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RADIO CONSTRUCTOR

1/3
Vol. 3 No. 10
MAY 1950

For Every Radio Enthusiast

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Contents

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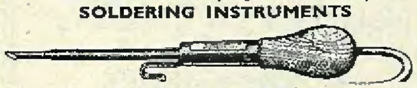

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Radio Constructor

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Edited by: C. W. C. OVERLAND, G2ATV

EDITORIAL

Data Book Series.

WE can now announce the publication of the fourth book in this series at the end of this month. Many of our readers will have seen 'Inexpensive Television,' the most popular book we have yet produced. This new 'Inexpensive Television' will be even more in demand, for it will be double the size. The original contents have been retained, with some revision. For instance, we have now included the complete circuit of the R1355, plus the RF Units 25 & 26. Additional material has been inserted, some of which is published for the first time.

The 'Power Supplies' section has been enlarged to cover metal rectifier and RF oscillator EHT packs. The 194 Unit, the 145 Mcs. Pye Strip, and a Home Built Vision Receiver are additions to the 'Vision Receiver' section, and there is data on the use of the RF27 Unit for Sutton Coldfield. The 'Sound Receiver' section now includes the 194 Strip and a Home Built Sound Receiver. A modified Time Base Amplifier is given as an alternative to the original in this section. Also included are articles on the Care & Use of Cathode Ray Tubes, Aerial Data for both the present transmissions, and some miscellaneous notes.

Altogether, a fine investment at 2s. 6d. for the TV enthusiast.

Miniaturisation.

Misprints are often very amusing. We could not help chuckling the other day when we read in a contemporary about a 1000 ton ½ watt resistor !

Your Workshop.

We have often wondered how the average constructor, if there is such a person, is equipped to carry on his hobby. This is not just idle curiosity on our part, for in order to print articles which will be acceptable to the reader, we should first have some idea as to his capability for making use of such articles. As an example, your Editor some time ago built a machine for engraving tuning dials of up to 6in. diameter, the finished dials being capable of being read to a tenth of a division. Now an article could have been written around this—but a lathe would be necessary to build the machine, and we do not believe that many radio constructors are thus equipped.

The case of articles on radio apparatus is not altogether similiar. The builder of a televisor can hardly expect maximum results unless he is well equipped with test apparatus, but here we are at least able to describe the construction of test apparatus.

On the whole, then, we can only please you most by being in a position to know what you are equipped to tackle. So we shall welcome any details of equipment sent in, whether it consists of the kitchen table and a few hand tools, or larger outfits with a work-bench and laboratory gear.

G2ATV

NOTICES

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

BUILDING YOUR OWN
SIGNAL GENERATOR

By **W. G. MORLEY**

PART SIX

SINCE the article clearing up questions raised by readers which appeared in last month's issue of the " Radio Constructor " was written, the author has been asked to give a circuit diagram of the complete unit.

Although, really, the articles were written to give guidance on the various snags which might be encountered in constructing one's own signal-generator, there is, of course, no reason why a complete and concrete circuit diagram of an easily-made model should not be given here. To cater for all tastes, the author has made up two circuits : one for a simple and one for a more complicated signal-generator. As explained in the articles, the photographs were used simply as an illustration to show the construction of a completed signal-generator. There is no necessity to use the layout shown in the photographs, it being necessary simply to remember that all RF-carrying leads must be short and rigid.

Figure " A " shows the circuit of a simple but very useful signal-generator. An ECO is used and the attenuator gives coarse control of the output voltages. The output to the attenuator is taken from coupling coils adjacent to the appropriate grid coils. To save useless repetition of what has been already written, the list giving the values of the various components also contains references to those parts of the articles in which they were reviewed.

Figure " B " shows a more ambitious model. In this case a tuned-grid oscillator is employed. Such coils as Wearite " P " coils would be ideal here, and on page 153 (Jan. issue), may be found a list of types which would cover the range of 145 kcs to 31.8 Mcs. The attenuator is fed from a cathode follower (see page 182, Feb. issue), and offers both fine and coarse control.

Two levels of AF modulation are available, being controlled by the switch connected across R6. When the values of R5 and R6 are being found (and this must be done by experiment), this switch should primarily be closed. A suitable value for R5 (i.e., one which will give about 30% modulation), may then be chosen. The switch should then be opened and R6 fitted. R5 and R6 together should cause a modulation depth of about 10%.

A slightly different AF oscillator circuit is used in Fig. " B," insofar that a low impedance output is taken from the AF transformer. This precludes the use of an ordinary intervalve transformer (as suggested on page 183 in the

Circuit Values to Fig. " A" Opposite.

L1, 2, 3, 4, 5, Grid coils of RF oscillator. These may be home-wound. See page 152 (Oscillator Coils)—Jan. issue.
L6, 7, 8, 9, 10, Coupling coils to attenuator. See page 151 (The Oscillator Circuit)—Jan. issue.
L11, AF oscillator coil. See page 183 (The AF Oscillator)—Feb. issue.
L12, Mains transformer.
L13, 14, RF chokes. See Fig. 15 and text—March issue.

R1, 20 K Ω
R2, 4, 5, Attenuator. See Fig. 8 and text—Feb. issue.
R6, See March issue (Modulation) and Fig. 13.
R7, Between 10 and 100k Ω. See page 183 (The AF Oscillator)—Feb. issue.
R8, 25 k Ω
R9, See Fig. 14 and text—March issue.
R10, 2k Ω

C1, 50μμF. See page 152 (The Oscillator Circuit)—Feb. issue.
C2, 500μμF tuning capacitor.
C3, 100μμF
C4, 0.01μμF mica. (Should be mounted near RF oscillator).
C5, Experimental—tunes AF oscillator coil.
C6, 0.005μF
C7, Between 0.001μF and 500μμF. See page 183 (The AF Oscillator)—Feb. issue.
C8, 9, 10μF or more.
C10, 11, 12, 13, 0.01μF

V1, RF oscillator.
V2, AF oscillator.

Any low-power triode may be used for V1 and V2, i.e., types 6J5, 6C5, L63, etc.

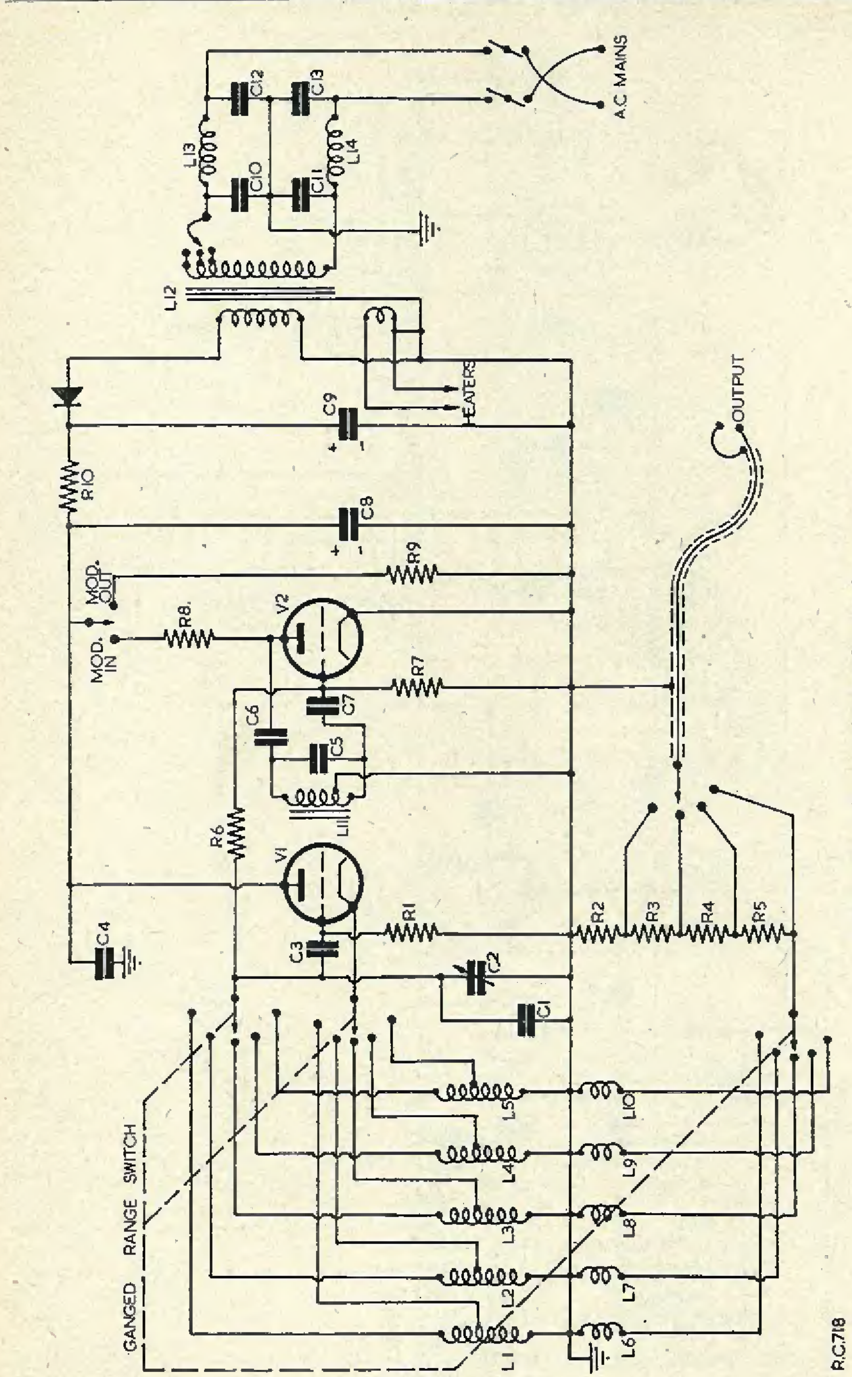


Fig. " A ". Circuit of a simple signal generator.

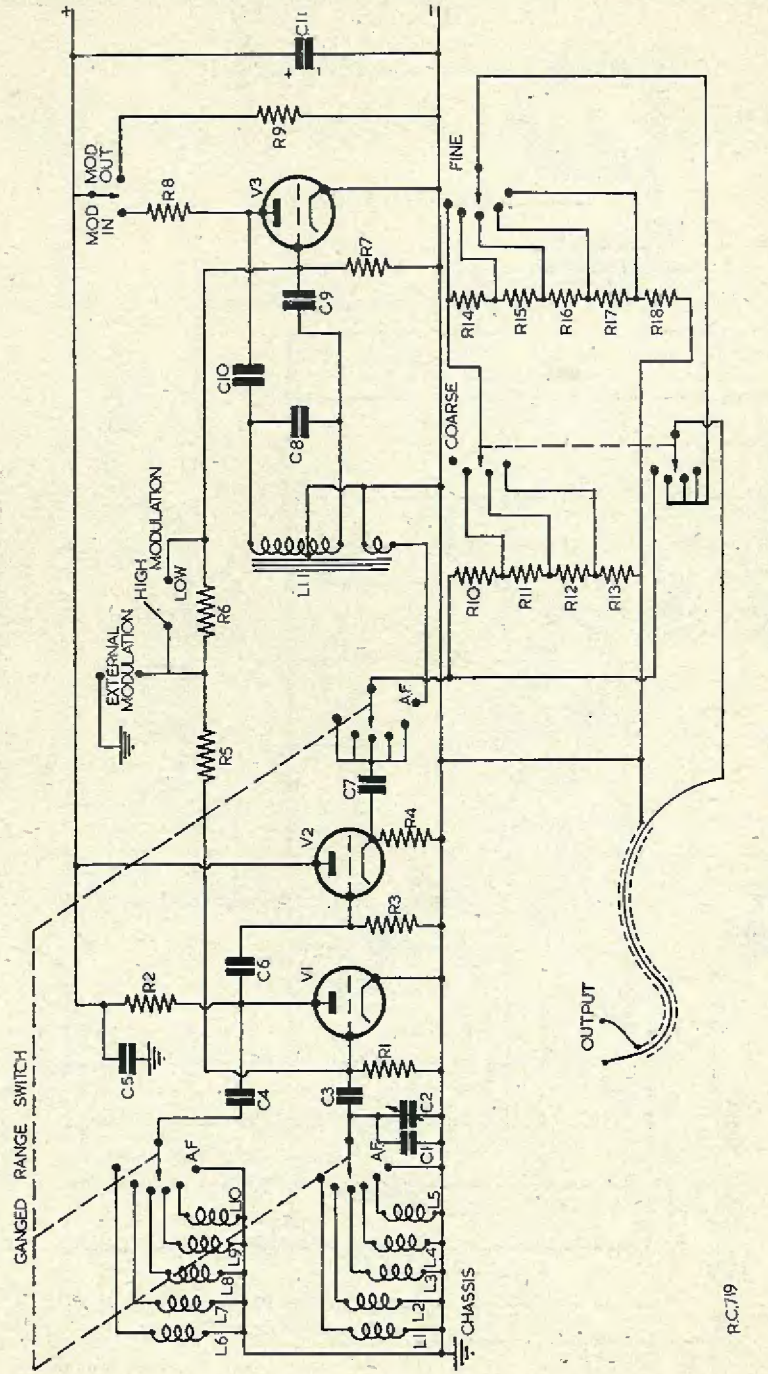


Fig. " B ". Circuit of a more ambitious signal generator.

Feb. issue), but a centre-tapped speaker transformer may be used quite satisfactorily in its place. The secondary then affords the low-impedance AF output. Alternatively, a microphone transformer with a tapped secondary may be used, the secondary being used as the oscillator coil. The AF from the low-impedance winding is taken to a sixth position of the range switch, from which it is passed to the attenuator. Thus, in addition to having an RF output, it is also possible to pass an attenuable AF signal to the signal-generator output as well.

The power unit circuits of Fig. " B " have not been shown as they correspond with those of Fig. " A." Capacitor C11 of Fig. " B " carries out the same function as C8 of Fig. " A," and the diagrams to the right of these two capacitors may be considered identical.

Finally, it must be pointed out that the range switches for the coils should have an earthing bar which short-circuits all coils not in use to chassis. If this type of switch is not available, another bank should be added to the range switch, the purpose of whose contacts is to short-circuit the grid coil adjacent to and higher in frequency than the one in use.

Circuit Values to Fig. " B" Opposite.

L1 to 10, Grid and coupling coils of RF oscillator. (See text above).
L11, AF oscillator coil with tapping. (See text above).
R1, 20k Ω
R2, 20k Ω
R3, 100k Ω
R4, 1,000 Ω
R5, 6, See text above.
R7, Same as R7 in Fig. " A."
R8, 25k Ω
R9, Same as R9 in Fig. " A."
R10 to 18, Values correspond to those in Fig. 10, page 185—Feb. issue.

C1, Same as C1 in Fig. " A."
C2, 500μμF tuning capacitor.
C3, 100μμF
C4, 0.001μF
C5, Same as C4 in Fig. " A."
C6, 50μμF
C7, 0.02μF mica.
C8, Same as C5 in Fig. " A."
C9, Same as C7 in Fig. " A."
C10, 0.005μF
C11, 10μF or more.

V1, RF oscillator.
V2, Cathode follower.
V3, AF oscillator.

Any low-power triode may be used for V1, 2 and 3, i.e., types 6J5, 6C5, L63, etc.

"RADIO CONSTRUCTOR" QUIZ

Conducted by W. Groome

(1) This month the writer dons the dunce-cap and takes the position usually held by our arch-bungler, Mr. Brain. With only a little over two hours of TV transmissions per evening, one can be easily tempted to rush an experimental job in order to try it out before the B.B.C. closes down.

In one such case the writer used a 4μF electrolytic capacitor (ex-WD) with a top positive connection, can negative. In his haste, he forgot the advice he has given frequently in these columns and hooked the thing up without checking the voltage rating. It was found later to be of 350V rating and the voltage across it was over 400.

After half an hour's use, the capacitor exploded with sufficient violence to send the top seal and connection flying across the room (the chassis being on its side at the time) and to bend the tinplate chassis by its recoil. The roll of foil was found yards away.

The prime cause was, of course, the application of excessive HT, but what action had taken place which could cause a quite spectacular explosion ? The writer offers his theory in the " answers " section, and you may find it interesting to think of an explanation and then to compare. Meanwhile the writer hangs his head in shame !

(2) Why is transformer intervalve coupling rarely used in AF amplifiers having pentodes as voltage amplifiers ?

(3) In which position does a frame aerial give minimum input to the receiver ?

(4) What is the object of line interlacing in TV ?

(5) How is interlacing achieved ?

(6) What may be the cause of the following faults observed on a TV screen :—

(*a*) A bright bar, horizontal, rolling up or down the screen when there is no picture, but stationary when sync is applied ; (*b*) a wavy edge to the raster in the vertical direction ; (*c*) poor frame locking ?

(Answers on page 299)

LOGICAL FAULT FINDING

The eighth in a series of articles to assist the home constructor in tracing and curing faults

By J. R. DAVIES

10: GENERAL APPROACH

IN this article we shall review the general manner of approach to a faulty receiver. This is almost as important as is the actual location and replacement of the faulty members of the circuit.

By the "general approach" we do not mean that the set should be carefully rested on the bench and lulled to security with such loud comments as "Think I'll go to the pictures tonight," or "It would be a nice evening to have a drink with the boys," the receiver being left for half an hour; after which one sidles up to it and tears its guilty secret from its surprised and unsuspecting interior. Rather do we mean the more mundane process in which time is saved by simply sitting down and looking the job over before the fault is chased to its lair.

FIG. 60A

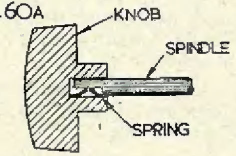
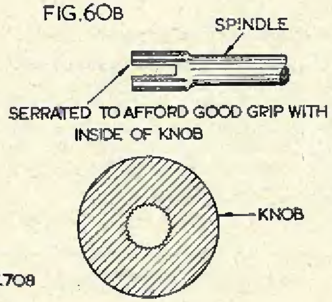


FIG. 60B



RC.708

Fig. 60 (a) and (b). Two common methods of fastening a knob to its spindle by means of spring devices.

Removing the Chassis

Now, quite often, the removal of a receiver chassis from its cabinet is not a quick and simple job. Knobs have to be removed, speaker connections unsoldered, tuning dials unhitched, and all manner of other irritating little things have to be seen to. For this reason it is always very well worth while making certain that the fault cannot be rectified whilst the chassis is in the cabinet. Such things as unserviceable valves, bad connections to plugs, etc., are all faults within this category. However, it must always be borne in mind (particularly if one is carrying out service work commercially), that the set might as well be given a good overhaul whilst it is on the test-bench; this, of course, nearly always necessitates the removal of the chassis. The serviceman has to decide how far he intends to go with his repair work in each particular case.

It is by no means always essential to remove the chassis, even for an overhaul. The manufacturers of some sets (particularly of those in which the components have overflowed from the chassis and are fixed at odd points to the cabinet itself), quite often fit a small inspection cover to the bottom of the cabinet, thus enabling one to get at most of the components and trimmers quite easily. These covers are occasionally used to provide screening as well, and consist either of a metal plate, or, more often, of a sheet of cardboard or plastic covered with metal foil or metal paint. In this case it is very important to see that a good electrical connection exists between the receiver chassis and this screen when the set is reassembled. Usually the connection is made via one of the metal mounting brackets to which the screen is screwed. If any of the screws holding the screen are missing and cannot be replaced, always make sure that, of those remaining, one is fixed to this earth-connected bracket.

Removing the Knobs

The first thing to do, when removing a chassis, is to take off the knobs. These should first of all be examined to see if they are held with grubscrews. Always use a good screwdriver with a cleanly-ground blade for removing grubscrews, as it is very easy to break them if the proverbial B.F.A.B.I.* is used.

If no grubscrews are found, the knobs are most probably held by some spring device in the knob itself. Fig. 60 shows two of the most common types of fastening encountered. These knobs are removed by the simple process of pulling them off. If a fastening of the type shown in Fig. 60 (*a*) is employed, care must be taken to see that the small metal spring does not fall out of the knob and get lost. These little springs have a habit of hopping out of the knob as it is removed.

Occasionally, the springs holding the knob are so tight that it is very difficult to pull it off. Fig. 61 (*a*) shows a cross-section of a particularly awkwardly shaped knob where the only purchase that may be obtained by the fingers is on the rim. If an example of this type is encountered, the method which is definitely *not* recommended is that of levering the knob off with a screwdriver. The angle of pressure is entirely incorrect and, if the serviceman is not left with a broken or chipped knob, he is almost certain to scratch the cabinet. The correct way of removing a knob of this shape and position is to put a handkerchief (or a rag with a strong hem) between the knob and the cabinet as shown in Fig. 61 (*b*). The ends of the handkerchief are then brought round until they cross each other. See Fig. 61 (*c*). The ends are then brought down and the knob is pulled off as illustrated in Fig. 61 (*d*).

If any of the receiver knobs project from the side of the cabinet, it may be found that they are mounted on a small separate spindle (see Fig. 62). In this case the spindle should be removed as well as the knob.

Removing Connections and Mounting Bolts

After the knobs have been detached, the next item on the agenda is to see if any connections have to be removed. Usually the speaker is mounted directly on the cabinet and the leads to this component may need to be unsoldered. Most makers thoughtfully fit a plug and socket. (Unfortunately, the wire they fit from the speaker to the plug is often not long enough to enable the connection to be made when the chassis is on the test-bench. That, however, is another story!)

If any components are fixed to the inside of the cabinet it is usually worth while unscrewing them, and bringing them out on the end of their leads as the chassis is removed. The set will not, of course, work without them in circuit, and it is usually quicker to unscrew the actual component than it is to keep making and re-making the various connections.

Any mechanical couplings such as that to the tuning drive, etc., should next be removed.

After the serviceman is certain that the

*B.F.A.B.I.—Brute Force and B——— Ignorance.

FIG 61A

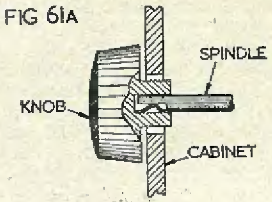


FIG. 61B

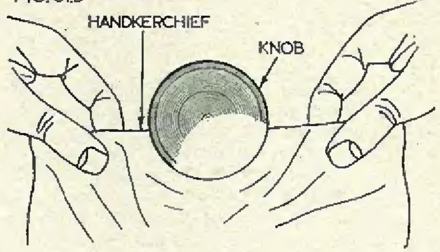


FIG. 61C

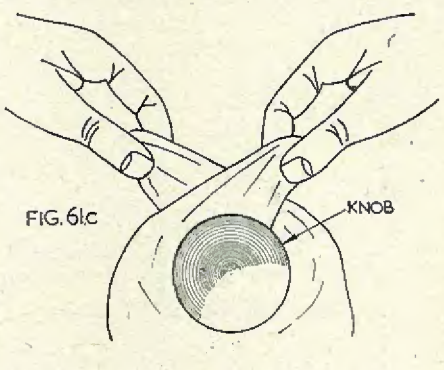
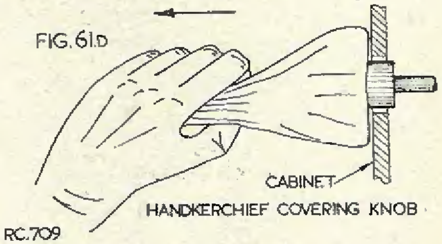


FIG. 61D



RC.709

Fig. 61(a) and (b). Showing the successive steps needed to remove an "awkward" knob from its spindle without damaging the knob or scratching the surface of the cabinet.

chassis is free the mounting bolts may be unscrewed. These will usually be found underneath the cabinet. Although it may seem incredible, the writer has come across several cases in which a careless serviceman has removed the last chassis-mounting bolt whilst the cabinet was on its side, with the result that the chassis, not being held, has fallen out of the cabinet and suffered considerable damage. The quickest and safest method of removal is to put the cabinet on its side and remove all the screws except those two which are at the top. See Fig. 63 (*a*). Then set the cabinet down so that the remaining two screws project over the edge of the bench and may be removed in that position. (Fig. 63 (*b*)).

Alternative methods of mounting the chassis are sometimes encountered. In one case, the chassis slides along two channels in the inside of the cabinet, being held by two screws at the rear. In another, the chassis has two holes in its front surface which coincide with two cone-shaped pieces projecting back from the inside of the front of the cabinet. Again only two screws at the rear are used.

One occasionally finds that small spikes are fitted to the bottom of the chassis. When the

FIG. 63A.

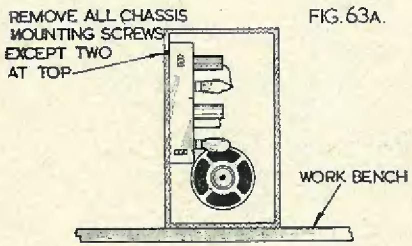
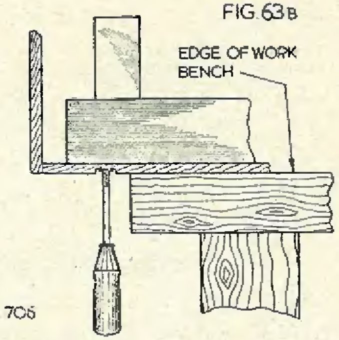


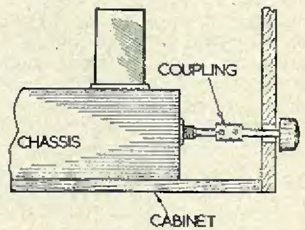
FIG. 63B



RC 706

Fig. 63(*a*) *and* (*b*). *A quick and safe method of removing the chassis mounting screws.*

FIG. 62



RC.707

Fig. 62. *Knobs projecting through the side of the cabinet are often coupled to the chassis by means of a separate spindle, as shown here.*

mounting bolts are tightened, these spikes grip into the wood of the cabinet, and make removal a little difficult.

Most receivers, nowadays, are fitted with some form of floating mounting between the chassis and the cabinet. This sometimes consists of rubber washers which may get mislaid during servicing, and care must be taken in this respect. In addition, some AC/DC receivers may be found to have some form of insulated washer fitted between the chassis and the mounting screws, this being a precaution to obviate the liability of shock should the latter be touched. Here again, care is necessary during reassembly.

When the chassis has been removed and is on the test-bench, all that remains to be done is to see that all connections are remade to those components which remain inside the cabinet. The speaker leads need especial care. If the speaker transformer is mounted on the speaker, the set should never be switched on unless the transformer primary is in circuit. Otherwise full HT voltage will be applied to the screen-grid of the output valve whilst the anode circuit is open. This will very often damage the valve. If the necessary connection has to be made direct to the speech coil, good quality wire should be used for the link. It is amazing how much distortion can sometimes be caused when the circuit between the speaker transformer secondary and the speech coil introduces a small value of resistance, even if only of the order of an ohm or so.

Finally, before running the set through its various tests, the knobs should be refitted to the spindles. This will save considerable time during servicing and will obviate any crackles that may occur when a spindle which is making bad electrical contact with the chassis is rotated. When the spindle is insulated from the hand by means of the knob, the crackling disappears.

—To be continued—

THE 1950 STRAIGHT FIVE

By G3XT

THIS set is giving good results in a part of the country which is notoriously bad for reception of the B.B.C. programmes. Nevertheless, I would urge you *not* to copy my design as it stands, but to begin where I left off, and thus—I hope !—produce an improved version which will beat mine hollow.

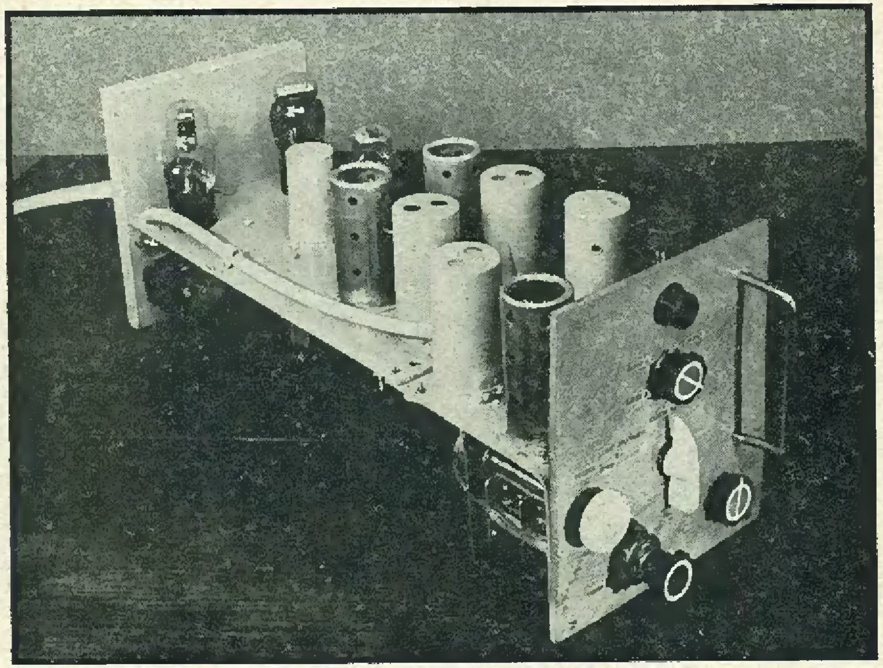
The rather crude experimental model shown in the photographs is built almost entirely with re-used parts, second-hand, Government surplus or home-made. Nor are the valves new. As for the loudspeakers (the receiver feeds one principal speaker and two small extension instruments in other parts of the house), one is 15 years old, and another is a second-hand one salvaged from a local dealer's junk heap for five shillings !

With this unpromising combination, speech and music have been heard clearly up to a distance of 50-100 yards outdoors. Quality is lifelike and beautifully clear on speech, and up to a good average on music ; a more ambitious and efficient loudspeaker would probably effect a marked improvement where loud music is concerned, as the present speakers tend to overload somewhat if the volume is turned full on.

During an evening's test, practically every worthwhile European station on the medium waves could be received at loudspeaker strength with a small indoor aerial and no earth. Selectivity would be poor with a large outdoor aerial, unless it were very lightly coupled to the set, say through a very small capacitor.

MAIN FEATURES

1. *Complete frequency-coverage for the new Copenhagen waveplan (in force from March,* 1950).
2. *Automatic selector control giving choice of three programmes:*
   (*a*) *one fixed spot frequency, long-wave (e.g., Light Programme on* 1,500 *metres), with fixed reaction;*
   (*b*) *one fixed spot frequency, medium-wave (e.g., Home Service or nearest regional), with fixed reaction;*
   (*c*) *any one spot frequency within the range* 160-600 *metres, with tuning and reaction pre-adjusted for optimum results; or, variable tuning tuning and reaction for " touring " round medium-wave stations.*
3. *Medium-wave band covered in three switched ranges, with ample overlap, giving best inductance-capacity ratio for any portion of band, and wide coverage with easy tuning.*
4. *Adequate selectivity for most purposes. Good sensitivity, will receive most worth while medium-wave programmes at good strength with short indoor aerial, and no earth.*
5. *Colour-coded controls make for easy operation by non-technical members of household.*
6. *Push-pull output, giving good quality and volume. Speech and music from principal stations has been heard clearly up to* 50-100 *yards from loudspeaker in open air.*
7. *All components readily accessible for testing and servicing. Chassis stands firmly in almost any position—upright, inverted, sideways or on end—thus facilitating construction, wiring and servicing.*
8. *Set can be built entirely from cheap " surplus " and home-made components.*
9. *Flexible layout with plenty of space for modifications or additions to suit individual needs.*
10. *Simple, easily-made wooden cabinet.*



Three-quarter view of receiver showing front panel and top of chassis.

Selectivity is also impaired if the RF volume control is turned full on and little reaction used ; but by turning back the RF volume control and advancing reaction to make up for the loss in signal-strength, selectivity becomes surprisingly good considering the simple, straight circuit used.

This circuit, as you will see from a glance at the diagram is basically a conventional TRF arrangement, but with the addition of some novel modifications which make all the difference. The valve line-up is 6K7 RF, 6J5 detector, 6J5 AF and a pair of 6V6's in push-pull for the output stage. Transformer coupling is used before the 6V6's, and this may be open to criticism on the grounds of quality. Actually, a phase-splitter with RC coupling was tried, but discarded, because the gain in quality over a *good* transformer did not seem sufficient to justify the extra complication.

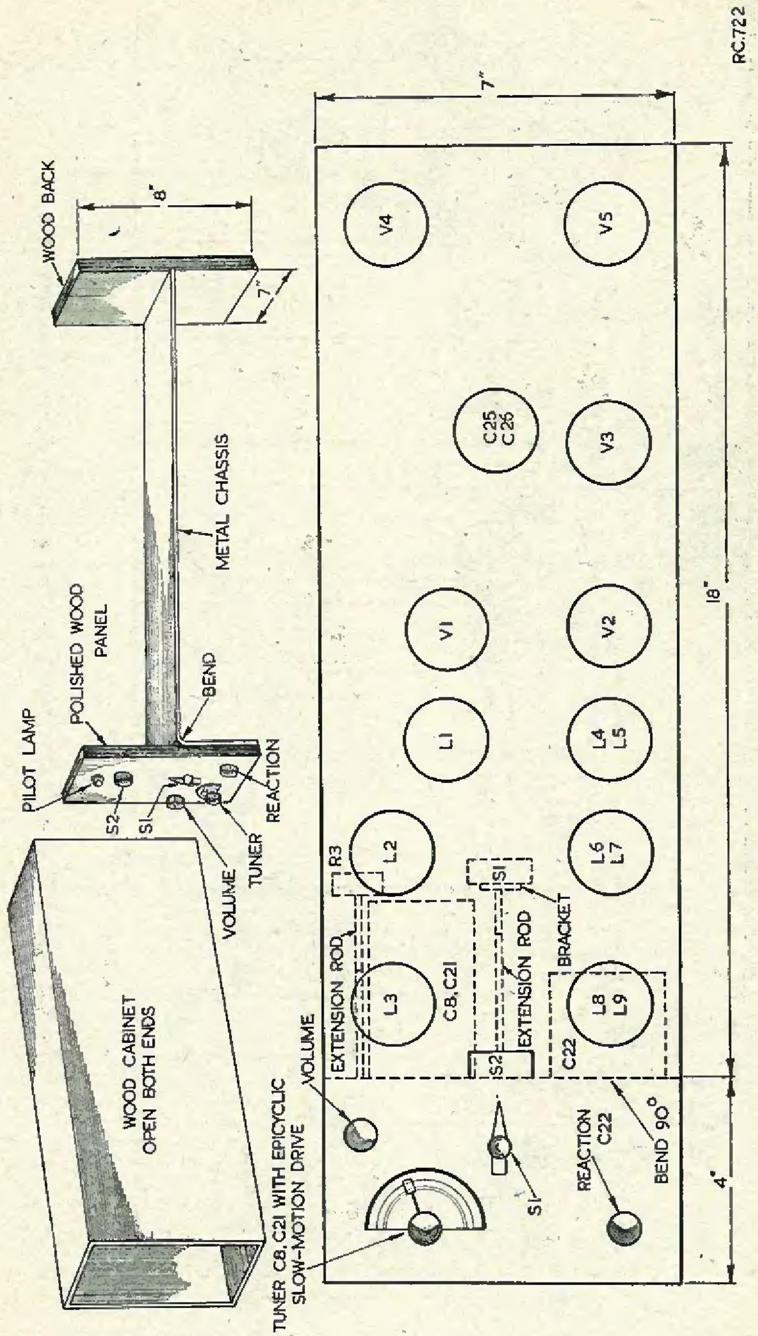
As the majority of constructors would probably prefer to be more up-to-date and use the phase-splitter, however, I have left ample room on the chassis for the extra valve to serve this purpose.

The most novel features of the set are in the tuning arrangements, and here a most useful system has been devised, which would be equally suitable for adaptation to a superhet and is, therefore, I think, of general interest to all home constructors.

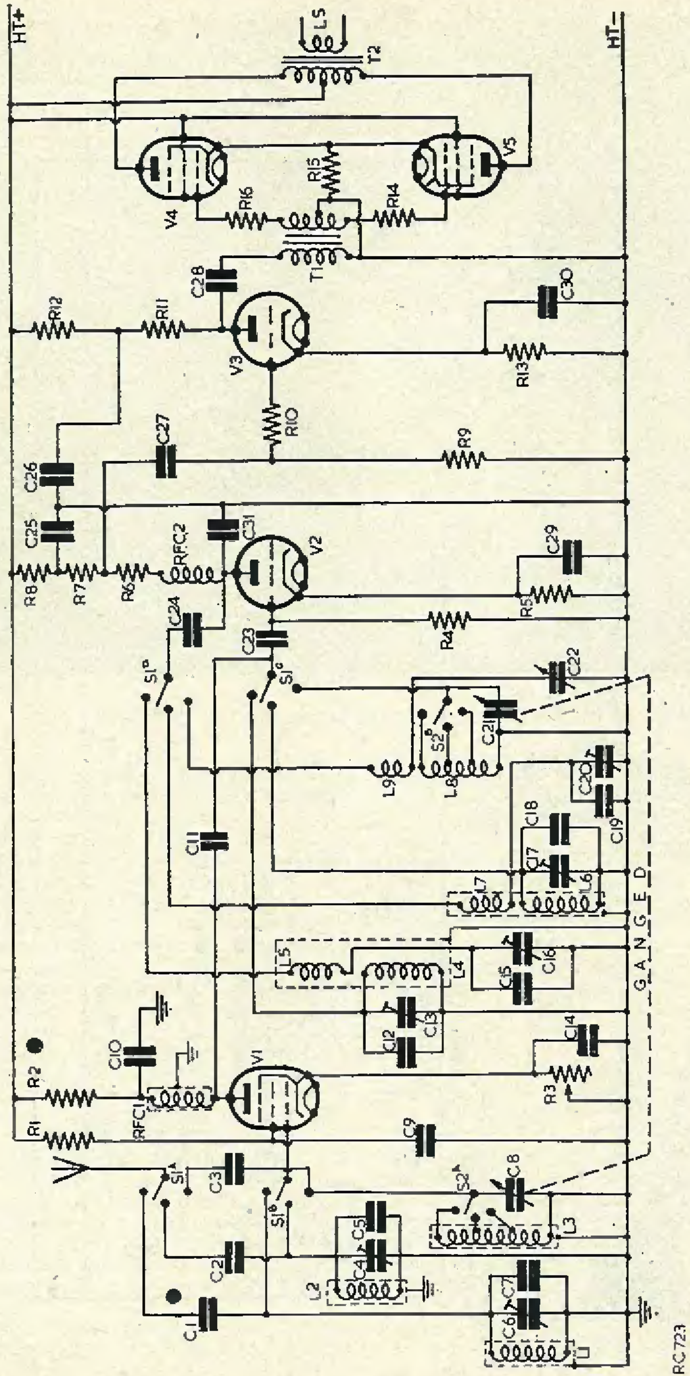
You will see from the photograph that the panel carries five controls (and a red pilot-light). Three of the control-knobs are colour-coded by enamelling their centre discs green, blue and red (or any other distinctive colours you like). These are intended for use by technically-minded members of the household who like tuning round for distant stations !

The two remaining controls are enamelled white all over, so that they can be distinguished at a glance. These "XYL's handles" are for use by non-technical members of the household who want to get two or three programmes only, quickly and easily without a lot of knob-twiddling or dial-reading !

The central white pointer-knob is the main control. It drives a four-pole three-way wafer switch which deals, simultaneously and automatically, with aerial, RF tuning, detector tuning and reaction, giving "preselected" choice of one fixed spot frequency in the long waveband (e.g., the 1,500 metre Light Programme), one fixed spot frequency in the medium waveband (say, the Home Service) and one variably-preselected programme on any available frequency within the range



Constructional details of the 1950 Straight Five receiver.



Circuit diagram of the 1950 Straight Five receiver. Component values are tabled on next page.

RADIO CONSTRUCTOR

LIST OF COMPONENTS

C1, C2, C3, Silver mica or air-dielectric pre-set with ceramic insulation ; values depend on length of aerial and spot frequencies chosen. Limits 5 to 100$\mu\mu$F
C4, C6, C13, C16, C17, C20, 0-40$\mu\mu$F pre-set trimmers.
C5, C7, C12, C18, 300 or 350$\mu\mu$F silver mica.
C8, C21, Twin-gang air-dielectric variable, 500$\mu\mu$F per section.
C9, C10, C14, C28, C29, 1μF
C11, C15, C19, 300$\mu\mu$F silver mica (200-500$\mu\mu$F will do for C15 and C19 if reaction turns are adjusted accordingly).
C22, 500$\mu\mu$F variable (reaction).
C23, 100$\mu\mu$F silver mica.
C24, .002μF mica (but any capacity from .001 to .1μF will do).
C25, C26, 8 + 8μF (electrolytic).
C27, .01μF
C30, 25μF (electrolytic).
C31, 200$\mu\mu$F (approx.).
R1, 20,000-50,000 Ω 1 watt.
R2, 17,000 Ω 1 watt (7,000).
R3, Say, 0-10,000 Ω variable volume control.
R4, 1M Ω
R5, 4,700 Ω
R6, 10,000 Ω
R7, 100,000 Ω
R8, R12, 25,000 Ω
R9, .5M Ω
R10, R14, R16, 5,000 Ω
R11, 50,000 Ω
R13, 1,000 Ω
R15, 350 Ω
L1, L2, L3, L4, L5, L6, L7, ¾″ diam., 32 SWG (see text).
(L3 has inductance value to match L8, L5 and L7 are reaction coils).
L8 1″ diam., 32 swg, 120 turns, tapped at 40th and 80th turns.
L9 1″ diam., 32 swg, reaction, 40 turns.
S1, 4-pole, 3-way wafer switch.
S2, 2-pole, 3-way wafer switch.
RFC1, Screened RF choke.
RFC2, Ordinary RF choke.
T1, Intervalve transformer, push-pull type.
T2, Output transformer to match speaker.

covered by the set.

This novel feature means, in practice, that you can tune in any one station, before you go off to work, which your wife or family may choose, adjusting reaction, etc., for best results. Then, by handling the two white controls only (the RF volume and selector switch) the non-technical user of the set can switch at will to the Light Programme, Home Service and the other programme, B.B.C. or Continental, which they have chosen beforehand.

Thus you have all the advantages of a three-station push-button receiver with the added advantage of a wide variety in the third choice.

With the selector switch in the third position, the variable tuning and reaction controls are brought into action ; also a wavechange switch giving three frequency-ranges. This splits up the medium waveband so as to give exceptionally wide coverage (about 160 to 650 metres) which is necessary to take full advantage of the new Copenhagen waveplan in force from March, 1950. It also permits an optimum choice of inductance-capacity ratio for any given portion of the waveband. This in itself is a big help in getting good signal-strength combined with adequate selectivity.

You will notice that there are only two tuned stages (RF and detector), but six coils, five of them fully screened. This may seem an unnecessary extravagance at first glance, but as plenty of good screening-cans were available for next to nothing from an old surplus ex-R.A.F. receiver, and the home-made coils cost only a few pence each to make, it was well worth while, since experiment showed that these separate tuners were really necessary in order to provide the automatic selector arrangement which is such a novel and useful feature of the set.

There is, of course, nothing new in automatic selector tuning, but the addition of automatic reaction is, I think, an innovation. It makes a tremendous difference in a simple straight receiver such as this, and the automatic pre-set control eliminates any need for adjustment by the non-technical user, cuts out any possibility of the said non-technical (and probably feminine) hand causing discomfiture to the neighbours by howling and squealing with excessive reaction (though this would be hardly likely to occur anyhow in the present circuit, due to careful screening of the RF stage and the fact that a small indoor aerial is all that is needed with the set).

To get this automatic reaction arrangement working properly, the six separate broadcast coils were found to be necessary, and I should not advise anyone who builds the set to attempt to simplify it by the use of fewer coils. It will be seen that one of the detector coils is unscreened. This gave slightly better results, and screening was found to be unnecessary with the other five fully screened. It would not be advisable to omit the screens on any of the remaining coils, however, as they are fairly close together and the tuning of the " variable " coil would be likely to interact with the fixed resonance of the pre-set coils, thus spoiling the reliability of the " automatic " arrangement.

I hesitate to give exact details of the coil-windings, as these will naturally depend on what stations you want for pre-selection.

At my own location we generally rely on the Midland frequency for normal reception of the Home Service programme, as the Norwich station operating on this frequency gives the strongest signal as a rule. But in other regions, of course, another choice will be necessary, so each individual constructor must find out for himself the number of turns and the associated capacity required to tune exactly whatever frequency he wants pre-selected.

The four pre-selection coils were wound on tubular formers three-quarters of an inch in diameter, and the wire used was 32 swg enamelled. As a rough guide, something in excess of 100 turns will be needed for the medium wave fixed frequencies, and about 300 odd for the long-wave spot frequency. The windings were put on in multi-layer fashion, with cellulose self-adhesive tape between the layers. Not a very efficient arrangement, perhaps, but it worked well nevertheless. The reaction winding can contain sufficient turns to bring the circuit near to the verge of oscillation in conjunction with a fixed silver-mica capacitor of, say, 300 or 400pF shunted by an efficient and reliable pre-set capacitor of, say, 40-50pF for the final critical adjustment.

I repeat, the best values for the coils and capacitors in these fixed-tune circuits must be found by practical experiment. But for the variable-tune circuits I can give you more explicit details. The two coils for these are wound on tubular formers, and in my own version I used a 1-inch diameter tube for the unscreened coil and a smaller one (¾-in.) for the screened (RF) coil. The detector coil consisted of 120 turns of 32 swg enamelled wire in a single layer, tapped at the 40th and 80th turns to form three equal sections. The winding occupies a length of 13 inches. The reaction winding was a single layer of the same wire, 40 turns, placed as close as possible to one end of the grid winding.

The RF coil should be wound to match the grid coil electrically—i.e., when the two coils are tuned by a twin-gang 500pF capacitor, they should keep in step. But as one coil is screened and the other not, and as the screened coil is on a smaller diameter former (to prevent the winding being too close to the screening can) it will obviously need a different number of turns. Stray capacities, too, will be different ; so here again I should advise you to proceed by trial and error methods.

The tuning of the RF stage will probably be less critical than that of the detector, and in some districts where interference on B.B.C. programmes is very bad (as it is in my own area), you *may* even find it advantageous to deliberately arrange a certain degree of mismatch in the coils, so that the RF circuit is slightly out of step with the detector, as I have found that this sometimes gives an improvement in selectivity ! Of course, it cuts down the signal strength when the two circuits are thus misaligned, but there is plenty of amplification available in this set to make up for any such losses. (Of course, the RF circuit must *not* be tuned to a strong unwanted signal !)

For the fixed-tuned circuits, best quality silver-mica or ceramicon fixed capacitors, shunted with reliable trimmers, are the safest choice. Some types of (alleged) mica will be found greatly inferior and should not be used. I also used silver-mica for the grid capacitor in the detector circuit. The remainder of the components require no special comment, and the list will show what is needed.

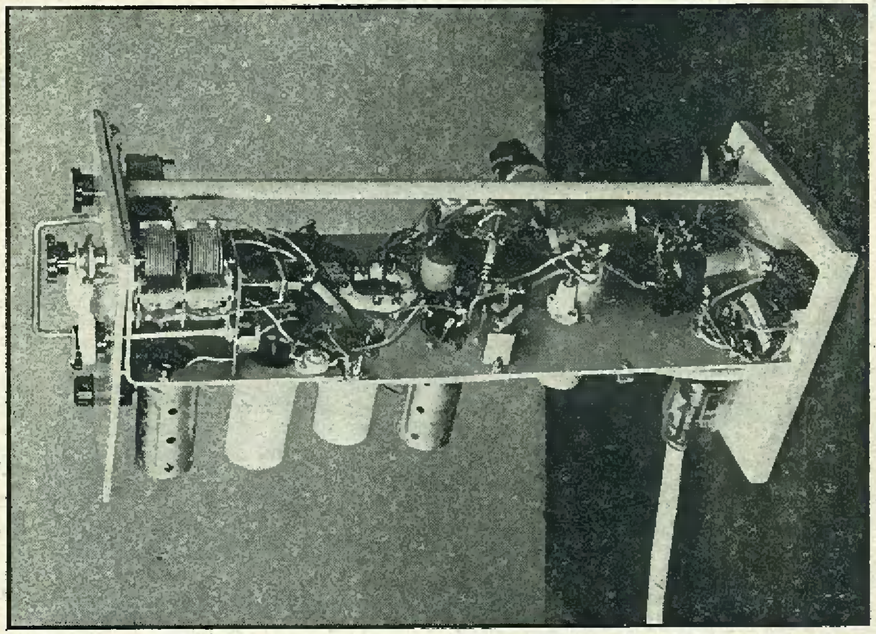
On second thoughts, it might be well to stress the importance of using really good switches for the pre-selection and wave-range positions, as these have to do a lot of the work, and bad contacts here will certainly spoil results completely.

The chassis can be made of heavy-gauge aluminium, with wooden end-pieces forming the front panel and back of the set. The whole thing can then slide into a wooden cabinet, open at both ends, and made very simply with four pieces of wood. The method of construction has one great advantage : unlike most sets, the chassis of this one can be stood firmly upside down, sideways, or even on end, while experimenting with different components or testing for faults in the event of subsequent breakdown. This rigidity in the upside-down position is equally convenient in facilitating the actual assembly and wiring of the whole receiver.

A separate power-pack and separate loudspeakers are used at G3XT, and if space permits I should suggest you do the same. Risk of interaction, hum, etc., are thus minimised. But if you *must* incorporate the power pack in the set, the chassis size suggested is big enough to take the extra components. In fact, this receiver may be criticised on the grounds of bulk—the overall dimensions when in the cabinet are about 20-in. by 8½-in. by 7½-in., but this was done purposely to allow plenty of space for any individual modifications, and to make every part of the set easily accessible for testing, repairs, etc., when needed. A much more compact layout *could* be adopted, but I doubt whether it would be advisable.

The original model was found to work much better without any earth connection ; and only a short length of flex was needed for the aerial. Even this has series capacitors between the aerial and the grid circuit of the RF valve. These capacitors help a lot towards giving adequate selectivity, and it pays to use the smallest capacities compatible with good signal-strength.

Many weeks of experimenting went into the production of this receiver, and some battle-



View showing sub-chassis arrangement of receiver.

scars from the initial trials and errors can be detected in the photographs—i.e., unwanted holes, joins in the chassis, and not-too-tidy wiring ! You will, I hope, be saved all this spadework and be able to profit by my mistakes so start where I left off and don't do as I did—do better ! I think you will then be pleased with the results.

TRADE REVIEW

Surely a " must " for the radio constructor's workshop is the new " ARAX " range of solders.

Short of aluminium and kindred materials, practically any metal may be soldered with it, to produce really effective joints. One such test case carried out by your reviewer was a repair to the steel framework supporting a speaker cone.

In this instance, " ARAX " solder fully supported the maker's claims. The fractured sections, being old, were thoroughly oxidised through exposure. No cleaning was attempted, yet the fluxes incorporated in the solder effecitvely cleaned as they flowed, taking the solder well into the joint.

An ordinary electric iron is perfectly satisfactory, but it would appear to be advisable to re-tin the iron before use with whatever type solder is to be employed.

It must be understood that to carry out such soldering, special fluxes must be used, and one word of warning would be timely here. " ARAX " solders must NOT be used for radio or electrical connections ; a full range of " Ersin Multicore " solders are available for this purpose.

Constructors will no doubt recall to mind many instances where this new solder would have solved a workshop problem. To those readers requiring techinical data, Messrs. Multicore Solders, Ltd., Mellier House, Albemarle Street, London, W.1, will be pleased to supply full details.

Design of the SUPERHET

PART 7 By R. J. CABORN

LAST month we dealt in some detail with the diode detector, finally evolving a circuit which was not only typical of modern superhet practice but was also very practicable and trouble-free in operation.

The Infinite Impedance Dtector

Now, it should be remembered that the diode detector imposes a slight load on the last IF transformer, thereby sometimes necessitating a tighter coupling in the transformer than would normally be the case. It may also be seen that this loading effect is liable to damp the transformer secondary, causing a reduction in the efficiency of that tuned circuit, and resulting in lowered selectivity and sensitivity.

In practice, this loading effect is not so great as to cause a large loss in signal strength or selectivity, but it is nevertheless a disadvantage.

A type of detector which is used sometimes in specialised equipment (particularly in high-fidelity receivers) is the infinite-impedance detector. A circuit of this detector is given in Fig. 1. It will be seen that the valve functions in something of the same manner as the cathode follower. No current is drawn by the grid of the valve and the detector, therefore, imposes no load on the tuned circuit. The cathode circuit biases the valve almost to cut-off. Only positive half-cycles of RF appear across the resistor R^1, thereby giving the necessary detecting action. The value of R^1 is a little critical and that given in Fig. 1 may have to be varied (probably reduced) in some cases. The capacitor C^1T by-passes

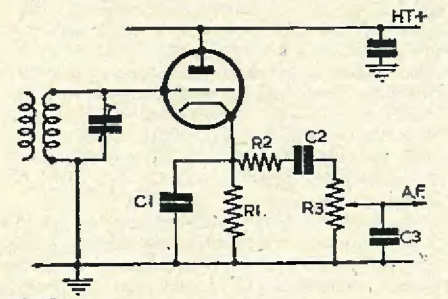


Fig. 1. The infinite impedance detector.

most of the RF energy developed across R^1T and the AF component built up across this resistor is passed via R^2 (which offers a high impedance to RF) and C^2 (which blocks the DC component from being passed to the following AF grid) to the volume control. The capacitor C^3 is optional and may alternatively be connected across the whole of R^3. Its purpose is to by-pass any RF energy still remaining in the circuit. If a screened lead is used for connection to the following AF grid, the self-capacity in this may render C^3 unnecessary.

The advantages of the infinite impedance detector are those of linear operation, resulting in very high fidelity of reproduction ; freedom from overloading (the upper limit being set only by the available anode voltage) ; and the fact that the tuned circuit is not loaded.

The disadvantage of this type of detector is that it is very difficult to use it to supply any AVC voltages.

Automatic Volume Control

Let us now turn our attention to the AVC circuits themselves.

The disadvantage of receiving weak or distant stations is that these stations appear to be subject to what is known as fading. To overcome this effect, automatic volume control is very often fitted to superhet receivers. The purpose of AVC is to automatically vary the sensitivity of the receiver according to the strength of the signal being received, the sensitivity being made greatest on reception of weak signal and least on reception of a strong signal. Thus, the effect of a continually fading signal is to a great extent cancelled by the AVC circuits and a fairly constant audio level is applied to the loudspeaker.

Automatic volume control is carried out, in practice, by detecting the IF voltage (or a portion of it) applied to the detector. Instead of utilising the resulting AF, however, the DC component is used. The AVC detector is connected in such a way that this DC voltage is negative with respect to chassis, and it is then used to bias the valves preceding the detector. As the value of the DC voltage developed will depend upon the strength of the signal applied to the detector, it may be seen that it will increase in proportion to signal strength.

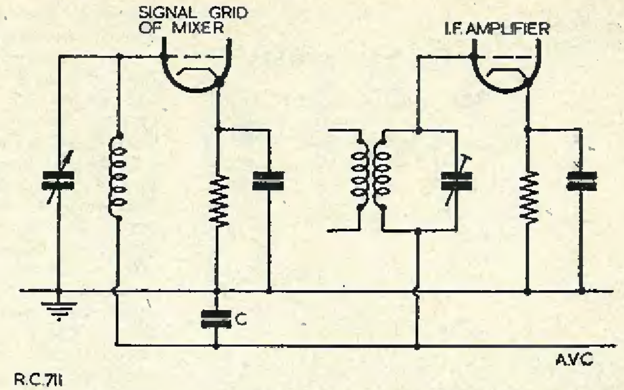


Fig. 2. How AVC is applied in a simple superhet.

If we look at Fig. 2 we may see how this negative voltage is applied. In this diagram (representing the state of affairs in a typical superhet) both the signal-grid of the frequency-changer and the control grid of the IF amplifier are returned, via the coils of their tuned circuits, to the AVC line. This AVC line carries the

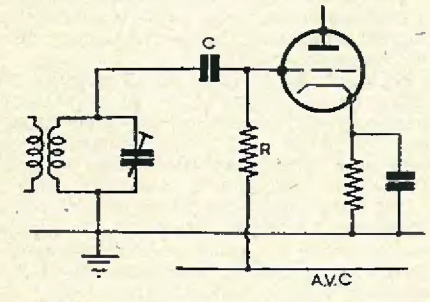


Fig. 3. An alternative method of applying the AVC voltage to individual valves.

negative voltage given by the AVC detector. Both the valves shown in the figure have variable-mu characteristics. That is to say, their amplification factor may be smoothly controlled by varying their grid bias, the amplification factor decreasing as the bias becomes more negative. Therefore, as the negative voltage of the AVC line increases, owing, say, to the reception of a strong signal, the amplification factor of the two valves becomes less. The result is a reduction in the sensitivity of the receiver, and a corresponding weakening in the signal applied to the audio detector. In this way the process of automatic volume control is carried out.

It must be pointed out that the circuit of Fig. 2 represents the connections to the AVC line in a simple superhet. If more than two valves were controlled, it would very probably be necessary to have more adequate decoupling of the various AVC feed connections than would be offered by the single capacitor C.

Applying the AVC Voltage

In Fig. 2 the AVC voltage is applied to the control grids via the coils of the tuned circuits. The capacitor C is used to provide the return path to chassis necessary for the RF and IF tuned circuits. In the case shown, this capacitor should be mounted as close to the RF coil as possible, because it is itself part of the RF tuned circuit.

An alternative method of applying AVC to any of the valve grids is shown in Fig. 3. In this case the grid is biased via the resistor R, the capacitor C preventing a DC circuit to chassis. This circuit is not widely used as there is little necessity in supplying the extra resistor. In addition, there is a possibility of detection owing to the similarity of this circuit to that of a leaky-grid detector. One

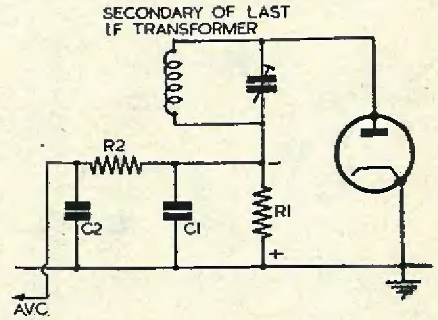


Fig. 4. A simple AVC detector.

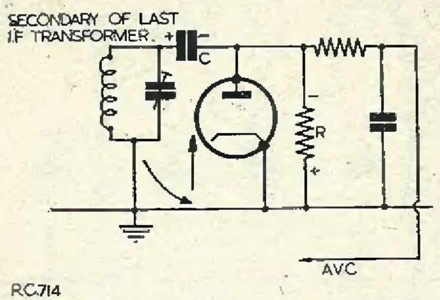


Fig. 5. An alternative to Fig. 4.

advantage of this type of biasing, however, is given by the fact that it is not necessary to have a capacitor in series with the tuned circuit (as occurred in the case of the FC signal grid circuit in Fig. 2) and this tuned circuit may, therefore, be made slightly more efficient.

Simple AVC

In Fig. 4 we see the circuit of a simple AVC detector. This is similar to the audio detector discussed last month. Readers will remember that, when we considered the voltages built up across the diode load R^1, we found that a DC voltage was present, its strength being proportional to the amplitude of the signal supplied by the IF transformer. This proved to be a disadvantage so far as audio detection was concerned, but it is an ideal state of affairs for AVC detection.

To obtain automatic volume control, all that we need to do is to apply the negative voltage developed across R^1 to the variable-mu valves of Fig. 2. However, in addition to the DC voltage developed across R^1 there will also be found the normal AF component produced by detection. This is removed by the filter R^2 C^2, thus leaving a steady DC voltage to be applied to the AVC line. The values of R^2 and C^2 are critical to a certain extent. If either had too large a value, the voltage developed

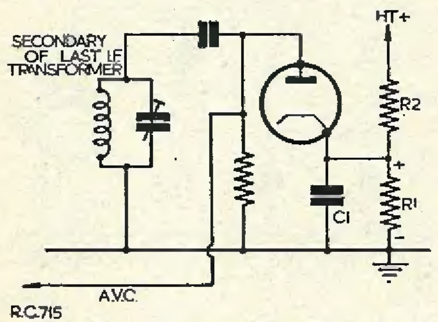


Fig. 6. Applying a delay to the AVC detector.

across R^1 would take an appreciable time to charge the capacitor C^2 and the AVC system would have a noticeable time lag. At the same time, should R^2 or C^2 have too low a value, the lower AF frequencies would not be entirely removed, and would find their way into the AVC line. A compromise is reached, and typical values of R^2 and C^2 are 1MΩ and 0.05μF respectively. In practice, C^2 also performs the duties of the decoupler C shown in Fig. 2, and it should, therefore, of course, be mounted as close to the RF tuned circuits as possible.

Another form of detector for simple AVC is shown in Fig. 5. This uses a parallel diode circuit, but the effect is similar to the series diode circuit of Fig. 4. By reason of its rectifying action, the diode allows electron current to flow only in the direction of the arrows, tending to charge the capacitor C. The DC voltage developed across C is then fed to R via the coil of the tuned circuit. In practice, C charges up on each half-cycle, discharging slowly through R, from which component the rectified voltage is taken.

Delayed AVC

Simple AVC has one disadvantage. It is always operative, even when receiving weak signals, and the set, therefore, never works at its maximum sensitivity.

Delayed AVC helps to overcome this disadvantage. This form of AVC only becomes operative when the signal strength has reached a certain pre-arranged voltage. (The term "delayed" means that the AVC system has a *voltage* delay, not a *time* delay).

Figure 6 shows a simple delayed AVC circuit. By reason of the potentiometer, R^1/R^2, connected across the HT supply, the cathode of the diode is given a positive bias. Let us assume that this bias is, say, 3 volts. The diode, then, would not conduct until the RF voltage applied to it exceeded the necessary 3 volts. The AVC, therefore, would be delayed and only come into operation when the amplitude of the signals received was sufficient to overcome the delay. Thus weak signals would always be received at maximum sensitivity.

Figure 7 shows a method of obtaining delayed AVC when a double-diode-triode valve is fitted in the receiver. In this diagram we use a typical series detector circuit for obtaining our AF. RF is fed to the AVC diode via C^1, the AVC voltage then being developed across R^1. It will be seen that the AVC is delayed by a voltage equal to that developed across the cathode resistor.

Figure 8 shows an alternative method of applying the IF voltage to the AVC detector. In this case the IF is obtained from the primary of the last IF transformer. For most AVC detectors, the values of C and R may be 50-100pF, and 1-2MΩ respectively.

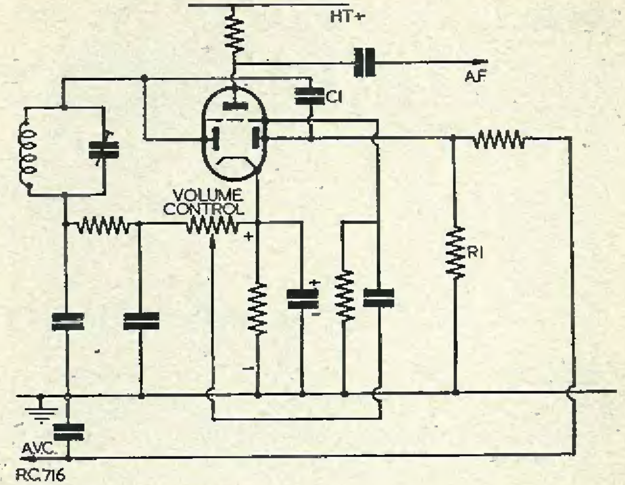


Fig. 7. A practicable method of utilising a double-diode-triode to supply delayed AVC in addition to the functions of audio detector and AF amplifier

Quiescent AVC

When AVC is fitted to a sensitive receiver, tuning-in a station naturally renders the set less sensitive. However, when the set is not tuned to a signal it is at its most sensitive and may give considerable background noise. The result is that turning the tuning dial on such a receiver causes a noisy background to appear between stations. The purpose of quiescent AVC is to minimise this effect.

At first sight, a simple way of doing this may appear to lie in simply applying a voltage delay to the audio detector as was done for delayed AVC. This, however, introduces distortion.

Several systems of delayed AVC have been developed, the simplest consisting of a circuit which damps some of the pre-detector tuned circuits by the AVC-controlled valves. This is carried out by allowing only a small standing bias (or no bias at all), on the valves chosen, so that, in the event of there being no AVC voltage present, grid current will flow, damping the tuned circuits connected to the appropriate grids and reducing their efficiency. On reception of a signal, this damping is removed and the set functions normally.

Amplified AVC

Amplified AVC consists usually of a design in which the DC voltage obtained by the AVC diode is amplified by a DC amplifier circuit. These circuits are often fairy complicated in design and are not always reliable in operation.

Another form of amplified AVC utilises a further stage of IF amplification after the diode detector. The amplified signal is then fed to a separate AVC diode, and used for

(*continued on page 292*)

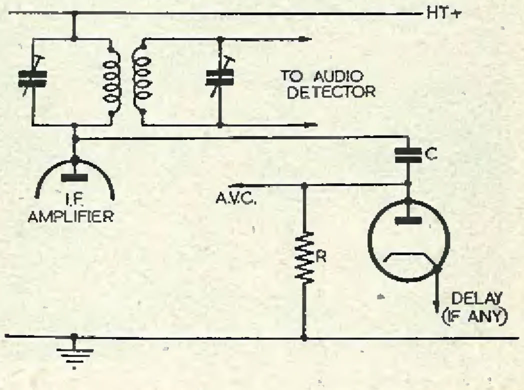


Fig. 8. A popular method of obtaining the IF voltage for AVC detection (the diode shown could be part of a double-diode-triode).

TELEVISION PICTURE FAULTS

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

THE VISION RECEIVER

Stability, Gain and Noise

TO obtain the bandwidth referred to last month, and also to realise the gain necessary to provide adequate modulation of the cathode ray tube, valves with a very high mutual conductance are invariably used in the vision receiver. Recent valve development has produced a variety of types suitable for vision receiver use, which for the purpose of constructional problems can be classified as those with a grid lead at the top, and single-ended types.

With the latter valves, whether used in TRF or superhet circuits, satisfactory screening of the input and output circuits of each valve is easily obtained by the use of a screen directly across the valveholder. Where supply leads for HT, heaters, etc., have to enter several compartments which are screened from each other, the possibility of feeding a signal along the supply wires occurs. Adequate filtering of these leads then becomes necessary. In the case of HT, bias or control leads, this is generally a simple matter of decoupling the various points which they connect, to prevent signals passing directly along the wire and to by-pass at suitable places along the lead any radio frequency energy which may be picked up. Capacitors of small size, and having a capacitance in the region of 0.001μF are most suitable, or there are available capacitors of special design which can be mounted as a "feed-through" lead and at the same time effectively by-pass radio frequencies to earth. For the intermediate frequency stages of a superhet, using an IF between 7 and 20 Mcs, by-pass capacitors of 0.01 to 0.1μF may be used, and overall screening is more easily obtained as more conventional circuits will be used, differing only slightly from that of the normal short-wave receiver. Isolating resistors of from 270 to 4,700 Ω are common, and produce negligible voltage drop.

Heater supplies present a different problem.

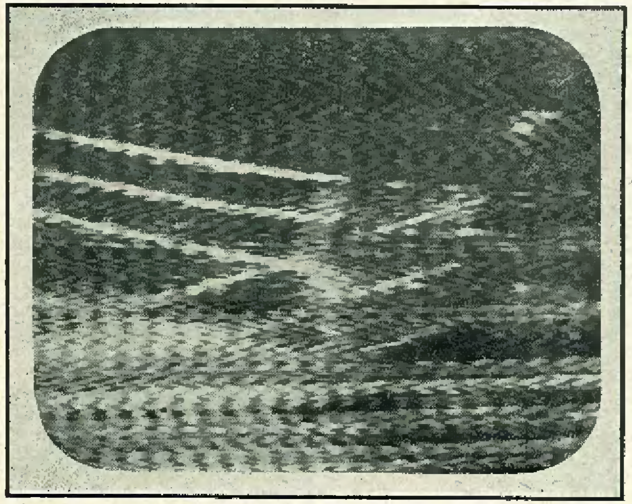


Fig. 1. Instability causing partial break-up of the picture.
(John Cura 'Tele-Snap')

Tele-Snaps were supplied to the delegates of the Central Council of International Radio who recently visited this country in order to study British Television. These photos will provide a lasting record of the picture quality obtained on British receivers from British transmissions.

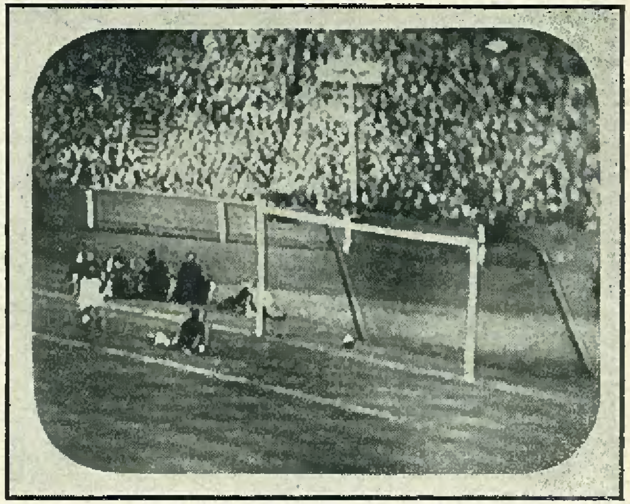


Fig. 2. Ringing effect due to insufficiently damped tuned circuits.
(John Cura 'Tele-Snap')

They generally have to carry a current of several amperes, so that the use of resistors to isolate stages is out of the question. It is usual to earth one side of the heater of the valves very close to the base, and to by-pass the other side as close to the valveholder as possible with a suitable capacitor. The supply lead is then taken out of the compartment near the unearthed heater pin to enter the next compartment close to the equivalent pin on the next valve. Occasionally the thick connecting wire is wound into a long coil of small diameter, which acts as an RF choke and helps to attenuate any radio frequency energy which may attempt to pass along it.

In the case of valves with top grid connections, additional precautions have to be taken to prevent radiated energy being picked up by the longer grid leads. As this type of valve is more often found in the IF stages of superhets rather than in circuits operating at 40 to 60 Mcs, suitable screening may be carried out as in a normal type of short-wave receiver. Radio frequency amplifiers using this type of valve are difficult to construct if several stages are used, and are difficult to stabilise.

When instability occurs, it is sometimes difficult to identify due to the apparent lack of sensitivity in the receiver. This is probably best explained by the following example. Suppose a receiver has instability occurring towards the aerial end of the circuit. The valve in question will oscillate at a frequency near the normal signal frequency. A signal of considerable amplitude will pass down the strip and will be rectified by the detector. The latter will give a large DC output of polarity depending on which way round it is connected. If the detector has its anode directly connected to the video valve the detector output will be negative, and this may be of sufficient amplitude to cut off the video valve completely. This will generally show as a rise in the anode voltage of the video valve up to that of the HT line.

When a detector with its cathode connected to the video valve is used, the detector output will be positive, and the video valve will conduct heavily and may even run into grid current if the grid becomes more positive than the cathode. This will show as a very low anode voltage on the video valve and a high voltage drop across its bias resistor.

Both of these cases would block the receiver completely when the instability occurred, and no modulation would reach the cathode ray tube. The condition is easily identified, however, by checking the anode voltage of the video valve and then shorting the grid to earth (to prevent cut-of or grid current, as the case may be) and noting whether the anode voltage returns to its normal level. The presence or degree of instability may be controlled by the setting of the vision gain or contrast control, and this may give some indication of the part of the circuit which is going unstable. If the gain control is turned down and the instability disappears, it indicates that the trouble lies in the controlled stage or stages. In extreme cases it may be an advantage to increase the value of one or more of the cathode bias resistors.

Incomplete instability may show in a number of different ways. The most common of these is probably "ringing" of one or more tuned circuits, a typical example of which is shown in Fig. 1. To a very great extent, television waveforms consist of a number of pulses of very short duration which are capable of causing an undamped circuit to oscillate for a very short period. The effect of this will be to give the appearance of a second image following the original, in those parts of the picture where a sudden change in light value occurs. For example, after a very white image on a black background, or vice versa.

The second image may not necessarily be of the same light value, and may show as white following black, or black following white. This effect is clearly demonstrated in Fig. 2. This fault may generally be corrected by "damping" the tuned circuits with a suitable resistor, and requires a considerable amount of trial and error before suitable values are found. The lower the value of resistor used, the lower will be the gain of the circuit and the greater the bandwidth. If some specific design is being followed, it will be as well not to deviate from original values without prior reference to the designer. The usual value of damping resistor lies between 2.7k Ω and 10k Ω.

General rules for curing instability may be roughly tabulated as follows. Investigate the anode and cathode voltages of the video stage, and use these as an indication of the presence or otherwise of instability. Check the image on the cathode ray tube for the tendency of the picture to break up into complex patterns or streaks. Check all earthing and screening, in particular, at valve bases, metal valve spigots, tag strips and leads or valve pins which are returned to chassis. Check all by-pass capacitors by substitution or by connecting a similar value capacitor across each in turn. Earth the grids of the valves in turn, starting at the aerial end and working towards the video stage (this may give some indication as to whether the instability is caused by overall feedback or localised to one particular part of the circuit). Ensure that damping resistors, if used, are of correct value and are not faulty.

Additional points which are worthy of note are that the vision receiver may be perfectly stable when the aerial is connected, that instability may occur if a balanced twin aerial wire is used when the design calls for a coaxial input lead, and long unscreened leads from the output of the receiver may produce overall feedback.

Noise in a vision receiver can be due to several causes, and will usually show as dark streaks across the picture, or what appears on close examination of the screen to be countless small black dots superimposed on the viewed image. This latter type of noise is very often associated with valves, and in a high-gain receiver working at long range it is very difficult to avoid, and a certain amount will usually have to be accepted.

In areas of good signal strength, valve noise should not be troublesome, and if it is present, substitution should be tried, especially of the valves in the first stages.

A further point to investigate when looking for noise in a receiver is the valve pins. Valves with wire-type pins are very prone to make bad contact with their holders. The offending valve can usually be located by gently rocking each valve in turn in its holder, watching the tube screen for dark streaks. The aerial connection should be examined, not only where it connects to the receiver, but also at the dipole itself. It is usually advisable to solder the aerial downlead to the dipole if possible, or at least make sure the screw connections are really good when erecting the aerial.

(To be continued)

DESIGN OF THE SUPERHET

(continued from page 289)

AVC control in the normal manner. This form of AVC is very rarely used.

Corrected AVC

Corrected AVC is used when a very high level of AVC control is required. By reason of the fact that the AVC voltage is supplied by the signal itself, it is obviously impossible for the AVC circuits to ensure that all signals are received at the same strength. All that AVC may do is to ensure a fairly uniform signal strength and reduce the discrepancy between strong and weak signals.

With corrected AVC, however, the AVC voltage is used to control the amplification of the AF stages in addition to that of the RF and IF circuits. This is usually done by applying the AVC to a variable-mu valve in the AF amplifier. With a well designed circuit of this type, almost perfect AVC is possible.

Query Corner

A "Radio Constructor" service for readers

The Basic Superhet

"*I am building the Basic Superhet receiver according to the instructions contained in the fiirst of your 'Data Booklets' series. Can you please advise me as to the best method of connecting a pick-up to this receiver?*"

P. Mayo, London, N.8.

For the benefit of new readers we must say that the Basic Superhet is a standard 4-valve plus rectifier receiver employing an LF section which consists of a double-diode-triode resistance-capacity coupled to an output pentode. The following notes, therefore, apply equally well to all receivers which fall within this general class.

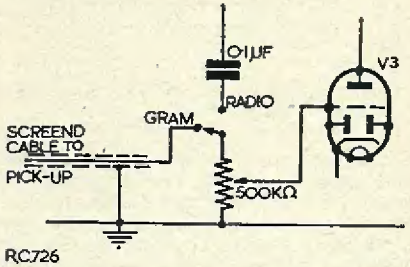


Fig 1. *Method of connecting a pick-up to the Basic Superhet.*

The volume control in the receiver is located in the control grid circuit of the double-diode-triode and thus, by connecting the pick-up across this control it may be utilised on either radio or gramophone reproduction. It is not, however, advisable to join the pick-up leads directly across the volume control, as such a connection would result in the reproduction of the radio programme when the pick-up was in use. To prevent this a radio/gramophone switch is employed, as shown in the circuit diagram of Fig. 1. It is most important to prevent hum voltages from being induced into the leads to the switch by locating it as close to the volume control as possible. Screened cable must be employed between the pick-up and the receiver, and if an electric gramophone motor is used the metal casing must also be earthed.

This type of pick-up connection may be used with all high impedance moving iron instruments. A low impedance pick-up must be coupled to the receiver by means of a step-up transformer, such as supplied by the manufacturers of the pick-up. Standard crystal pick-ups require a certain amount of treble boost or top lift when used on commercial records, and this is simply obtained by means of the corrector circuit shown in Fig. 2. This corrector is connected in the live lead between the pick-up and the receiver.

The above recommendations apply to the standard pick-ups which are at present on the market, and it will be found that in all cases good gramophone reproduction is obtained.

Negative Feedback

"*I recently constructed a two-stage amplifier which I have been using in conjunction with a pick-up for gramophone reproduction. Although the quality of the reproduction is quite good I always have the feeling it could be improved, and I wonder if this might be achieved by the addition of a system of negative feed back. If this is possible would you please suggest such a system?*"

L. Grays, Chichester.

We have received from time to time a number of queries of this type requesting information on methods of applying negative feedback to amplifiers. Unfortunately in many cases the addition of any worth while degree of feedback so reduces the overall gain of the amplifier that a further stage of amplification becomes necessary. It must be appreciated that the subject of negative feedback is very complex, but the following notes may be regarded as an introduction.

Basically there are two types of negative feedback, voltage feedback and current feedback. With the latter type the voltage which is fed back to an earlier part of the amplifier is proportional to the cathode current of the output valve; whilst in the former system the voltage fed back is merely a fraction of the voltage appearing across the output load. This, then, is the difference between the two types of feedback, but their effects upon the output stage of an amplifier are very different. Current feedback has the effect of increasing

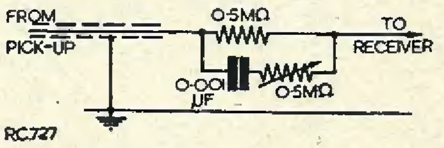


Fig. 2. *Tone corrector for use with crystal pick-ups.*

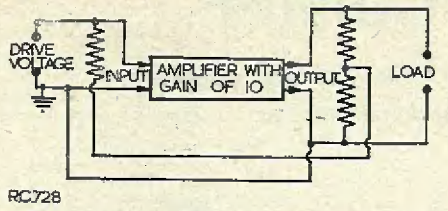


Fig. 3. Block diagram of amplifier with negative feedback.

the internal resistance of the valve, whilst voltage feedback reduces this resistance. For reasons which will be discussed later, the effects of increasing the internal resistance of the valve are detrimental to quality reproduction, and hence when designing audio amplifiers current feedback is of no value. Voltage feedback on the other hand, when correctly applied, has the effect of reducing the internal resistance of the output valve whilst at the same time reducing the overall gain of the amplifier.

Figure 3 shows a block diagram of an amplifier stage which we will assume has an overall gain of ten; in other words, an input of one volt will produce an output of ten volts across the load. If, now, one-fifth of this output voltage (i.e., 2 volts) is fed back into the input circuit we must increase the input to 3 volts if we are to retain the 10-volt output; this means that with feedback the overall gain of the amplifier has been reduced to $\frac{10}{3}$. In some cases, where there is an excess of voltage amplification, this loss of gain is an advantage as it prevents the overloading of the output valve before the volume control has been turned up to its maximum position. In other cases it may be possible to increase the gain of the amplifier to compensate for the loss resulting from the introduction of the feedback.

Now let us turn to this problem of decreasing the effective resistance of the output valve. It will be appreciated that the valve is virtually in shunt with the speaker, and therefore the lower the valve resistance may be made, the greater will be the damping of the speaker. This problem of speaker damping has in the past led quality enthusiasts to the use of low impedance output triodes. However, by employing feedback the effective resistance of the pentode may easily be reduced to that of a triode, and because of this fact the output triode is now in less demand for use in low and medium power amplifiers. Loudspeaker damping greatly assists in smoothing out irregularities in the frequency response curve of the loudspeaker by damping out the cone resonances. The effect of this damping may be easily demonstrated by watching the needle of a milliameter whilst it is being shaken both with and without its terminals shorted. It will be seen that with the terminals shorted it is almost impossible to shake the needle from the zero position. A similar effect is obtained with a loudspeaker, but in this case it is the cone which vibrates and not the needle as in the case of the meter. Thus in order to damp out unwanted speaker resonances it is necessary to feed the speaker, or, the speaker transformer, from a low impedance source. This requirement is not fulfilled by the normal output pentode unless it is used in conjunction

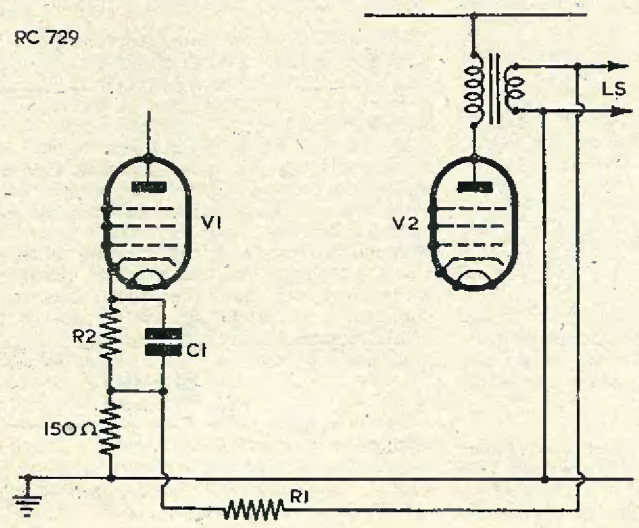


Fig. 4. Skeleton circuit of a two-stage amplifier. C1 and R2 are the normal bias components of V1. R1 governs the degree of feedback and will depend on overall gain of amplifier. Typical value = 1500 Ω.

with some method of negative voltage feedback. The manner in which this feedback reduces the effective output impedance of the valve may be appreciated by considering the effect of a change in voltage across the load.

Without feedback, a change in voltage at the anode of the valve will result in very little change in anode current, which is, of course, merely another way of saying that the output impedance is fairly high. However, with feedback a reduction in the anode voltage is fed back to an earlier stage in the amplifier, is amplified and returned to the grid of the output pentode whereupon it results in a reduction in anode current. In other words, a small change in voltage has been made to result in quite a large change in current, producing the effect of a low output impedance. This brief explanation will be sufficient to indicate the main characteristics of negative voltage feedback and Fig. 4 shows its practical application in a two-stage amplifier circuit. Here the feedback is taken from the secondary of the output transformer to the cathode circuit of the first valve. It is important with this type of circuit to ensure that the feedback is in the correct phase, as it is possible to obtain positive feedback, with consequent instability, by simply reversing the connections to one or other of the output transformer windings. It is also important that there should be negligible phase shift across the transformer at all frequencies at which the amplifier is capable of operating. Should an appreciable phase change occur at any one frequency, there will be a tendency for the whole amplifier to oscillate at that frequency. When employing a feedback system which involves the secondary of the output transformer, it is possible to safeguard against an excessive phase change across the transformer by keeping its leakage reactance down to a minimum, or in other words by using a well designed transformer.

"Query Corner" Rules

(1) A nominal fee of 1/- 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 the more general interest will be reproduced in these pages each month.

Stopper Resistors

"*In order to ensure against instability, I wish to include stopper resistors in the anode, screen, and control grid circuits of the modulator which I have under construction. What values of resistors do you recommend?*"

K. Knole, Paddington.

It is important that a stopper resistance should not materially reduce the operating voltage of valve electrode to which it is connected. Normal values for such stoppers are :—

Anode circuit 47 ohms ;
Screen circuit 100 ohms ;
and Control grid circuit 1,000 to 5,000 ohms. The stoppers must be connected as close to the valve holders as possible.

BOOK REVIEW

YOUR RADIO AND TELEVISION.
Odhams Press Ltd. 128 pages with over 80 illustrations. Price 3s. 6d. net.

Here is a book which will be of interest to all our readers, for though not technical, it is compiled of contributions from personalities—each an expert in his own sphere—which together provide an intriguing insight into the scenes behind your broadcast or television receiver.

How to listen and look. Or do you merely hear and see? Elkan Allan explains the difference.

Richard Rowland (Radio Script Writer) tells how radio programmes originate.

Wynford Vaughan Thomas, well-known B.B.C. Commentator, and Brian George, Head of the B.B.C. Recorded Programmes Dept., contribute on their respective spheres of activity.

Kenneth Dick, Assistant to Head of News Output, B.B.C., and Frank Phillips, B.B.C., Newsreader and Announcer, make interesting reading of what might seem, at first glance, to be a dull subject.

The story of television is described by Cecil Madden, B.B.C. Television Programme Organiser.

The two final chapters are on choosing a receiver, by Robert Walton, and on receiver installation and simple fault tracing, by S. W. Amos, B.Sc.(Hons.)Grad.I.E.E., of the B.B.C. Engineering Training Dept. G2ATV

SURPLUS RADIO EQUIPMENT

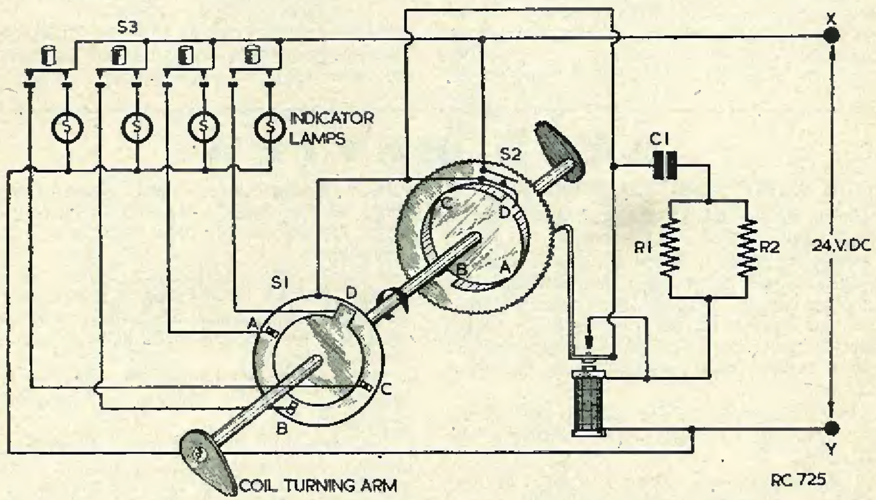
described by B. Carter

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."

RECEIVER UNIT TYPE 159 (10 DB/6098)

THE Receiver Unit Type 159 is a unit about which little information is available. It would appear to be the front end of a VHF receiving system. The incoming signal is fed to the cathode of V2—a grounded grid RF amplifier—by the black Pye plug. The valve V1 is an oscillator whose output is mixed with that of V2 by the diode mixer V3. After mixing, the signal is passed to V4, the first IF amplifier, and out of the unit by the white Pye plug. The coils L1 and L2 represent four of each kind, which are mounted in the form of a cross on two wheels, one wheel either side of the selector switch. As the wheels rotate with the selector switch, so two contacts on the selected coils engage stationary switch fingers on the casing. Each coil consists of three or four turns of 20 swg enamel wire on .310-in. diameter polythene formers having adjustable brass cores.

The Selector Switch is a clever combination of a buzzer and switching. To understand its operation one should consider the controller, which is a small box—not unlike a cigar box—mounted upright with the long narrow edge facing. Into this edge is set a five-digit press-button switch labelled " A "—" D " and " OFF." Each button has an indicator light alongside it; also included is a transmit/receive key-switch and sometimes a receiver attenuation switch. Similar units are used with TR1196, SCR522, R1225, Rx 73, etc. To select a channel, one of the buttons (S3 A-D) is depressed. Taking S3C as an example, the open contacts S2 are shorted and immediately the circuit is completed, from " X " through S3C to the stationary portion of S1 (arrows), from the rotating ring of S1 to the " buzzer " reed through the winding to " Y." As this circuit is completed the buzzer reed is attracted by the core and in doing so pulls the ratchet wheel round one stop. Owing to its buzzer action, this making and breaking will continue until the ratchet wheel has been pulled around to where the gap in the ring of S1 has reached " C " arrow, and the contact S2 falls into the " C " slot ensuring that the further depressing of S3C will have no effect. The capacitor C1 and the resistors R1 and 2 are for spark reduction purposes. The coil of the " buzzer " is designed for operation from a 24-volt DC supply.



The Selector Switch Motor — 10DB/6338.

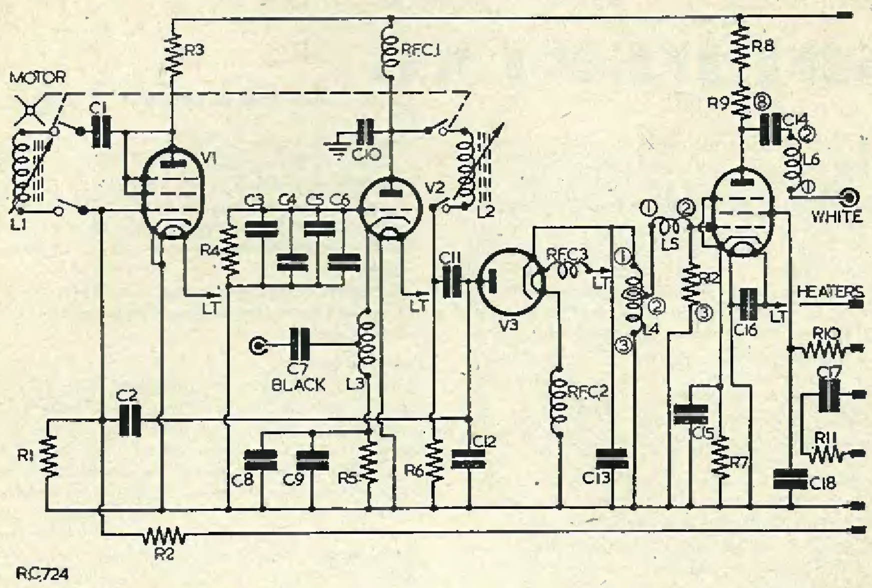


Fig. 1. Circuits of the Type 159 Receiver Unit. Black squares indicate outside connections.

COMPONENT VALUES

Numbers associated with L4-5-6 indicate coil former tags.

R1, 47 kΩ		C7, 10 pF
R2, 10 kΩ	V1, VR91 (EF50)	C8, 0.002 μF
R3, 10 kΩ	V2, CV66 (RL37)	C9, 10 pF
R4, 2.2 kΩ	V3, VR92 (EA50)	C10, 10C/12148
R5, 100 Ω	V4, VR65 (SP61)	C11, 10 pF
R6, 4.7 kΩ		C12, 2 pF
R7, 100 Ω		C13, 10 pF
R8, 1 kΩ		C14, 200 pF
R9, 4.7 kΩ	C1, 25 pF	C15, 10C/12148
R10, 1 kΩ	C2, 2 pF	C16, 25 pF
R11, 5 Ω 7W	C3, 4, 5, 6, 25 pF	C17, 0.1 μF
R12, 10 kΩ		C18, 10C/12148

G.E.C. MAGNETIC RECORDING TAPE

A high grade iron-oxide-coated magnetic recording tape is announced by The General Electric Co. Ltd., for use in British, American and Continental designs of recorders.

Two grades of tape are made :

GRADE A.

This is the latest high-coercive-force tape and will give " radio " quality recordings when run at a speed of 7½"/second or " dictation " quality at half this speed. The characteristics of this tape are similiar to the best tapes used in American recorders.

GRADE B.

This tape is intended for use in Continental machines based on German designs. The tape speed for " radio " quality is 15"/second and for " studio " quality 30"/second. The characteristics are approximately equa to the German type C tape.

It is important to note that the two grades of tape are not interchangeable on a particular recorder but must be chosen according to the design of machine.

Mechanical dimensions of the tape are :—

Width : 0.25" + 0.002" — 0.004"

Thickness : 0.0025" + 0.0" — 0.0003"

Standard reels, available with or without aluminium spools, are as follows :—

1,250 ft. reels .. .. .. 7" diameter.

1,000 metre reels .. .. 11" diameter.

Details of prices and deliveries are available on application to the General Electric Co. Ltd.

A NOVEL METHOD OF SOLDERING

By *E. Kaleveld, PAØXE*

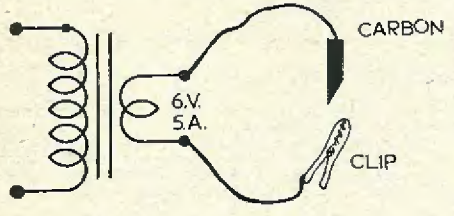
DURING the war, electric soldering-irons became very scarce at first in the Netherlands, and they gradually died out. One more of those minor disadvantages of the war, but something had to be done about it. So what? Going back to the old gas-iron method? That did not sound very appealing. Clever minds went to work, and the carbon soldering-iron was brought to light. It proved so extremely useful that lots of Dutch hams, including your scribe, are still using it, and I would not swap it for the most expensive iron. The cost of this weird and wonderful apparatus? I suppose all the material needed can be found in a junk box, but if not, the cost would be a few shillings. So on with the description.

All you need is a transformer that can deliver 6.3 volts at 5 or more amps; a piece of carbon from a discarded torch battery, and a clip.

Now if we connect things up as in Fig. 1, and press the carbon on the clip, considerable heat is developed—enough to melt solder in a few seconds. So there you are.

The advantages of this system are obvious:

1. Immediately ready for use, no warming-up time.
2. With primary on, but not actually soldering, practically no current is consumed.
3. Because of the long tip, it is easy to reach those hard-to-get-at places in a crowded set.
4. No dirty tips of an iron.
5. No maintenance cost. When the tip is worn out after a year or so of intensive service, simply make another tip from a piece of carbon from a discarded torch battery.
6. The 6.3 volts can be used as heater voltage in emergency cases.
7. The " iron " is very light in the hand.



RC.664.

Fig. 1.

The disadvantage is:

1. When soldering coils with thin wire, etc., always make sure to put the clip on the right spot, so that the current does not pass through the coils! This is very important. It once cost me an IF transformer, so let that be a lesson to you!

In eight years of constant use, no more disadvantages have been found, however critically I searched.

The Construction

The transformer, in my case, was wound on the core of an old BC transformer, of which the primary was intact, but with a short-circuited secondary. Many of you may have one lying around the shack. Unwind the secondaries, and count the number of turns on the 6.3 volt winding. If it has but a 4 volt winding, multiply that number of turns by 1.6 (1.4 x 4 is 6.3 approx.) and put on a new secondary of the number of turns necessary to get 6.3 volts. The gauge of the wire should be No. 17 swg.

The connecting wires to the clip and the carbon-tip should have sufficient diameter to pass the current without getting warm. For each lead I am using both the leads of twin rubber-covered lamp cord, connected in parallel.

The clip should present no difficulties. The one I am using is an American one, manufactured by Muller, type 85, which cost me sixpence. The piece of carbon needs a holder for convenient handling. Mine was made from a piece of a broomstick, sawn off when the XYL was shopping, and smoothed down with sandpaper. A hole was drilled through it to let the lampcord pass, while at one end we cleared the hole a bit to put in a piece of hollow curtain-rod. The lampcord is jammed between the wooden handle and the curtain-rod, while the curtain-rod, which was, in my case, too large to fit the piece of carbon, was given four incisions, and then pressed together to hold the carbon-tip tight.

At the end where the lampcord leaves the handle, a screw through the handle prevents the cord from being pulled out.

Fig. 2 should clarify the position, beside giving the dimensions. The carbon-tip should be no larger than ½", and it should be sharpened a bit to give it a pointed end. For this process use a stone outside your house, again when the XYL is shopping. Just one thing: however you construct it, keep it light.

It is a good idea to put a neon-lamp (with resistor, of course) across the primary of the transformer. This prevents you from forgetting to switch it off.

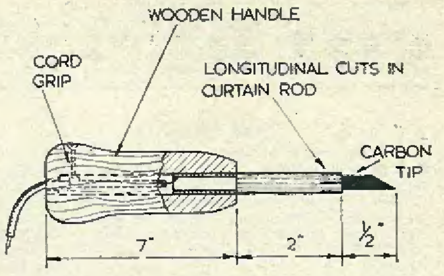
One may locate the transformer anywhere, but rather a good idea is to hang it on the ceiling over the workbench. This prevents the leads from getting entangled.

The Technique

As with all things, soldering has to be learned. There have been several very good articles about this subject in this periodical (*viz.*, S.W.N. July 1949, p. 178) so we will only touch upon the difference between soldering with an iron and with a carbon tip.

1. The best solder to use for this work is the type in wire shape. No soldering flux is necessary there, either.
2. Connect the clip near to the spot to be soldered. The joint should, of course, be mechanically strong, and be clean, as with an ordinary soldering iron.
3. Apply simultaneously the carbon-tip and the solder, and keep the tip there until a *little* solder is flowing.
4. Take the solder away, but keep the tip on the spot.
5. After the solder has run well all over the joint, take the carbon tip away.
6. Let the joint cool off.
7. Now test the joint for mechanical strength by pulling.

As said already, soldering is an art, and has to be learned. Learn it first by soldering together pieces of wire.



RC.665.

Fig. 2.

For the rest, all the remarks in the above-mentioned articles are referred to.

Once one is used to this method of soldering, the iron is an obsolete thing in the junk box.

And now, happy soldering, and let me hear from you direct, or c/o the Editor if you like.

PAØXE

ANSWERS TO QUIZ

(1) A likely explanation is that sparking took place inside the case, with a consequent generation of heat. Vaporisation of the moist contents, or possibly the production of gas by heat-assisted chemical action, set up considerable pressure inside the can. Such pressure would not develop in a poorly sealed component, and many constructors will recall that failure of pre-war capacitors was frequently heralded by the messy oozing of the contents through the seal. The modern tropicalised article, however, is tightly sealed and not until considerable pressure was stored did it yield—and then sudenly and quite violently.

An interesting point, which increases one's respect of these components, is that at no time was a dead short apparent, although there must have been some conduction.

(2) The presence of induction in the anode load causes excessive amplification of the high frequencies when using pentode voltage amplifiers. Correction would result in lowering the gain to that of a triode, so that the benefit of pentode amplification would be lost.

(3) Minimum signal is obtained when the frame is at a right-angle to a straight line between transmitter and receiver, unless the signal has been reflected in any way—which is rare on medium or long waves.

(4) In order to prevent perceptible flicker, it is necessary to increase the rate of frame repetitions to about double that necessary to achieve the illusion of movement. As all the necessary detail can be resolved with 25 frames per second, it would be a bad proposition to increase the frame repetition rate merely to overcome flicker. Therefore, the " information " or detail of a complete scan of 405 lines is divided and screened in two frames, thus doubling the repetition rate without increasing the amount of detail to be transmitted. In the cinema, a rather similar result is achieved by showing each frame twice, with a black-out between each presentation. In the case of TV, each complete picture is divided into two frames by scanning odd and even lines in succession, i.e., a frame of odd lines is followed by a frame of even lines.

(5) As there is an odd number of lines (405) and the frame frequency is an even number (50), it follows that each frame must begin or end at half a line from where the previous frame began or ended. If line No. 1 commences at the extreme top left, the last odd line will end half way over, at which point the frame scan transfers it to the top of the screen, where it becomes the second half of line No. 2. Thus the total " stagger " is one line. Provided the frame scan is accurate, each scan will consist of odd or even lines each spaced by the width of one line, and due to persistence of vision the two sets will appear to interlace.

(6) Mains ripple (hum) in each case. In (*a*) the EHT supply, video or phase splitter may have a ripple. In (*b*) it is affecting the line timebase and (*c*) the frame timebase.

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