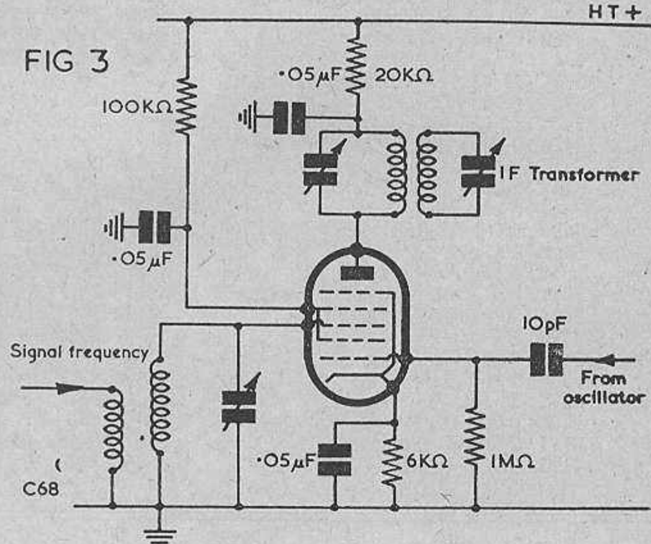


Fig. 3: A practical circuit employing a pentagrid as mixer, for use with a separate oscillator.

"from our MAILBAG"

Dear Sir, ... At the present time I am interested in short wave reception, and have purchased an ex-Army receiver Type 21, which has the two ranges I wish to listen on at present. This set tunes on one range from 4.2 to 7.5 Mcs as a superhet, and on the other range from 18 to 31 Mcs as a double superhet. On trying it out, I can receive the 40 metre band quite well, with many Continental and American stations, but on the 10 metre band (18—31 Mcs) I cannot get anything except a break-through from the other band. I am wondering if you or any of your readers can give me any information on this receiver.

I have a feeling that on the higher frequency band there must be some other unit which is required. I should be very much obliged if you can help me on this matter, as the 10 metre band is the one I most desire to listen on.

I am receiving this band on an RAF R3084A receiver, which I originally purchased for television conversion, but the trouble with this is that the IF's are 30 Mcs, therefore I am getting IF break-through. I must say that I have logged some twenty-thirty amateurs, among these quite a number of W stations, although I cannot tune it, and have to wait for the strongest signal to drown the others so that I can identify it.

G. GIBBINS (*Reading, Berks*)

Ex-W.D. COMPONENTS

We present the sixth list of ex-WD components, together with reference numbers and values. This list is compiled from information supplied by readers. As before, all the numbers stated are preceded by the reference 10/C. Our thanks to those readers who suppli ed the information given below.

3042	1 pF, ± 20%, 500V wkg.	4193	0.0023 μF, ±5%, 500V wkg.
3214	500 pF, 500V wkg.	4240	7.5 pF, ±5%, 500V wkg.
3216	300 pF, 500V wkg.	4413	50 μF, 25V wkg.
3218	75 μF, —0+50%, 12V wkg.	4433	500 pF, 500V wkg.
3263	80 pF, 500V wkg.	4500	25 μF, 25V wkg.
3268	75 pF, 500V wkg.	4614	2 μF, 300V wkg.
3317	8 μF, —0+50%, 150V wkg.	4768	5 pF, 500V wkg.
3318	25 μF, —0+50%, 12V wkg.	4920	200 pF, ±5%, 500V wkg.
3386	0.005 μF, 5 kV wkg.	4942	10 μF, 50V wkg.
3474	12 μF, —0+100%, 200V wkg.	4950	4 μF, 350V wkg.
3476	2 coils each 0.423 μH, octal base.	4951	100 pF, ±5%, 500V wkg.
3477	2 coils each 1.06 μH, octal base.	4980	25 μF, 25V wkg.
3478	2 coils each 0.213 μH, octal base.	5036	200 pF, 500V wkg.
3544	8 μF, 150V wkg.	5349	25 μF, 50V wkg.
3586	100 pF, ±5%, 500V wkg.	5357	8 pF, 500V wkg.
3606	200 pF, ±1%, 500V wkg.	5532	0.006 μF, 250V wkg.
3611	6 pF, 500V wkg.	5563	25 μF, 25V wkg.
3781	8 μF, —0+50%, 200V wkg.	5661	2 pF, ±20%, 500V wkg.
3794	50 μF, 50V wkg.	5663	100 pF, 500V wkg.
3796	500 pF, 25 kV wkg.	5678	50 μF, —0+100%, 15V wkg.
3860	8 pF, 500V wkg.	5761	100 pF, ±5%, 500V wkg.
3906	50 μF, 12V wkg.	5810	4 pF, 500V wkg.
4095	20 μF, 50V wkg.	5822	8 μF, —10+30%, 450V wkg.
4190	0.001 μF, ±20%, 500V wkg.	5872	150 pF, 500V wkg.
4191	230 pF, 500V wkg.	5881	8 pF, ±10%, 500V wkg.
4192	0.0023 μF, 500V wkg.	5960	3 pF, ±10%, 500V wkg.

A TV AERIAL FAULT

by R. W. G. Graves

Nothing causes more annoyance to viewers than interference which causes deterioration in the picture, and consequent loss of entertainment value. It has recently been my misfortune to suffer severely in this direction, and from a source which was extremely difficult to trace. It is quite likely that several television owners are blaming 'conditions' or their neighbours, when the fault is in their own installation.

The set in question, installed some seventy miles from Alexandra Palace, behaved rather erratically from the start. Being a new viewer and not expecting anything too wonderful, the heavy fading experienced during the first three days was endured as something to be expected in a 'fringe' area.

The fading was quite rhythmical, the picture varying from normal to very dark at about 2-second intervals. After three days it was felt that perhaps 'conditions' could not entirely be blamed. It was also noticed that the fading was much more pronounced when a stiff breeze was blowing.

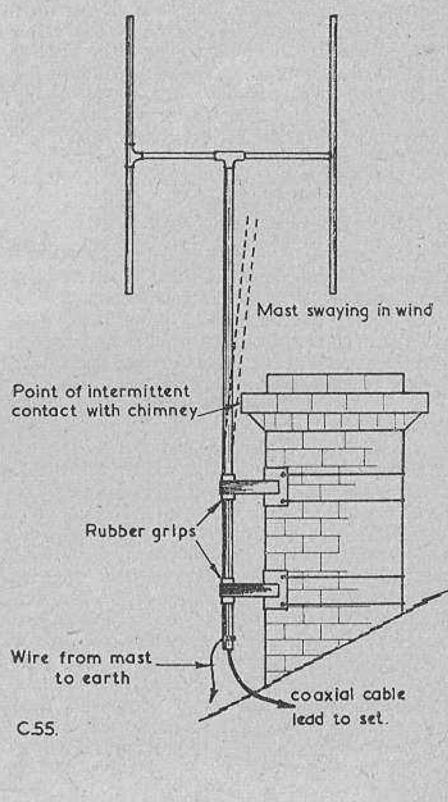
The engineer who carried out the installation was contacted, and he at once diagnosed a faulty reflector element in the dipole aerial, which had been strapped to a twenty foot steel mast attached to the house chimney.

The whole aerial system was dismantled, every joint of the dipole tested and screwed home tightly. Nearly a day's work this! The aerial was then re-erected and the set switched on—and the picture faded to the same old rhythm. Climbing to the roof the engineer shook the aerial system. The movements were faithfully reproduced on the screen by sympathetic fading. Obviously the aerial was at fault, but how?

Then came the solution to the problem. The mast was held to the chimney by two metal brackets, thick rubber sleeves being used to grip the mast where it passed through the brackets. The mast was thus insulated from the brackets and from the chimney. That is to say it was insulated some of the time, because when the wind blew and the mast swayed, it just touched the coping stone of the chimney. It was proved that this intermittent 'earthing' of the mast caused the fading.

A glance at the diagram will show exactly how the trouble arose.

A very small thing perhaps, but one which may be happening in many homes. It was easily remedied by running a wire from the base of the steel mast to earth. Since then reception has been quite normal with no fading, even in high winds.



TV Picture Faults

Continued from p. 65

or by variations in the operating conditions of a valve. Check the operating conditions of the frame sync separator valves and the frame oscillator valve, try substituting them, check all earth points and soldered joints, ensure that decoupling circuits are satisfactory. If, after a thorough check on these points, the trouble still persists, it will be necessary to probe deeper and to check that the sync pulse amplitude is sufficient, and that serious distortion of the sync pulses is not occuring during their passage through the sync separator circuits.

Noise pulses entering the sync circuits from the vision receiver may, if the sync separator is of a simple type, cause irregular timing of the line time base. This will show as a jagged vertical edge to the picture, and may in very severe cases break up the picture. The separation of the sync pulses from the picture signals should remove, to a great extent, noise coming in with the signals. If the sync separator does not limit sufficiently, there is a greater chance of irregular timing of the time base. It may be helpful, in cases where the signal strength is very low or varies widely, to have two limiting stages in the sync separator and a noise limiter in the video stage. This should prove very effective in bad locations. Information on noise limiting circuits will be given at a later date.

Design of the Superhet

[*Continued from p.* 67

presents a considerable amount of freedom from intercoupling between oscillator and signal tuned circuits; and, in addition, its conversion conductance is sufficiently high to make it an attractive choice from the point of view of sensitivity.

Fig. 3 shows a practical pentagrid circuit. It will be seen that the signal and oscillator frequencies are fed to grids 3 and 1 respectively, grid 2 offering a high degree of screening between the two. In addition, as the signal frequency affects the electron stream *after* the oscillator grid in the valve, coupling *via* the electron stream is almost entirely obviated. The values shown in the diagram should enable good results to be obtained in practice, although a greater amount of amplification may be obtained if the cathode resistor is reduced. Using the high value shown, the valve is liable to act as an anode bend detector; and whether it then gives greater sensitivity than would be offered if a cathode resistor of, say, 750 ohms were used, (this latter allowing normal mixing in the electron stream), is best ascertained by experiment when the receiver is being tested.

To reduce interaction to a minimum, not only must the screen-grid, but also the cathode decoupling capacitor be a really high-grade component. For this reason, it is extremely desirable to use mica instead of paper capacitors for decoupling these electrodes.

Conclusion

We have now reached the end of this series of articles on the superhet. As may have become apparent, the main points in superhet design are concerned with the circuit. The actual construction and layout of a superhet is, of course, just as important in getting a receiver to work well; but, once the constructor is aware of the fundamentals of superhet principle, and provided he uses constructional methods and layout that are not hurried but are well-planned out and logical, then he can hardly fail to build himself a successful and efficient superhet receiver.

Using RF25 Unit for Sutton Coldfield

Dear Sir, . . . I feel that maybe you might be interested in the easy way in which the RF25 Unit (for use with the R1355 receiver) may be altered for use on the Sutton Coldfield frequency.

Referring to the circuit diagram on page 28 (enlarged edition 'Inexpensive Television'), 2 turns are removed from L1 and the grid tap moved down 1 turn. 1 complete turn is removed from L2. L4 is not touched, but the coil feeding it from the HT line, L5, has 24 turns removed.

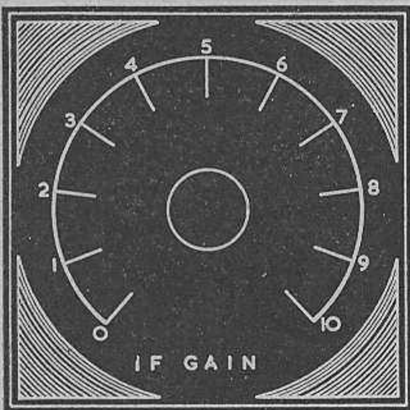
That's all there is to it. Sound will tune in on switch position 1, and vision can be received on positions 2 or 3. M. BROWN (*Bristol*)

Panel Sheet No. 3 (SEE NEXT PAGE)

The third of our Panel Sheets consists of a number of panel control dials which, used in conjunction with those of Panel Sheet No. 2, will cater for receivers of the communications type.

Two alternative dials are given for ' Variable Selectivity ', as this may be achieved by the use of a variable capacitor or by a potentiometer, each having a different amount of rotation of the knob.

For the benefit of new readers, these dials may be photographed and reproduced on celluloid, or they may be pasted direct on to the panel. In the latter case, some protection is necessary — we recommend ' Sellotape ' for this purpose.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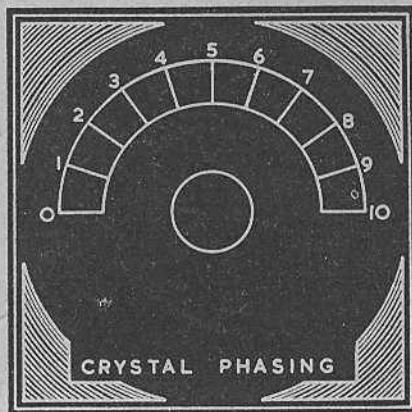
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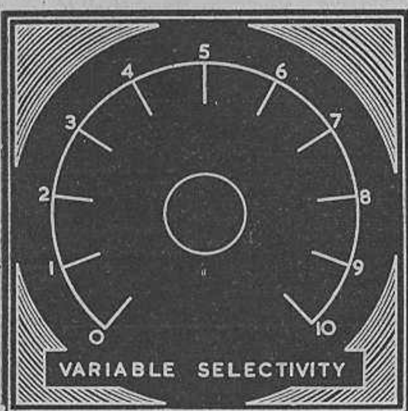
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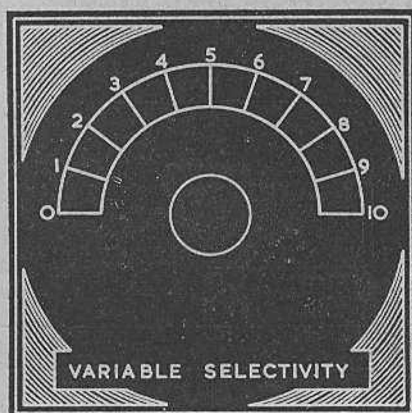
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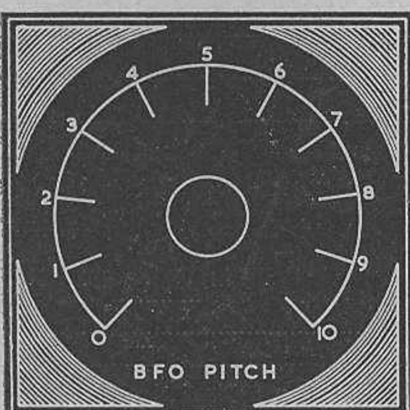
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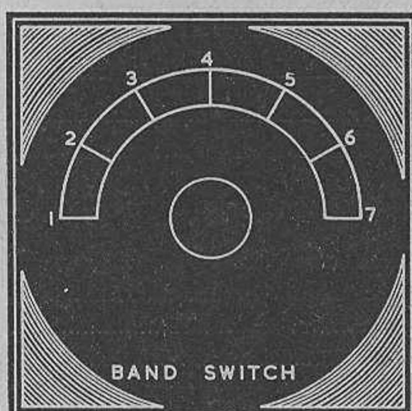
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