PHILIPS

SERVICE DOCUMENTATION

SUPERHETERODYNE RECEIVER UNIVERSAL TYPE FOR A.C. AND D.C. MAINS.

Type 588 U

General Remarks.

This receiver is designed for operation on both D.C. and A.C. supplies and employs the " Superheterodyne " principle. Of the four knobs on the front panel the left-hand knob regulates the volume control ; the right-hand knob the continuously variable tone filter. The octagonal knob comprises the on/off switch and wave band switch while the small knob concentric with the octagonal knob is for tuning. At position one of the octagonal knob the receiver is switched off, at position two the medium wave band is in use and at position three the long wave band is in use. The intermediate frequency of this receiver is 115 K.C. The receiver can be adjusted to the following voltages on either D.C. or A.C. mains, 110-119 volts, 120-130 volts, 200-224 volts, 225-250 volts by a simple method of altering the voltage changing disc or links provided at the right hand side of the chassis looking at the back. A safety contact socket is fitted at the back of the receiver which automatically renders the set electrically dead when the back panel is removed.
The mains filter coils fitted at the extreme top left-hand corner looking at the back are not shown on the illustration (fig. 8) or diagram (fig. 7) but one coil is wired in series with each mains lead.

When adjusting, testing or repairing the receiver it is desirable to use an A.C. supply which should have a double wound transformer between the supply and the receiver with the secondary winding not earthed.

Description of circuits.

In giving details of the circuits etc., the items referring to only one of the wavebands are placed in brackets.

H.T. Circuits.

The two H.F. circuits C10-S4 (S5-C17) C18, C11-S6 (S7-C17) C18 are designed to tune to the incoming signals on the aerial.
The two circuits comprise together a band-pass filter having (C17) C18 in common and they form a direct capacitive current coupling between the two circuits. These two circuits are trimmed with condensers C13, C14 but no trimming condensers are provided for the long wave side of the receiver. When an incoming signal tuned to the broadcast wave band is received they are passed to the grid of L1 (Grid 4) FC13.

Oscillator circuit.

The circuit C12-S8 (S9-C19) C20 is connected to the grid 1 of the octode valve FC13 while grid 2 of this

valve forms the plate of the triode section. This grid 2 is coupled back to the tuned circuits by S10 (S11)and therefore oscillation is obtained. The values of self-inductance and capacity are so arranged that the difference in frequency is always equal to 115 K.C. The oscillator is trimmed for the medium wave band by the trimming condenser C15. C20 is the padding condenser for medium wave and C19 is connected in series with C20 to form the padding condenser for long wave.

Intermediate frequency Amplifier.

It will be noted that the octode has six grids and an anode. The two grids nearest the cathode form the triode heterodyne oscillator while the third grid acts as a screen between the oscillator and mixer portions of the valve. The remaining three grids and anode form an H.F. pentode with the suppressor G6 connected to the cathode. The auxiliary grid and screen are also connected together inside the valve. There exists between grid three and the control grid (grid 4) of the pentode a " virtual cathode " formed by a cloud of electrons which have been accelerated by the high potential screen and repulsed by the negative control grid of the pentode. The heterodyne frequency of 115 K.C. from the oscillator circuit is super-imposed on the electron stream and the resultant pulsation is modulated by the signal frequency applied to the grid of the pentode portion. The circuits C22-S12, C23-S13, C23-S14, C25-S15 are tuned to this frequency and consequently the required amplification is obtained.

Detection, Automatic volume control, and Low Frequency amplification.

Following the I.F. stage, detection occurs at the diode valve L3 (2D13) and the super-imposed A.C. potentials on the D.C. component are led back through R9, C21, R7, to L1 (FC13) and L2 (VP13A) so that these valves have a varying negative grid bias voltage applied to them. Therefore, when a sufficient powerful signal is received, any variation of signal caused by fading is practically non-existent.

Following the diode detector the voltage is applied to the grid of the valve L4 (SP13) via R10, R11, C27. This voltage is amplified by a stage of resistance capacity coupling and is passed to the grid of the output pentode valve (Pen 26) ; finally these signals are passed through an output transformer to the built-in loudspeaker. The condenser C37 and the variable resistance R17 form the tone filter which can be varied according to the personal taste of the user. An aerial filter S3, C36 is fitted, tuned to the intermediate frequency of 115 K.C.

An extra loudspeaker of high impedance can be connected to the primary winding of the output transformer, which it will be seen is connected to convenient sockets at the rear of the chassis via the condenser C34 and C35. If the loudspeaker has two leads only and is connected by a two pin plug it will only be necessary to use the two outer sockets. The third centre socket is a dummy and is intended for use with a special three pin plug supplied by Philips. This three pin type of plug is used so that the loudspeaker cannot be inserted in the mains socket.

The supply circuits.

The mains voltage is connected across C39 via a safety contact socket fitted on the back panel, fuses, and a mains switch. The heaters of the valves are wired in series and are connected in the following manner. L7 (8065) pilot lamp, L6 (CY1) rectifier, L5 (Pen 26) output valve, L2 (VP13A) I.F. valve, L1 (FC4) octode, L3 (SP13) L.F. valve, L4 (2D13) diode.

For a mains voltage of 120/130 volts the resistance R16 is switched in circuit. For a mains voltage of 200/250 volts the regulator lamp L8 (C1) is placed in circuit. When an A.C. supply is used, single phase rectification is obtained with L6 (CY1) half wave rectifying valve. When a D.C. supply is used the heater of this valve allows continuity of circuit. When the receiver is adjusted to either of the two lower ranges of mains voltages the rectifying valve is followed immediately by C1 but on the two higher ranges of mains voltages the resistance R18 is connected between L6 and C1 to prevent an overload of voltage.

Following C1 the rectified voltage has a resistance R1, choke coil S2 and the two electrolytic condensers C2 and C3.

For a mains voltage of 200/224 and 225/250 volts R19 and R20 respectively are automatically switched in circuit. The anode voltage of L5 (Pen 26) is taken from the connection between C2 and S2. The normal capacity of C3 is 32 m.f. The valves L1, L2, L4 and L5 obtain their negative grid voltage from the voltage drop across the resistances R3, R4, R5, R6. These circuits are decoupled by C5, C6, C7, C8. It should be noted that C7 and C8 are dry electrolytic condensers. Therefore they are polarised and care should be taken to be sure that the end of the condenser marked red is connected to the positive side of the circuit.

Description of Receiver Circuits.

The chassis is connected to the earth via condenser C31 ; this condenser should not be of higher capacity than that given in this manual. It must be noted that when the receiver is used on A.C. supply the chassis will be under a high voltage to earth. Further this A.C. voltage is distributed by the potentiometer formed by the condensers C38, C9 and (C10, C11, C13, C14, C17, C18). The voltage on the latter condensers shown in brackets is likely to cause a modulated hum in L1, therefore this part of the voltage is by-passed through the choke coil S19. It will be seen that the full mains voltage is across the aerial and earth condenser and C38 only but as these two condensers have different capacities, two thirds of the mains voltage is connected to the aerial. Consequently, if a rare gas discharge tube such as Philips Aerial Discharger Type 4382 is used as a lightning arrester there is a possibility of an intermittent breakdown which would be likely to cause crackle. There is no danger, however, in touching the aerial as any voltage on C38 is discharged across the resistance R23 which is in parallel with the aerial and earth sockets. If, however, it is found that the lightning arrester continually short circuits, a resistance .02 megohm may be connected between the aerial and earth sockets. The gramophone pick-up sockets are connected via condenser C32 and C33 to the volume control R11. The capacities of C32 and C33 should not be increased above the values given in the manual. In case the chassis is under voltage the pick-up will, of course, be under voltage and therefore

it would be dangerous. The third I.F. circuit is short circuited by C40 when the gramophone pick-up is used, therefore no interference can be experienced from radio. Note carefully that the leads to condenser C27 are screened, as this part of the circuit is likely to produce a hum and therefore care should be taken when handling these leads which are connected to the grid of L4.

Very Important Notes.

As previously mentioned, if the chassis is being handled under a voltage such as when trimming, testing for faults, measuring, etc., there is a possibility of a shock being experienced. It is, therefore, necessary to use a transformer which is double wound and has reasonably good insulation between the windings. On no account should the secondary winding be earthed. If such a transformer is not used it is possible for the chassis to have a voltage to earth and therefore touching it then would be dangerous. If, therefore, a double wound transformer having no connection to the earth is used the chassis may be earthed direct and the handling of the chassis is quite safe and is exactly the same as operating an ordinary A.C. set. The earth via the clip is not sufficient as the chassis is then earthed via C.A. see diagram fig. 1, page 7.
If two or more chassis are connected to the same double wound transformer, it is essential to connect the same points of the chassis together otherwise there is a possibility of voltage occurring on the chassis of one of the receivers, see fig. 2. Providing, however, both chassis are correctly earthed, the secondary side of the transformer will become short circuited if a faulty connection is made. If dealers require a transformer suitable for testing the universal type of receivers a special type of transformer can be supplied for this purpose. These transformers are supplied in two types, one to carry two or more receivers code No. 28.522.470 and one suitable to take one chassis code No. 28.522.460. Particulars can be had upon application.

Balancing the Receiver.

If any part of the tuned circuits either H.F. or I.F.—such as coils, variable condensers or trimmers of the apparatus—are changed or if the sensitivity or selectivity has been diminished in any other way it will be necessary to rebalance the receiver.

The apparatus required is as follows :—

1. A service Oscillator similar to Philips Type 4028C which covers a range of 100/1,500 K.C.
2. An output indicator.
3. A combined screw-driver and box-spanner which is insulated in the centre, Philips Code No. 09.991.050.
4. A pair of head phones.

The Method of Balancing the I.F. and Oscillator circuit is as follows :—

I. **Rebalancing the I.F. Circuits.**

1. Short circuit R8 (by earthing grid 1 of L1).
2. Connect the output meter.
3. Earth the chassis.
4. Turn the volume control to maximum. If the output is too high, reduce the volume control of the service oscillator and not the volume control of the receiver.
5. Turn the variable condenser to maximum and switch to long wave.
6. Place across each winding of S12 and S15 a resistance of 10,000 Ohms.
7. Switch on the mains supply. Place a signal of 115 K.C. via a fixed condenser of 200 u.u.F to the grid 4 of L1. This grid is connected to the top of valve FC13.
8. Trim C23 and C24 until the maximum output is obtained.
9. Disconnect the resistances from S12 and S15 and connect them across S13 and S14. Trim with C22 and C25 until a maximum output is obtained. It will be found that C22 and C23 are fitted on one common insulated plate and C24 and C25 are similarly fitted. C22 and C24 should be adjusted with a spanner and C23 and C25 with a screw-driver.

II. **Aerial Filter S3 and C36.**

If either S3 or C36 is replaced it will be necessary to retrim the aerial filter circuit. The following is the method of doing this.

1. Adjust the variable condenser to maximum with the receiver switched to long wave. R8 should be left shorted.
2. Apply a frequency of 115 K.C. to the aerial socket.
3. Adjust C36 until a minimum output is obtained on the output meter.
4. Seal the screws and nuts with sealing wax.

III. **Adjusting the oscillator for the medium wave band.**

1. Remove the short circuit from R8 and place the wave change switch to the medium wave band. Turn the variable gang condenser to maximum ; fit a resistance of 10,000 ohms in parallel with S12 and leave this connected during the whole of the measurements.
2. Adjust C15 until the vanes have an opening 1 m.m.
3. Place a signal of 225 metres to grid 4 of L1 (FC13).
4. Turn the variable condenser until two tuning positions are obtained, one will have a frequency of 1333+115 K.C.=1448 K.C.= (207 metres) and another with a frequency of 1333—115 K.C.=1218 (247 metres).
5. Make sure that the variable condenser is fitted in the same position as the frequency of 1448 K.C. (This will be the first signal

heard turning from minimum. The position of the variable condenser should remain until the operation under instruction V. is made.

IV. **Trimming the H.F. circuits on the medium wave band.**

1. Place a signal of 225 metres to the aerial socket.
2. Trim with condensers C13 and C14 until a maximum output is obtained. (Telephones can be used if the output is low).

V. **Trimming the H.F. circuits on the long wave band.**

1. Connect the grid 1 of L1 to the chassis.
2. Switch the receiver to long wave ; place a signal of 900 metres to the aerial socket. Since R8 is short circuited the oscillator circuit will not function and therefore no intermediate frequency amplification will occur. The intermediate frequency amplification will not pass the wave length of 900 metres, therefore it will be necessary to connect a small condenser of approximately 25 u.u.F between the anode of L1 and the aerial socket of a second receiver which is accurately tuned to 900 metres. The band pass circuit can now be trimmed with the aid of this second receiver which should have the output meter temporarily connected to it.
3. Adjust the receiver under test until the maximum output is obtained and the two H.F. circuits will now be tuned to 900 metres.
4. Make sure that the variable condenser is kept in the same position and disconnect the second receiver.

VI. **Trimming the Oscillator on long wave.**

1. Remove the short circuit of R8 and connect the output meter to the receiver under test.
2. Trim with C16 until a maximum output is obtained.
3. Seal all nuts and screws with sealing wax.

VII. **Adjusting the scale.**

1. Pass a signal of 350 metres to the aerial socket.
2. Tune in the receiver.
3. If necessary release the scale and adjust it to its correct position. The scale should be adjusted approximately 1½ per cent. per metre on the short wave and 3 per cent. per metre on the long wave.

HOW TO TRACE FAULTS.

General Remarks.

1. The following data is as complete as possible, but some of the cases may never occur in practice.
2. This list cannot be complete, as there may be compound faults.
3. In general it may be said the majority of faults are due to short circuits in the bare wires or to open or short circuits in one of the component parts ; these will be indicated as R..... or C..... shorted or open circuit as the case may be.
4. Always carry out, first of all, test measurements so as to find the cause of the fault.

The method of procedure is as follows :—

I. Carefully check all contacts connected to the removable back, the fuse, the mains switch, all the filaments of the valves, together with the barreter.

II. If the pilot lamp is in order but no output can be obtained test the receiver with a known good set of valves. Should it be found that there is still no output then the receiver should be tried on the gramophone side of the instrument and if results are obtained see under V. Should no results be obtained then it is desirable to measure the voltage across C3 and check the receiver according to paragraphs III and IV.

III. **The voltage is abnormal across C3.**

1. C1, C2, C3, or C30 short circuited.
2. (R18), R1, (R19), (R20), S2 open circuited.
3. L6 (CY1) has a defect.
4. Open circuit in voltage change over plate or disc.
5. Short circuit in one of the screen leads.
6. C4 short circuited. (In this case the voltage across C3 will be very low and R2 will be overheated).

IV. **Voltage normal across C3 but no gramophone reproduction.**

A. **L4 has abnormal voltage and current.**

1. R13, R5, R2 or R12 open circuited.
2. C7, or C27 short circuited.

B. **L5, has abnormal voltage and current.**

1. S16, R6, R22, R14, R15, R21, R1 open circuited.
2. C30, C28, C29 short circuited.
3. Short circuit of R21 to the screen.

C. **L4 and L5 have normal voltage and currents.**

1. C32, C33, R11, C27, C29, S17, S18 open circuited.
2. S28 short circuited.
3. Short circuit in screening cable between R10, R11, C27.
4. Open circuit in either the loudspeaker output transformer or speech coil winding.

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

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

1. S14, R4, S12, R9, R10 open circuited.
2. The valve cap of L2 shorting.

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

1. S12, R3, S10, (S11), R8, S6, (S7), R7, R9, R10 open circuited.
2. C5, C12, C15, C20 short circuited.

C. **The measurements of voltages and currents are found to be normal but no reproduction when a modulated signal of 115 K.C. is passed to the grid 4 of L1 and grid 1 is earthed or when signal is passed to grid of L2.**

1. I.F. circuits are out of balance.
2. C22, C23, C24, C25 or C26 short circuited.
3. C22, C23, C24, C25 or S15 open circuited.
4. Defective contact in valve L3.

D. **Reproduction from radiogram but no output with signal of 225 metres on grid 4 of L1.**

The earth connection to grid 1 if connected should be removed and the gang condenser turned. Should the oscillator section be out of order the following defect may have occurred.

1. C12, C15, C20 (C19, C16) S8, (S9) open circuited.
2. C16, C19 short circuited.

It is also possible for the oscillator to be functioning on an incorrect frequency. To make sure if the correct frequency is being obtained a test can be made as follows :— Connect a condenser of approximately 1,000 u.u.F from grid 1 of valve L1 (FC13) to earth. A rise of current will be measured on grid 2 if L1 is oscillating.

E. **In order to make sure that the oscillator is operating correctly a test can be made as follows :—**

Connect the anode of L1 (FC13) via a condenser of 100 u.u.F to the aerial socket of a second receiver which is tuned, say, to 300 metres (1,000 K.C.).

Tune the receiver on test until the oscillator is heard in the speaker at maximum strength. If the receiver (which is to be tested) is tuned to say 340 metres (883 K.C.) the oscillator will have a frequency of 883+115=998 K.C. This figure is near to 1,000 K.C., therefore the oscillator can be said to be normal and the small differences can easily be adjusted by trimming. Should, however, the dial read 320 metres (940 K.C.) it is certain that there is a defect and this would be caused by C15 having become open circuited. It is very unlikely to have a faulty scale reading (940+115—1,000=55 K.C.). It is desirable to make these tests at midway on the scale, say, 350 metres.

F. **Oscillator frequency is in order but no reception is obtained from the aerial socket.**

1. C36, C38, C9, C11, C13, C14, C17, C18 open circuited.
2. R23, S19 short circuited.
3. C13, C14 out of balance or the gang condenser has become out of track.
4. C17, C18 short circuited.

V. **Reception on one wave band only.**

In addition to defective wave change switch this defect can also be due to an open circuit S5, C17, S7, C16, S9, C19, S11 or a short circuit in C17 or C16.

VII. **Gramophone reproduction obtained but reception not up to standard quality.**

A. **The Receiver hums.**

1. S19 open circuited.
2. C1, C2, C3 open circuited.
3. One of the LF decoupling condensers open circuited.
4. A loose earth connection.
5. One of the screen leads has become open circuited from its earth connection.

B. **Weak reproduction.**

1. The voltage and currents are not correct.
2. The receiver is out of balance.
3. C9, C29, C27 open circuited (very weak).
4. A defect in the loudspeaker or output transformer. (This defect would also probably cause distorted reproduction).

C. **Distortion.**

1. C7, C8 short circuited.
2. R12, R14, open circuited.
3. A defect in the loudspeaker or output transformer.

D. **Receiver crackles.**

1. Defective contact in the aerial or earth connection.
2. Defect in one of the switches, valve holders or variable resistances or one of the soldered joints.
3. An intermittent short circuit in one of the bare wires.

4. A defective contact in the voltage change over tapping plate.
5. One of the component parts may be intermittently touching the bottom of the cabinet.

E. **Receiver oscillates or " motor-boats."**

1. C4, C5, C21 open circuited.
2. R9 open circuited.
3. The metallized coating of one of the valves is not connected to the cathode.

Note.—Motor-boating can also be caused by R23 which is across the aerial and earth, being open circuited if a lightning arrester is in use.

F. **Cabinet resonances.** A defect of this nature may be due to loose parts such as valve screen caps, leads or screws. The vibrating part should be fixed by means of a piece of felt etc.

REMOVAL AND CHANGING OF PARTS.

1. Removing the chassis.

The method of removing the chassis should preferably be done in the following way.

1. Remove the rear panel.
2. Take out the valves.
3. Unsolder the flexible leads to the output transformer.
4. Remove the control knobs by disconnecting the grub screw.
5. Take out the four base screws on the underside of the cabinet.
6. Remove the chassis.

2. Important points to be noted when repairing.

1. The apparatus is constructed as a precision instrument and should be treated as such.
2. It is preferable to use a support so that no damage is done to the coil boxes.
3. Do not make any alteration in the wiring or in the position of the screening plates.
4. Refix all earth connections to their original points.
5. Do not place any insulating fabric round the bare wiring of the circuits and make sure that these wires do not touch the insulating fabric of other conductors.
6. If necessary make a sketch of the wiring or mark the wires with coloured sealing-wax.
7. See that all bare wires are kept clear of each other.
8. Replace spring washers, insulating material etc., in their original places after repair and if necessary rivets may be replaced by screws and nuts, for instance, when replacing valve holders, etc.
9. All moving parts may be greased with a little pure vaseline.
10. As far as possible and if necessary give the contacts a mechanical tension.
11. Solder as quickly as possible so as to avoid parts from becoming overheated.

We give below additional details with regard to the method of dealing with repairs which are likely to involve difficulty.

Electrolytic condensers C1, C2 C3.

When changing these condensers a spanner of the type shown in figure 3. (Code No. 09.990.760) can be used. It will be found that in order to reach the large nuts of the electrolytic condenser some of the component parts may require temporary removal.

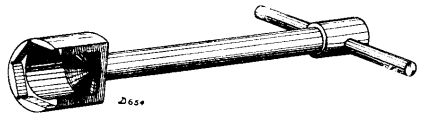


Fig. 3

Electrolytic condensers C7 and C8.

As previously mentioned, it is important to note that when one of these condensers is replaced the end which is marked red and therefore positive should be carefully observed so that it is replaced correctly.

Driving mechanism.

After the connections of R17 have been unsoldered the two bolts on the front and the nut securing the strut on the back of the chassis can be unscrewed. It will then be found that the driving mechanism is now quite free and can be taken from the chassis. Therefore the changing of the parts can now be easily affected. It must, however, be pointed out that the double cogs should have a fair tension between them. In order to obtain good friction one should proceed as follows :—

1. Remove the screws which hold the dial and pointer to the variable condenser.
2. Turn the half-single cog wheel until it is disconnected from the double cogs.
3. Give the double cogs the necessary tension. The pointer should be in the middle of the blank part of the celluloid dial.
4. Turn the cog until it grips into the teeth of the two cogs.
5. Tighten the fixing screw temporarily.
6. Tune to a known station at about 350 metres.
7. Make sure that the variable condensers are not moved ; loosen the fixing screw and turn the celluloid dial until the correct reading is obtained.
8. Tighten the fixing screw and cover it with sealing wax.

Three-gang variable condensers.

Unsolder the connection and uncouple the driving mechanism ; release the small fixing plate at the back of the condenser. Further, remove the bolts which hold the condenser to the chassis ; the condenser can now be taken out from the rear and changed.

Mains Switch.

Release the two screws on both ends of the top metal strip and also the grub screws on the spindle. The spindle can now be turned until the connection strip can be removed. If the quick-break is defective the spring and spring holders can be replaced after the small plate with stators and rotors with the wiring has been turned. Make sure that the catch arm is engaging before final assembly.

Voltage changing tapping plate.

If the disc type of assembly is fitted, loosen the screw in the centre of the insulated disc until the complete disc can be turned and the voltage required is shown under the arrow at the top. After adjustment tighten the fixing screw carefully.

In some receivers the tapping plate consists of a flat plate with link connections. These links can be adjusted according to the paper indicating disc on the inside of the back of the receiver. It is essential to alter this disc after changing the links to a different voltage.

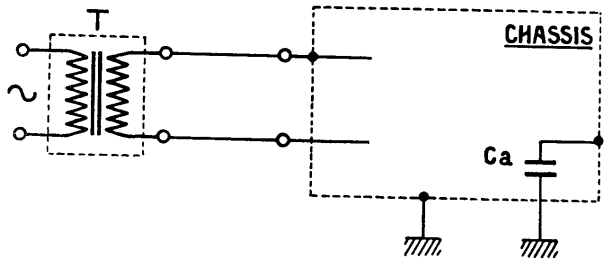


Fig. 1.

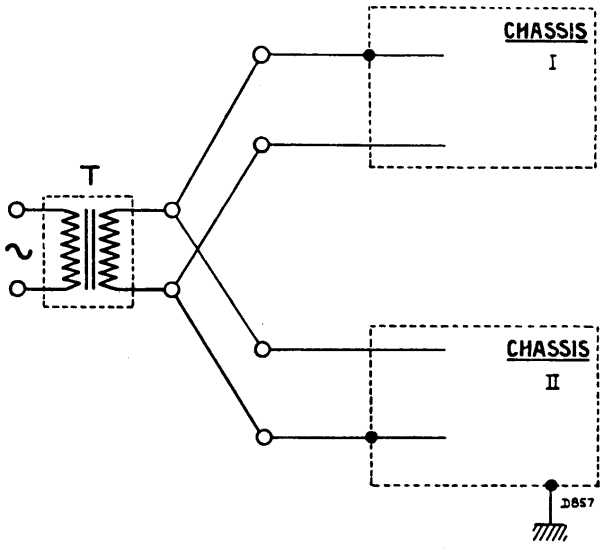


Fig. 2.

REMOVING AND REPAIRING THE LOUDSPEAKER.

Method of removal.

The loudspeaker can be removed by merely loosening the three eccentric clamps and unsoldering the leads to the transformer.

Important points to be considered when repairing.

1. See that the repair is carried out with good tools on a table or bench (not an iron one) free from dust or filings.
2. Under no circumstances may the front and back plates (fig. 4 item 107 and 109) be removed from the magnet as this would impair its magnetism (as would also be the case when working on an iron bench).
3. Replace the cover of the loudspeaker immediately after the repair has been carried out.

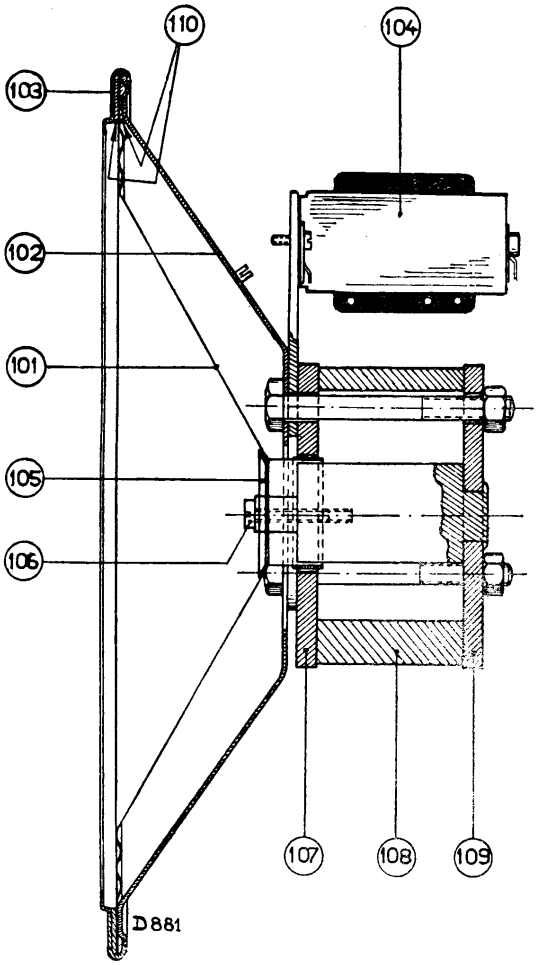


Fig. 4.

Centring the cone.

Loosen the centring screw (item 106) place 4 distance-pieces of 0.2 mm. thickness through the perforations of the spider (item 105) into the air-gap. Refix the centring screw and withdraw the distance pieces. No sound should now be heard when the cone is carefully moved up and down (fig. 5).

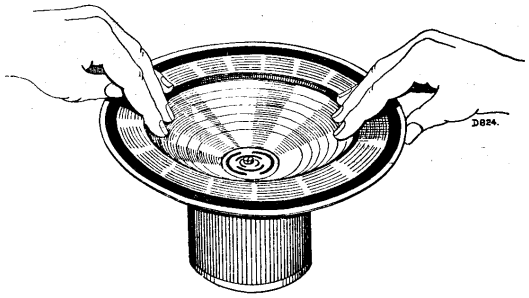


Fig. 5.

Changing the cone.

Unsolder the connections from the transformer (item 104) cut through the clamping ring (item 103) and loosen the centring screw (item 106). The air-gap, when dirty, should be cleaned with a piece of strong material, namely Brass, Pertinax, etc., wrapped in wadding that has been moistened with alcohol. Any iron particles should be removed from the air-gap by means of a steel plate-spring. The new cone is to be centred as indicated above and fixed with a special service clamping ring (Code No. 28.445.820). Commence by bending the tags at 4 points positioned at angles of 90° from each other; the distance pieces are not to be taken from the air-gap until all the tags have been bent. The flexible leads of the transformer should be of the correct length (if they are fitted too taut they will impede movement; if they are too slack they will touch the cone and cause rustling).

Changing the cone holder.

A gauge is required of the type shown in figure 6 (code No. 09.991.020). Remove the cone and place the gauge in the air-gap. Now mark out the internal

Fig. 6.

circumference of the cone-holder as well as possible on the front plate (item 107) unscrew the nuts of the 3 bolts and stand the loudspeaker on the back plate (bearing in mind paragraph 2, page 8). When mounting, do not withdraw the gauge from the air-gap until the 3 draw-bolts have been securely tightened. A gauge will also be required if the cone is no longer accurately centred in the aperture of the front plate.

Faults.

Before commencing a repair, try a different loud-speaker and transformer in order to make sure the fault is not to be found in the receiver.

No sound.

There is an open or short circuit in the speech coil or output transformer. Measure up with an ohm-meter ; the resistances are stated on the folder at the back of the manual.

Sound weak or distorted.

The coil may have become jammed in the air-gap (shown in fig. 4) or there is a partial short circuit in the windings of the speech coil or transformer.

Rustling or resonance.

This fault may be caused by loose particles (possibly also from the cabinet) or by some hindrance in the movement of the cone, e.g., connections too taut or too slack, dirt in air-gap or distortion of the speech coil. The glued joint may also be loose in one part or the cone may be torn.

LIST OF SPARE PARTS, TOOLS, GAUGES, etc.

When ordering any of these items please state:

1. Code number.
2. Type and Serial number of receiver.
3. Description.

N.B.—Item numbers are indicated in cases where errors may otherwise occur.

Fig.	Item.	Description.	Code No.
		CABINET.	
		Cabinet with 3 indicating strips	25.867.140
		Indicating strips (separate)	25.013.710
		Escutcheon (colour 026)	23.999.052
		Escutcheon with trade mark	25.866.560
		Window	25.293.120
		Circular knob diameter 30 mm. (Colour 026)	23.950.011
		Circular knob diameter 25 mm. (Colour 026)	23.950.190
		Octagonal knob (Colour 026)	23.950.373
		Rear panel	28.395.062
8	2	Spring for fixing rear panel	25.673.860
8	3	Spring for top of panel	28.750.040
		Mains socket for rear panel	25.742.000
		Cardboard disc showing voltage ranges	28.695.920
		Rubber chassis suspension distance piece	25.655.820
		Earthing Spring	28.672.720
		Trade mark disc	25.488.613
		CHASSIS (Top).	
		Voltage changing plate (round)	25.867.130
9	6	Voltage changing plate (rectangular)	25.867.120
		Interconnecting strip on voltage changing plate	25.258.230
8	1	Mains two pin plate	28.864.550
		Valve holder with five contacts (small)	25.160.240
		Valve holder with eight contacts (large)	25.161.921
		Holder for pilot lamp	25.160.450
		Coil S4, S5	28.561.022
		Coil S6, S7	28.561.032
		Coil S8, S9, S10, S11	28.561.043
		Socket plate (aerial and earth)	28.864.600
		Socket plate (gramophone pick-up and loudspeaker)	28.864.590
		Valve cap	28.852.050
		Small cap for L1	28.906.021
		Coils S3, S19	28.561.271
		Scale plate with spindle and double cogged wheel	25.867.040
		Friction coupling	25.747.171
		Spindle for friction coupling	25.516.813
		Clamping ring for driving gear	07.891.011
9	11	Semi-circular cog wheel	28.890.020
		Link coupling arm for wave change switch	28.822.121
9	8	Roller for link coupling	28.943.000
		Spindle for volume control	28.000.130
		Spindle for R17	28.000.160
8	4	Fuse Z1, Z2	08.100.950
		Scale pointer	25.973.236
		Loose insulated plate for volume control	28.475.590
		Choke S2	28.545.190

LIST OF SPARE PARTS, TOOLS, GAUGES, ETC.—continued.

Fig.	Item.	Description.	Code No.
		CHASSIS (Underside).	
		I.F. coils S12, S13	28.561.221
		I.F. coils S14, S15	28.561.201
		Nut for Electrolytic condenser	07.095.000
		Unit complete with stators and rotors for mains switch	08.527.980
9	7	Link arm for mains switch	28.852.000
		Wave change switch complete	08.528.210
9	10	Catch plate for " star " click plate	25.668.710
		LOUDSPEAKER.	
		Loudspeaker complete	28.951.090
4	101	Cone with coil	25.152.421
4	102	Protecting cap (cone-holder)	28.250.430
4	103	Clamping ring	28.445.820
4	104	Output transformer	28.519.201
		Paper ring with same diameter as cone	28.445.390
		Clamp for securing loudspeaker to cabinet	25.012.210
		TOOLS, GAUGES, etc.	
		Centring gauge for air gap	09.991.000
		Pertinax distance pieces for centring cone and coil	09.990.840
		Box spanner for electrolytic condenser	09.990.760
		Combined screwdriver and spanner	09.991.050
		Small Key spanner	09.991.070
		Service Oscillator	00.040.280C
		Screened cable (separate)	25.980.450
		Artificial aerial	25.730.840

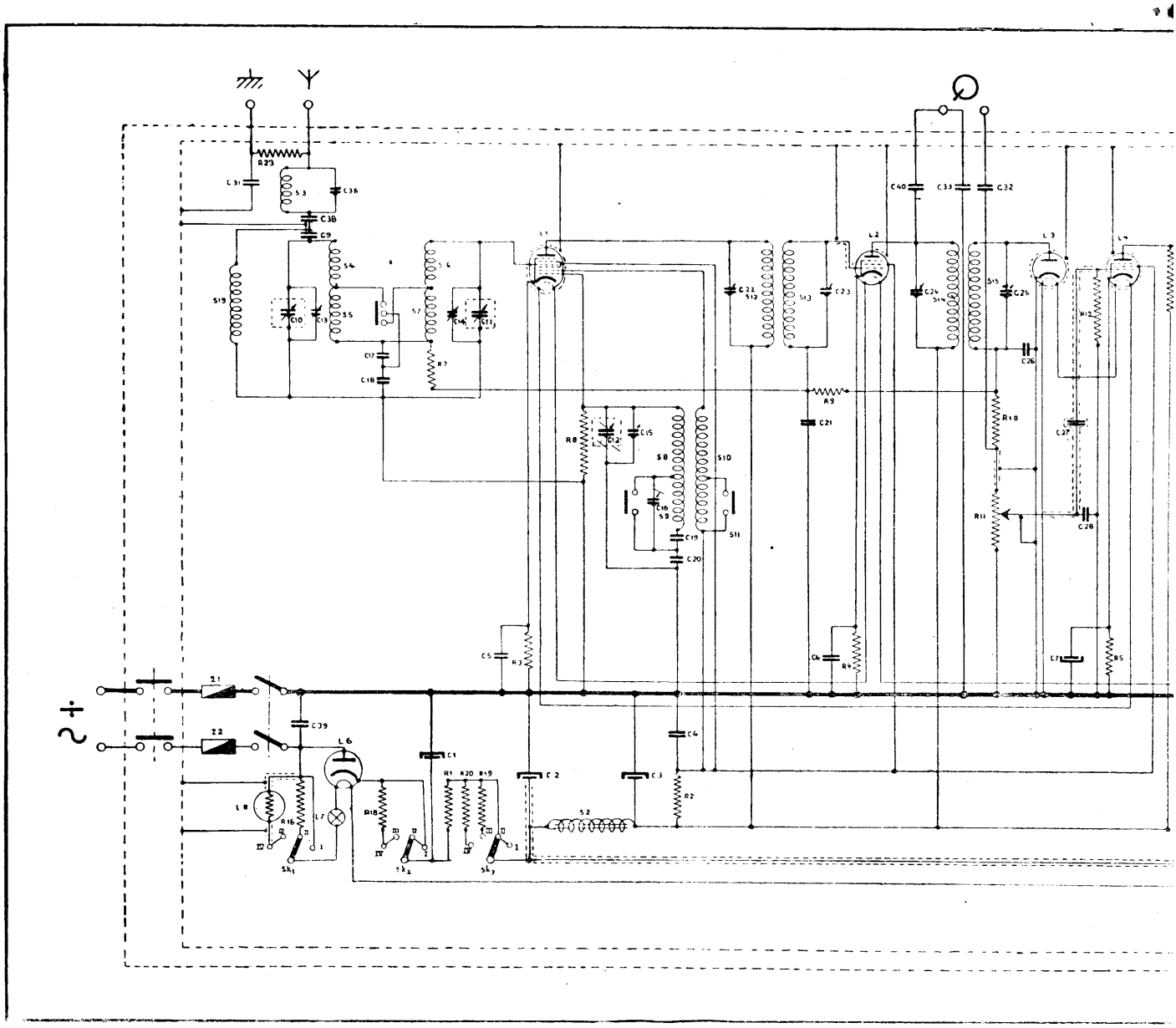


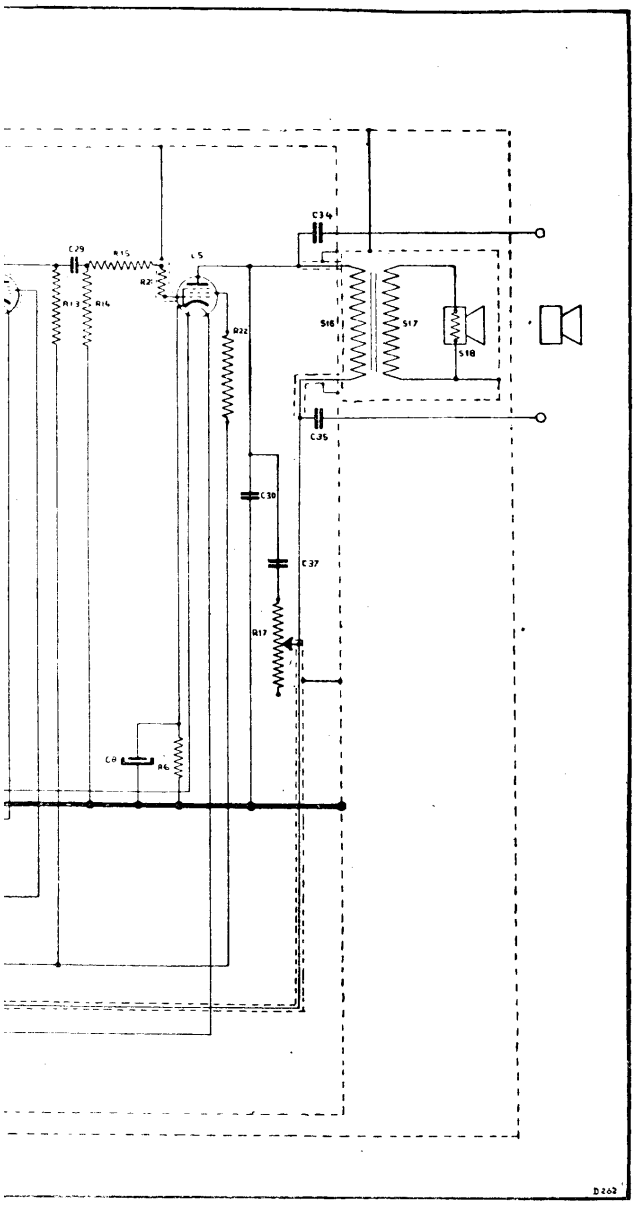
Fig. 7

VOLTAGES AND CURRENTS

	L1 (FC13)	L2 (VP13A)	L4 (SP13)	L5 (Pen 26)	
Va	115	115	32.5	105	Volts.
Vg′	60 grid 2–3–5	60	60	104	Volts.
–Vg	1.5	1.45	2.25	13.0	Volts.
Ia	0.6	1.60	0.43	45.0	mA.
Ig′	Ig 2=1.52 Ig3=Ig5=3.27	0.6	0.19	7.4	mA.

OHMIC RESISTANCE OF COILS.

Coil	Resistance (Ohms.)	Coil	Resistance (Ohms).
S4 ; S5	3.9 ; 36.8	S16	126–154
S6 ; S7	3.9 ; 36.8	S17	1.0–1.2
S8 ; S9 ; S10 ; S11	9.75 ; 27.5 ; 4.1 ; 10.7	S18	4.35–5.3
S12 ; S13	135 ; 135	S2	410–500
S14 ; S15	135 ; 135	S3	127.
		Mains filter	2.0 ; 2.0



The voltages were measured with volt-meters taking practically no current. Low values will, of course, be arrived at when measuring with moving-coil volt-meters when resistances are in circuit. The result will then depend upon the internal consumption of the meter. In some cases the currents and voltages may deviate from the above values, without necessarily indicating an error as these figures are mean values on a large number of receivers.

RESISTANCES.		
Designation	Resistances.	Code No.
R1	160 Ohm	28.770.820
R2	10000 Ohm	28.771.000
R3	250 Ohm	28.770.190
R4	640 Ohm or	28.770.230 or
	5000 Ohm	28.770.320
R5	4000 Ohm	28.770.310
R6	1000 Ohm	28.770.870
R7	10000 Ohm	28.770.350
R8	50000 Ohm	28.770.420
R9	1 M. Ohm	28.770.550
R10	50000 Ohm	28.770.420
R11	0.5 M. Ohm	28.808.610
R12	1.0 M. Ohm	28.770.550
R13	0.2 M. Ohm	28.770.480
R14	0.5 M. Ohm	28.770.520
R15	0.1 M. Ohm	28.770.450
R16	60 Ohm	28.796.840
R17	65000 Ohm	28.808.520
R18	250 Ohm	28.796.810
R19	1000 Ohm	28.796.850
R20	1250 Ohm	28.796.860
R21	1000 Ohm	28.495.540
R22	100 Ohm	28.770.150
R23	0.1 M. Ohm	28.770.480
CONDENSERS.		
C1	32 μF	28.180.010
C2	32 μF	28.180.010
C3	32 μF	28.180.010
C4	0.5 μF	28.198.270
C5	50000 $\mu\mu$F	28.198.170
C6	0.1 μF	28.198.200
C7	25 μF	28.180.020
C8	25 μF	28.180.020
C9	25 μF	28.190.070
C10	0.430 $\mu\mu$F	28.210.140
C11	0.430 $\mu\mu$F	
C12	0.430 $\mu\mu$F	
C13	7.55 $\mu\mu$F	28.210.230
C14	7.55 $\mu\mu$F	28.210.230
C15	7.55 $\mu\mu$F	28.210.250
C16	7.55 $\mu\mu$F	
C17	25000 $\mu\mu$F	28.198.400
C18	25000 $\mu\mu$F	28.198.400
C19	930 $\mu\mu$F	28.190.291
C20	1810 $\mu\mu$F	28.190.302
C21	0.1 μF	28.198.200
C22	25–145 $\mu\mu$F	28.210.260
C23	25–145 $\mu\mu$F	
C24	25–145 $\mu\mu$F	28.210.530
C25	25–145 $\mu\mu$F	
C26	100 $\mu\mu$F	28.190.130
C27	10000 $\mu\mu$F	28.198.100
C28	200 $\mu\mu$F	28.190.160
C29	10000 $\mu\mu$F	28.198.100
C30	2000 $\mu\mu$F	28.198.570
C31	0.1 μF	28.198.070
C32	0.1 μF	28.198.200
C33	50000 $\mu\mu$F	28.198.170
C34	0.2 μF	28.198.230
C35	0.2 μF	28.198.230
C36	25–145 $\mu\mu$F	28.210.520
C37	32000 $\mu\mu$F	28.198.200
C38	1000 $\mu\mu$F	28.198.590
C39	0.1 μF	28.198.200
C40	10000 $\mu\mu$F	28.198.100

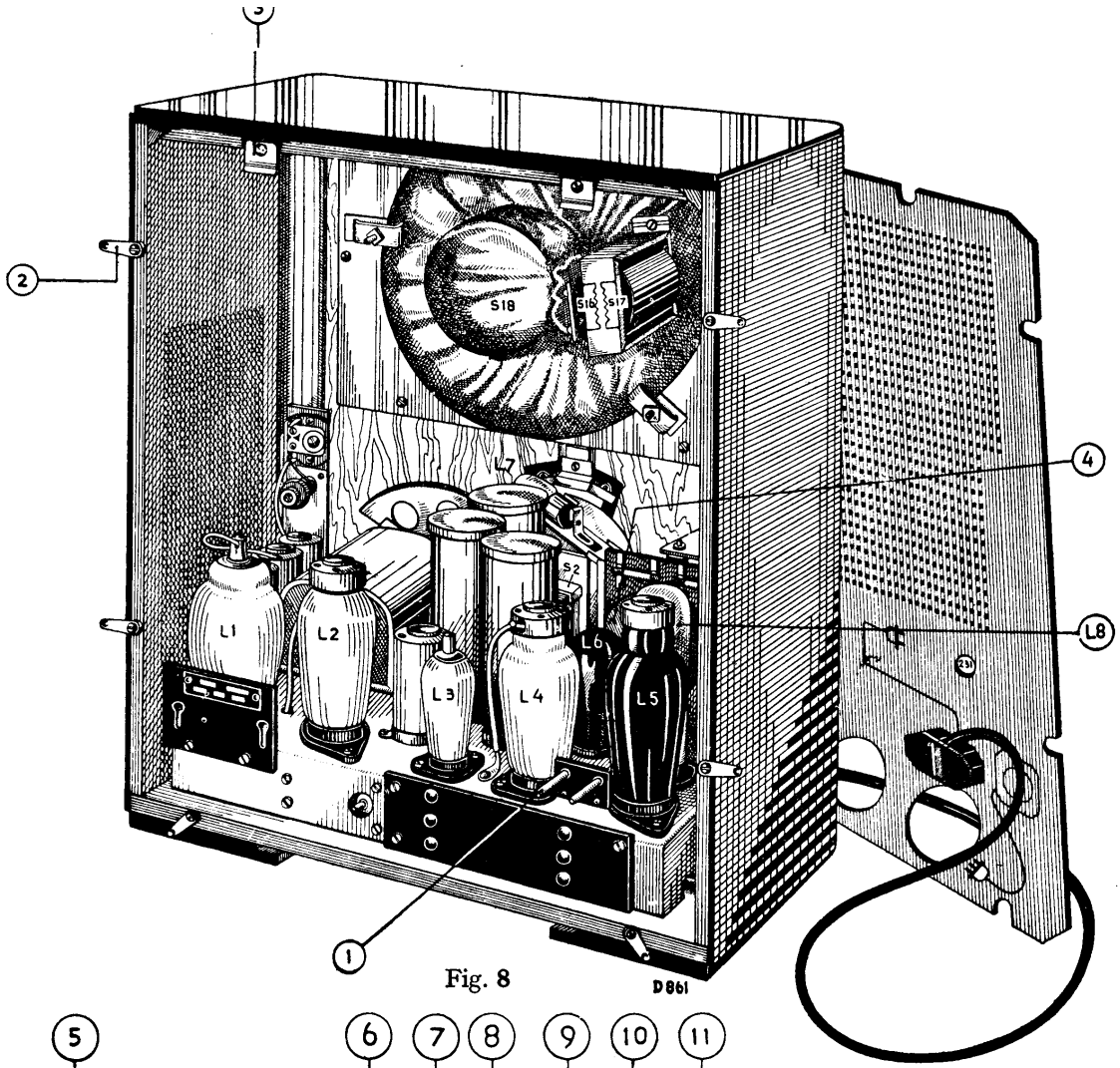

S18
S16
S17
L7
S2
L1
L2
L3
L4
L6
L5
1
2
4
L8
D861

Fig. 8

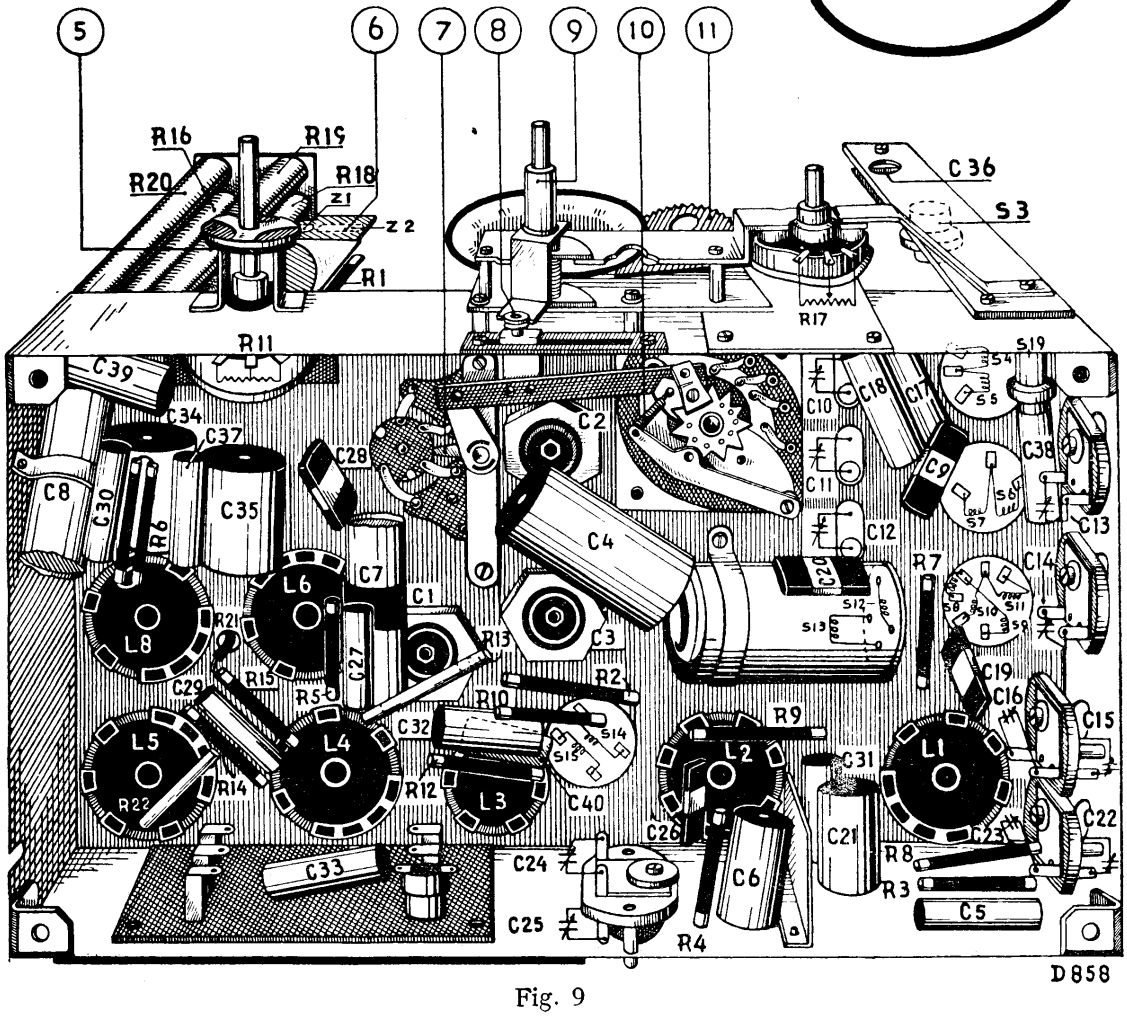

5
6
7
8
9
10
11
R16
R19
R20
R18
Z1
Z2
R1
R11
C39
C34
C37
C28
C8
C30
R6
C35
L6
C7
C1
L8
R21
R15
C27
C29
R5
L5
L4
R14
R22
C32
R12
L3
C33
C2
C4
C3
R13
R2
R10
S14
S15
C40
C24
C25
C26
C6
R4
R9
L2
C31
C21
L1
C23
R8
R3
C5
C22
C15
C16
C19
R7
C14
C13
C38
S6
S7
S5
S4
S19
C18
C17
C10
C11
C12
C20
S12
S13
S10
S11
C9
C36
S3
R17
D858

Fig. 9