SERVICE INSTRUCTIONS

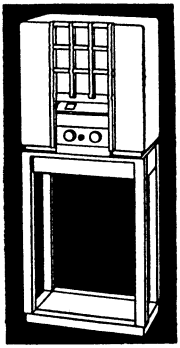
on the

MURPHY A3A

ALL-MAINS THREE-VALVE

RECEIVER

MURPHY RADIO LTD., WELWYN GARDEN CITY,
HERTFORDSHIRE – TELEPHONE: WELWYN GARDEN 800



Preface

EVERYTHING in this booklet will probably be elementary and stale news to some of our dealers. And some others may say that it is too much for them. If this is so, I shall know that it is really about what is needed.

Anyway I appeal to all dealers to let me know about it. Tell me whether you want the same sort of books about other Murphy sets, and whether you see any way of making future booklets better.

CONTENTS

INSTALLATION

We realise that in many cases the dealer has not a free hand as to installation ; customers already have bad aerials and earths, and don't want any change made ; or they have quite settled on an unsuitable position for the set, and so forth.

But where you **have** a free hand, or a chance of advising the customer, the following points are important for the A.3.A. receiver.

Test the set in your own service workshop before installing, in case it should have been damaged in transit.

Where interference is not bad, and maximum performance is required, use a long and high aerial ; for selectivity a short one. Keep the lead-in as short as the customer will let you.

It is worth taking some trouble to get a good earth : use a proper clip if earthing to a pipe.

Don't forget to adjust the set for mains voltage.

When the set has been installed, measure the valve currents and run a pick-up test. (See p. 10 for details.) Record the results on a card like that printed overleaf. This seems rather a waste of labour, but it is not. In case of trouble later, it gives just the needed data as to how the set behaved when known to be in good order ; and it will also tell you whether the customer has already changed any valves.

If the local station is fairly near and the user unskilled, adjust the aerial volume control so that with the local switch down, and reaction at zero, the set is rather weak. Then the user can control volume, both for local and distant stations, on the reaction, and won't need to readjust the aerial volume control.

Lastly, get the user to handle the set. Don't be content with telling him, but see that he actually gets some results himself while you look on.

INSTALLATION RECORD CARD

Make—MURPHY. Type A3A. No..... Date.....

Installed at.....

.....

Mains..... .....Volts.

Valves :

Pentode : Make..... No..... .....mA V

Aux. grid.....V

Detector : Make..... No..... .....mA V

S.G. : Make..... No..... .....mA .....V ;

Screen .....V.

Pick-up Test.

Pick-up No..... Make..... Record No.....

Output Volts.....

R.F. Test :

.....

.....

When any changes made, cross out the corresponding data and note new results (with date) on back.

SERVICE

When a customer asks for service, there may be one or two delicate points as to guarantee, etc. The dealer must use his own discretion as to whether it may pay him, in some cases, to give **more** free service than he is actually obliged to.

The point that affects these **technical** notes on service is whether the work is to be done at the customer's house or in the dealer's service workshop. There is no doubt that it can be **better** done in the shop ; and the tests are arranged with that idea.

If it is decided to try and rectify a fault at the customer's house, it is best to take spare valves, a soldering iron, and a universal meter, and carry out the valve test (see p. 13). If this does not reveal a simple fault, remove the set and test in comfort at the shop.

When the fault has been found and rectified, think for a little whether it may have had any bad effect on other parts of the set. For example, a short in the set may have overheated the mains transformer and weakened its insulation ; or an open circuit may have caused excessive voltage on the smoothing condensers ; and such points should be checked to be sure that everything is all right.

FAULT FINDING

GENERAL NOTES

In setting out to find and correct a fault in a receiver, it must be clearly realised that detailed schedules of tests are most useful to the new hand, and those not used to the set. Experience, and especially experience of the particular type of set, gives a facility—a knack of putting one's finger quickly on the defective spot—which is most surprising to those who have not had such practice.

But for those who are not experienced, or who do not know the Murphy A.3.A. receiver, the following schedule will be of great assistance ; and it will also help the skilled on the occasions when they meet a fault which is new to them.

It is important to remember, when testing voltages in a radio receiver, that the connection of the meter may itself alter the voltage. For this reason the values given in the list are by no means always those which are there in the absence of the meter. Further, the use of a different meter may lead to different readings being found. The readings which we give are definitely those found with a voltmeter taking only about 1 milliamp when in use.

The method of testing described will locate all of the **simple** faults that we have found in practice or been able to imagine. But when a set has two or more faults, their location may be much more difficult ; sometimes the symptoms of one fault may hide those of the other. In such cases the tester must rely largely on his wits and experience. It is always advisable to be on guard against this if the set shows any signs of rough treatment, either mechanical (as

by a fall or blow) or electrical (look for signs of overheating, especially on the mains transformer).

Another difficult type of fault is the intermittent one. Its symptoms are those of the same permanent fault; they appear when the customer tries to use the set, but always vanish when one looks for them. The only way is to try and bring them on by vibration—tapping various parts of the set, etc.—or by gently straining the chassis or pulling on leads. Sometimes such a fault will show up when the set has been on for some time and is thoroughly warm. In case of intermittent faults, be especially suspicious of all places where current has to pass a non-soldered joint; mains connectors, aerial and E terminals, valve sockets, switch contacts and so forth.

When the complaint is, generally, of the nature of bad reception —such as under headings 200 onwards—the first and most obvious course is to check the valves. But in complete breakdowns, as in heading 100, this is not always advisable. It is just possible that the breakdown may have been such as to burn out the valves, in which case the new ones will probably go too; so that replacement of valves is best deferred till certain preliminary tests have been made. Detailed instructions on the valve test are given in a separate schedule on p. 13.

It is most important to know what performance may be expected from a normal set in your neighbourhood. This is, of course, even more important when installing a set than when it has gone wrong. The record card explained in the Notes on Installation is also a very valuable help in fault-finding.

For the same purpose—that of getting some sort of standard to go by—it is very desirable to put up a standard record and pick-up on a simple turntable, and measure the output. The pick-up may be any first-class one. The record should be one of the set of Parlophone pure note test records.*

The output may be measured quite easily with the right sort of A.C. voltmeter though it must be understood that the results are comparative only, for such meters, being designed for 50~, may give false readings at high audio frequencies.

All that is necessary is to connect a 2mF. condenser in series with the meter, if this is of the rectifier type, set the latter to its 200 or 500 V. A.C. range, and connect the combination across R10.

If it is desired to make this test on a set in its cabinet, this can be done as follows: Use an Avodapter on the pentode, and connect the meter-condenser combination between the anode terminal and the earth terminal or chassis of the set.

* The Parlophone Co. Ltd., 85 City Road, E.C.1: "Sound Test Records" No. P9794 (1) Gliding tone, 6,000–100 cycles; (2) Gliding tone, 6,000–150 cycles, with "wobble" 10 times per second. P9795, four "wobble" notes, 150, 300, 600, 1,200. P9796, two "wobble" notes, 2,400 and 4,800, and two special notes with wide wobble. P9797 and 9798, each eight pure notes, one 32 to 4,096, other 50–6,400.

Price 15/- each, or 42/- set of any three in album. Nett cash.

TESTING INSTRUMENTS

The instruments called for in carrying out these tests will probably be available in every Service Department. They are :—

A D.C. voltmeter with some such ranges as 0–10, 0–100, 0–1,000 ; or 0–5, 0–50, 0–500. This must be of high resistance ; about 1,000 ohms per volt. If it is not a really high-resistance instrument it must always be used in a range three or four times higher than what is being measured (*i.e.*, measure 100 volts on the 500-V. scale, and so on).

Next, a D.C. milliameter, with 0–5 and 0–50 or similar ranges.

Next, an A.C. voltmeter, 0–500. This is mostly for checking primary and H.T. secondary mains transformer voltages. For this work either a " moving-iron " or a " rectifier " instrument will do equally well. The moving iron type is cheaper, but the rectifier better ; and it also has the advantage that it can be used to measure the audio-frequency output of the set.

Unless the 0–500 V. A.C. meter is of the rectifier type, another meter will be needed for measuring the audio-frequency output of the set. This can be either a 0–5 V. voltmeter across Tags 1 and 5 of the speaker (*i.e.*, across the speech coil) or a 0–200 or 0–500 V. meter connected, **in series with a 2-F condenser,** across the output transformer primary. Whichever is used, the meter **must** be of the rectifier type.

There will also be needed some means of checking the resistance of various circuits. Accurate measurement is not needed, so the direct-reading ohmmeters offered by various firms will do very well. If there is not one available, a rough test can be made thus : connect up a 1-mA. meter in series with a 2,000 ohm resistor and a 2-V. battery, and take leads from this combination to the circuit to be tested. The reading for any resistance is got from this Table :—

Ohms in circuit.	mA. reading.
100	·95
200	·91
400	·83
600	·77
800	·71
1,000	·67
1,500	·57
2,000	·5
3,000	·4
4,000	·33
6,000	·25
8,000	·2
10,000	·17
20,000	·09
50,000	·04

For lower resistances, put a 100-mA. meter in series with a

20-ohm **variable** rheostat and the 2-volt battery. Set the resistance so that with the output leads short-circuited, the meter just gives its full deflection ; then use as above, but read 1/100 of the value given on the table for resistance, against 100 times the current. For example, in the table ·57 mA. means 1,500 ohms. With the 100-mA. meter for low ohms, 57 mA. will mean 15 ohms.

NOTES ON THE FAULT-FINDING TABLES

1. The key letters and numbers to components are the same as those on the schematic (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. " C17 —P.—choke—P.—C13 " means : From condenser C17 a pink lead runs to the choke itself and from the other end of the choke winding a pink lead runs to C13. 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 from time to time be changed, for production reasons. So check the **run** of any lead as well as its colour.

3. Where resistances are given, remember that these are approximate only : they may vary by 10 per cent. from set to set.

4. The way of using the tables is self-explanatory ; simply answer all the questions in turn. Each answer will lead you on to further questions and instructions till the fault is located. For example—suppose you have a set returned : symptom—" No music ; it simply stopped while we were listening." Unknown to you, the intervalve transformer primary has broken down.

Page 13 shows that " no output " is dealt with under No. 100. On p. 15 you find under No. 100 : " Does the pilot light ? " As it does, you are directed to No. 104. Here you find : " Is the silence **complete,** or is there some hum ? " As you of course know, with an O.C. in the intervalve transformer primary there will still be some hum ; so on listening to the set you would hear it and pass to No. 112 as instructed. Here you are told the fault is probably in an R.F. or A.F. circuit and the next step is to make the valve test.

As there is no D.C. through the transformer primary, this will show nothing abnormal, indicating that all the H.T. feeds are correct.

The next step is to try a pick-up and record, or tap the detector valve. In this case, nothing will result, so we are directed to No. 113. Here the first part gives advice on abnormal valve test results. The second paragraph: "If valve tests normal," is what we want. First we are told (a) "to check the detector grid circuit," which of course will show nothing wrong; (b) says "check A.F. anode circuit," shows how it runs and says: "with C11 shorted, resistance should be 1,200 ohms."

On test, we should find it O.C., and it is only a minute or two's work to find that the O.C. is not in the wiring but in the transformer itself.

FAULT-FINDING TABLE

No output at all, search under	**100**
For the remaining symptoms, first make the Valve Test (see below). If this does not find the fault at once, refer to the number given:	
Excessive mains hum	**200**
Noisy—crackles, frying, etc., all the time	**300**
Noisy, but only when receiving a station	**400**
"Modulation Hum"	**500**
Distortion	**600**
Poor sensitivity—weak signals	**700**
Flat tuning, poor selectivity	**800**
Poor frequency response: lack of bass, top cut-off	**900**
Defective reaction: won't oscillate, won't stop oscillating	**1,000**

VALVE TEST

When testing the valves, use the D.C. meters and an adapter. If the results are abnormal, in all cases try a spare valve (known to be good) before going further. Remember that anything within, say, 10 per cent. of the standard value is counted as "normal."

Also, remember that a short in a valve-holder itself or defective contact of a valve-pin, may not show up in the valve tests, as the adapter pins may not produce the same fault as the valve pins. Check these points if the valve test doesn't show up an obvious fault.

Begin with the Pentode, and first check the screen or auxiliary grid voltage: it should be about 220 V. As this is connected straight to C18, absence of volts here shows either

(a) broken flex lead—easily checked; or
(b) no H.T.

In the latter case go straight to 100 in the Fault-finding Table.

If the screen volts are normal, check the anode current and voltage, which should be about 30 mA., 210 V.

Current high..... see A.
Current low..... see B.
Current nil..... see C.
Current and voltage normal..... see D.

A. Pentode anode current high—check the voltage.

Voltage low..... see A.1.
Voltage high..... see A.2.

A.1. Pentode current high, voltage low.

Probably an open grid circuit, or short across the bias resistance. Signals may be nil, or weak and distorted. Check the circuit for continuity. It is : Pen G. socket—Bk.—T1 Terminal G—T1 sec.—Terminal G.B.—Bk.—R8—chassis. The resistance of the transformer sec. should be 3,000 ohms, and of R8 50,000 ohms. If normal, check C14 for short-circuit or leak to earth. If this also normal, check from Pen cathode circuit to chassis. This tests R9 and should show 290 ohms.

A.2. Pentode current and volts high.

This may simply be mains over-voltage : check with 500-V. A.C. voltmeter from Tag 1 on strip to S6. (Ware shocks!) and compare with position of mains tapping adjustment.

If this is normal, and the voltage is 20 V. or so high, suspect the choke. Its circuit is : C17—P.—choke—P.—C13, and resistance should be 500 ohms.

If, on the other hand, the voltage is up to 260 V. or so, and there is practically no output, suspect a shorted speaker field : the circuit is : C17—Bk.—L.S. Tag—field—L.S. Tag—Bk.—C13, and the resistance should be 2,000 ohms.

B. Pentode current low—check the voltage.

Voltage low..... see B.1.
Voltage high..... see B.2.

B.1. Pentode current and voltage low.

This may be due to a poor rectifier ; replace and see.

If rectifier O.K., and the current is not very low, say about 25 mA., check C17 for open circuit (by putting a spare across it).

If the current is quite low, say 10 mA. or so, and there is no A.F. output, the fault is probably an O.C. in the output transformer T3. The circuit is : C18—B.—T3 Pr—B.—Tag 6 on strip, and the resistance 165 ohms. Remember that an O.C. in the circuit will show not infinite resistance but 25,000 ohms, as R10 is across it.

B.2. Pentode current low, voltage high.

Accompanied by no (or very weak) output. This is a curious effect, usually produced by an O.C. in C18. The reason for the low current and high voltage is that the L.F. end of the set is oscillating at above audible frequency.

C. Pentode current nil, voltage nil, though screen volts normal—

Can only be (a) anode lead o.c.
(b) cathode lead o.c.

(a) This is the B. lead from Tag 6 of strip.

(b) Circuit is : Pen cathode socket—P.—R9—Bk.—chassis, and resistance 290 ohms. There is a third remote possibility : that both R10 and the O.P. transformer have broken down.

D. Pentode current and voltage normal. Test the Detector. The normal values are 7 mA., 110 V.

Current high..... see D.1.
Current low or nil..... see D.2.
Current and voltage normal..... see E.

D.1. Pentode normal, Detector current high.
Short or partial short in R6.

D.2. Pentode normal, Detector current low or nil.
The anode circuit is O.C., or C11 or C12 shorted. Go straight to No. 113 in main table.

E. Pentode and Detector normal. Test the S.G. valve.
The normal values are : 1·5 mA., Anode volts 100, screen volts 50. (Note: the voltages are particularly sensitive to meter resistance, and will vary according to the meter used ; they are **not** the working values.)

Current high..... see E.1.
Current low or nil..... see E.2.

E.1. Other valves normal, S.G. current high.
Voltage low : O.C. in grid circuit—go straight to No. 118 in main table—or just possibly R9 low in resistance (this will give high screen volts) or R2 or C6 shorted. R2 should be 1,100 ohms.
Voltage high : R5 shorted or low in resistance.

E.2. S.G. valve anode current low or nil.
Voltage low or nil : anode circuit faulty—go straight to No. 114 in main table—or R2 O.C.
Voltage high : due to absence of screen volts. Again see No. 114.

FAULT FINDING TABLE

100. NO OUTPUT

Do pilot and heaters light ?
If none, or only the rectifier, go to..... **101**
If some besides the rectifier do light..... **104**

101. Pilot and heaters do not light, or rectifier only.
Does rectifier heater light ?
If not, go to..... **102**
If it does..... **103**

102. Neither pilot, heaters, nor rectifier heater light. This points to an O.C. in the mains transformer primary circuit, or a dead short on a secondary. The primary circuit is: Mains flex—No. 1 Tag on strip—Y.—T2 Prim—R., Br., or B.—3-way tapping—plug—flex—main switch—mains flex. Remove the lamp adapter from lamp-socket and check the circuit. The resistance will depend on the voltage and frequency, as different transformer and tappings are used. They are:—

	25–40 cycles	40–100 cycles
100 V.....		15·6
120 V.....		17·5
200 V.....	73	65
220 V.....	80	70
240 V.....	92	80

If this is normal, and a test shows that the correct mains voltage is actually present (check with meter on A.C. 500 V. range from Tag 1 on strip to S2, and 'ware shocks), the fault can only be a secondary short. Remove all valves, and test with a 5 V. A.C. voltmeter across each low-voltage secondary, *i.e.*, Tags 1 to 2, and then 3 to 4 on transformer. If normal, or rather high voltage, test with A.C. 500-V. meter, from rectifier An. socket to chassis and then G socket to chassis ('ware shocks!). Each should show 320 V. If normal the short must be in one of the valves themselves; replace.

103. As rectifier filament lights, evidently power is coming from the mains transformer. If no others light, the fault must be at the transformer itself, as the circuits are all run separately back to it. See that the Bk. and B. leads are all on Tags 1 and 2 of T2, and check the voltage here.

104. Some heaters light. Replace any that do not, to see if fault is in the valves. If not, check each heater circuit, which for all but the rectifier simply consists of the B. and Bk. leads straight from the transformer tags to the valve sockets.

The rectifier heater circuit is Tag 3 on T2 — R.—socket—heater—socket—R.—Tag 4 on T2. Its resistance is too low to measure (0·15 ohms.).

If all heaters light, proceed to the valve test.

If this does not at once show the fault, listen carefully for the usual mild hum from the speaker.

If complete silence, set "dead," go to..... **105**

If some, or normal, hum, go to..... **112**

105. Heaters light, but set dead. If valve tests showed normal or high on pentode screen, go to..... **111**

If pentode screen volts low or nil, test in turn from C17, C13 and C18 to chassis, with meter on D.C. 500-V. range. They should be:
C17, 330-V.; C13, 300-V.; C18, 220-V.

If volts low or nil at C17, go to **106**
If volts normal at C17, low or nil at C13 ..... **109**
If volts normal at C17 and C13, low or nil at C18 **110**

106. There is power in the transformer, but no D.C. volts from the rectifier. With the rectifier in place, test with the 500-V. A.C. meter between An. socket and chassis and then G socket and chassis ('ware shocks!). Normal voltage 320 V. in each case.

A.C. volts on rectifier, nil or low, go to **107**
A.C. volts on rectifier, normal, go to **108**

107. No A.C. volts on rectifier. Test the secondary windings and circuits. They are: An. or G. socket—Y.—T2 sec. —Bk.—chassis; one side should be 520 ohms and the other 750 ohms for 50-cycle transformers; about 950 ohms each for 25-cycle.

108. A.C. rectifier volts normal, no D.C. output. First try a spare rectifier valve. If still no volts at C17, test from a heater socket of the rectifier to chassis (on 500-V. D.C. range; and 'ware shocks!). These should be 330 V. This checks the R. lead from the valve to C17. If still no or low volts, there is probably an earth somewhere in the H.T. circuits. Remove all valves except the rectifier and repeat. If still no volts, test systematically for shorts.

(a) Switch off and dis. the R. lead from C17. Switch on again and confirm that there is 330-V. D.C. from the R. lead to chassis.
(b) Switch off. Find the resistance from C17 to earth. It should be too high to measure; if, as we expect, there is an earth, it will be low.
(c) Dis. the P. lead from C17 and try again. If still an earth, it is in C17 itself. If not, make the joint again.
(d) Dis. the P. lead from C13 and try again from C17 to chassis. If earth still on, it is in the choke or its P. leads from C17 and C13. If earth now gone, make the joint again.
(e) Dis. the Bk. lead from C13 and try again. If earth on now, it is in C13 itself. If not, make the joint again.
(f) Dis. the Bk. lead (not the **flex** lead) from C18 and try again. If earth on now, it is in the speaker field or its Bk. leads to C18 and C13. If not, make the joint again.

(g) Dis. the B. lead from C18. If short now on, it is in C18 itself; if not, it is in the output transformer T3 or its B. leads to C18 and Tag 6 on the strip.

109. Normal voltage on C17, nil on C13.
Check choke circuit: C17—P.—choke—P.—C13; resistance should be 500 ohms.

110. Normal voltage C13, nil at C18.
Check speaker field circuit: C13—Bk.—Speaker—Bk.—C18; resistance should be 2,000 ohms.

111. Set dead, valve test shows normal.
Open the Bk. lead to Tag 5 on speaker, and check for resistance, first between Tags 1 and 5, which is the speech coil itself, and then between Tag 1 and the disconnected Bk. lead, which is the sec. of T3. The former should be about 2 ohms or rather less. T3 sec. is too low to measure—about ·15 ohms.
If both normal, proceed as for..... **112**

112. Some hum, but no output. Valve test has not shown fault.
Make the pick-up test (see p. 10), or failing this tap the detector or short the gram. jack to earth.
No output **113**
Normal noise or output **114**

113. This result—no output on pick-up—indicates that the fault is in the L.F. end of the set.
If the valve test has shown low or no voltage, check the supply circuits. It is assumed that the Pen. screen voltage is normal at 220-V.—otherwise refer back to 110. If the Pen. anode voltage is low or nil, the circuit is C18—B.—T3. Prim.—B.—Tag 6 on strip—B.—An. socket, as already indicated in the valve test (B.1). If the pentode is normal, but detector current low, first check the feed circuit. It is: C18—R6—Tag 3. on strip—O.—Det. An. socket, and then to chassis via the B. heater lead to the S.G. valve heater socket, tag of R2 and B. lead to chassis. R6 is 15,000 ohms. If this normal, check C11 and C12 for shorts. To do this, dis. the Y. lead from the An. socket and see if voltage now normal. If so, replace the lead, and dis. the **other** Y. lead from C12. If volts now low again, C12 is shorted or leaky. If normal, the fault is in C11 or the lead to it.
If the valve test showed normal values for detector and pentode, the fault must be in the A.F. circuits.
(a) See that the lead from C.10 and gram jack to det. grid is continuous and not earthed.

(b) Check the A.F. anode circuit. It is: Det. An. socket—Y.—C12 and same tag to Y.—C11—Y.—T1 terminal D—T1 prim.—Terminal A—Chassis. With C11 shorted, resistance should be 1,200 ohms. Check C11 for O.C. by making a pick-up test with a spare condenser (·2 to 1 m.F.).

(c) Check. pen. grid circuit; the D.C. path is apparently O.K., as the valve test is normal: the only remaining part is C14, which may be O.C. Try a spare.

114. Pick-up test normal, but no output on radio. Obviously the fault is in the H.F. part of the set.

(a) If the S.G. anode current is nil, test between the anode flex lead and Tag 2 on strip with wave switch at **long**. This tests the R.F. coils, and the total should be 29 ohms. On switching to **short,** it should be 5 ohms. If not normal, check the circuit bit by bit. It is (long wave): Tag 2 on strip—Y.—Tag 6 on reaction coils—L10—L9—Tag 1 on reaction coils—Br.—L8—L7—Y.—C10. On short waves the same at first, and then: Tag 6 on reaction coils—L10—Tag 4—0—S4—R.—L7—Y.—C10.

If this is normal, switch on the set, and put a D.C. milliammeter across C9. It will show 2 mA. if R5 is correct at 150,000 ohms.

If this fails to show, test C9 to earth. If there is an earth, it may be anywhere along the anode circuit given above: dis. it bit by bit, watching when the earth comes off. This will show the faulty component.

Lastly, the anode current may be low with high voltage owing to an open screen circuit. This is simply C18—R3—Tag 4 on strip—Y.—S.G. screen socket. Test for resistance by putting the D.C. milliammeter from S.G. screen socket to cathode. If R3 has its right value of 0·5 megohm, the reading will be about 0·5 mA.

(b) If the valve test showed normal results, it must be a radio-frequency circuit that is wrong. The best check from now onwards is to use an oscillator. If not available, test on an aerial at a time when you know good strong signals are available.

First make sure that the main tuning condenser is actually moving as the drum rotates: very rarely, the drum comes loose on the spindle.

Remove the S.G. valve. Connect the aerial, through a ·0001 or smaller condenser, to the anode

flex lead. This puts the signal direct to the third tuned circuit: if this is normal, the set will work, but naturally it will be weak and flat-tuned; it is best to get used to the behaviour of a good set in this test.

Results normal, go to..... **116**
No signals..... **115**

115. No signals with Ae. to S.G. anode lead.

The coils must be continuous, since the valve test showed normal. Check them for correct resistance, as under 114 (a) above. If they are normal, the only remaining cause of **no** signals is:—

(a) An O.C. in C10 or the Y. lead from L7 to C10, or
(b) C9 O.C.

116. Signals with Ae. to S.G. anode lead are what one gets with a good set under same conditions.

This shows that the tuned anode circuit is normal. Replace the valve and re-connect the flex lead, and transfer the aerial, still through the small condenser, to the G. socket.

This tests the valve itself and its grid circuit.

If signals now good, but tuning flatter than normal, see **117**
Signals fair or weak, tuning dead flat, see..... **118**
No, or very weak, signals..... **119**

117. The grid circuit is probably normal, and the fault in the Ae. circuit or coil. The circuit is (long wave): Ae. terminal—P.—Tag of S1—O. from same tag—C2—L1—L2—Br.—Tag 1 of coupling coils—L5—L6—Tag 3—Y.—chassis: (short wave) same up to L1, then—R.—S2—Br.—Tag 2 of coupling coils—L6—Tag 3—Y.—chassis.

The resistances are: L1 4·7 ohms. L2 21 ohms, L5 3·1 ohms, and L6 is too small to measure, being only 0·1 ohms. If the resistances seem normal, make sure there is no earth where there shouldn't be: dis. the Y. lead from the 6-way chassis tag, and test between the lead and earth. Resistance should be infinity. If it is not, dis. the Br. leads from Tag 1 of the coupling coils, and test in turn from the tag and the leads, to see which has the earth. If it is from the tag, L5 or L6 is earthy. If it is from the leads, make the joint again and open the joint in the lead going to C1. This will tell you whether it is C1 or the coil assembly that is earthy.

118. This indicates an O.C. in the tuned grid circuit. If the valve test indicated an open D.C. grid circuit, check for resistance. The circuit is (long wave): G. socket—Y.—

L3—L4—Br.—Tag 1 of coupling coils—L5—L6—Tag 3—Y.—chassis; (short wave): G. socket—Y.—L3—R.—S3—Br.—Tag 2 of coupling coils—L6—Y. chassis. The resistance of L3 is 4·7 ohms and L4 21 ohms; for L5 and L6 see 117 above.

If the valve test was normal the D.C. grid circuit is probably in good order, and the fault can only be an O.C. in the Y. lead from the grid socket to the variable condenser C4.

119. Probably an earth on the grid circuit. Dis. the Y. lead from the 6-way chassis tag, and test from the lead to earth. If the resistance is not infinity, check as in 117 above, but in this case the last test is to dis. the Y. lead to C4 from the G. socket; separating the two Br. leads on Tag 1 of the coupling coils will show whether the first or second coil assembly is earthy.

200. EXCESSIVE MAINS HUM

Make the valve test: hum is often due to a faulty valve. Apart from this, the most likely cause in the A3A is that the heater circuit is not earthed, and this is shown by no pilot lamp. Check the B. lead from the heater end of R2 to the chassis.

Sometimes a bad earth will give this trouble, and occasionally it is due to the choke, or the condenser across it within its box, being shorted or faulty. The only test is by replacement: dis. the P. leads from C17 and C13, and connect a spare choke to these condensers.

300. **Noisy**, even when no station being received. Remove aerial and earth to make sure the trouble is really inside the set. If so, make the valve test.

Note that kicks in the pen. and detector currents do not give much indication of where the trouble is. If the valve test shows normal, short the gram. jack to chassis.

If noise stops, go to..... **301**
Noise goes on, go to..... **310**

301. **Noise,** which stops on shorting gram. jack. The seat of the noise is before the det. grid. Short the G. socket of the S.G. valve to chassis.

Noise now stops, go to..... **302**
Noise goes on, go to..... **303**

302. **Noise stops** on shorting S.G. valve grid. It must be arising in the band-pass filter. Make sure the local-distant switch has no leak across it. If the noise only occurs on "Local," it is of course in R1. If no clue here, open the leads to the first two gang condensers and test them with a pair of 'phones and 10 V. or so, listening for noises while moving the control. Make sure that

S1 and S2 are really making and breaking. If normal, make the same test from the coil sides of the joint in the C1 lead and from the G. socket of the valve, to earth, to show if any loose or dry joints in the coil assemblies. If there is noise in **both** cases the trouble is probably in the coupling coils.

303. **Noise** is stopped by shorting det. grid, but not by shorting S.G. valve grid. Probably due to a leak to earth or variable contact in the anode or screen feed, or perhaps from a leak in C10 or a fault in R4. These last can only be tested by replacement, so try other things first.

Remove the S.G. valve (see that the loose anode lead does not touch the chassis).

If noise stops, go to..... **304**
If noise goes on, go to..... **307**

304. This shows that the fault is **not** due to earth leakage in the anode circuit, for that would be unaffected by removing the valve. Now touch the flexible anode lead to the chassis.

If noise comes back, go to..... **305**
Still quiet, go to..... **306**

305. **Noise** stops in removing S.G. valve, but returns if anode lead touched to chassis. This shows that the noise occurs only when current flows in the anode circuit. Put the valve back and connect up the anode lead. Now take a lead with clips and connect it from C9 in the condenser block to the **back** tag (the one away from the detector grid) of C10. This shorts all the tuning coils. If the noise still goes on, it is probably in R5 ; replace this. If it stops, it is in the coils or wave switch. Check the latter for good contact. If all right, shift the clip lead from C10 to Tag 1 of the reaction coil assembly, and switch to long wave. If the noise stops, it is in the reaction coils ; if it goes on, in the tuning coils. Check the faulty unit for dry joints, etc.

Remember that trouble in the reaction coil unit may be in the L11–L12 side, due to irregular reaction (for example, a bad contact in R7 may show up as noisiness due to L9). If the trouble seems to be located in L9 or L10, check this ; dis. the P. lead from S5. If the noise now stops, it **is** due to trouble in L11, L12, R7 or C12.

306. **The valve** is O.K. (by valve test), but the noise stops if it is removed, even if the anode lead is earthed to produce anode current.

It may be that R2 or C6 is faulty. This can be tested simply by putting the valve back and shorting

across from the cathode socket to the chassis. If the noise now stops, the trouble is in C6 or R2. If this test shows no fault, the trouble is probably in the screen feed. The only test is to replace R3 and C5 by spares.

307. The noise goes on without the S.G. valve, but stops if gram. jack is earthed. It is probably due to a leak to earth somewhere in the anode circuit, or a fault in C10 or R4.

First dis. the O. lead from the tag of C9 and take it, via a spare condenser (about 1 m.F.) to frame. This checks C9. If no improvement, replace the lead. Then open the joint in the Y. lead from C10 to C7, to check the latter. If no improvement make the joint again. Take off from C10 the Y. lead going through the base to L7; take off from Tag 6 of the Reaction coil assembly the Y. lead to R5; and join a clip lead from this last lead to the back tag of C10. That cuts out of circuit C8 and all the coils, but still keeps H.T. on the anode.

If noise now stops, go to **308**
If noise goes on, go to **309**

308. If the set is now quiet, the leakage is located in the coils. Keep on the clip lead as in 307. Join up the L7–C10 lead again, and dis. the Br. lead from Tag 1 of the reaction coil assembly. This leaves C8, L7 and L8 connected, but not L11 and L12. Switch to long wave. If now quiet, the fault is in the reaction coil assembly; if noisy, in the tuning coils.

309. **Noise** goes on with coils cut out. It can only be due to R5, C10 or R4 and these must be replaced one by one.

310. The set is still noisy with the gram. jack shorted. The noise must therefore be arising in the supply circuits or the L.F. part of the set. The valve test has given no clue. Short the pen. grid socket to chassis.

If noise stops, go to **311**
Noise goes on, go to..... **316**

311. The noise is arising somewhere before the pen. grid. Remove from the pen. grid the earth lead you have just put on, and take it instead to the D. terminal of T1.

If noise now stops, go to **312**
Noise goes on, go to **315**

312. Evidently the fault is in the det. anode circuit. Take out the detector valve.

Noise stops, go to **313**
Noise goes on, go to **314**

313. The last test was for leakage, and the fact that there is no noise without the detector indicates that that was **not** the trouble. It is almost certainly due to a fault in R6.

314. **Noise** goes on without the detector. Suspect leakage through C11 or C12. Dis. the Y. lead from C12 to C11. If the noise goes on, the trouble is almost certainly in C12. If it stops, it may be in C11; test by replacing it by a spare (·1 to ·5 mF.). If this does not effect a cure, one must suspect the A.F. transformer.

315. The Noise goes on with the primary of T1 shorted, but stops if the pen. grid is earthed. So the trouble is in the sec. of T1, in C14, or in R8. Short the secondary and R8 in turn. If neither test stops the noise, try replacing C14.

316. Noise goes on with pen. grid shorted to earth. (It may be **less,** but is still present.)

It is probably in the supply circuit, but may be in the O.P. transformer or speaker. Put the meter, on 500-V. D.C. range, across from C17 to chassis ('ware shocks!). If the noise is accompanied by kicks on the meter, it is fairly easy to locate the fault. If not, the only thing is to try spare components one by one. Don't forget first to try replacing the rectifier valve. If you do observe meter kicks, then turn back to 108 and carry out the tests shown there (a) to (g), but looking for a stoppage of the kicks as one part after another is disconnected.

If these tests give no clue, the trouble must be in the O.P. transformer secondary, or the speech coil; try a new speaker.

NOISY ONLY WHEN ON A STATION

400. The trouble in this case is of the same nature as in 300; but is not in a supply circuit, as that would still give noise, even with no signals. Testing is not easy, because anything that stops signals of course stops the noise.

Make the valve test. If this gives no clue, see if the trouble occurs when using a pick-up and record.

If no trouble on pick-up, go to..... **401**
Trouble still present, go to **402**

401. No noise on gram record. This locates the trouble in the H.F. part of the set. Test out as in 114 above, but remember that you are looking, not for a complete breakdown, but for an intermittent one, a high-resistance leak to earth, or a bad contact. For "results normal" read "set now quiet" and for "no signals" read "still noisy." Also, it is unlikely that the D.C. feed circuits or by-pass condensers are wrong; they would probably be

equally noisy with no signals. The trouble is much more likely to be in a **tuned** part of the set, so that it is the R.F. currents that are setting up the noise.

402. If the noise occurs with the pick-up in, but only when actually playing, the only likely offenders are: C11, T1, T3 or the speech coil and its leads, and these should be examined and replaced if necessary.

500. **"Modulation Hum,"** i.e., excessive mains hum only heard when a station is tuned in. Make sure that the fault is really in the set: this you can only do by knowing how much hum actually comes in from the station on a normal set. This fault is usually due to a defective S.G. valve; put in a spare. Another likely course is a poor earth or over-long earth lead; so check this point.

DISTORTION

600. This is rather a vague term, and may cover various troubles. Resonance, buzzing or roughness on certain notes, always the same ones in any particular case, is probably a loud speaker fault, and the only test is replacement. But before doing this make sure that it is not due to something loose about the set. Especially check the baffle, scale window, metal screens, condenser cover, metal back, etc., and see that everything is tight.

If there is a real roughness on loud notes, put the 0–50 mA. meter and adapter on the pentode and observe the current: it may be that the loud speaker is insensitive and the pentode is being overloaded to get reasonable loudness; or the valve itself may be faulty.

If there is no clue here, remember that the detector may set up distortion, and change it.

Lastly, there is one type of fault that sounds like distortion on loud notes, but is not really this: it is sometimes quite difficult to locate. It occurs when there is a bad contact, dry joint, or microphonic valve, which is shown up by vibration from the speaker on loud notes. Test for it by disconnecting the speaker and putting the output on to a spare one some distance from the set. If the symptoms then disappear, it must be searched for as an intermittent fault under 300 above.

POOR SENSITIVITY

700. First make sure that aerial and earth are in good order; and make the valve test. If this is normal make the Pick-up test.

701. The trouble is on the H.F. side.

Remove the pick-up.

First of all check the trimming (see p. 29). It is a useful clue that poor trimming usually gives poor selectivity at the short end of the scale. Next note whether the trouble occurs on both short and long waves, whether it can be made normal by using more reaction or not, and whether it is accompanied by poor selectivity.

Weak signals, with normal or even increased sharpness, may be due to C2 or C10 being O.C. or low capacity; a very small aerial; or L5 (L.W.) or L6 (S.W.) having shorted turns or being leaky to earth; or sometimes by C5 being O.C.

On the other hand, weakness, together with flat tuning, may be: high resistance of a tuning coil, due to poor contact; or low shunt resistance across it, due to leaks to earth. Or exactly similar faults in a tuning or main tuning condenser. Low resistance in R4, or a leaky valve holder will produce the same effect.

It is not possible to make accurate tests of these components without elaborate apparatus: but with a little experience much help in locating the faulty circuit may be got by testing out as in 114 (b) above, remembering that the fault is probably in the tuned part of the circuits, and not in the supply part.

702. The pick-up test shows low output. Try new det. and pen. valves, even if the valve test showed normal currents. Check the loud speaker and its transformer. Open one side of the secondary speech-coil circuit. If the output voltage now comes up to normal or above, the trouble was a partially-shorted speech-coil; check this; the resistances should be 1·75 ohms for the speech coil, and too low to measure (·14 ohms) for the secondary. If normal, dis. one side of the primary (the B. lead from C18 or Tag 6 on the strip), measure the primary resistance; it should be about 160 ohms.

If these tests give no clue, suspect C11 O.C. or trouble in T1: check by replacement.

703. The output sounds weak, though the A.F. voltage on pick-up test is normal. This can only be lack of sensitivity in the speaker itself. Check the field coil for resistance; it should be about 2,000 ohms. If normal, the only thing is to replace the speaker and perhaps T2.

FLAT TUNING

800. If this is, as often the case, accompanied by poor gain, see above under No. 701. If the strength is near normal, or perhaps even above ; suspect high resistance or O.C. in L5 or L6. A very rare fault, giving flat tuning and rather weak gain, is that the main tuning condensers have gone out of gang. It is not easy to identify : sometimes it is shown by the fact that bringing up the reaction from zero to near osc. point causes a change in the best setting of the gang condenser. There is no easy cure : the gang must be replaced and returned to factory.

POOR FREQUENCY RESPONSE

900. For lack of treble (top cut-off) see..... **901**
For lack of bass..... **902**
For annoying resonances..... **903**

TOP CUT-OFF

901. First, make sure that it is really a fault in the set. If the set is used on a poor aerial with critical reaction all the time, there must always be top cut-off. This is unfair use and not a breakdown. If, however, there really is top cut-off on a station with not more than reasonable reaction, the trouble may be due to any of the following components having changed in value : C10, R4, or C12 too large ; also, possibly C16. A partial breakdown of the sec. of T1 may also give this trouble : test for resistance and insulation to earth after removing the Bk. lead to C14. The L.S. **might** give this trouble, but it is not likely ; test by replacement if no other clue.

LACK OF BASS

902. Remember, in investigating this, that the set **out of its cabinet** will always be weak in the bass, owing to absence of the baffle effect of the cabinet.

In most cases this will be due either to C11 being low in value, or the primary of T1 having a partial breakdown. Put a spare condenser across C11. If no success, dis. the bare lead on the A tag of T1 and test the resistance of Pr. and Pr. to frame (the latter, of course, should be many megohms). It is possible (though unlikely) that similar trouble may arise in T3. This can only be tested by replacement.

RESONANCES

903. Resonances.—In ninety-nine cases out of 100, trouble of this kind is due to the speaker, and it must be replaced. Very rarely an O.C. in C18 or C13 may give trouble of this kind, but it is unlikely.

See also No. 600; sometimes, on investigation, a "resonance" is found to be really a buzz.

DEFECTIVE REACTION

1000. This covers several faults:

No oscillation on either range..... **1001**
No oscillation on one range only..... **1002**
No oscillation over part of wave-range only..... **1005**
Uncontrollable oscillation on both ranges..... **1006**
Uncontrollable oscillation on part of one range..... **1007**

In all the above, check the detector valve and try a new one, as well as carrying out the usual valve test.

If signals are abnormally weak, see above under No. 700 first; under the present sections it is understood that signals are what one would expect with no reaction.

NO OSCILLATION AT ALL

1001. No oscillation at all.

The fault can only be C12 O.C. or very small capacity, R7 shorted, or L11 and L12 O.C.

First check the wiring; the Y. lead from Tag 2 of the reaction coils to R7 and the R. and P. leads on C12, for leak to earth, and the P. lead from R7 to Tag 5 of the reaction coil unit, for O.C. If these are normal, dis. the Y. lead from R7 and test R7 for resistance: it should vary from 0 to 200 ohms as the control is moved. If normal, test from the Y. lead you have removed to chassis. This tests L11 and L12; the resistance should be 2 ohms on long wave, 0·7 ohms on short. If all these normal, try with a spare condenser (·005 m.F.) across C12, in case this is low capacity.

1002. Set refuses to oscillate on one wave-band.

No oscillation on short **1003**
No oscillation on long..... **1004**

1003. The most obvious fault is that the wave switch reaction contacts are not making. Check the switch itself (S4 and S5) and also the four leads from it, for continuity. Next, L12 may be shorted. This is not easy to test, for its proper resistance is only ·7 ohms; so be careful in

testing. Last, L10 may be shorted. Test between Tags 1 and 6 of the Reaction Coil Unit ; it should be ·2 ohms ; but as this is really too low to measure, you will have to depend mostly on seeing that there is no short.

1004. No oscillation on long waves.

Here again, the most frequent cause is in the wave switch ; make sure that contacts of S4 and S5 open clear on **Long**, and that there is no short across the tags or between the leads.

Next, either L9 or L11 may be shorted or O.C. Test L11 for resistance, between Nos. 2 and 3 tags of the coil block. It should be 1·4 ohms. For L9, test from Tag 1 to Tag 4 ; resistance 3·8 to 4 ohms.

1005. No oscillation over part of a range.

Most often this is due to a poor detector valve ; but with an extra **good** valve, a fault which would usually stop oscillation over the whole range may actually stop it over a part only ; so refer back to No. 1002.

1006. Uncontrollable oscillation on both waves.

If it is the detector that is oscillating, this can only happen if the shunt path through R7 is of too high resistance ; it may be the Y. lead to R7, or R7 itself, and is easily tested. But the S.G. valve may oscillate if defective, or if C5 is O.C., so test the latter.

1007. Uncontrollable Oscillation over part of a range.

This is due to a defective S.G. valve or some part of its circuit. It is this valve, not the detector, which oscillates, and usually over some part of the short wave band. If a change of valve does not cure it, check C5 for O.C.

TRIMMING

In trimming, remember that the first thing one does is to tune as well as possible on the main condenser. If the three circuits are not exactly alike, but differ in sharpness of tuning, then the **sharpest** of them will make the biggest difference to signals on shifting the main tuning, and hence the sharpest of the three will be found nearly right after tuning. This is, in practice, the Screened Valve Grid Circuit, trimmed by C3.

Another point : although special precautions are taken to get both the coils and condensers highly accurate, they cannot ever be quite perfect. So see that the ganging is most accurate at that part of the wave-range where your locality has the worst interference—provided it is not a longer wave than say 375 m. So choose carefully the wave-length at which you do the following work :—

Begin thus : Tune. Then adjust C8. Tune again. Then adjust C2. Tune again, and you should then find that any adjustment of any trimmer makes things worse, so you are truly trimmed.

Now tune to different known waves, and check the calibration, especially at the low-wave end of the scale. If all right, the job is done. If the calibration is low—for example, if a real 230-metre wave is best tuned at a setting **below** 230, there is too much capacity in all the trimmers. Give C3 half a turn to the left, and repeat the whole process. *Vice versa*, if a real 230-metre wave tunes at a setting **above** 230, turn C3 to the right, and repeat the whole process.

SPECIAL TRIMMING FOR 210 METRES

The recent changes of wave-length make it important in some districts to get the shortest possible wave, even at some sacrifice of accurate ganging on longer waves.

To get this, begin by tuning and adjusting C8 as above. Then if C8 is zero (*i.e.*, turned to the left as far as it will go), proceed at once to the next paragraph. If not, give C8 a turn or two to the left, and **also C3 and C2.** Then tune again and adjust C8 to best results. If best results are got with C8 not at zero, again turn all three trimmers to the left, and repeat. Go on until the trimming is correct with C8 at, or very near, zero ; and then finally adjust C2.

The set has now as low a wave-range as it can get with exact trimming. If it is still desired to go a little lower, this can be done by slightly decreasing C3, until, with the main tuning adjustment as low as it will go, the desired station is loudest. If it is found that this has had a noticeably bad effect on other stations, C3 must be set part way between exact tuning and the special setting just found.

360—1.33