STRICTLY CONFIDENTIAL

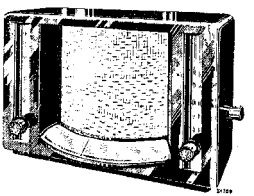
FOR PHILIPS SERVICE DEALERS ONLY

PHILIPS

SERVICE MANUAL

SUPERHETERODYNE ALL-WAVE RECEIVER For A.C. Mains 110/250 Volts

Type V5A



GENERAL REMARKS.

This octode super-heterodyne receiver is designed for the following wavelengths :—

16.7–51 metres (18–5.9 M.C. Short Wave)
200–585 ,, (1,500–521 K.C. Medium Wave)
725–2,000 ,, (414–150 K.C. Long Wave).

It is provided with delayed automatic volume control, a variable tone filter, connections for gramophone pick-up and at the back of the instrument a mains socket is fitted so that when the latter is lifted from the receiver the instrument is completely free from voltage.

The left-hand knob on the front panel is the volume control and mains on-and-off switch. The right-hand knob is for tuning. The special knob on the right-hand side is for the control of the wavebands, and the coloured dots coincide with the coloured wavebands on the scale.

The receiver is suitable for A.C. mains voltages of 110, 125, 145, 200, 220 and 245, having a frequency of between 50/100 cycles. The tapping plate for the voltage adjustment will be found at the rear.

DESCRIPTION OF CIRCUITS.

In the first place the circuits are described with the instrument adjusted for the medium waveband. The aerial voltages are inductively (S6) and capacitively (C14) coupled to S8. The first tuned circuit of the capacitively coupled band-pass filter consists of S8, together with the tuning condenser C10, trimmer C7, and coupling condenser C16, while the second tuned circuit is formed by S10, C8, C11, and C16.

The voltage across C8 is fed via R17 to the fourth grid of L1 (FC4). R17 is fitted to prevent self-oscillation when the receiver is adjusted to the short waveband.

The tuned circuit of the oscillator, consisting of S14, S16, and C9, together with the series padding condenser C20, is connected to the first grid of L1.

The coils S15, S17, which are coupled to S14, S16, are connected to the second grid of L1. The cathode, together with the first and second grids of L1, should be considered as an oscillating triode, the frequency of which is always 128 K.C. higher than the frequency to which the H.F. circuits are tuned.

S20, by C21, is adjusted to the intermediate frequency of 128 K.C. This circuit is connected to the anode of L1.

The I.F. voltage which is induced across S20 is again coupled to S21, which together with C22, has also been tuned to 128 K.C. These circuits form an inductively coupled band-pass filter.

The I.F. voltages are amplified by L2 (VP4B) and passed to the second inductively coupled band-pass filter by C28 to the first diode anode of L3. The I.F. voltage across C24 is then rectified, consequently forming a D.C. voltage with a superimposed I.F. A.C. voltage. This is passed to the circuit first anode, cathode, R7 and R16.

The L.F. A.C. voltage across R7 (volume control) is passed via C26 to the control grid of L3 (TDD4).

Further amplification is obtained by resistance capacity coupling between L3 anode and the grid of L4 (Pen.A4). R14 is fitted to prevent high frequency oscillation.

A 2

An I.F. voltage also exists across C25, and is passed to the second diode anode of L3, but when a strong signal is received a larger current will occur in the circuit of the second diode anode, cathode, R1, R11, so that the voltage at the second anode becomes more negative. This voltage is fed as an extra negative grid voltage to the fourth grid of L1 via R10, R4, S11, S10, and consequently forms a means of automatic volume control.

The voltage is also passed via S21 to the control grid of L2.

As the second anode of L3 is negative owing to the difference in voltages across R1, the automatic volume control is delayed. Therefore, the current only originates when the I.F. signal is in excess of a certain value.

The circuit connected between aerial and earth, S5, C13, is tuned to the intermediate frequency so that this circuit acts as a filter to interfering signals on the frequency of 128 K.C.

The valve L5 is the rectifier, while C1, R2 and C2 form the smoothing filter.

For the long and the short wavebands, the I.F. section is the same as for the medium waveband. When the long waveband is in use the following coils, condensers and resistances are in circuit.

Aerial Circuit. S6, S7.

H.F. Circuit. S8, S9, C15, C16, C7, C10, S10, S11, C15, C16, C8, C11.

Oscillator. Grid circuit: S14, S16, S18, C9, C19, C20, C12. Anode circuit: S15, S17, S19.

When the receiver is adjusted to the short waveband the following component parts are in circuit:—

Aerial Circuit. S12.

Grid Circuit of L1. S13, C8, C11.

Oscillator. Grid circuit: S14, C9, grid condenser C19, C20, R6. Anode circuit: S15.

TRIMMING THE RECEIVER.

In order to obtain maximum selectivity and amplification, the various tuned circuits must be accurately adjusted. In this receiver use is made of the self inductance between the **I.F. coils** for trimming purposes. These coils are S5, S20, S21, S22, S23.
When the I.F. circuits have been adjusted the high frequency circuits of the medium waveband (1,450 K.C.) must be trimmed by means of the trimming condensers C10, C11, after the tuning condenser has been tuned to the first signal from the minimum value. When this adjustment has been made the tuning condenser should be left in exactly the same position and the waveband switch placed to long wave. Apply a signal of 411 K.C. and trim with the trimming condenser C12 for maximum output.
It is important that the I.F. coils are adjusted with extreme care. Each coil assembly consists of two coils. When the distance between the two is adjusted the self-inductance is altered; consequently the intermediate frequency to which the circuits are tuned can be obtained.
The **outer coils only** should be altered, as, if the inner coils are adjusted in any way, the band width is altered considerably.
The small coils on the tube are fixed in position by means of wax, and consequently they must be released by means of a warm soldering iron.
Adjustments may be carried out by the hand, providing a rubber glove is worn.
It should be noted that it will very rarely be necessary to trim the I.F. circuits.
When it is necessary to alter the adjustment of the coils, care should be taken to make quite sure that the wires do not break. If it is found that one of the coils should become open circuited, then it is desirable to refit a new coil assembly.
When this is being done it is important to see that they are correctly placed in position, as otherwise it will be found that the band width is too narrow and the volume insufficient.
It should be noted that C12 consists of a thick wire with a thin wire wound on it, and this assembly is fixed with wax.
The I.F. signal should be passed to the receiver via a condenser of 32,000$\mu\mu$F, while if the H.F. and oscillator sections are trimmed a condenser of 140 $\mu\mu$F should be used as an artificial aerial.
When trimming, the volume control must be placed at maximum, and it is important that both the receiver and service oscillator should be correctly earthed.

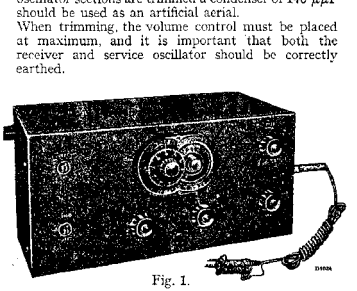


Fig. 1.

The following tools, etc., are recommended for trimming :—

1. A service oscillator similar to Philips Type GM.2880. Fig 1.
2. An output indicator similar to that which is fitted to Philips Universal Measuring Testboard, type 4526. (See Fig. 3.)
3. A condenser of 32,000 $\mu\mu$F.
4. A condenser of 140 $\mu\mu$F.
5. An insulated trimming screwdriver. Fig. 2.
6. Wax for fixing the coils.

METHOD OF TRIMMING THE I.F. CIRCUIT.

1. Apply a modulated signal of 128 K.C. via a condenser of 32,000 $\mu\mu$F to the control grid of L2, and connect the output indicator to the primary of the loudspeaker transformer S25.
2. Heat the **outer** coils of S22, S23, until the wax becomes soft.
3. Adjust the outer coils until maximum output is obtained. First adjust the outer coil of S23, and after that the outer coil of S22.
4. Apply a modulated signal of 128 K.C. via a condenser of 32,000 $\mu\mu$F to the fourth grid of L1.
5. Heat the outer coils of S20 and S21 and trim for maximum output.
6. Apply a modulated signal of 128 K.C. to the aerial socket via a condenser of 140 $\mu\mu$F. Adjust the receiver to long wave and tune the variable condenser to its maximum capacity (2,000 metres). Heat S5 and trim until the output indicator indicates a minimum value.

TRIMMING THE H.F. AND OSCILLATOR CIRCUITS.

1. Adjust the receiver to medium waveband and alter the tuning condenser so that the receiver is adjusted to 200 metres.
2. Rotate C11 completely and C10 approximately half.
3. Apply a modulated signal of 1450 K.C. via a condenser of 140 $\mu\mu$F to the aerial socket. Rotate the tuning condenser slightly until the first signal becomes audible from the minimum position, and adjust to largest output.
4. Adjust C10 and C11 until the output indicator indicates the maximum output.
5. Leave the tuning condenser at its previous position and adjust the receiver for reception of long wave.
6. Adjust the service oscillator to 411 K.C. and adjust C12 to maximum output.
   If the capacity should be found to be too small, an entirely new thin wire can be wound on the thicker wire.

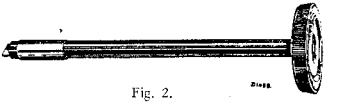


Fig. 2.

E 1

HOW TO TRACE FAULTS.

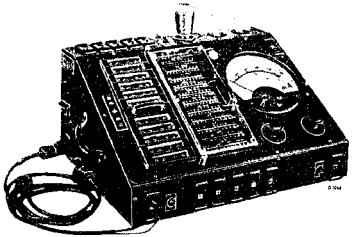


Fig. 3.

GENERAL REMARKS.

Fault-finding will be considerably facilitated by the use of efficient testing apparatus. Attention is drawn to the Philips Universal Measuring Testboard (Fig. 3) which enables both A.C. and D.C. voltages and currents, capacities and resistances, to be measured over a large number of ranges.

Furthermore, particulars are given of the "point to point" method of testing a receiver, and it will be found that this method considerably assists in finding any defect that may have occurred in the instrument.

Particulars and prices of the Universal Testboard can be obtained from the Service Department, Mitcham Junction, Surrey.

The following instructions for tests are as complete as possible, but as there is a possibility of a combination of faults occurring, it is not possible to give a complete survey of all faults which may occur. It can be said, however, that most defects are due to either short or open-circuits in the wiring, or in one of the component parts. These are indicated as R—— or C—— open or short-circuited. The following procedure is suggested :—

I. Carefully check all contacts connected to the removable back, mains switch, and the heaters of the valves. If the valves burn normally, this indicates that the safety contacts, mains switch and heaters of the valves are in order (subject to the possibility that the heaters of one of the valves may be short-circuited). Check the receiver with another set of valves which are known to be satisfactory, and also try another loudspeaker.

II. If there is still no output, test to see if gramophone reproduction is possible.

III. Check the voltage across C2, namely, by measuring between S20 and earth. If this is found to be abnormal, the following parts should be tested.

1. A fault in the mains switch or safety contact fitted on the back of the receiver. (Measure primary voltage.)
2. A defect in the mains transformer (measure the secondary voltage).
3. A defect in the rectifying valve L5.
4. C1, C2 or C33 short-circuited.
5. R1, R2 open-circuited.
6. A short-circuit in or close to one of the I.F. transformers.
7. A short-circuit between primary and secondary winding of the loudspeaker output transformer.
8. Bad contact in one of the valve holders.

IV. **Voltage across C2 is normal, but no gramophone reproduction.**

A. **L4 has abnormal voltages and currents.**

1. S25 or R15 open-circuited (no anode current).
2. C29 short-circuited (anode current too high).
3. R13 or R14 open-circuited.

B. **L3 has abnormal currents and voltages.**

1. R12 open-circuited (no anode current).
2. C26 or C6 short-circuited (anode current too high).
3. R8 or R9 open-circuited.

C. **L3 and L4 have normal voltages and currents.**

1. R7, C26 or C29 open-circuited.
2. Short-circuit between S25, S26.
3. C27 short-circuited.

V. **Gramophone reproduction but no radio reception.**

A. **L2 has abnormal current and voltages.**

1. S22 or R3 open-circuited (no anode current).
2. C5 short-circuited (anode current too high).
3. R10, R11 or S21 open-circuited.

B. **L1 has abnormal current and voltages.**

1. S20 open-circuited (no anode current).
2. C16 short-circuited (anode current too high).
3. S15, S17, S19, R6, R4, S10, R17 or S21 open-circuited ; C4 short-circuited.

C. **L1 and L2 have normal currents and voltages, but no radio reception.**

(a) No reproduction of a modulated I.F. signal of 128 K.C. when applied to the control grid of L2.

1. S22, S23, C24, C23 short-circuited.
2. C28 or R16 open-circuited.

(b) No reproduction of a modulated I.F. signal of 128 K.C. when applied to the fourth control grid of L1, but signals received when applied to the control grid of L2.

1. S20, S21, C21 or C22 short-circuited.

(c) No reproduction of a modulated **H.F.** signal when applied to the fourth grid of L1, but reproduction of an I.F. signal when applied to this grid.

1. One of the coils or condensers in the oscillator circuit of L1 may either be open or short-circuited.

(d) No reception of a modulated signal applied to the aerial socket, but reception when applied to the fourth grid of L1.

1. This may be caused by an open-circuit or short-circuit in one of the following coils or condensers:—S7, C10, C8, C11, S6, S7, S8, S9, S10, S11, S12, S13.

VI. **Radio reception and gramophone reproduction, but quality is not satisfactory.**

A. **Automatic volume control not operating.**

1. C25 open-circuited.

B. **Receiver oscillates.**

1. One of the decoupling condensers is open-circuited, for instance, C4, C5, C6, C33 or one of the screening connections has become open-circuited.

C. **Receiver hums.**

1. C1, C2 open-circuited.

D. **Resonances due to loose parts.**

This difficulty may be due to some loose parts, such as valve holders, strips, springs or washers, etc. When the resonating part has been located it should be secured either with its retaining screw or part, or with a piece of felt.

F 1

FAULT FINDING BY THE "POINT TO POINT" METHOD.

When the "point to point" method of testing is adopted in conjunction with a Philips Universal Testboard, Type 4256, a defect in the receiver may be quickly and systematically located.

I. The receiver is connected to the voltage to which it is adjusted, and is tested with its own valves on an outside aerial or service oscillator.

II. Should the receiver not function, the valves should be replaced by another set of valves which are known to be in good working order, and also with another loudspeaker. If it is still found to be faulty it will be known that the valves and loudspeaker are in good order.

III. A gramophone pick-up is connected to the receiver. If it is found that satisfactory reproduction can be obtained from this position then the chassis can be tested by working backwards, and subsequently placing an H.F. signal via a condenser of 0.1 μF to the control grids of the various valves.

IV. Should, however, no gramophone reproduction be possible or should the tests on the H.F. side of the receiver fail to give some result, then the following tests should be made.

1. All the valves are removed from the receiver and a valve holder which has its anode and heater sockets connected as mentioned on page 7 is inserted in the valve holder of the rectifier. The receiver should not be connected to the mains.

2. A Philips Universal Measuring Testboard (Type 4256) is then connected up and adjusted for resistance measuring (Position 12). It is desirable that the positive pin of the test flex is sufficiently insulated and long enough so that the various parts of the chassis can be easily reached.

3. The various resistances between the points, indicated in the accompanying table, and chassis, are measured by touching each contact with the positive pin. The reading obtained should then be compared with the value shown on the table (page 7).
P.U. or A. indicates that measurements should be taken between the gramophone pick-up or aerial sockets and earth.
21/22 indicates that a measurement should be taken between the points 21/22.
It is possible for discrepancies of 10 per cent. to occur without the component part being necessarily defective.

4. When the resistances have been measured the Testboard should be adjusted for capacity measurement, and the values specified in the table are then checked.

5. When it is desired to take a measurement from the valve holder of the rectifier then the short-circuiting of the latter is temporarily removed. All the circuits shown in the theoretical diagram are covered by these measurements, and therefore identification of the faulty part can easily be obtained by reference to the diagram.

The various contacts to the valve holders are systematically numbered in the following way:—

1 & 2 = heaters.
3 = control grid.
4 = metallising contact.
5 = cathode.
6 = extra grid.
7 = a screening grid.
8 = anode.
9 = an extra grid (for instance when employed in the octode).

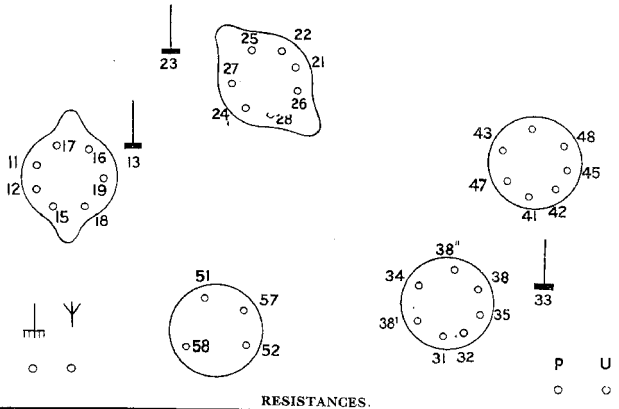
From the table of measurements it will be clearly seen that the numbers are grouped according to the value of the resistance or capacities, so that all grid circuits (13, 23, 33, etc.) are measured in Position 9. On the other hand, all heater and cathode connections which are of low resistance are measured at Position 12. In some measurements it may be necessary to adjust the wavelength switch. When this is necessary it is indicated in the table as:—

3X	3X
—	—
Aerial	13

S., M. and L. indicate the position of the waveband switch.

When measurements are made on electrolytic condensers (resistance measurement) a deflection will, when the leak current is observed, be returned to a definite value. It may, however, be possible that the value is much too high owing to the condenser being defective, but it must be pointed out that if the receiver has not been in use for some considerable time, a similar type of reading will be obtained.

It is, therefore, desirable to check the electrolytic condensers carefully.



RESISTANCES.

12	3X Aerial S 95	M 365	L 460	11 / 12 5	21 / 22 5	15 / 24 5	25 / 26 5	31 / 32 5	34 / 35 5	P 5										
11	18 465	45 200	47 460	48 400	52 / 58 210															
10	16 150	17 245	19 245	27 / 28 390																
9	13 105	23 110	33 135	38 280	38' 230	38" 180	43 145	U 220												

CAPACITIES.

12	3X 13 S 410	M 410	L 375	16 405	33 175	38 240	38' 195	38" 130	43 145	U 195										
11	17 / 19 305	23 280																		
10	27 / 28 235	48 300	57 / 58 410																	
9	3X Aerial S 500	M 485	L 390	18 405	45 400	47 485	51 / 52 455													

Short 51 and 57 for resistance test.
Volume Control at Maximum.

REMOVING AND CHANGING OF PARTS.

When repairing receivers the following points should be noted :—

1. Always keep the wiring or screening plates in their original position.
2. Make sure that all the wires are kept clear of each other : not less than $\frac{1}{4}$ in.
3. All washers, insulated material, etc., should be replaced in their original position.
4. Rivets can, if necessary, be replaced by screws and nuts.
5. Moving parts may be lubricated with a little pure vaseline unless otherwise stated.
6. If necessary place a slight tension on contacts.
7. Solder as quickly as possible so that the components are not overheated.
8. When soldering compound condensers, it should be done at least 1 cm. away from the compound in order to avoid overheating. All compound condensers should suspend free from all wiring.
9. All resistances should be fitted in such a way that they do not make any contact with other component parts.

The receiver is so constructed that all the component parts are easily accessible, since these are all fitted either on the base board or around the loudspeaker.

Electrolytic Condensers.

A box spanner similar to that shown at Fig. 4 should be used when replacing electrolytic condensers.

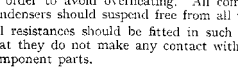


Fig. 4.

DESCRIPTION OF WAVECHANGE SWITCH.

The wavelength switch consists of one or more units ; a stop plate to determine the number of positions, spindle, springs.

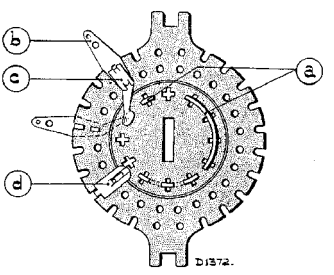


Fig. 5.

The unit (Fig. 5) consists of a stationary ring called the stator, a rotor, contact springs (b) which are secured to the stator with staples (c) ; one or more springs (d) which keeps the rotor in alignment with the stator and also various types of contact members and connection strips (a).

The stator is provided with 24 apertures distributed over a circle. On one side of the stator 12 contact springs may be fastened ; between the springs one aperture is always left open so that the contact springs on the other side can be secured. Consequently 12 contact springs can be secured on either side of the stator.

EXPLANATORY NOTES OF THEORETICAL DIAGRAM.

In order that the diagram of the wavechange switch can be understood, the following comments are added :—

The contact springs on the side of the stator that are fitted towards the stop plate are indicated as small circles in the outermost circle.

When a contact spring is not fitted a dot is shown. Therefore, a total of 12 positions can be drawn in the outermost circle. In the innermost circle there are also 12 positions which indicate the contact springs on the other side of the stator.

Connections on the side of the rotor which turns towards the stop plate are shown as full lines in close proximity to the outermost circle, while those on the other side of the rotor are shown as a dotted line close to the innermost circle. Contact pieces are indicated as short lines between the inner and outer circles.

The rotor contacts cover one or more apertures, and form on one side a part of the circuit.

The contacts are provided with lips that fit into the aperture of the rotor and by means of which the contacts are securely fixed. This is done by pressing them together with a pair of very smooth pliers, and the lip may also, on the other side, again act for contact purposes.

It is therefore essential to take precautions that the lip is truly flat.

DESCRIPTION OF CONNECTING PIECES IN THE LIST OF SPARE PARTS.

The connections (Fig. 6) may be made in several types, and therefore a special method has been adopted so as to make quite sure which type of connection is intended.

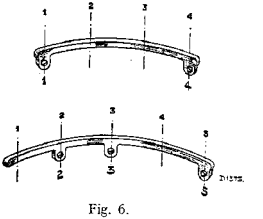


Fig. 6.

The first number specifies the number of apertures that are covered, while the other numbers indicate into which aperture the lip is fitted. For example, 4.1.4 denotes that four apertures are covered, and that, starting from the left, the apertures 1 and 4 are made for fixing and also contact purposes on the other side; 5.2.3.5 denotes that five apertures are covered, and that the apertures 2.3.5 are used for securing and also for contacts on the opposite side. The connecting pieces are shown in this manner in the list of spare parts, so that it will be possible to immediately know the code number of the part.

FITTING THE CORD DRIVE.

Before a new length of cord is used it is desirable that it is stretched by suspending a weight of approximately 1 lb. at its end for two minutes. It is taken around the spindle approximately $3\frac{1}{2}$ times, and fixed to the projecting forks as near to the rotating point of the lever as possible.

Adjust the tension of the spring so that it is fully closed and carefully fix the clamp so that the cord is not cut.

DRIVE AND POINTER.

If the pointer fouls the moulding or scale, the slotted guide bracket should be examined. It is possible that it has been bent and a slight readjustment will allow the pointer to travel freely.

VARIABLE CONDENSER, VALVE HOLDER, AND WAVEBAND SWITCH.

These parts are in one assembly. The spindle of the waveband switch is secured in position by a square nut. If it is desired to remove the assembly it is only necessary to release the grub screw and retaining nut and unsolder the small number of leads connected to the assembly.

VOLUME CONTROL AND ON/OFF SWITCH.

This component is held in position by a one-hole fixing, and can be removed after the grub screw and nut have been released and the leads unsoldered.

POWER PACK.

The parts are secured to the base board and the base is secured to the moulded case by four screws and clamps.

COILS.

The majority of these component parts are secured to slots in the moulded case by compound. Should they become loose they can easily be secured by a compound similar to Chatterton's.

REPAIRS TO THE CABINET.

Any cracks that may develop in the cabinet can be closed by the means of filling with shellac and a soldering iron.

The rough parts of the filling should be removed with a sharp chisel and polishing can be made by means of emery cloth and a little oil. The size of the emery cloth should be chosen according to the extent of the damage. When the damage has been made good it can be polished with a special type of paste, if necessary, supplied by the Service Department, namely, G.2246. The final polish can be given with woollen rags.

REPAIRS TO THE LOUDSPEAKER, TYPE 9617.

Care should be taken to ensure that any repairs made to the loudspeaker are carried out on a dust-free table or bench with good tools. On no account may the front and rear plate be removed, as the magnetism is likely to be affected. When the repairs have been made the loudspeaker cover should be replaced immediately so as to avoid unnecessary damage.

The cone and coil can be re-centred by four small feelers which can be obtained from the Service Department. These feelers should be placed in the air gap through the perforations of the centring disc, or spider, but should it be necessary to renew the cone carrier, it is desirable to use a special template for centring the pole piece.

Before commencing the repair of a loudspeaker, make quite sure that the fault is not in some other part of the circuit by trying another loudspeaker, and if possible another output transformer.

When it is desired to remove the loudspeaker it can be done in the following way.

At the back of the receiver it will be found that there are four screws at each corner of the moulding. These four screws hold the loudspeaker silk and frame in position. When this frame is removed, four screws will be disclosed at the front of the cabinet. These should be removed after the speech coil leads have been unsoldered. The loudspeaker can now be withdrawn from the cabinet.

It should be noted that speaker rattle can be caused by the leads to the loudspeaker being too rigid or too loose, or one of the leads may be touching the cone. These parts should be inspected before removing the cone and coil.

A special service clamping ring is available from the Service Department.

LIST OF SPARE PARTS, TOOLS, GAUGES, TEST GEAR, ETC.

When ordering any of these spare parts please state :—

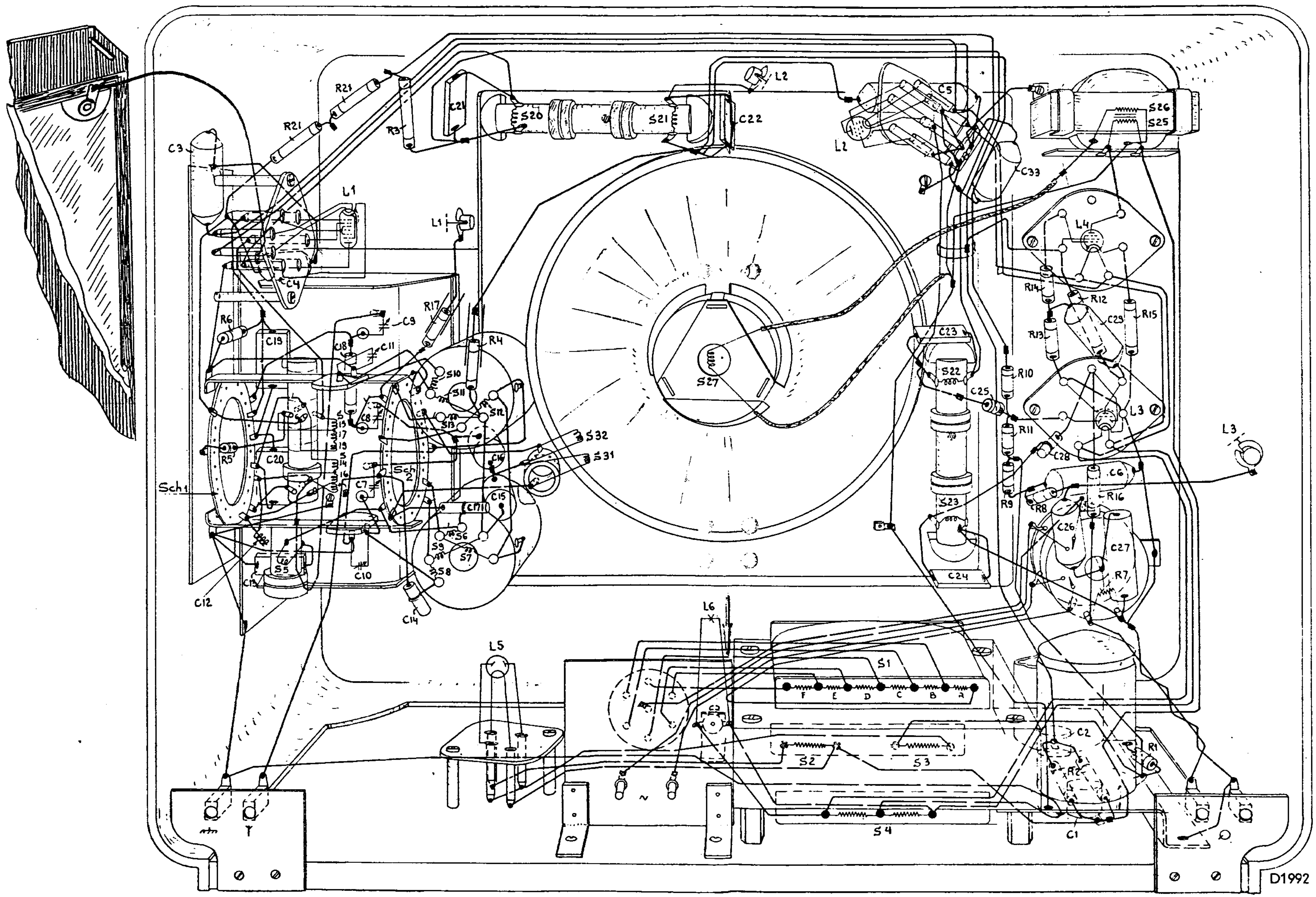
1. Code number of spare part.
2. Type and serial number of receiver.
3. Description of spare parts.

Fig.	Item.	Description of Parts.	Code No.
7	1	Cabinet	23.660.262
7	1a	Frame with speaker silk	28.825.831
7	2	Station scale	28.705.210
7	3	Pointer	28.944.954
7	4	Knob	23.610.351
7	5	Wavelength knob	23.610.362
8	6	Spindle	28.002.672
8	7	Valve cap	28.906.022
8	9	Stator without contacts	28.934.580
8	10	Rotor without contacts	28.477.210
5	a	Rotor contact, 1.1	28.904.161
5	a	Rotor contact, 2.2	28.904.390
5	a	Rotor contact, 2.1	28.904.260
5	a	Rotor contact, 3.2	28.904.211
5	b	Stator contact	28.750.970
5	c	Clip for stator contact	28.077.391
5	d	Conductor contact	28.077.380
5	d	Spring of arresting plate of wavelength switch	28.751.890
5	d	Bearing of arresting plate of wavelength switch	89.205.040
8	11	Diffusion screen	28.399.544
8	12	Driving cord (1,054 mm.)	06.606.290
8	13	Cord clamp	28.078.610
8	14	Plate with pins for voltage adjustment	28.871.702
8	15	Voltage adjustment disc	28.855.291
8	16	Two-pin mains plate	25.870.740
8	17	Clip for back	28.673.860
8	18	Contact box (mains)	28.838.630
8	19	Back plate	28.872.890
		Service clamping ring for loudspeaker	25.870.750
		Protective cap for loudspeaker	28.255.062
		Paper ring	28.450.690
		Valveholder, 5 pin	28.225.900
		Valveholder, 7 pin	28.225.420
		TEST APPARATUS, TOOLS, GAUGES, ETC.	
	1	Service oscillator, type G.M.2880	09.991.260
		Right-angled screwdriver	09.990.360
	2	Universal measuring instrument, type 4256	09.991.030
		Box spanner for electrolytic condensers	09.991.540
		Measuring pin	09.991.620
		Centring template for loudspeaker	09.991.530
		Pertinax feelers for loudspeaker	09.990.840
		Insulated screwdriver for trimming	09.991.501

D.C. RESISTANCES OF COILS

Designation.	Resistance in Ohms.	Code No.
S1	40	
S2	0.2	28.530.790
S3	130	
S4	0.2	
S5	130	28.587.520
S6	.25	
S7	90	
S8	4.5	28.571.360
S9	50	
S10	4.5	
S11	45	
S12	2.0	28.571.351
S13	0.2	
S14	0.2	
S15	.25	
S16	10	28.587.510
S17		
S19	6.5	
S18	.25	
S20	85	
S21	85	28.587.531
S22	85	
S23	85	28.587.531
S25	500	
S26	0.4	28.526.940
S27	1.5	28.220.430
S31	.75	
S32	.75	28.587.690

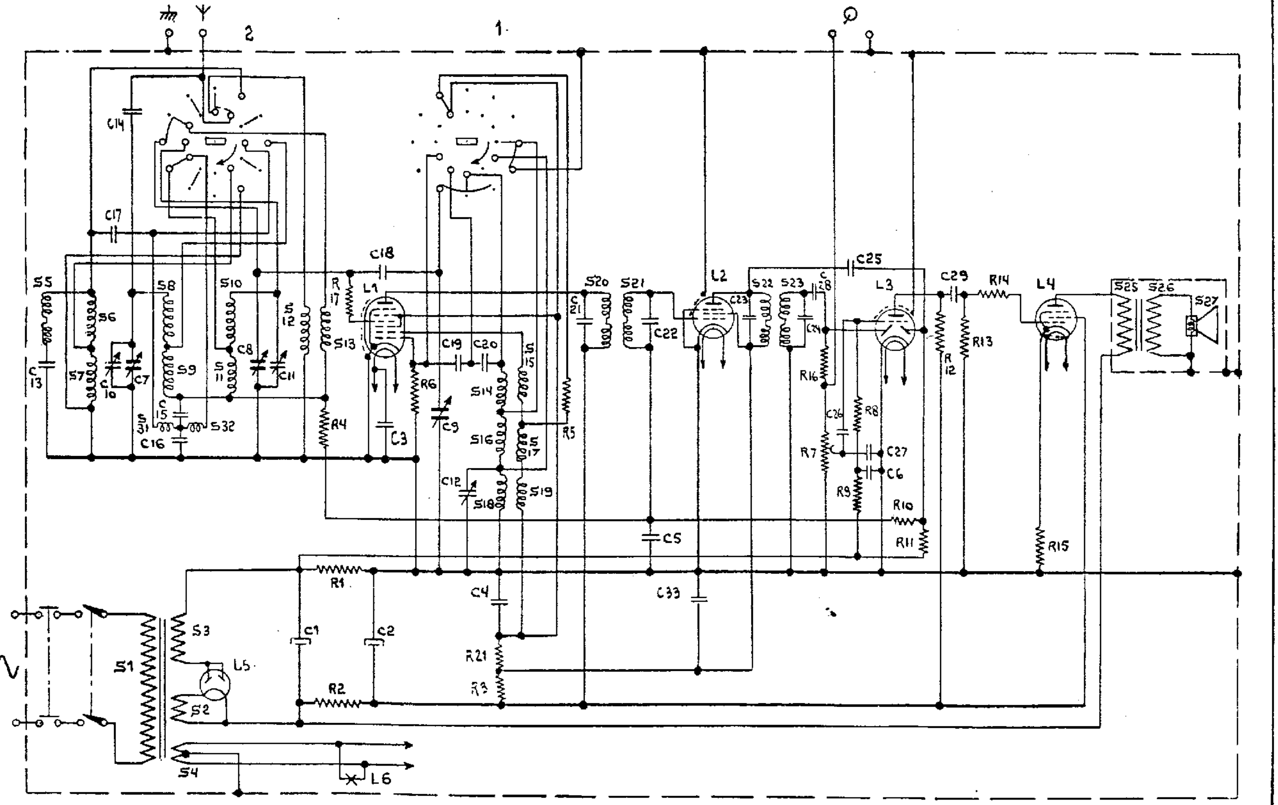
S:	5. 14,15,16,17,19. 10, 11, 13, 6, 7, 8, 12, 9, 20. 32 31. 21. 27. 2. 1, 4. 3. 22, 23 25, 26.
C:	3. 12. 13, 20, 4, 19. 18, 8, 11, 10. 21, 14, 17, 16, 22. 5, 23, 1. 24. 25, 33, 2, 28, 26, 29, 6, 27.
R:	6, 5. 21. 3, 17. 4. 9, 10, 14, 13, 11, 8, 12, 2, 7, 16, 15, 1.



S: 5, 6,7, 31,32,1, 8,9, 2,3,4, 10,11, 12,13, 14,16,18,15,17,19, 20,21, 22,23,24, 25,26, 27.

C: 13, 10,14,7,17, 15,16, 8,11, 1, 3, 2,18, 9, 19,12,20,4, 21, 22,5, 33, 23, 25,24, 26,27,6,28, 29,

R: 4, 1,2,17, 6, 21,3, 5, 16,7,8,9, 10,11, 12,13, 14, 15.



RESISTANCES.

Designation.	Resistances.	Code No.
R1	40 Ohm	28.770.110
R2	4000/2 Ohm	28.770.960
R3	10000/2 Ohm	28.771.000
R4	0.1 M. Ohm	28.773.900
R5	40 Ohm	28.773.560
R6	50000 Ohm	28.773.870
R7	0.5 M. Ohm	28.811.470
R8	0.8 M. Ohm	28.773.990
R9	0.25 M. Ohm	28.773.940
R10	1 M. Ohm	28.774.000
R11	0.5 M. Ohm	28.773.970
R12	0.32 M. Ohm	28.770.500
R13	0.8 M. Ohm	28.773.990
R14	0.2 M. Ohm	28.773.930
R15	125 Ohm	28.770.160
R16	0.2 M. Ohm	28.773.930
R17	50 Ohm	28.773.570
R21	10000 Ohm 6400 Ohm in series	28.771.000 28.770.330

CONDENSERS.

C1	32 μF	28.180.130
C2	32 μF	28.180.130
C3	10000 $\mu\mu$F	28.201.080
C4	0.1 μF	28.199.090
C5	0.1 μF	28.201.180
C6	0.25 μF	28.201.220
C7	11–490 $\mu\mu$F	
C8	11–490 $\mu\mu$F	28.211.891
C9	11–490 $\mu\mu$F	
C10	7–55 $\mu\mu$F	28.211.860
C11	7–55 $\mu\mu$F	28.211.860
C12	20 $\mu\mu$F	28.211.900
C13	100 $\mu\mu$F	28.193.180
C14	20 $\mu\mu$F	28.206.370
C15	16000 $\mu\mu$F	28.201.100
C16	25000 $\mu\mu$F	28.201.120
C17	50 $\mu\mu$F	28.206.240
C18	2 $\mu\mu$F	28.205.880
C19	700 $\mu\mu$F	28.191.230
C20	1490 $\mu\mu$F	28.191.880
C21	180 $\mu\mu$F	28.193.260
C22	180 $\mu\mu$F	28.193.260
C23	180 $\mu\mu$F	28.193.260
C24	180 $\mu\mu$F	28.193.260
C25	2 $\mu\mu$F	28.205.880
C26	10000 $\mu\mu$F	28.201.080
C27	1000 $\mu\mu$F	28.198.890
C28	16 $\mu\mu$F	28.206.360
C29	10000 $\mu\mu$F	28.198.990
C33	0.1 μF	28.199.090

VALVES AND PILOT LAMPS.

L1	L2	L3	L4	L5	L6
FC4	VP4B	TDD4	PEN A4	1821	8042–07

TABLE OF VOLTAGES AND CURRENTS.

	L1	L2	L3	L4	
Va	230	155	60	245	Volts
Vg1	—4.0	—2.2	—2.2	5.0	Volts
Vg2	70	155	—	225	Volts
Vg3.5	70	—	—	—	Volts
Vg4	2.2	—	—	—	Volts
Ia	1.9	6.0	0.50	35/40	mAmps.
Ig2	2.0	2.0	—	4.5	mAmps.
Ig 3.5	3.5	—	—	—	mAmps.

Total H.T. current = 60 mAmps.
Total Watts = 55.

The voltages are measured with voltmeters having a resistance of 200 Ohms per volt. Moving coil voltmeters give readings which depend upon the resistance in circuit and the current consumption of the meter itself. The values given are the mean of several measurements, therefore some readings obtained may differ appreciably, particularly as variations may arise due to the tolerance of the components as well as the valves.

Before finally deciding that a valve is defective, it is recommended that a replacement test with the same type of valve is made.

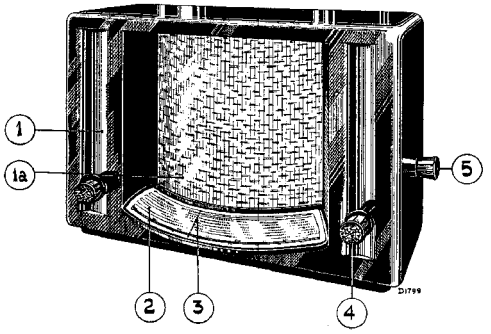


Fig. 7

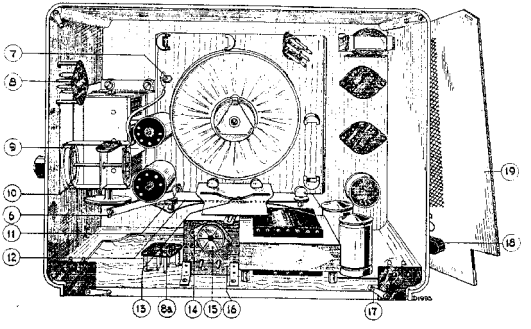


Fig. 8