# SERVICE INSTRUCTIONS

for the

# MURPHY A8

## EIGHT VALVE SUPERHETERODYNE RECEIVER

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HERTFORDSHIRE — TELEPHONE: WELWYN GARDEN 800

# CONTENTS

# THE DESIGN OF THE A8

THE ideas behind the design of the Murphy A8 Receiver have already been clearly explained in our previous pamphlet, but a description of the more practical details of this design may prove useful.

The folding frontispiece of this booklet is a schematic diagram of the set, and the first part of the description is based on this. First, the feed circuits. These are quite ordinary as regards anode and heater feeds, though the way in which the eight heaters are allotted between the two 4-V windings on T2 is quite important. It is not usually realised that there is a small but perceptible coupling between valves *via* their heater circuits. So unwanted coupling between the R.F. valves and the oscillator, for instance, is avoided by putting the oscillator on a different heater circuit ; and so on throughout.

The H.T. feed circuit is only notable for the large and robust Voltage-divider (R17 to R20), which provides a 50-60 volt tapping for the R.F. and I.F. valve screens, a 40-50 volt one for the first A.F. valve screen, and a tapping at about 0.8 volt for the R.F. and I.F. cathodes, which gives these valves a minimum steady bias apart from any set up by the auto-bias circuit.

The bias circuits need special attention. The pentode and 1st A.F. valve are biassed from a voltage-divider consisting of the three resistors R25, R26, and R27 across the loud speaker field ; the latter is used as a smoothing choke and is connected in the negative side of the circuit. All the R.F. and I.F. valves except the oscillator have the gain control auto-bias to be described presently, and the first detector is self-biassed (by R3) in addition. The R.F. and I.F. amplifying valves also have 0.8V steady bias, as mentioned above.

To get a clear idea of how the automatic gain control functions, one must first understand fully how the detector works. There has been a certain amount of misunderstanding about this, mainly because it is rather different from the usual type, but it is actually more simple than most. It is, in fact, almost exactly like the mains unit power rectifier. Everyone knows that when a 50 cycle A.C. voltage is applied to V9 from the H.T. secondary of T2 the result is a D.C. current coming out of V9's filament and returning to the centre-tap on the transformer winding. Also, this "D.C." has a large 100 cycle ripple on it, most of which goes through C35, leaving a little to be smoothed out by the rest of the smoothing gear. Further, if the mains voltage varies, so does the D.C. output.

The second detector V6 works in just the same way, L17 being the centre-tapped secondary, and C25 the smoothing condenser. But there is one important difference. The " Mains voltage " here is at 120 KC frequency, and is constantly varying, and we *want* this variation, for it is the A.F. output. So C25 is only made large enough to smooth out the 240 KC ripple, leaving the output still varying as the modulation changes the input.

The output, then, can be regarded as a D.C. plus an A.F. current, all of which passes through R15 and R16, and sets up corresponding voltages. The A.F. voltage is applied through C30 to the next valve.

Now an increase of input makes the D.C. output greater, and to get auto gain control we use this D.C. output to increase the bias of the previous valves and so lower the gain. But at the same time we must NOT let the rapid changes due to modulation have this effect ; if we did, we should control the modulation out of existence and there would be no A.F. from the detector. So R14 and C24, plus the separate grid decoupling circuits (C4 and R1, etc.) are designed as A.F. filters, which keep back the A.F. output from the detector, and only pass pure D.C. for biassing.

The feed circuits being dealt with, we can trace what happens to incoming signals. S1 being open (it is only closed for gramophone working) signals pass through C2. This is a small trimmer inserted so that the first tuned circuit can be adjusted if necessary to suit different aerials. It is only very rarely, for " freak " aerials, that it need be adjusted. The first tuned circuit is quite an ordinary one, as is also the " band-pass " circuit between V1 and V3. The latter has a pure capacity coupling (by C9).

At this point the incoming signal is mixed with the local oscillator output, which is coupled to the grid circuit of the first detector V3 by means of coil L12. (It will of course be realised that although L12 is between *Cathode* and earth it is none the less part of the grid circuit, which is from the grid through the tuned circuit and C9 to earth and thence through L12 and C15 to cathode).

The signal, now converted to a fixed frequency of 120 KC passes through the I.F. amplifier, each coupling of which is itself a band-pass filter with mutual inductance coupling. At V6 it is finally rectified, and V7 and V8 form an ordinary A.F. amplifier.

There is, however, one matter which has an important bearing on the performance of the set. It will be seen that there are no less than 14 trimmers (C2, 3, 5, 6, 7, 8, 11, 12, 16, 17, 19, 20, 22 and 23) ; and any casual attempt to adjust these without a clear idea of what is being done, is almost certain to put the whole set wrong, so that it will have to be returned to works for readjustment. It is essential to know just what the trimmers do, and for that we must discuss the selectivity of the set.

First, suppose that the set is perfectly trimmed with the R.F. circuits tuned to a signal of 1,000 KC (300 metres). If correctly ganged, the oscillator will be working at 1,120 KC (268 metres). The first detector V3 will have an output at the difference of these —(120 KC)—and the I.F. circuits are exactly tuned to this.

Now let the neighbouring station start working. It will be 9 KC different, i.e., 1,009 KC, or less than 1% different from what the R.F. circuits are tuned to ; so that if it is a powerful near station it will probably get through. But when it mixes with the oscillator at 1,120 KC, the output from the first detector will be at 1,120—1,009 or 111 KC instead of 120, a difference of 7½%, which is enough for the three I.F. filters to cut it out completely.

So you see that *selectivity against stations of near frequency is obtained in the I.F. amplifier.*

But if we tried on this account to abolish the R.F. tuned circuits, there would be another trouble. Take a station working on 1,000 KC as above, and assume that the set has no R.F. selectivity at all, then on tuning the oscillator to 880 KC (341 metres) there would again be a difference of 120 KC, and our 1,000 KC station would be received at full strength: in fact, many stations would be received at two different dial settings. Now, suppose that while we were listening to 1,000 KC with the oscillator set at 1,120 KC, another station started up on 1240KC (242 metres). There would again be 120 KC difference between the oscillator and this station, and both stations would come through at once: the I.F. circuits would naturally not separate them at all so that any one position of the tuning circuit would bring in two stations.

It will now be apparent that, although the three R.F. tuned circuits help somewhat in ordinary selectivity, their main object is to cut out completely stations some way off in the wave-band, to avoid " double-tuning " and similar troubles.

Now we have a clue to the action of the trimmers. If those on the I.F. amplifier are out of adjustment, so that the circuits are not all tuned to the same frequency, its gain will be greatly diminished, and its " band " will be widened, and also probably made "cock-eared" or unsymmetrical. There may be interference from neighbouring stations, and a poor audio-frequency response curve.

Now suppose that the I.F. trimmers were set so that all the circuits were tuned alike but to a wrong frequency—say 115 or 125 KC. The point to get hold of clearly is that the wavelength of the signal that is receivable depends entirely on the Intermediate Frequency and the oscillator setting, so that if the I.F. is 5 KC out, the only way to get a station is to have the oscillator 5 KC out too. Hence the first symptom of this trouble will be wrong calibration: stations will not come in at the right scale reading.

In an effort to correct this, one might adjust the trimmers of the oscillator. But then one would fall into another trap. The oscillator circuit, although tuned by one of the four ganged condensers, must always be tuned 120 KC different from the other three circuits. This is not at all easy to arrange, but is done by first using a smaller coil for the oscillator, so that at 200 metres (1,500 KC) the frequency difference is correct. If this were all, there would be trouble at the other end of the scale; but this is corrected in turn by the " padding " condenser C14 in the oscillator circuit.

If now the I.F. is wrong, and we try to bring the calibration right by faking the oscillator trimmer C11, it will be found impossible to get the calibration right all over the scale.

So that in the long run it comes to this; the only possible way of making the set perform properly is some routine similar to that adopted in the factory. First the I.F. trimmers are adjusted one by one against an oscillator working at 120 KC, so that each circuit is tuned exactly. Next, the oscillator trimmer is set to bring the calibration exactly right, and only then are the R.F. trimmers adjusted to give maximum gain. There is no way of trimming the I.F. amplifier without an oscillator working at 120 KC and accurately calibrated; so sets which are out of adjustment in this respect should be returned to the works.

But the oscillator and R.F. trimmers can be adjusted easily if the work is tackled in the proper way, and full details are given on pages **17** and **18**.

# INSTALLATION

In giving the following hints it is assumed that the dealer has a free hand, and that there is no aerial, etc., already erected. Of course, if the customer already has an aerial, lead-in and so forth the matter is different, although even then it should be examined carefully and, if necessary, improvements suggested.

For the A8 receiver it is a great advantage to have the best possible aerial. This is not at all *necessary* to get stations, but it has a great influence on the amount of background noise present when weak stations are being received.

The design of the aerial itself must of course depend entirely on the building and surroundings. But it is important to arrange that the down-lead is not too close to any building. If possible see that it is not nearer than three feet or so. The bottom end of the down-lead should go to the lightning arrester, if one is in use. Remember that an earthing switch inside the building is quite useless. It is doubtful whether any such device at all is needed as it is exceedingly rare for a set to be struck. But if some device of this kind *is* considered necessary, let it be an effective one; and the only effective type is a proper lightning arrester *outside* the house, with a lead going straight down from it to a separate earth close at hand.

At the lightning arrester the down-lead is connected to the lead-in wire. The arrangements for getting this through the wall or window-pane cannot be specified here as they depend on the particular type of house and window. Once inside the window the aerial-to-set lead should be made as short as possible. If the owner insists on having the set some way from the window try and get permission to run the lead on stand-off insulators so that it is some way out from the wall (say six inches), and keep it high up near the ceiling. If the owner will not agree to this, on the grounds of appearance, put it along the *outside* of the picture rail, if possible; at all costs try to avoid having it fixed close to the plaster of the wall.

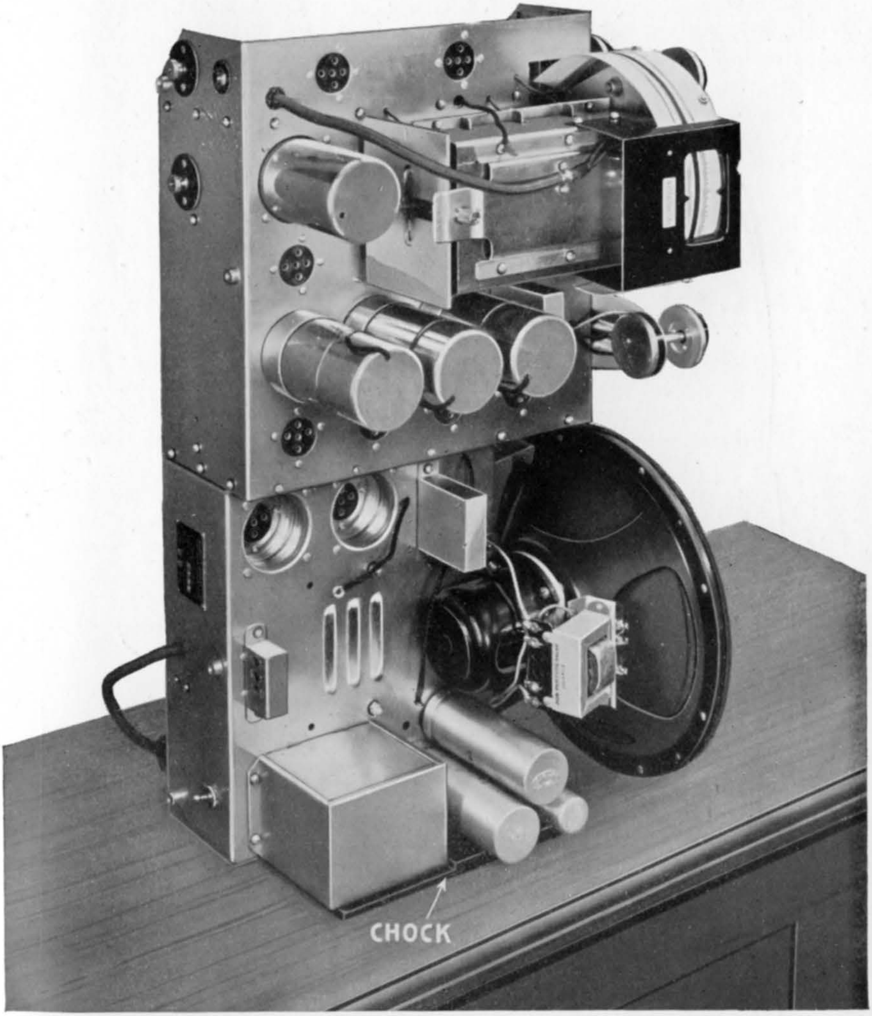



Fig. 2—VIEW OF CHASSIS ON END

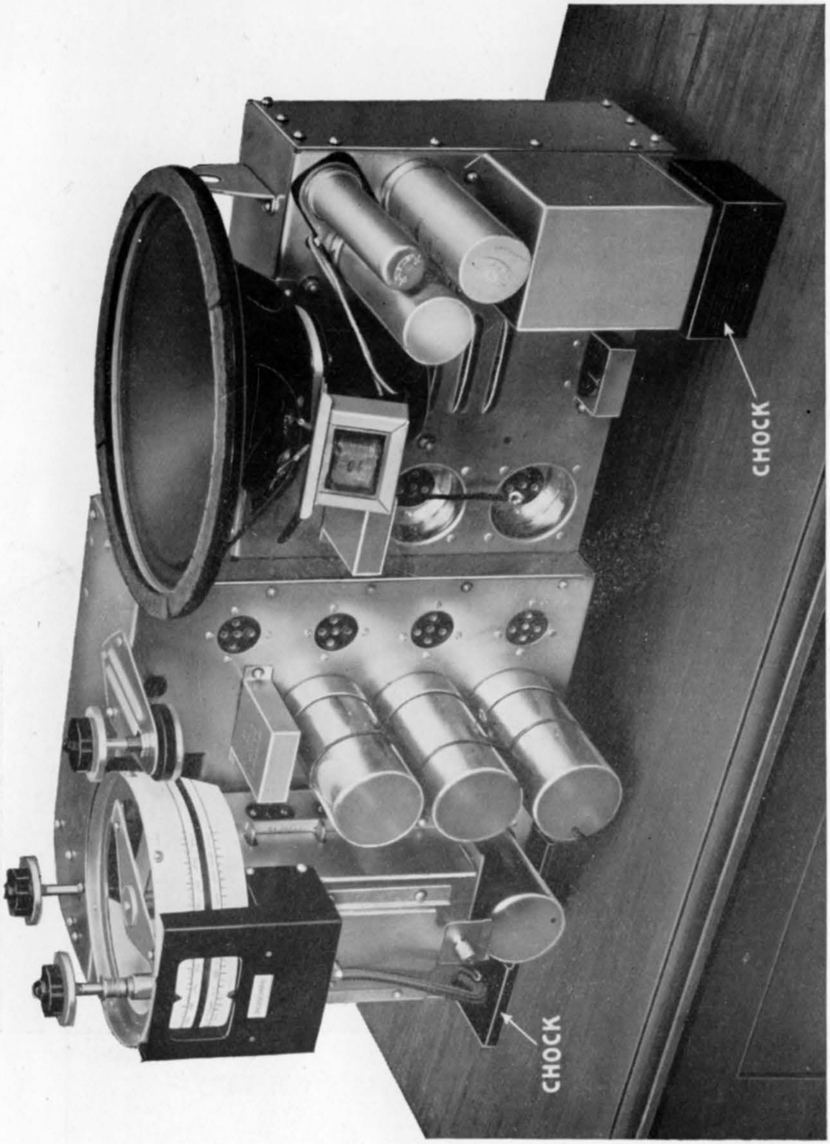



Fig. 3—VIEW OF CHASSIS ON ITS SIDE.

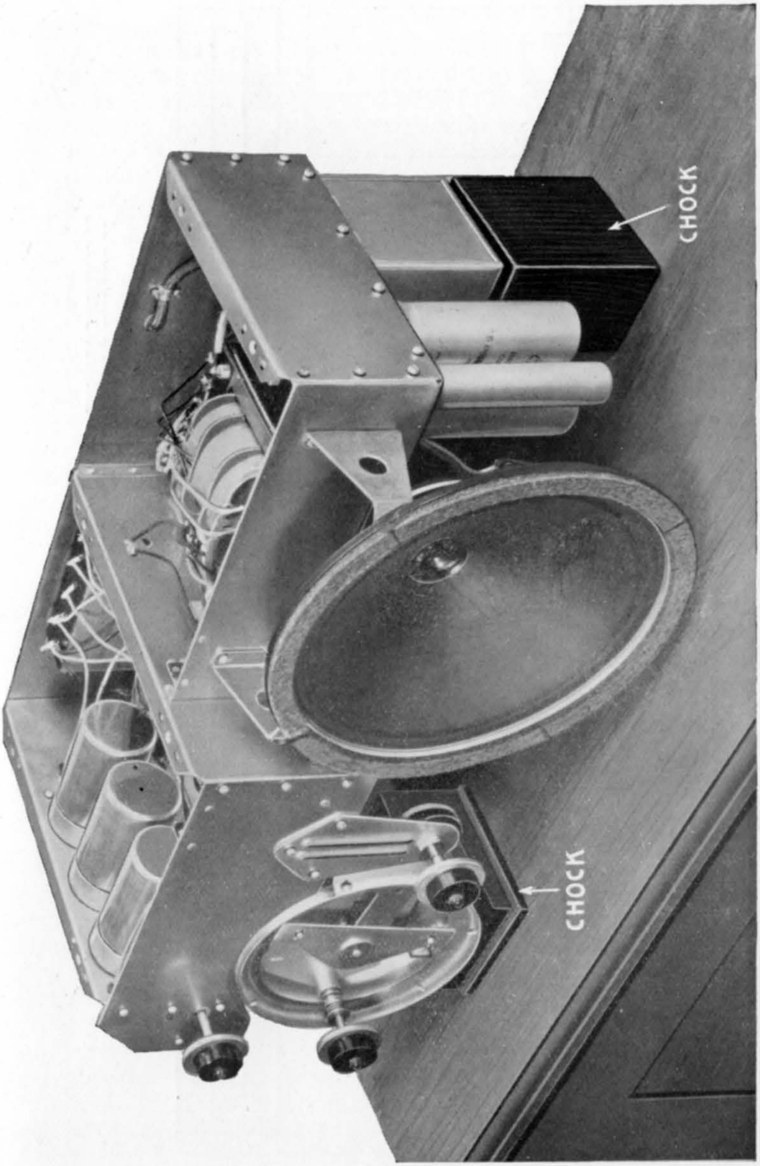
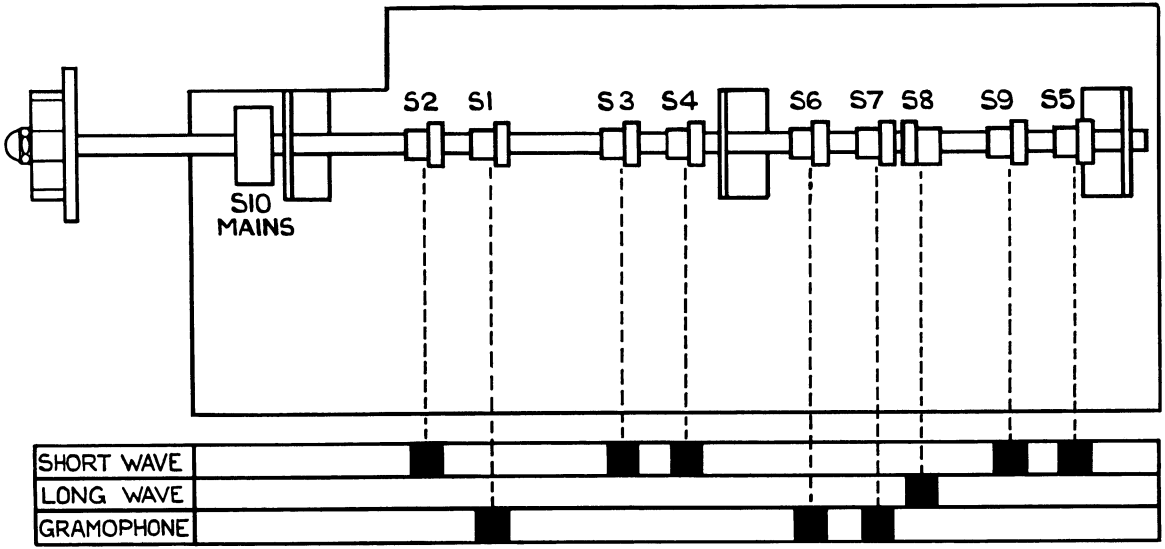



Fig. 4—VIEW OF CHASSIS ON ITS BACK.




BLACK SQUARES SHOW CLOSED CONTACTS.

Fig. 5—WAVE AND GRAMOPHONE SWITCH ASSEMBLY.

In some cases there may be severe interference from " man-made static." When this can be traced to some definite source in the house or nearby the trouble should be attacked at the origin,* but when this cannot be done it is often very helpful to use a " screened lead-in." This is only effective if the aerial is a good outside one. In this case the lead from the lightning arrester to the set is of lead-covered electric lighting cable (2000 megohm grade), and the lead covering is earthed. The earth *must* be a good one, and the lead-in wire not too long. The E terminal of the receiver is connected to the lead covering. When using this kind of lead-in it is *not* necessary to keep it away from walls; it can be fixed down to them.

It has already been recommended to keep the aerial wire high up in the room. Earth and mains leads, on the contrary, should be kept low; either on the floor level or at the top of the skirting. The details of the actual earth connection must be left to the discretion of the dealer who installs the receiver. Undoubtedly it is best to use a short lead to a buried earth plate. But sometimes one has to choose between a long lead to a direct earth and a shorter one to a water-pipe or the like. In such cases take several temporary earth leads, try each, and then make a permanent job of the one found best. In any case, if the earth is finally made to a pipe see that the pipe is well cleaned and that a proper clip is used.

As to the mains connection, a plug joint is far preferable to using an adaptor in a lamp-holder. For one thing, the latter upsets the lighting arrangements and is very ugly; for another it is not so safe. If there is no plug point handy and the customer is prepared to have one installed, fit it low down on the skirting board (if any), close to the desired location of the set. The best type of fitting is a 5-amp plug switch and the circuit should be lightly fused—2 amps is quite heavy enough.

If the customer asks for a turntable and pick-up, the most important points are (1) see that the make of pick-up is one which is known to work well with the set, and (2) use screened flex for all the pick-up connections, and earth the screening.

## EXTRA LOUD-SPEAKERS

Arranging for extra loud-speakers is not nearly so easy as it appears. The output valve of the A8 is carefully matched to the speaker by a transformer and tone-control designed to give the best obtainable quality; and the casual addition of any kind of external speaker is almost certain to spoil the effect.

We especially deprecate the use of extra loudspeakers of the moving-iron type which will not only give poor results themselves but probably also cut off all the bass from the set's own speaker.

On the other hand there is no objection at all to fitting a second speaker *of exactly the same type* as that in the set, for use as an alternative; i.e., in cases where both speakers will not be in use at once.

*See " Interference with Wireless Reception arising from the Operation of Electrical Plant ", obtainable from The Librarian, Institution of P.O. Electrical Engineers, G.P.O. (Alder House) LONDON, E.C.1. Price 6d plus postage.

If it is particularly desired to use both speakers at the same time, then the leads to the distant one should be made of rather higher resistance than otherwise, to ensure that most of the power goes to the speaker in the set.

For *alternative* use, where each speaker is desired to work at full efficiency, use leads as follows : never use less than 23/0076 flex. Use this up to 15 yards run of twin ; for 15 to 30 yards use 40/0076.

For *simultaneous* use, up to 25 yards use 14/.0076 flex, and *do not use less than* 25 *yards* ; if that is more than needed coil down the extra out of sight. From 25 to 40 yards use 40 yards of 23/.0076.

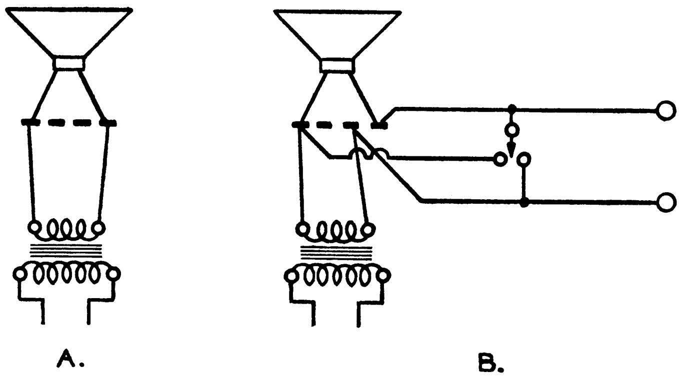



Fig. 1—EXTRA LOUD SPEAKER CONNECTIONS.

With regard to actual connections on the set, do not connect to the primary of T1 at all. Use the extra loudspeaker without its transformer, and do all the alterations in the speech-coil circuit itself. You will find on the speaker, close to the cone itself, a 4-way tag strip. The speech coil and the leads from the transformer are connected to the outer tags, the inner ones being unused—see Fig. 1, Sketch A. Shift one transformer lead to the inner tag, as in Fig. 1, Sketch B, and make the other connections as shown there. With the switch to one side or the other, one or other speaker is shorted ; with the switch central both are on. So if *alternative* working is wanted, use a switch with *no* off position : if the customer wants to be able to use both occasionally, use a 2-way and off switch.

The neatest way of doing the work is to fit the switches and terminals (or jack) at the loud-speaker end of the back of the chassis, near the tone control switch. But this is not very easy, as it calls for fairly large holes through the steel chassis, and corresponding ones in the steel back. It is easier, though not so neat, to fit them to the end of the cabinet. In this case arrangements must be made so that the leads can be disconnected before removing the chasiss.

*N.B.*—In running extra loudspeaker leads, keep them well away from the aerial.

Lastly, a few points of routine in dealing with sets for installation :

(1) *Test the set in your own workshop before installing,* in case it should have been damaged in transit.

(2) *Don't forget to adjust the set for mains voltage,* and if you are on 25 cycles, make sure it is a 25-cycle set.

(3) Get the customer to handle the set. Don't be content with just telling him how to use it, but see that he actually gets some results himself, while you look on.

# MECHANICAL SERVICE

The first requirement in servicing an A8 receiver is, of course, to get it out of the cabinet. The chassis is held to the cabinet base by six ¼″ Hexagonal screws. The heads are sunk into the base, so a box spanner is called for.

To remove the chassis first take off the control knobs then turn the set over (carefully) on to its back or one end (on no account lay it on its front, or the controls will be damaged). Then undo the two *middle* screws only. Turn the set right way up again with one end projecting over the edge of the bench, when it will be found possible to get at the two screws at that end. Remove them, turn the set round and take out the last two screws. The chassis will then slide out. To re-assemble proceed in exactly the reverse way, putting in the end screws first with the set right way up then turning it over to gain access to the middle ones.

For testing and working on the chassis, one needs chocks and supports to hold it " wrong way up." Three positions have been found useful and these are illustrated in figures 2, 3 and 4.

(1) The chassis can be stood on end with the loudspeaker end downward. It stands quite well, especially if a double layer of corrugated board be placed between the bench and the electrolytic condenser. (*See* Fig. 2.) Of course one must be careful not to push it right over.

(2) If more convenient, the chassis can be laid over on its hinder side, i.e., with the mains flex and terminals on the bench. It is essential to have a supporting block, about 1″ thick, under the screened choke L18, and the chassis must not be laid on its side until this is in place for fear of damaging the valves. (*See* Fig. 3.)

(3) Lastly, the chassis can be turned completely upside down. This needs a block about 1″ high which comes against the gang condenser and one about 6″ thick to come under the choke L18. It will then be found that the set is supported at 3 points ; the ganged condenser, the choke and the edge of the loudspeaker cone ring. (*See* Fig. 4.)

There are very few kinds of mechanical trouble in this set nor is there much difficulty in dealing with them.

## WAVE AND GRAMOPHONE SWITCH

At some time or other the wave-change switch may possibly need attention. It is important that there should not be excessive end-play in the shaft. This is adjusted by the collar next to the central bearing : endwise movement of the shaft is stopped in one direction by the nearest switch cam and in the other by the collar. The latter should be adjusted if necessary to allow about .020 movement, i.e., just enough to avoid any risk of binding. Fig. 5 shows details of the contact on the wave and gramophone switch assembly.

Occasional trouble with contacts is cured by cleaning and re-setting the contact springs in the usual way. On one or two early sets there has been trouble from the spring blades losing their springiness, so that no amount of setting will keep them right. If this should occur, it is best to return the set, or alternatively dismount the whole switch and return it, so that improved contacts can be fitted.

On one or two occasions a cam has broken. This is always the cam nearest the central bearing and is the result of a blow on the control knob. It is best to replace the whole spindle. The spindle bearings should be lubricated, if necessary, with vaseline.

## MAIN TUNING DEVICE

This gives very little trouble. Once or twice there has been slip and if it should occur it can be cured in the following manner: First remove the U washer and thus release the friction spring, which can then be stretched or replaced. See that there is lubrication (vaseline) in the knob spindle bearing.

## COIL UNITS

It is important to see that coil units are not loose. If one is faulty or needs examination it can easily be removed from below. Trace all leads coming through its base and disconnect them at their far ends. Then with a box spanner slack off and remove the two 6 B.A. nuts which hold the unit, when the whole can be withdrawn upwards.

TAKE GREAT CARE NOT TO DISTURB THE TRIMMING CONDENSERS

Before removing, mark the unit to make sure it is replaced right way round ; however, if this precaution has been forgotten a comparison of the leads and the wiring diagram at the end of this book, will ensure that the unit is replaced correctly.

## VARIABLE CONDENSER

Trouble with this is very rare but if it is really necessary to remove it first take off the drum drive, then work from the underside of the set with a long screwdriver between the L6-L7 coil-can and

C15, and remove one screw holding the condenser to its spring platform. After this, remove the other two (hex. headed) screws from the front with an open end spanner.

## TEST EQUIPMENT AND TOOLS

The equipment called for in these tests is that described in our recent book, " Measurement No. 1," which gives the absolute minimum necessary for reasonable service. This includes a set of suitable D.C. and A.C. current and voltage meters, an ohmmeter, and (desirable but not *absolutely* essential) a capacity-tester. Dealers are referred to the book for details.

There are also one or two special tools needed for the A8 and these comprise :

A ¼″ Whitworth box spanner for the chassis-to-cabinet bolts.
A standard 2 B.A. box spanner for the nuts holding the mains transformer.
A 6 B.A. box spanner for the nuts holding the coil units.
A 1 B.A. box spanner for the control knob nuts.
A protected screwdriver for trimming, and this is best home-made. Get an " Electricians " model turnscrew, with a blade ¼″ wide, and insulate the blade for 2″ back from the working end, leaving only 1/16″ exposed. A fairly tight-fitting piece of sleeving is the simplest method of covering the blade, but if there is none handy two layers of good quality insulating tape can be wound on instead.

# TRIMMING

Before touching any of the trimmers it is essential to read page 6 in order to gain a correct idea of the special duties of the various circuits. Any casual trimming may put the set so much out of adjustment that it will have to be returned to the factory.

The *general idea* of the adjustment of an A8 may be given in a few words ; first, the six I.F. circuits are tuned exactly to 120 k/c ; second, the oscillator is trimmed to make the calibration right on medium waves ; third, the three R.F. circuits are trimmed to maximum output on medium waves ; fourth, the oscillator is trimmed for correct calibration on long waves ; fifth, and last, the R.F. circuits are trimmed for maximum output on long waves.

Unfortunately, the first of these items—the trimming of the I.F. circuits—cannot be done without special apparatus. Reference should be made to current issues of the Murphy News for announcements concerning an oscillator suitable for the purpose.

The other adjustments can all be made quite easily, provided they are done in the right way. The following points are important. First, use a special screwdriver, as described above. Second, don't attempt to tune by ear. It is essential to measure the output after the I.F. part of the set while the adjustments are being made.

See page 20 for instructions. Third, do the work exactly as set out below.

(1) Oscillator, for medium waves.

Tune in to several stations on wave-lengths between 200 and 250 metres *that you can definitely recognize* ; tune them very carefully for maximum I.F. output on the meter, and compare their scale-readings with their wave-lengths as given in *World Radio*.

If the scale readings are correct, go on to (2) below.

If the scale readings are *not* correct, tune to a station as near 230 metres as possible. Then set the main tuning knob to the exact wave-length of this station and tune to maximum I.F. output *by adjusting* C11 (see the wiring diagram for the location of this adjustment). For choice, use a small aerial or a distant station, so that it is not too strong.

(2) Check on I.F. trimming.

Then tune in some station near 480 metres ; North Regional and Prague are suitable. Tune it carefully to maximum I.F. output on the meter and then see if its scale reading is correct. If it is, go on to (3) below.

If it is not, the I.F. trimming is out, and the set must be returned to the factory. Before finally deciding to do this, however, repeat the test and make absolutely sure of it. The essence of the test is that if the oscillator cannot be so adjusted that the calibration is correct on both 230 and 480 metres, the I.F. trimming must be out.

(3) R.F. circuits ; for medium waves.

When the oscillator has been got right and not before, trim the R.F. circuits.

Tune in to a station as near 230 metres as possible, and tune for maximum I.F. output. Then adjust the following trimmers *in this order*, tuning for maximum I.F. output in each case : first C2, then C7, then C6.

Check, by re-trimming on the main knob, that maximum is now got for the correct scale-reading of the station.

If the maximum output is obtained, the medium-wave trimming is complete and the long wave can be proceeded with as in (4) below. If not, it is necessary to go right back to (1) and work through the trimming operation all over again.

(4) Oscillator, for long waves.

The trimming is done in the same way as for short waves (see (1) above) but in this case a station working on about 1,120 should be chosen. Moscow (Moscow Popoff not Moscow Trades Union) is the best, but Oslo or Kalundborg may be used. The trimming is carried out by adjusting C12.

(5) R.F. Circuits, for long waves.

This is done as in (3) above, but using the same long-wave station as in (4). The condensers to adjust are : First C3, then C8, then C5.

# SYSTEMATIC FAULT FINDING

When carrying out repairs on a particular A8 Receiver, it may be found that the wiring on the chassis differs somewhat from that shown in the wiring diagram at the end of this book. These modifications do not affect the actual circuit of the A8, but represent small alterations that have been found desirable both from the manufacturing and servicing points of view.

The attached diagram shows the present arrangement, but copies of the original diagram are still available and may be had on request.

Most of the remarks on fault finding made in the A3A Service Instructions apply with equal force to the A8 receiver. Owing to the nature of the A8, however, it is rather important to give, in addition, a few general tests designed to locate the fault to one particular section of the receiver. These tests would be absolutely easy and definite if the Dealer's Service Department carried the equipment of a good laboratory, i.e., a standard oscillator—wave-meter or signal generator and its accessories, as well as a source of pure audio notes. However, this book is essentially written for those who have not such equipment and we have therefore to find what tests can be applied in practice.

The first of these is the pick-up test which shows whether the L.F. end of the set is up to standard or not. It is simply using the set on " Gram " with a test record and *measuring the output*. Three points need attention; the pick-up itself, the record, and the connection of the meter for measuring the output. The best records to use have already been described in our book Measurements No. 1, and there is no need to say anything further here.

There is little to say about the pick-up. Choose a really good one and for test purposes cut out any " scratch filter " that may be fitted.

For the meter, it is best to use a high resistance rectifier A.C. voltmeter, of one of the following types. Either an 0–5 voltmeter or an 0–200 voltmeter can be used. The 0–5 voltmeter should be connected by clip leads directly across the tags on the output transformer secondary to which the speech coil is connected. To use the 200 volt range, connect one side of a 2mF condenser (at least 600 V test) to the anode socket of the pentode, and connect the other side of the condenser to one terminal of the meter and the other terminal of the meter to the chassis.

Owing to the variation in output between different makes of pick-ups it is impossible to state in advance what the actual output from the receiver should be, so the dealer must try this for himself on a set which he knows to be good. Make a rule always to use the same pick-up and make of needle, use a loud needle and try on, say, two records; for example, the 100-cycle and 2000 cycle pure notes. Make a careful note of the voltage on the meter and keep it for comparison with any doubtful sets under test.

The next measurement which should be made is the "I.F. Output." This is a test of the steady output from the 2nd detector, due to the carrier. It is important because it doesn't depend on modulation, and is therefore a test of the R.F. and I.F. circuits.

The actual measurement is made quite easily with a 5-volt or 10-volt D.C. meter,which *must* be of the 1000 ohms – per – volt type. The positive terminal goes to chassis and the negative to the right-hand tag of C30, i.e., the middle tag of the C24–C30 condenser block. The meter thus comes across the detector output.

Simply connecting the meter in this way and tuning in to a station shows whether the set is alive or dead as regards signals, but it can give little more information because the automatic volume control upsets things. The very nature of A.V.C. tends to make all sets behave alike, so that for a really comparative test it is necessary to replace the auto bias by a fixed voltage thus: First disconnect the Blue lead that goes from the right hand tag of C30 to R15, then connect the meter negative lead to C30 and its positive lead to chassis. Put the positive lead of a grid battery to chassis and the negative to the Blue lead just disconnected from C30. In this way the battery volts are made to replace the auto bias.

A suitable station should now be chosen for testing on; a British station is best, particularly one of the new Regionals as they are very reliable. The station should not be more than 50 miles off, to avoid fading, and it should not be too near for fear of overloading. If the only suitable station is rather near use a small indoor aerial for this test. Tune in to the station with a known good set in its ordinary condition, and the voltmeter connected in the first position. The meter reading will be from 1 to 3 volts and this figure must be noted. Now change over to the grid battery and connect the meter in the second position, as described above. Then adjust the grid volts until the station gives the same strength as before, when approximately the same reading should be obtained on the voltmeter. Carefully note this reading and the grid voltage used. Once this has been done the readings can be taken as standard. Any good A8, tuned to this station on the same aerial, with the same voltage of battery bias should give a similar reading. If the bias has to be altered more than, say, 20% up or down to get the usual meter reading, then the set being tested has an extra high or low gain and it may be necessary to change some of the valves or search for faults.

In sections 117–124 of the table similar tests are described with various stages of the R.F. and I.F. amplifiers cut out. It is worth while to carry out all these tests on a good set as this will give definite standards to go by when judging the behaviour of any set under test.

A point worth remembering when servicing the A8 is that the switch provided is of the single pole variety and this may leave some points alive even when in the "Off" position. Hence, to be on the safe side, a double pole switch external to the set is recommended. This switch can be conveniently situated at the plug point.

# NOTES ON THE FAULT-FINDING TABLES

In trying to locate a fault in a comparatively complicated set of this kind, the essence of reasonably quick work is first to find out in which part of the set it lies and only then to start detailed checks of each circuit.

Sometimes, of course, the symptoms themselves give this indication. For example, trouble on only one wave-band *must* come from a fault in the R.F. part of the set, since the I.F. and L.F. are the same for both.

In a set with few valves it is best to test these first. But it is quite a long operation to test all the valves of an A8 and it is best to proceed rather differently. The general idea of the method recommended is :—

(*a*) Find out if anode and heater supplies are present and at least approximately correct.

(*b*) If so, test with a pick-up and record to see if the L.F. side is in order.

(*c*) If A.F. side is in order, check the oscillator as described on page 18 for calibration and output.

(*d*) Knowing that the oscillator is in order apply signals to the grid of V3. This tests the first detector and I.F. amplifier and so tells one whether the trouble is in that or the R.F. side.

(*e*) Having thus located the trouble as I.F. L.F. or R.F. one can test the valves and circuits of the part indicated.

The following notes are also important :—

1. The key letters and numbers to components are the same as those on the schematic diagram (front cover) and the wiring diagram (back cover).
2. In the details frequently given as to the run of the circuits, the letters refer to the colour of the leads. For example, take the smoothing choke. " C37–P–choke–P–C35 "

means from condenser C37 a pink lead runs to the choke itself and from the other end of the choke winding a pink lead runs to condenser C35. The colours are referred to by the following letters :—

| | |
|---|---|
| Blue | B |
| Black | Bk |
| Brown | Br |
| Red | R |
| Yellow | Y |
| Pink | P |
| Orange | O |

But remember that the colour-code may be changed from time to time for production reasons. So check the *run* of any lead as well as its colour. For example, in 60 A8 sets, numbered between 5500 and 5600 and issued between January 11th and 16th, 1933, some or all of the leads marked " P " were for production reasons actually " Y."

3. Where resistances are given remember that these are approximate only ; they may vary by 10% from set to set.

# VALVE TEST

It is assumed throughout that the voltages on the common H.T. tag and on all the taps of the voltage-divider are normal. Also, before testing, remove V6 so that there is no chance of the auto-bias upsetting the measurements. Have the mains switch on Radio (either wave) *not* Gram.

Remember that owing to the variation between different valves of the same type, it is not to be expected that all the currents will be exactly as specified. If they are within, say, 20% up or down they can be classed as " normal."

If the results for any valve are definitely not normal, replace the valve by a spare known to be in good order. If the results are still abnormal check the circuits as described.

Even if the results are normal, make the " Grid Test " described under each valve, as this shows that the grid circuit is in order.

The method of testing the grid circuits of the various valves is a rather unusual one. It is adopted in this case because the grid circuits all contain high resistances. This means that the grid bias cannot be measured in the usual way with a voltmeter, nor can the resistances themselves be checked with the usual type of ohmmeter.

Accordingly, we apply definite voltages from a grid battery to various points of the grid circuit and observe the effect on the anode current. In all cases the grid battery should be put in series with a 10,000 ohm resistance as this shows up shorts as well as breaks in the grid circuits. So that the abbreviated instruction " Grid test —V, + to chassis – to RH of R15, current—," means "join the + end of a—volt grid battery to 10,000 ohms, and the other end of the resistor to the chassis. Connect the negative socket to the right hand tag of R15. The anode current should then be — m.A.

## A.F. VALVE TESTS

**N.B.—R.H. and L.H. Tags, etc., refer to components as seen on the wiring diagram at the end of this book.**

**V8.** Normal anode current 25–30 mA, Anode Volts 180–200V. Screen volts 200–230 V.

First grid test $12\frac{1}{2}$V with + to chassis and – to R.H. tag of R25. The anode current should now be about 5 mA less than before, i.e., about 20–25 mA.

Anode current nil or low ........................................ 8A
Anode current high ........................................ 8B

**8.A. Anode current nil or low.**

Anode volts nil or low ........................................ 8A.1
Anode volts high ........................................ 8A.2

**8A.1. Volts and current nil or low.**

Break in anode or cathode circuits. Just possibly C.34 is earthed, but this would give low volts at the common H.T. tag. The anode circuit is : Anode socket—R—T1 —P—C36, and the resistance of T1 primary is 680 ohms. The cathode circuit is : Cathode socket —Br—L.H. tag of C33—P from same tag—tag of speaker BK from same tag to chassis.

**8A.2. Current nil or low, anode volts normal or high.**

Points to trouble in the grid circuit, giving excessive bias. The first grid test will bring the current up to about 25 mA. Almost certainly an O.C. in R26 or R27, the links that join them, or the Bk earth lead from R27 (R.H. end), or auxiliary grid lead O.C.

**8B. Anode current high.**

Anode voltage high ........................................ 8B.1
Anode voltage low or normal ........................................ 8B.2

**8B.1. Anode current and voltage high.**

Perhaps over-voltage generally ; check voltage at common H.T. tag. Otherwise, T1 may be shorted ; check anode circuit as in 8A.1 above. Or L.S. field short circuited turns, or shorted to chassis —its resistance will be low in either case so test it accordingly.

**8B.2. Anode current high, voltage low or normal.**

Suggests insufficient bias.

If the first grid test reduces the excessive anode current, R25 is O.C. or perhaps the P lead from R25 (L.H. end) to the – tag of C35 and C36. If the first grid test gives no effect, shift the – end of the battery to the G socket of V8.

If the current now comes back to 25 mA or thereabouts check the P leads from the R.H. end of R25 to C33, and from the same tag of C33 to the L.H. end of R23, and the B lead from R23 to grid socket they may be either O.C. or earthed, or C33 shorted or R23 O.C.

If the current is still excessive in the last test, there must be an earth on the B grid lead to R23, or the link to C32, or a short in C32.

**V7. Normal anode current 2 mA, Anode volts 110-120 Screen volts 40-50.**

**First grid test** $4\frac{1}{2}$V battery + to chassis – to L.H. tag of R26 The anode current should drop by about 0.5 mA.

Current low or nil ........................................ 7A
Current high ........................................ 7B

**7A. Current low or nil.**

Anode volts low or nil........................................ 7A.1
Anode volts high or normal........................................ 7A.2

**7A.1. Volts and current low or nil.**

Shows trouble in anode or cathode circuit. The cathode circuit is simply Br—Chassis—Bk—Tag 1 of the voltage-divider, and is easily checked. The anode circuit is: Anode terminal—flex lead—L.H. end of C38, C32 and R22—R22—P—Tag 6 of voltage-divider. R22 is 50,000 ohms. Test the whole for continuity and also for earths; a short in C38 or C32 will give these symptoms.

**7A.2. Current low or nil, anode volts high or normal.**

Screen volts low, or excessive bias. The screen is supplied direct by the P lead from Tag 4 of the Voltage-divider.

Excessive bias can only arise from an O.C. in R27, or the link which joins it to R26.

**7B. Anode current high.**

Anode volts high........................................ 7B.1.
Anode volts low........................................ 7B.2.

**7B.1. Current and volts high, short in R22.**

**7B.2. Current high, voltage low,** points to excessive screen volts, which is easily checked, or insufficient bias. If the first grid test gives normal result, the fault is R25 or R26 O.C. If, however, it gives no effect, test with battery negative on grid socket (Vol. control set to maximum).

Current drop to normal........................................ 7B.2.a.
Current unaltered........................................ 7B.2.b.

**7B.2.a.** Earth on C31, the P leads from it, or the Bk lead from R26 to volume control; or this last lead O.C. or a break in the volume control.

**7B.2.b.** Earth on B lead from grid socket to volume control.

**V6.** This valve cannot be tested in the usual way. The only useful way of testing the valve itself is: put the valve in the adaptor and test with a milliammeter *in series with a 9V battery*, between anode and cathode and then between " grid " and cathode. In each case there should be at least 1 mA flowing with the cathode negative; but with connections reversed and cathode positive, no current at all.

## I.F. VALVE TESTS:

Tests on the S.G. valves, V1, V3, V4, V5, are rather complicated by one or two special points. First, their grid bias is not a fixed voltage; it depends on the detector output. Even if the detector is removed, there may be enough grid current in the S.G. valves to give some bias by the voltage set up in the various grid resistors. Second, none of these valves can be safely tested in the usual type of valve adaptor, as the capacity between the grid and anode leads will cause them to oscillate.

So the tests for anode current should be made by connecting the meter leads direct to the anode terminal and the flex lead; the two leads should be short—say 2 ft. at most—and must be screened. The best thing to use is single flex without braiding and with Lewcos flex, screening tube pulled over it: then the two meter leads can be twisted into a pair bound together with fine wire at one point, and an earth lead taken from the binding to the chassis of the set. The lead from the anode terminal itself should always go to the – of the milliammeter. The anode volts can be observed by connecting – of the voltmeter to chassis and + to the + side of the milliammeter. The screen volts must be measured separately, from the screen socket of the valve-holder to chassis. (Remember, before starting to test individual valves to see that the anode volts (at common H.T. tag) and the screen volts (at tag 5 of the V.D.) have their normal values of 200–220 and 50-60V respectively. Also check cath. line – .8V negative to chassis. If anode volts abnormal refer back to V8.)

As the grid connections of V5 are different from the others, it is best to test V4 first. *Remove V6-and V2.*

**V4.** Normal anode current about 4mA. Anode and screen voltages same as common H.T. terminals. If the current seems on the low side but not very low—say about 3½mA—check C30 by shorting it. Doing so should give a drop of about ½mA ; if it does not then probably C30 is internally shorted.

**Grid test:** 3v battery + to chassis – to central tag of the C30—C24 block, the anode current should drop by 1½ or 2 mA, and should rise again instantly if the battery is disconnected. If the current only returns slowly to its normal value on removing the grid battery, it is almost certain that R15 or R16 is O.C. (or their circuit, i.e., the B lead from C30 or the Bk lead from R16 (R.H.) to chassis).

Anode current low or nil.................................................. 4A.
Anode current normal but does not drop with grid battery .................................................................. 4B.

**4A. Anode current low or nil** ; check the volts from anode to chassis.

Anode volts low or nil ..................................................... 4A.1.
Anode volts normal .......................................................... 4A.2.

**4A.1. Anode volts and current low or nil.**

Can only be due to a high resistance or O.C. in anode circuit, which is :—

Common H.T. tag—P—L14 in middle coil can—flex lead.

Its resistance should be 96 ohms, due to L14. If there appears to be a fault inside the coil can take the whole unit off (*see* page 16) for proper examination.

**4A.2. Anode current low or nil, volts normal.**

This may be due either to absence of screen volts or an open cathode circuit or an open circuit in R20. To find out which shift the – of the voltmeter from chassis to the cathode socket of the valve. If the volts are still normal suspect the screen circuit, which is simply the P lead from R17—R18 to the screen socket of V5 and on to V4.

If with – of voltmeter to cathode socket the anode volts are nil or low, the trouble is in the cathode circuit. This is :—cathode socket—Br—C29—P from same tag—Tag 3 of VD—R20—chassis; and its only resistance is the 25 ohms of R20.

**4B. Anode current normal, but does not answer to grid test.** This is the sign of an O.C. or earth somewhere in the grid circuit. Repeat the test with – of battery on the Auto-Bias line (i.e., the R.H. tag of the C30 – C24 block).

Normal result ........................................ 4B.1.
Still no current drop ................................ 4B.2.

**4B.1. Grid test normal on auto-bias line though not on R15.** This means either an O.C. in R14 or an earth somewhere in the leads connected to R15. Test for the former by shorting the middle R.H. tags of the C30—C24 condenser block and then repeating the grid test. If it gives normal results, there *is* an O.C. in the circuit : – C30—B—R14—Bk—C24. Check the wiring, measure R14 if you can (0.25 megohm) or replace it.

If with C30 shorted to C24 the grid test does *not* give the normal drop of anode current, there is an earth. Remove the wire shorting C30 to C24, and then disconnect from C30 in turn the Y and O leads. This will tell you whether the earth is on the Y lead, the O lead or C30 itself.

Earth on Y lead from C30. This is easy to check. The lead goes only to S6 on the wave switch.

Earth on O lead. This means removing the coil-can (see page 16). Then examine the wiring and check C25 for breakdown.

Earth in C30. Check this by removing the B, O and Y leads from C30. Then join the B, O and Y leads but *keep them clear of* C30. Make the grid test again, with the battery joined to the three leads. If now normal, the trouble was in C30, and the block must be replaced.

**4B.2. No drop on grid test either on C30 or C24.** Transfer the battery – to the R.H. tag of R8.

Results now normal ................................ 4B.2a.
Still no drop ........................................ 4B.2b.

**4B.2a. Grid test normal with battery on R8.** This means that the trouble is either an O.C. in R8 or an earth on the auto-bias line. Short R8 and test on C24. If the test is now normal R8 was O.C. If not, there is an earth on the auto-bias line. This can only be either (1) on the resistance rack itself (2) in the Bk lead to C24 or (3) in C24 itself and it is easy to find which.

**4B.2b. Still no current drop with battery on R8.** There is either an O.C. or an earth between R8 and the grid. Repeat the test with the battery – on the grid socket itself. If results now normal, the trouble is an O.C. either in the B lead from the grid, the O lead from R8 or in the coil-can itself. The resistance from grid to R8 should be 48 ohms being that of half L9. If still no drop there is an earth on the same part of the circuit. In either case if no fault shows in the leads the coil-can must be removed (see page 16.) Remember, if an earth is indicated, to check C18 for breakdown.

**V5.** No attempt should be made to test V5 until the tests on V4 have shown that the common supply lines and bias circuits are in order.

The normal anode current is about 4mA and the anode and screen volts the same as the common supply lines. For the grid test, use 3V, and connect the + to the chassis and – to the L.H. end of R11. The current should drop by 1½ to 2 mA.

Anode current low or nil ........................................ 5A.
Anode current normal, but no drop on grid test 5B.

**5A. Anode current low or nil** ; check the volts from anode to chassis.

Anode volts low or nil ........................................ 5A.1
Anode volts normal ........................................ 5A.2

**5A.1. Anode volts and current low or nil.**

Can only be due to an O.C. or high resistance in the anode circuit, which is flex lead—can—L16 in upper coil—P—common H.T. tag. Its resistance should be 35 ohms, due to L16. If it appears that there is a fault inside the coil can, remove the whole unit (see page 16) for proper examination.

**5A.2. Anode current low or nil, volts normal.**

This could be due to open screen or cathode circuit, but the first is almost impossible, as the screen supply to V4 has been proved in order, and this goes *via* the screen socket of V5. So this trouble is almost certainly due to a dis. in the Br. lead joining the cathode sockets of V4 and V5.

**5B. Anode current normal, but does not answer to grid test.**

This, of course, shows trouble in the grid circuit. The tests on V4 will have got rid of many possibilities.

Repeat the test with – of battery on the R.H. tag of R11. If now normal, R11 is O.C. (or the link joing it to R15). If still no current drop, there is an earth or O.C. between R11 and the grid, i.e., in the O lead from R11 to coil can, in the can itself or the B lead to the grid of V5. Repeat the test with – battery on the grid socket itself. If now normal the trouble is an O.C., if still no drop, an earth. In the latter case remember to test C21 for breakdown when you are examining the coil unit (see page 16 for removal of this). The proper resistance from R11 to grid socket is 96 ohms, for L16.

**V3.** No attempt should be made to test V3 until the tests on V4 have shown the common supply circuits to be in order. Make sure that V2 and V6 are removed.

Normal anode current about 1½mA ; anode and screen volts same as supply points. For grid test use 6 V battery, and take – to auto bias line (Tag of C24). The anode current should then drop by nearly 0.5 mA, to about 1mA.

Anode current low or nil........................................ 3A.
Anode current high........................................ 3B.

Anode current normal, but does not drop on grid test ........ 3C.

**3A. Anode current low or nil:** check the voltage from anode to chassis.

Anode voltage low or nil........ 3A.1.
Anode voltage normal........ 3A.2.

**3A.1. Anode volts and current low or nil.**

Points to O.C. or High Resistance in anode circuit, which is :—flex lead—L8 in coil can—P—common H.T. tag. Its resistance should be 96 ohms, for L8. If there seems no fault in the wiring but the resistance is wrong, remove the coil unit (see page 16) for examination.

**3A.2. Anode current low or nil, volts normal.**

This may be trouble in the cathode or screen circuit. Shift the – of the voltmeter to the cathode socket itself. If the volts are still normal the cathode circuit is in order, and the trouble is in the screen lead (P) from V4 to V3. If, however, the first test shows low or no volts, check the cathode circuit. (It is :—cathode socket —Br.—C15 —Br.—L12 —chassis.) From cathode socket to chassis should be 2,500 ohms for R3. If there seems to be an O.C. it can be located by testing from the R.H. end of C15 to cathode and chassis in turn. The former should give 2,500 ohms (for R3) and the latter 3.5 ohms (for L12). If the trouble appears to be in L12, remove the oscillator coil unit for examination.

**3B. Anode current high** (About 4mA).

If the grid test shows a reduction in current but only from 4 to 2 mA instead of $1\frac{1}{2}$ to 1 mA as it should be, it is almost certain that the trouble is an earth on the cathode or short in R3. Test R3 as in 3A.2 above.

If the grid test gives no reduction in current shift the – lead of the battery to the L.H. tag of S4.

A drop in current now shows that there is an O.C. either in R2, the O. lead from R2 to S3, or the link between S3 and S4.

If there is no drop, there must be an O.C. either in the flex lead from the coil can to the G socket of V3, or in L6 or L7 or their leads inside the coil can. If the O.C. is present on both medium and long waves it must be in L6, if on long only, it is in L7.

**3C. Anode current normal, but grid test gives no reduction.**

This is due to an earth on the grid circuit somewhere between the grid and R2. As can be seen from the schematic, this may be anywhere in the band-pass filter, so tests must be made to locate it.

Switch off the set and test from the valve grid to chassis : the resistance will of course be low, owing to the earth. Now open the link between S3 and S4.

Earth still on........ 3C.1.
Resistance high ........ 3C.2.

**3C.1. Earth still on with S3 to S4 link disconnected.**

It must be in CIC or its lead, or in the flex lead to the grid coil

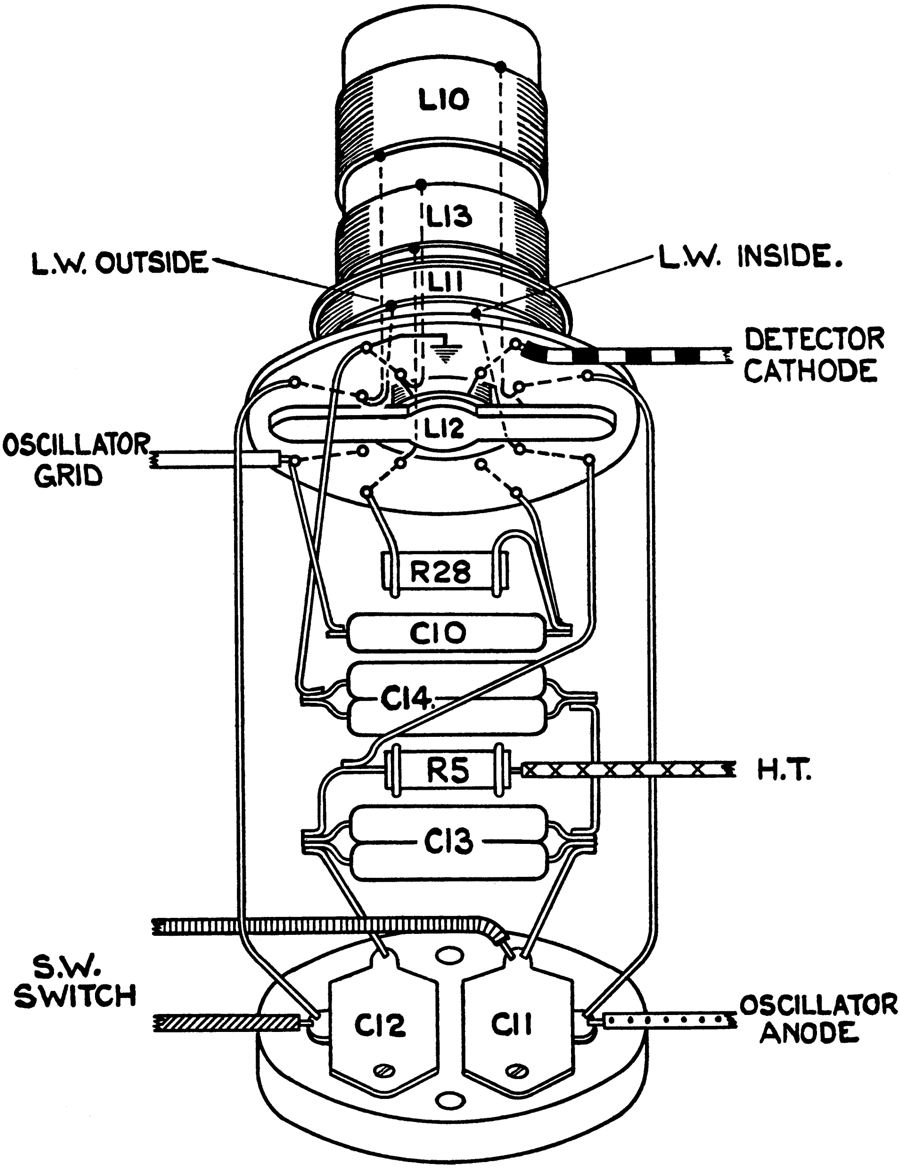



Fig. 6—DETAILED VIEW OF OSCILLATOR COIL.

can, or in the coil itself or S4. Try disconnecting the lead to CIC. If still earthing, examine the coil-can lead and the contacts and leads of S4. If all in order, open the coil-can and look for earths. If necessary test C7, C8 and C9, for shorts ; but remember that the leads joining them to the coils must be disconnected before testing each.

**3C.2. Earth goes off with S3 to S4 link disconnected.**

Join up the link again. The earth must be on the O. lead from R2, in S3, or in the anode coil can or C1B. Check as just described under 3C.1, but testing C1B, S3 and the anode coil-can instead of C1C, S4 and the grid coils.

## R.F. VALVE TESTS :

**V2.** V2 is likely to be tested before any other valve ; so all that is known by previous tests is that the common tag of the H.T. supply carries the right voltage. V2 being a triode must be tested in the adaptor. This will probably prevent it from oscillating but to make sure, before testing it short its grid socket to its cathode.

Normal Anode Current 2.5 mA, Anode Volts 60.

Current low or nil ........ 2A.
Current high ........ 2B.

**2A. Current low or nil.**

This means an O.C. somewhere in the feed circuit, or an earth on that part of it between R5 and the anode.

First make sure the Br. lead from cathode to chassis is in order, if so, switch off, remove the valve and test from anode to common H.T. tag. The correct value is 50,000 ohms (for R5) if a much lower value is obtained there is an earth, while an O.C. will show no current at all. If your ohmmeter does not give a clear difference between 50,000 ohms and O.C. test thus :—put a milliameter between anode and cathode sockets, and switch on. The current should be 4 mA, while if there is an O.C. it will be zero.

If this test shows normal, check resistance from anode to chassis. It should be over 50,000 ohms.

According as you find O.C. or earth, proceed as follows :—

O.C. in anode circuit ........ 2A.1.
Earth on anode circuit ........ 2A.2.

**2A.1. O.C. in anode circuit.**

(For testing this refer to the special diagram on previous page).

First test from anode socket to the R.H. Tag of S5. This checks L10 and the resistance should be 6 ohms. If this is in order, remove the coil cover. You will see that C13 and C14 are joined at one end. Shift the test lead from the valve anode socket to that end of C13, which is not joined to C14, leaving the other lead on S5. This tests L11 which should be 10 ohms. If it is in order shift the lead from S5 to the common H.T. tag and test again. This checks R5 which is 50,000 ohms.

**2A.2 Earth on anode circuit.**

First remove the coil cover, and test again. If now in order, look for bare wires too near the cover ; there is not much room here. Next remember that there is only one condenser in the can which gives an earth if broken down and this only shows up on short waves, it is C14. Disconnect the earth wire from it and test again, if this shows that the earth is still on, replace the wire and disconnect the flex lead from valve anode to C1D. If this gives no improvement remove the coil unit and examine it carefully. (See page 16). The most likely points for an earth are : the leads from C11 and C12 up to the coil base, and that from the join of R5 and C13 up to the coil base. Especially make sure that they don't touch the brass pillars or the lead from C14 up to the coil base, which are already earthed.

**2B. Anode Current high.**

Can only be due to a short in or across R5.
Remove Coil cover and examine.

**V1.** It is possible that V1 may come to be tested before any other valve (except V2) : so that there have been no previous tests to prove that the common supplies (including grid bias) are in order. The screen and cathode circuits are quite simple, but if there is any indication of trouble in the grid circuit, read the notes at the head of "I.F. Valve Tests" and make the valve test on V4, which will at once show whether there is any trouble in the common part of the grid circuit.

In any case, note the remarks in the same place as to trouble with valve adaptors, and take the precautions suggested ; also remove V6.

The normal anode current should be about 4mA ; the screen and anode voltages the same as at the common supply points (common H.T. tag for anode, tag 5 of V.D. for screen).

For the grid tests, use 3 volts, and connect negative to the auto-bias line (tag of C24) and positive to chassis. The current should fall by about $1\frac{1}{2}$ mA, i.e., to about $3\frac{1}{2}$ or 3 mA.

| | |
|---|---|
| Anode Current low or nil ........ | 1A. |
| Anode Current normal but does not drop in Grid Test ........ | 1B. |

**1A. Anode current low or nil.** Check the volts from anode to chassis.

| | |
|---|---|
| Anode volts low or nil ........ | 1A.1 |
| Anode volts normal ........ | 1A.2. |

**1A.1. Anode volts and current low or nil.**

Due to an O.C. or high resistance in the anode circuit itself. This circuit is very simple : it is (Flex lead—L3 in centre H.F. Coil can—P.—common H.T. tag) and its resistance should be 4.5 ohms (for L3).

**1A.2. Anode current low or nil, volts normal.**

Points to trouble in screen or cathode circuit, check by shifting the – of the voltmeter from chassis to cathode socket. If volts still

normal, the trouble is in the screen circuit, which is easily traced as the P. lead from valve to valve V1, V3, V4, V5 and thence to the V.D. If, however, the volts are low or nil to the cathode socket, it is the cathode circuit that is faulty. It is :—
Cathode socket—Br.—Tag of C29—P—Tag 3 of V.D.—R20—Chassis. Its only resistance is the 25 ohms of R20.

**1B. Anode Current normal, but does not drop on grid test.**
First go back to page 25 and make the valve test on V4. This will show up any faults in the *common* part of the grid circuit. If this shows no fault, the trouble must be in V1's own grid circuit. Shift the battery – to the L.H. tag of S2. If the current now drops as it should, the trouble is an O.C. in R1 or the O. lead from it to S2. If not, shift the battery – to the grid socket itself. If the test is now normal, there is an O.C. inside the Coil-can or the B. Grid lead. If still no drop, there is an earth in the same part of the circuit or in C1A. Test for the latter by removing the flex lead from the grid of V1. In either case, it is probably best to remove the coil unit (see page 16) for examination. If an earth is indicated, remember that it may be a breakdown in C3 or C4. Or C2 if earth only occurs when S1 is closed, i.e., when set is switched to gram.

# FAULT FINDING TABLES

| | |
|---|---|
| No output | **100** |
| Hum | **200** |
| Noisy | **300** |
| Noisy on stations | **400** |
| Modulation hum | **500** |
| Distortion | **600** |
| Poor gain | **700** |
| Flat Tuning | **800** |
| Poor response curve | **900** |
| Instability | **1000** |

## No Output.

**100.** Pilots, rectifier, Pentode Valves all light ? No ........ **101**
Yes ........ **102**

**101.** Trouble in Heater circuits.
If *none* light, check primary circuit. Dis. mains plug, switch on, and test from plug or adaptor. Circuit is Flex—Tag 1 on T2—R. from same tag—S10—R.—Tag2 on T2—Pr.—R., Br. or B.—3-way taps—Plug—Flex and resistance according to T2. See Primary table on schematic.
If Pilots light, practically certain that V8, V5, V4 and V2 Heater circuits are in order. To check other sec., test V1 heater sockets with A.C. 25V. range.
V7, V6, V3, V1 are fed from tags 3 and 4, and
V8, V4, V5, V2 and the pilots are fed from tags 5 and 6, on T2.

**102.** Heaters light. Test the voltage (D.C., 500-V. range) from the common H.T. tag to Frame.

Voltage more or less normal—say between 200 and 220 Volts .......... **109**
Voltage low or nil .......... **103**
Voltage high .......... **108**

**103.** The first thing is to find out whether the proper voltage is being generated.
Dis. from the common H.T. tag the pink lead that runs to C37, and test its voltage to earth, which should then be 400.

Voltage low or nil .......... **106**
Voltage normal .......... **107**

**104.** Low or no volts from C37. Join up the lead again. Make sure there is A.C. on the rect. valve, by removing it and testing from its G. and P. sockets (separately) to chassis, with the 500-V. *A.C.* meter.

There should be 300 V. in each case ; if there is not, make sure that the two section leads which form the centre-tap are joined to the tag on C35 and C36 neg. If so, the transformer is faulty (unless by some chance the V9 valve-holder has a short or the field coil is O.C.).

If there *is* proper A.C. on the rectifier, dis. the P. lead from it to C35, and take the (D.C.) volts from the filament socket to chassis, which should then be **280 V.** If low, try another rectifier.

If there is approximately correct D.C. output with the lead to C35 dis. from V9, join up this lead and test again from V9 filament to earth.

Volts now low .......... **105**
Volts now normal at **330 V.** .......... **106**

**105.** There must be an earth somewhere in the smoothing equipment. Keep the meter on, and dis. the lead from C35 to L18. If the voltage is still low C35 is earthed. If not, i.e., if the voltage comes up to normal, replace the lead, and open the lead joining C36 and C37 and that joining C37 to tag 6 on the V.D. If the voltage is now low again, the earth is in the choke and its leads, or in C37 ; if normal, the earth is in C36 or the leads to the output transformer, or the lead to the V.D. The former circuit is C36—P.—Loudspeaker—R.—V8 anode socket—R.—C34—R.—S11 or R24—E. (Check them for shorts to earth). The latter circuit is C37—P.—V.D.—P.—R22—Flex—Screen of V8 or from V.D.—P.—6-way tag.

**106.** Volts normal at V9, low or nil at C37. There must be an O.C. or high resistance in circuit. Check the resistance between the P. lead from V9 and C36. The circuit is V9—P.—C35 and same tag to—P.—L18—P.—C37 and same tag to —P.—C36, and its resistance is that of L18 (190 ohms).

If this is normal, test from the – tag of C35 and C36 to chassis. The circuit is C35 and C36 common tag —P.—speaker field—Bk—chassis. and the resistance is 1000 ohms

**107.** The H.T. voltage is normal at the terminal of C37, but low or nil when the common H.T. tag is connected. Obviously there is a partial or complete earth on the receiver side. First dis. the common H.T. tag from the voltage-divider, and check the resistance of this. From tag 6 to earth it should be approx. 14,000 ohms.

If this is normal the only thing is to test the anode circuits one by one. With the valves cold, there should be infinite resistance from the tag to earth,—voltage divider tag still disconnected. Dis. the P. leads one by one, testing each time till the resistance goes up beyond measurement ; the last one taken off is the faulty one.

If the lead to C26 is the faulty one, the trouble is in C26. Each of the other leads goes through a coil to a valve anode. If the fault is on the lead to any but V2, dis. the corresponding flying anode lead and test again. This shows whether the fault is in the valve or the coil and leads, and if the latter there is little difficulty in finding it.

**108.** If it is on the lead to V2, remember that the first part of the circuit inside the oscillator coil can is R5, which is 50,000 ohms. So if the earth is a low-resistance one it must be directly where lead D. comes into the can : earth *after* R5 would have practically no effects on the volts at the common H.T. tag. (If the common H.T. tag is normal, but volts are low on connecting it to the V.D. again, remember the possibility that the P. lead to R22, and the flex tag to the screen of V8, may be shorting to earth).

Voltage high from common H.T. tag to frame, check transformer tap setting against actual mains volts. If correct suspect short in L18 or the Field Coil, switch off and test there : L18 should be 190 ohms, and the field coil 1,000. ohms.

**109.** The anode voltage is normal from common H.T. tag to frame. Make sure that the voltage-divider is in order by connecting tag 6 to the H.T. again, and checking the voltages to earth. They are :—

| | | |
|---|---|---|
| Tag 6 or C26 | (already tested) | 200–230 |
| ,, 5 ,, C27 | | 50–60 |
| ,, 4 ,, C28 | | 40–50 |
| ,, 3 ,, C29 | about | 0.7. |
| Voltages all normal | | 111 |
| Voltages not normal | | 110 |

**110.** If there is a break in the voltage-divider, the tags above the break will be much too high in voltage, and those below will be zero.

But zero voltage might also be given by an earth on one of the circuits tapped off. Thus we get the following guide :—

(Assuming voltage at tag 6 normal). Tag 5 nil. Break in R17 or earth on C27 or screen circuit. Dis. the leads from tag 5 and test again. If voltage now 50-60V. at tags, the trouble is in C27 or the screen circuit. If C27 in order, remove V5, V4, V3, V1, in turn in case they have internal shorts. If earth still on it must be in the P. lead to the sockets, or in one of the sockets themselves.

**Tag 5 high, others low or nil** ; Break in R18 or earth on C28 or screen lead or V7. Dis. the leads from Tag 4, and test again. If now 40-50 volt, the trouble is not in R18. Test C28 for insulation. If normal, replace the leads or Tag 4, and remove V7. If voltage now normal, V7 was faulty. If not, it must be the lead or valve-holder.

**Tags 5 and 4 high, Tag 3 nil** : Break in R19.

Note that the voltage at Tag 3, though only 0.3 V. when the valves are cold, should rise to 0.7 when they have all warmed up.

**111.** The valves are apparently getting their normal feed voltages, but there is no output. Check the make and break of all contacts of the wave-switch. They should be as in the diagram on page 12 .

Make the pick-up test (see page 19) (remember to turn the main-switch to gram).

Output normal .................................................... **113**
No output.......................................................... **112**

**112.** No output on pick-up.
Make the valve test on V7 and V8. If this shows nothing abnormal, we know that all the D.C. circuits in the L.F. end are in order. Looking at the schematic, we find that there is not much difficulty now in finding the fault. It must be either :

(a) In the A.F. coupling from V7 to V8,
(b) Between pick-up and V7 grid,
(c) In the L.S. secondary circuit.

(a) This is simple. We know the circuit is in order up to the L.H. end of C32 and from the R.H. end of R23. The fault can therefore only be in C32 itself or the link from its R.H. end to R23.

(b) Assuming that the pick-up leads themselves are in order, and the plug making proper contact, then the only parts of the circuit not already proved in order are (A) the P. lead from jack to C31, and on to R26, and (B) the other side of the grid circuit of V7, which is Jack—P.—S6—Y.—C30—P.—R21—C31. These are easily tested for continuity and insulation to earth. They are not, of course, *completely* insulated, as the circuit (A) is earthed through R27 (50,000 ohms) and (B) through either R15 and R16 (.5M$\omega$) or R21 and 27 (.5 M$\omega$).

(c) This can be tested by opening one of the leads between T.1 sec. and the speech coil: the resistance of the speech coil should be about 1.6 ohms, and that of the transformer secondary 0.35 ohms.

**113.** Normal output on pick-up test: the trouble is in the I.F. or R.F. circuits.

The first thing under these conditions is to make sure that the oscillator is working. First make the valve test on V2. Then see whether, on removing the short across the grid and filament (which has been put on for testing) the current in the anode circuit of V3 rises by 0.25 mA, as it should. This indicates that V2 is oscillating. The next thing is to check its calibration; assuming that there is no special calibrated test oscillator available, the check can be made with a good class receiver which is marked in wave-lengths.

The procedure is as follows: put the receiver near the A8. Attach a long lead to the cathode socket of V3, and twist it for a yard or so round the aerial lead of the receiver (insulated, of course,) so that some of the output of the oscillator will reach the receiver, through the small condenser thus formed.

Now tune in on the receiver any of the stations in the following list, and then tune the A8 through the wavelength marked in the third column. As you do so, you should hear the usual "chirp" (in the *receiver's* loudspeaker, of course) as the oscillator cuts across the station. To prevent any confusion from the A8. itself picking up signals, remove the detector V6, or else turn the manual vol. control to minimum.

| *Station.* | *Receiver Setting.* (*Metres.*) | *A8 Setting* (*Metres.*) |
|---|---|---|
| Beromunster | 459 | 563 |
| Rome | 441 | 535 |
| Mid. Regional | 399 | 475 |
| Leipzig | 390 | 462 |
| Toulouse | 385 | 455 |
| Scottish Regional | 376.4 | 443 |
| London Regional | 356 | 415 |
| Brussels | 338.2 | 391 |

| | | |
|---|---|---|
| Milan | 331.5 | 382 |
| Poste Parisien | 328 | 378 |
| Breslau | 325 | 374 |
| Cardiff | 310 | 354 |
| North National | 301.5 | 343 |
| Hilversum | 296.1 | 336 |
| Scottish National / Bournemouth / Plymouth | 288.5 | 326 |
| Heilsberg | 276.5 | 311 |
| Turin | 273.7 | 307.5 |
| London National | 261.5 | 292 |
| Horby | 257 | 287 |
| Gleiwitz | 253 | 282 |
| Trieste | 247.7 | 275 |
| Belfast | 242.3 | 266 |
| Cork | 224.4 | 246.5 |
| Aberdeen | 214.3 | 234.5 |
| Newcastle | 211.3 | 231 |

It is as well to check on two or three stations. The result of this test will show how to proceed :—

No oscillation .......... **114**
Incorrect calibration .......... **115**
Results normal .......... **116**

No oscillation.

**114** The valve test has shown that the anode circuit is continuous and not earthed : the remaining possibilities in it are a short across L10 or L11, or an O.C. in C13 or C14 or their leads. If the anode circuit is normal, check the grid circuit. This is by the B. lead to C10, R28 and L13. R28 should be 1800 ohms and L13, 4.5 ohms. If they are normal, test C10 with a capacity-tester if you have one ; if not, replace it. The special diagram, Fig. 6, on page 29 will be of assistance in checking the oscillator circuits : be especially careful not to disarrange any of the leads so that they short against the can, as there is very little room to spare.

**115.** V2 oscillates, but not at the right frequency.

**Don't touch C11 and C12 at first.**

A possible cause is a change in C13 or C14. Test these with a capacity-tester if possible : their values are: C13, .00137, C14, .00177 M.F.D. If these seem all right, examine the gang condenser to make sure the drum has not shifted on the spindle, and that the flex from the anode of V2 is in order. (See note on page 49).

Only when you are quite certain that these are all normal should you touch C11 and C12 ; if you want to adjust these, turn to page 17, for " Trimming."

**116.** The oscillator is in good order, and calibration correct, and the pick-up test has shown the A.F. side to be normal.

The next thing is to check the I.F. amplifier; and this can be done as follows: undo the arrangements just made for checking the oscillator. Connect the aerial, through a small condenser (say .0001) to the grid socket of V3.

If you look at the schematic, you will see that this is a test of the I.F. amplifier. For it has already proved that:

(1) The A.F. side is in order.
(2) The oscillator is in order.

So if we tune to a near station we must get signals unless:

(a) There is a fault in the grid circuit of V3.
(b) A fault in the I.F.
(c) Trouble in the second detector.

Tune in a good strong station known to be working, and observe the result.

No signals........................................ **117**
Signals normal........................................ **122**

No signals: fault in I.F. amplifier.

**117.** First check the 2nd detector circuit. This is: centre-tap of L17—O.—R.H. Tag of C30—B. from same tag—R15—R16—chassis, and back to cathode by the Br. lead from chassis and cathode socket of V7. The A.F. part of the voltage across R15 and R16 goes through C30, and the pick-up test has proved this in order. The I.F. part of the output goes straight from L17 to earth through C25 in the coil can. Make the valve test on V6, or substitute a known good valve. If this shows no fault, remove V6, and test from G and from A. sockets to the R.H. tag of C30: the resistance should be half L7—say 48 ohms in each case: also test from G. to A. socket (96 ohms) and from either to earth (to check R15 and R16): this last should be too high to measure with the ordinary ohm-meter; .5 M$\omega$. If you have a capacity-tester, check C25 (.0005 M.F.D.)

When you are satisfied that the 2nd detector is in order, make the valve test on V4, V5 and V3. If this shows no fault, the next thing is to check the I.F. circuit of each stage, thus: first dis. the anode flex leads from V5 and V3, and by a short length of wire connect V5's lead to V3's anode terminal. Now replace V6 (which has been removed) and see if you get signals; they will, of course, be weak, for V3 is the only H.F. valve working. It is best to try these tests on a known *good* set, so that you have some idea of what to expect. Remember it may be necessary to adjust the tuning a bit, for the L16 circuit is trimmed for V5 and not for V3.

No signals ........ **118**
Signals normal for this connection ........ **119**

No signals with V4 and V5 out of action.

**118.** The fault must be either in L16 and its circuit or in the grid circuit of V3. The latter is not likely, for we are not really depending on this circuit for tuning (see explanation on page 7). It has already been proved by the valve test that the circuit is not broken or earthed. There is just the chance that L6 is shorted.

But it is best to test V5's anode circuit first. This should be 35 ohms from the anode lead to the common H.T. tag. In examining this or other I.F. coils, remember that in all cases the grid coil is the upper, the anode coil the lower one.

If it seems certain that L16, C22, and R12 are in order, it becomes necessary to check the grid circuit of V3. Dis. both the flex leads from its grid socket, and connect a " leak "—say 100,000 ohms or .25 M.O.—to the same socket. Dis. the lead from the R.H. tag of R2, and then join a lead between this tag and the free end of the " leak " you have just put in. This has the effect of cutting out the tuned circuit altogether, and you now again put the aerial on the grid of V3 and test. If you get signals this time, there is something wrong with the tuned circuit. Make sure that the contacts of S4 are in good order, and check the resistance of L6 (7.5 ohms). Also see that the flex lead to C1C is in good order, and that C1C and C9 have normal capacity.

**119.** With Ae to V3 grid and V5 anode lead on V3 anode, signals normal for that arrangement.

Put back V5's lead on its own anode : dis. the anode lead from V4 and put it on V'3s anode.

No signals ........ **120**
Signals normal ........ **121**

**120.** No signals with V4's anode lead on V3—obviously the fault is in V4's anode or V5's grid circuit. Check the coils for resistance : they are both 96 ohms. If they are normal, and C19 and C20 not shorted, the only remaining possibility is that C21 is O.C. (this would give poor signals), test its capacity (.01 M.F.), or if you have no capacity-tester replace it. Make sure there is no earth to the coil-can.

**121.** With V4's anode lead on V3's anode, and Aerial on V3 grid, signals are normal for these connections.

Replace V4 and V3 anode leads on their own valves. The fault is in L8 or L9 or their associated circuits. Test as described above (96 ohms) for L14 and L15 : but remember that the test from the grid socket of the V4 to R8 only tests *half* L9 (48 ohms).

To check the other half of the coil, make another test, with the coil can off, from the grid lead to the side of R7 that is not connected to R8.

**122.** With Aerial on V3 grid, signals normal.

The trouble must be in the H.F. part of the set. Make the valve test on V1. If this shows no fault, remove the Aerial from V3, and connect it (still through a small condenser) to the flex anode lead of V1. Try for signals again.

No signals ........ **123**
Signals normal ........ **124**

**123.** No signals with aerial on anode of V1.

This points directly to trouble in the first part of the band-pass filter, for the second part has already been checked. First test from V1 anode lead to the common H.T. tag, to make sure that L3 is not shorted: it should be 4.5 ohms. Then test from the flex lead to C1B to the R.H. end of R2: the resistance should be 7.5 ohms. (for L4) on the short wave, and 25.5 ohms (for L4 and L5) on long. This will show up shorts in the coils or tuning condenser. Make sure that the lead to C1B is continuous and not earthing; and see that the link for S3 to S4 (L.H. tags) is in order.

**124.** With aerial on anode of V1, signals normal.

The trouble must be in the first tuned circuit. Make sure that the contacts of S1 open properly. If so, check the resistance from the grid socket of V1 to the R.H. end of R1: it should be 7.5 ohms (for L1) on short wave, and 25.5 ohms (for L1 and L2) on long. See that C2 and C3 are not earthed, and that the Br. lead from Aerial terminal to C2 is in order.

## EXCESSIVE MAINS HUM

**200.** The various causes that may produce this are not very difficult to trace. It is therefore unnecessary to provide a detailed scheme for isolating them, as has been done for faults under 100.

It is best just to locate the fault in either the H.F., I.F. or A.F. section of the receiver, and then check through the list of possible causes.

It may help to remind you that hum may arise in five ways :—

(1) Direct, from ripple in the H.T. supply.
(2) Direct, from ripple in the G.B. or cathode circuit.
(3) Indirect, by coupling from heater to cathode.
(4) Indirect, by magnetic coupling.
(5) External, via the aerial.

So in case of hum, begin by shorting aerial to earth to make sure that the hum is not coming from outside.

**201. HUM FROM A.F. END:**

Short the gram. jack and switch to gram. If the hum still persists, it is either ripple in the whole H.T. supply or A.F. grid bias, or other part of the A.F. end. Likely causes are:—

V7 cathode lead O.C. E. lead from R20 O.C. giving wrong screen volts to V7 and trouble in the A.F. biassing resistor circuits.

All the above will show signs on checking the anode current and volts of V8 and V7 (see "Valve Test"). This will also show up an O.C. in C35, which gives low H.T. volts. An O.C. in C37 not only gives hum, but as a rule also causes a very obvious loss of bass notes. But C36 O.C. only gives hum and no other symptoms. These three can be checked by replacement. A fault that may or may not give hum in this test is an O.C. in the E. lead of Z. (i.e., from V1 to S1).

Other condensers that may give the same trouble are C28, C31 and C33. If any one of these is O.C. there may be hum.

**202. HUM IN I.F. AMPLIFIER:**

If the hum goes when on gram with the pick-up jack shorted, switch back to radio and remove the anode lead from V3. If hum is still present, it must be arising in the I.F. amplifier.

The previous test, on the A.F. end, will have shown up any trouble in the H.T. supply so we can neglect that. The most likely sources remaining are: C25 or C24 O.C. or shorted; the earth lead from R20 O.C.; defective valves in V4 or V5 positions (especially cathode shorting to heater). Check symptoms on these are:—

C24 or C25 O.C. none—test by replacement.

C25 or C24 shorted: shown up by grid test on V4 (see page 25).

R20 O.C. Anode currents nil, as there is no return path from cathode to earth.

C18 or C21 O.C. May cause I.F. oscillation.

Also make sure of the earth lead of Z., if this not already checked.

**203. HUM IN H.F. SECTION:**

If the removal of V.3's anode lead in the last test stopped the hum, the latter must be arising in the H.F. section. The previous tests make it very unlikely that the trouble is in any of the common supply leads (anode, screen, cathode, grid bias). It may be a defective valve, so make the valve test on V1, V2 and V3 and try replacements—including V2.

## NOISY

**300.** One of the things that has to be faced is the fact that in a receiver having such very great amplification as the A8, very small causes will produce a lot of noise. It may be taken for granted that when the set is used on an aerial, but with no signal coming in to work the A.V.C. and keep down the gain, there will be a fairly loud " breathing " some " valve hiss " and a general background of small electrical disturbances from outside. Even with the aerial earthed the breathing and hiss will still be there.

So that when a set is classed as " Noisy " we mean something more than the presence of the above symptoms.

Sometimes a set will build up a microphonic howl. There is no need to explain this in detail—anyone will recognise it. For this type of noise, see under " Instability " section 1000. Also, a few sets have developed a peculiar fault on the long-wave range only: clucking, grunting or " motor boating " at about 1250 metres. This also is dealt with under 1000.

There remains a host of noises which one can describe as clicks, bangs or rattles and which are almost invariably due to loose connections; also cases where the general background noise is excessive. Taking the last trouble first, the most common cause is noisy valves. The manufacturers still seem unable to make all valves equally quiet. As a general rule it is found that most of the trouble lies in V1, V2, V3 and V7, and replacements should be tried here first. Another source is in V6, the second detector, due to excessive emission. A test for this is to tune to 5XX or some other powerful *long-wave* station and then switch to gram, with pick-up in position. If the station still comes through at all, change V6.

On one or two occasions a No. 2 I.F. transformer (i.e., L14—L15) has been put in place of a No. 1 (L8—L9). This gives excessive gain and causes background noise. It can be checked by measuring the resistance from the grid socket of V4, to the O. lead at the R.H. tag of R8. The correct value is about 48 ohms, while a No. 2 coil unit will give 96.

Coming to rattles, etc., the first thing is to see whether the set is sensitive to tapping various parts. A check all over the set will very often show directly what the trouble is.

Failing this, do exactly as suggested above for mains hum. First test the A.F. end by switching to gram. and shorting the jack; next test the I.F. by taking off the anode lead of V3.

When the source of the noise is located in some particular circuit, examine all leads carefully for dry joints, etc. If nothing shows, switch off and check the values of resistances and condensers; if one of these gives unsteady readings on measurement, it is probably the source of the trouble.

Noise continues (though perhaps less loud) when switched to "gram" and jacked shorted.......... **301**
Noise stops under above conditions .................................. **302**

**301.** The noise is arising in the A.F. end or in the supply. Short across from V8 grid socket in the R.H. end of R25. If the noise now stops, the trouble is in R21, R22, R23, C38, C32, C33, or their associated wiring; or in V7 itself.

If it goes on, it can only be in T1 or the speaker, C34, R24 (or the contacts of S11) or in the H.T. supply circuit. The best test for the latter is to remove V8 and disconnect all leads from tag 6 of the V.D. *except* that from C37. Then put the D.C. voltmeter (250 v. range) from the same tag to chassis, and see if it kicks. If so, the fault is in the supply circuit, and you must check T2, V9, the three electrolytics, L18 and the speaker field, and of course their connecting leads.

**302.** The noise is arising before V7.
Switch back to radio, and disconnect the anode lead of V3.

Noise goes on (though perhaps less loud)........................ **303**
Noise stops ........................................................................ **304**

**303.** Evidently the fault is in the I.F. amplifier somewhere.

First, make the valve test on V4, V5 and V3. If you see any of the anode currents giving noticeable kicks, this may guide you straight to the trouble. You may find that the noise stops when you make the grid test, with bias from a grid battery; this at once points to trouble in R14, R15, R16, or C18, C21, C24 or C25.

If you get no clue from the above, disconnect the anode lead of V5. If the noise continues it is in V6 or in the L17—C23 circuit. If it stops, replace the lead and disconnect that of V4. If the noise now goes on, it is due to V5 itself, its grid or anode circuits, and you can find which by shorting V5's grid socket to chassis; if the noise continues it is due to the V5 anode circuit, if it stops, to the grid circuit.

If the noise stops on disconnecting V4's anode lead, it is due to V4 itself or its circuits; check just as for V5 above.

**304.** The noise stops on disconnecting the anode lead of V3.

Probably the trouble is on the R.F. side, but there is one other possibility; it may be in V3's anode or cathode circuit. To check this remove V3 and join a 50,000 ohm resistance between the anode lead and the cathode socket. If the noise comes back, the trouble is in the anode or cathode circuit. Connect the 50,000 ohms to chassis instead of cathode socket. If the noise is still there it is in the anode circuit (L8, C16, R6 and the leads to them). If not, the fault is in the cathode circuit—R3, C15, L12 and their leads.

If, however, the above test gives no noise, replace V3. The noise must come from the R.F. side.

Note whether it occurs on both long and medium wave, or one only: this gives valuable information for if it occurs only on one wave, it is probably in a coil or switch contacts, while if it shows on *both* waves it must be in some supply or other circuit which is common to both waves.

There is one trap in testing the H.F. end. One might think that if the noise stops on removing V2, the fault must be in the oscillator circuits. This is not so, however, it is *probable*, but not certain, for in some cases an intermittent bad contact in the circuits of V1 or V3 may only cause noise when V2 is oscillating. The following tests are therefore recommended:

First disconnect the anode lead of V1.

Noise goes on ........................................ **305**
Noise stops ........................................ **306**

**305.** The set is still noisy with V1 anode circuit open. The fault is either in the oscillator or the band-pass filter.

Disconnect the link joining the L.H. tags of S3 and S4. This cuts off the first coil of the filter, with its trimmers and C1B. If the noise now stops that is where the trouble is. If it still goes on connect S3 and S4 and join the grid socket of V3 to chassis.

If the noise now stops, it is in L6, L7, their trimmers, or C1C; if it goes on, it must come from the oscillator circuit.

In the latter case, change V2 and make the valve test on it. If it is apparently in order, make a close examination of the oscillator coil assembly. Check all components for resistance and capacity (watch especially for any unsteadiness in the readings when measuring). Also check all parts of that assembly for mechanical tightness. The screws or rivets holding the sunk "pot" that contains the assembly; the nuts holding the coils to the base; the three screws fixing the small oscillator coil on to its base and that base on to the main coil. Looseness in any of these may cause noise, also such things as one of the padding condensers touching a trimmer, or the like.

**306.** Noise stops on opening V1's anode circuit.

It must be arising either in L3 and its leads (unlikely and easily checked) or in the input circuit. Check S1 and S2 for good contact; if they are in order the trouble can only be in the coils, C4, R1, or the leads, and it is not difficult to check these.

## NOISY ONLY WHEN ON A STATION.

**400.** Here again it must not be forgotten that a certain amount of noise is unavoidable on a distant or weak station. The natural background is always increased by the presence of a signal, and a *weak* signal is not enough to bring the A.V.C. into operation and decrease the gain.

But if there is noise on a *strong* station, it is an indication of something wrong. In probably eight cases out of ten the trouble is a noisy valve. If the trouble is of the nature of a microphonic howl or instability, go to section 1000.

If it is true noisiness and *not* due to a valve then we must look for bad contacts or loose parts as in 300, excepting that the trouble is almost certainly *not* in the A.F. end or supply circuits, but probably in the H.F. or I.F. end, and in a tuned circuit. Systematic testing is almost impossible, as anything that stops the signal also stops the noise. So first try tapping the various components of the H.F. and I.F. parts of the set or gently straining them: this will often locate the trouble by increasing the noise. If this does not help, read sections 303 to 306 and note the various suggestions there; these may help, although (as already explained) the actual *tests* in these sections will not be conclusive as they stop the signal and hence the noise also. Finally make the valve test on V4, V5 and V3 and then on V2 and V1, and, of course, try spare valves.

## MODULATION HUM.

**500.** i.e., Mains hum only noticed when a station is being received.

Remember that quite a number of foreign stations actually have a fairly bad hum; so before searching for faults in the set itself try the same stations on another set, or else try several stations.

Generally speaking the most probable cause will be one of those already mentioned in section 200, under " Hum in I.F. Amplifier " and " Hum in H.F. section." The *tests* given there of course don't apply, as by stopping the signal they will stop the hum.

Also, make sure that both heater circuits are properly earthed (one by the Bk. lead from a heater socket of V1 to the R.H. tag of S1, and the other by the Bk. lead from a heater socket of V8).

## DISTORTION

**600.** By this is meant only one thing " Roughness " such as one gets on a battery set with an overloaded small power valve. Shrillness and too much bass are dealt with under 900 ; noisiness under 300 and 400 ; howls, oscillation, etc., under 1000.

True distortion is essentially a trouble of the A.F. end of the set, but in the A8 there is another possibility ; the A.V.C. may not be working properly and there may be H.F. overloading.

So notice (1) whether the distortion varies a lot according to the position of the hand volume control, (2) if it varies according to whether the station is a very powerful near one or not, and (3) whether the roughness only occurs on certain notes.

If the distortion does not seem to be bad when the hand volume control is turned down low, suspect V7 or V8 ; make the Valve Test on them and try spares. If they seem all right the trouble may be in the speaker (see below).

If, on the other hand, the trouble seems to crop up especially on a near strong station, it may be insufficient A.V.C. Make the valve test on V6, or try a spare, and if this gives no help make the Valve Test on V4, which shows whether the A.V.C. circuit is in order.

If there is still no clue, disconnect the P. and R. leads going to T1 and take extension leads to a spare loudspeaker ; there may be something wrong with the speaker. Suspect this especially if the distortion is only on certain notes, as in (3) above.

Lastly, look out for one sort of fault which *sounds* like true distortion on loud notes, but really isn't. It occurs when there is a dry joint, bad contact, or slightly microphonic valve, which is not bad enough to cause noise on its own, but is shaken up by vibration when the speaker gives a really loud note. This fault vanishes when an outside speaker is substituted, as in the last paragraph, and so may lead you to suspect the speaker, but you find that directly a new good speaker is put into the set the fault returns.

The only way to find it is to search as under 300.

# POOR SENSITIVITY

**700.** Be careful that a report of this defect is really correct. Owing to the A.V.C. it is not at all easy to find out what *is* the gain of an A8 receiver and further, as its great amplification is only needed on very distant stations it is bound to be somewhat affected by the peculiarities of long-distance working.

So before taking the set down give it a thoroughly good test on an aerial you know, and satisfy yourself that it *really* has got poor sensitivity.

If this is confirmed carry out first the Pick-up test and then the " I.F. Output Test " (see page 20). These will tell you at once whether the trouble is in the A.F. end of the set or earlier.

One peculiar trouble may be mentioned specially. If you have a complaint of low gain on gramophone but more or less normal results on radio, the fault is probably too much current in V6, even with no input volts ; this acts like a load on the pick-up and spoils its performance. The cure is to change V6.

Low gain on A.F. end .................................................. **701**
Low gain in I.F. or H.F. ............................................... **702**

**701.** If the low gain shows on the pick-up test, it is not very difficult to find. Assuming that the H.T. supply and valves themselves are normal, the trouble can only be a low value of R22 or R23 or C32, or something wrong with T1, the speaker itself, or the tone-control circuit.

The Valve Test on V8 and V7 will dispose of most of these possibilities ; if it shows no fault suspect a short in one winding of T.1, the speech coil or the speaker field. Test for all these by taking extension leads to a spare speaker.

If this does not locate the trouble test C34 and R24.

**702.** Low gain in the earlier part of the set is much more difficult to find. One must cut out various stages one at a time, checking the gain on the rest and this necessitates some sort of standard to go by. The best thing, as already suggested (see page 20) is to carry out all the following tests on a *good* set and note down the results, then compare the doubtful set and the known good one for each test.

Carry out the tests as laid down in sections 115 to 124, but in all cases measure the I.F. output as instructed on page 20. In each test compare the output with that of a known good set under the same conditions. Where sections 115—124 say " No signals " read this as " Gain still low."

The following are some of the most likely sources of low gain (apart from defective valves). Check them as you go along—remember that the normal gain of the A8 is so high that faults that would cut out all signals in an ordinary receiver may simply give low gain in this case. Such faults are : breaks in coils or leads to them ; trimming condensers O.C. or out of adjustment, partial shorts in R6, R7, R9, R10, R12, or R13 or C9. Whatever you do, *don't* touch the I.F. trimmers, even if you suspect they are out of order. If you suspect this trouble turn to " Trimming " on page **17** where you will find instructions for a definite test of the I.F. trimming, and if it proves to be wrong, return the set to factory.

## TUNING TROUBLES



### 801. FLAT TUNING

As in several other faults already noted, make sure you are not deceived in testing for this fault. Owing to the A.V.C. a very strong near station may *seem* flatly tuned, for as you tune through it the gain control keeps the output at practically the same level over a fairly wide band. On the other hand, if the A.V.C. is out of order, a strong station may simply swamp the set over a fairly wide waveband, thus giving the same effect.

The proper check is not to bother about the *apparent* width of band over which a station is heard, but to look for actual jamming and interference. If this *is* abnormal, search for a fault.

In nearly all cases, flat tuning and poor gain go together, so read through section 702 and test as indicated there. Remember that sometimes a defective valve will put heavy damping on the tuned circuits connected with it, and so give flat tuning.

There is just one possible cause of flat tuning that might be difficult to find. If several of the I.F. amplifier circuits are slightly out of tune, the odds are that the *average* tuning of the whole amplifier will be out, so that it will show up by bad calibration (see next page). But there is just the chance that some trimmers might be too far in and others too far out, so that the average tuning is still 120 k/c. In this case there will be poor selectivity with only a slight loss of gain, and apparently correct calibration. There is no way of proving this except a check with a special trimming oscillator.

**802. WRONG CALIBRATION**

This is simply a matter of trimming. If it is the oscillator trimming it is easily curable, but if it is the I.F. it is not. In any case, see page 17 where full instructions on trimming will be found.

**803. CALIBRATION CHANGES**

One or two very curious cases of this have come to light. A case of "hand effect," i.e., tuning changes when the hand is put to the tuning knob was found to be due to loose nuts holding down the main gang condenser; another similar case was due to the flex. leads to the gang condenser being too tight. When the weight of the hand comes on the tuning knob the condenser being flexibly being mounted moves a little; and if the leads are too tight they drag and strain and very slightly change their capacity to the chassis and so affect the tuning.

There have been other cases in which the set altered its tuning as it warmed up—one in particular in which it altered just enough to change over from one station to another. These are due to oscillator trouble. As a rule it is the valve itself which changes, and the cure is a replacement but in one case the trouble was a rare and curious one. The padding condensers C13 and C14 are just above the trimmers C11 and C12 in the oscillator can (see sketch, page 29). In this case they were touching and as the set warmed up or cooled they pressed more or less hard on the trimmer and altered its setting.

## POOR AUDIO QUALITY:

**900.** This is a general heading covering loss of bass, top cut-off, resonances, etc. But the sort of roughness usually called "Distortion" has already been dealt with under section 600 and for troubles due to oscillation or microphonic howls see 1000.



**901. LACK OF TREBLE**

First look at the obvious possibility, a short in the tone-control resistor R24, or S11, or its leads. Then make sure tags on C30 and C24 are neither touching, nor shorting internally.

About the only other possible source of this trouble is a defect in the speaker itself or T1, for which the obvious check is to try a spare.

## 902. LACK OF BASS

Remember, in testing for this, that the set *out of its cabinet* will always be short of bass notes, owing to the absence of baffle. If it is desired to test the quality with the set outside its cabinet, it is necessary to arrange a baffle, say, 2 ft. or 2 ft. 6 in. square so that it can be temporarily attached to the speaker, but even this will not give quite the same results as the cabinet.

Obvious sources of lack of bass are low capacity in C30 or C32—check by measurement—or a defect in T1 or the speaker itself, which should be checked by trying a spare. Less obvious sources are O.C.'s or low capacity in C31, C33, and C37, which upset the decoupling for low audio frequences.

Another possibility is low capacity in C18, C21 which may cause what is practically a demodulation of the signal for low audio frequencies, and so cause loss of bass.

Lastly, there may just possibly be an *apparent* loss of bass which is really an excess of treble. This will happen if C34 or R24 or their leads are O.C. or perhaps if one or more of the I.F. damping resistors R6, R7, etc., is O.C.

## 309. ANNOYING RESONANCE

This covers troubles which occur on certain notes only. It may be that these notes are always rough and distorted, or it may be that they are disproportionately loud.

Where the trouble is roughness it may be due to a faulty loudspeaker, or alternatively to something loose about the set which rattles or buzzes at its natural frequency.

Try the effect of removing the loudspeaker two or three feet away and running extension leads to it. If the buzz is still there, the trouble is in the speaker ; if not, it is something loose in the set, and the only method in the latter case is a careful examination. Try to find a frequency on the test records that sets up the buzz. Keep this going while you press with the fingers anything which might possibly be loose ('ware shocks !) until you find the actual source of the trouble. If, however, the buzz *does not occur on gram,* look carefully for loose parts in the coil cans, especially the oscillator (see sections 303 and 304).

If the resonance is an excessive loudness on certain notes it is probably a speaker defect, but there is one other possibility. This may be the sort of fault that tends to set up a microphonic howl but which is not bad enough actually to do so. The effect is to magnify those notes which are at the frequency at which the howl would occur if the fault was a bit worse. So check through as in section 1002, which deals with howls.

## INSTABILITY

**1000.** Broadly speaking, there are two sorts of instability that may occur in the A8.

I.F. instability or oscillation shown by the usual chirp or beat note on tuning a station, but perhaps accompanied by queer noises and " motor-boating " effects on certain wave-lengths and apparent A.F. instability, shown by microphonic howls.

Instability of the R.F. circuits would cause symptoms very like those for I.F. above, but is very rare and only happens with faulty valves (V1).



**1001. I.F. OSCILLATION**

The A8 is least stable when tuned to wavelengths between 1200-1300 metres. This is because the output of the 2nd detector contains a component of twice the I.F. frequency (just as the output of V9 contains a 100-cycle component). Now twice 120 k/c. is 240 k/c. or 1250 metres, so that various leads in the set—those connected to the centre tag of the C30—C24 condenser block—always have some 1250 metre voltage on them. If the R.F. circuits are also tuned to 1250 metres or near, there is just the chance that there may be enough reactive coupling to produce instability.

It is for this reason that in the Wiring Diagram at the end of this book the Y lead from C30 to S6 is marked " Keep this wire well this way." It should be kept clear of the flex leads to the Gang Condenser.

This is the first thing to see to if there are signs of L.F. instability at 1200—1300 metres. If it doesn't effect a cure, the following are the most likely causes and must be investigated in turn :

(1) Faulty valves (excessive gain).
(2) Grid lead of V4 taken to end of L9 instead of centre-tap (usually because an L14—L15 coil unit has been put in by mistake for an L8—L9 unit).
(3) C18, C21, C27 or C37 O.C. or low capacity.
(4) Orange leads from coil cans to R8 and R11 changed over ; see the Wiring Diagram to find out how they should run.

## 1002. MICROPHONIC HOWLS

The most frequent cause of this is valves, especially V2. If this valve is in the slightest microphonic it may be set in vibration by the loudspeaker. This affects the local oscillation and is just like modulating an incoming signal with the same note that the speaker is already giving. Thus the note is made stronger, the valve vibrates more and so on, until a howl is built up.

So if the set tends to howl *when on a station*, suspect V2 first. There are other possibilities, V1 may behave in the same way. On one or two occasions slightly loose vanes in the gang condenser have given the same trouble. Be specially careful to see that all the coils in the oscillator coil-can are tightly fixed and also the can itself. (See section 305).