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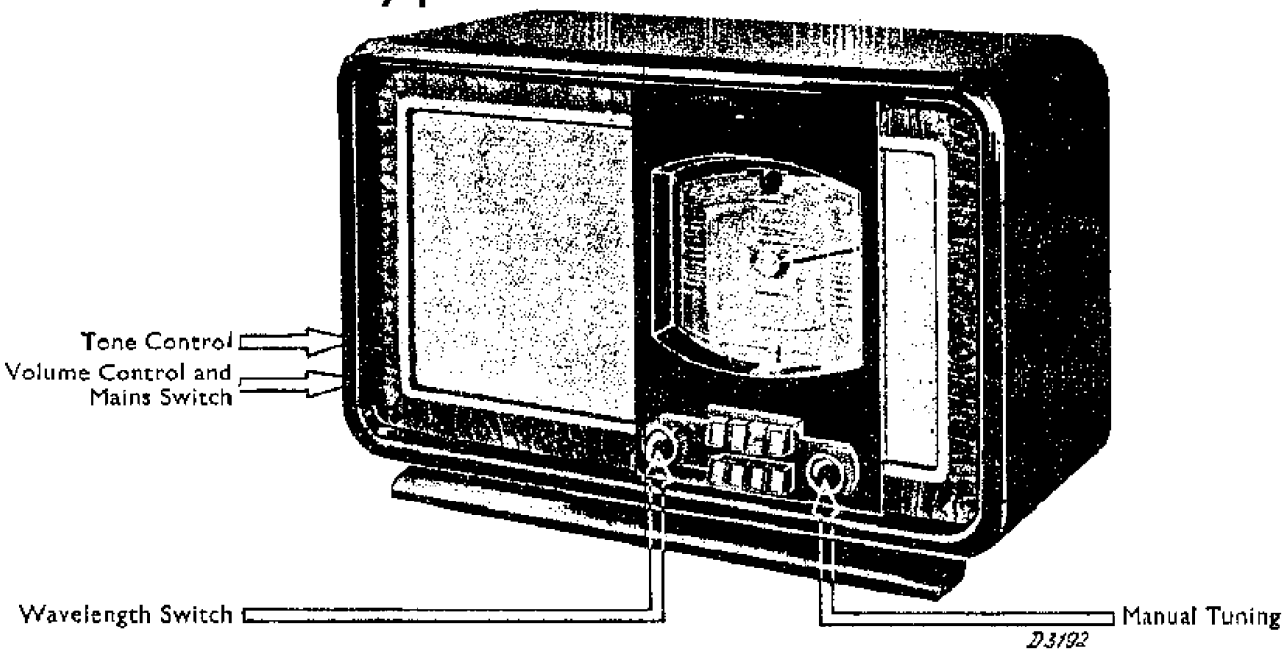
PHILIPS

SERVICE MANUAL

FOR RECEIVERS

Types 660 A and 660 U



The A receiver is suitable for use on alternating current and the U type on direct current.

GENERAL DATA.

This superheterodyne receiver is equipped with :—

Seven tuned circuits.

Delayed automatic volume control.

Visual tuning by means of electron indicator.

Noiseless R.F. Pentode.

Continuously variable tone filter.

Quality correction by means of feed-back.

Push-button tuning (eight buttons) which can be pre-set to any required station on the M.W. or L.W.

Manual tuning with vernier adjustment.

Permanent dynamic loudspeaker with anti-directional cone.

Connection for gramophone pick-up.

Connection for low impedance loudspeaker.

Safety contact, ensuring that the receiver is not connected to the mains supply when the back-plate is removed.

Tapping plate for voltages of 110 to 245 v., with automatic indicator on the receiver backplate.

Controls.

On front panel—left : waveband switch.
right : manual tuning.

Left-hand side—front : volume control and mains switch.
back : tone control.

At back of receiver : pick-up switch.

Wave Ranges :—
S.W. : 16.7—51 metres (17.96—5.88 M.C.)
M.W. : 186—585 metres (1,615—513 K.C.)
L.W. : 708—2,000 metres (424—150 K.C.)

Weight : 13.6 kg.

Dimensions : height, 37 cm. ; width, 59 cm., including knobs ; depth, 25 cm., including knobs.

DESCRIPTION OF CIRCUIT.

The incoming signal passes through a tuned circuit to the control grid of the R.F. amplifier valve L1 (EF8), and is then taken via a second tuned circuit to the control grid of the octode L2 (EK2). In conjunction with the oscillator voltage developed by the octode, the R.F. signal produces an I.F.

signal which is applied across the 1st I.F. transformer to the control grid of L3 (EF9). The amplified I.F. signal passes by way of the 2nd I.F. transformer to one of the anodes of the diode L4 (EBL1) for detection. The resultant A.F. voltage across the volume control R22-R64 is applied to the control grid of L4 for amplification and thence via the output transformer to the speaker.

A. The R.F. Section.

I. L.W. Range—
Aerial coil: S10, C17.
Input circuit of L1: S11, C8, C3. S10 and S11 are coupled inductively.
Anode circuit of L1: S16, C45.
Input circuit of L2: S17, C11, C4. S16 and S17 are inductively coupled.
Oscillator circuit of L2: S22, C48, C16, C14, C5.
Reaction coil for L2: S23 with damping resistance R35. S22 and S23 are coupled inductively.

II. M.W. Range—
Aerial coil: S8, C17.
Input circuit of L1: S9, C7, C3. S8 and S9 are coupled inductively.
Anode circuit of L1: S14, C44.
Input circuit of L2: S15, C10, C4. S14 is coupled inductively and across C43 also capacitively with S15.
Oscillator circuit of L2: S20, C27, C15, C13, C5.
Reaction coil for L2: S21 with damping resistance R35. S20 and S21 are coupled inductively.

III. S.W. Range—
Aerial coil: S6.
Input circuit of L1: S7, C6, C3. S6 and S7 coupled inductively.
Anode circuit of L1: S12.
Input circuit of L2: S13, C9, C4. S12 and S13 are coupled inductively.
Oscillator circuit of L2: S18, C26, C12, C5.
Reaction coil for L2: S19. S18 and S19 are coupled inductively.

Note.—R6 and R34 serve to prevent parasitic oscillation of L2.

B. The I.F. Section.

1st I.F. transformer: S24, C29, S26, C30.
I.F. amplifier valve: L3 (EF9).
2nd I.F. transformer: S27, S28, C33, S29, S30, C34.

C. Detector.

The I.F. voltage at S30 is applied to the first anode of the diode L4. The detector circuit comprises the diode anode, cathode, R64, R22, R21, S30 (C36).

D. A.F. Amplifier.

The A.F. voltage across the volume control R22 is taken across C41 and R29 to the control grid of L4, amplified and passed via the output transformer S31, S32 to the loudspeaker S33. R29 prevents parasitic oscillation of L4. C47 is for the suppression of background noise and whistles. The tone control consists of C42, R32, R33.

E. A.V.C.

The I.F. voltage on the anode of L3 is taken via C35 to the second anode of diode L4, thus setting up a direct voltage across R27 which is applied via R13, R7 and R6 to the control grid of L2 and via R13, R1 to the control grid of L1. This gives a control on the negative bias and therefore also the amplification of L1 and L2. When the receiver is switched to S.W., the control grid of L2 is earthed through R6 and R7 and the amplification control confined to L1.

F. Quality Correction.

The voltage required for the A.F. feed-back is obtained from an extra secondary winding on the loudspeaker transformer (S40-S41). The voltage from S40 is passed via filter R62, R63, C71 to the volume control R22-R64 and that from S41 via R60, R61 C70 and also across C50 to the junction of R22-R64 in the volume control. This ensures that when the volume control is turned up for the reception of weak transmitters, the transformer voltage is in phase with the A.F. signal coming direct from the diode, thus producing an increase in the strength of the output. When the volume control is turned down for the reception of stronger stations, the phase of the transformer voltage is opposed to that of the A.F. diode signal and the quality is thereby improved. Filters R60, R61, C70 and R62, R63, C71 maintain the most favourable A.F. characteristic curve for all outputs.

G. Visual Tuning.

A part of the rectified direct voltage from the 1st anode of the diode L4 is taken from the potentiometer R24, R25 to the control grid of the tuning indicator L7. On an increasing signal strength at the diode the negative bias of L7 becomes larger and the anode current decreases. The potential difference across R26 is then smaller, i.e., the difference between the screen of L7 and the deflector plates which are connected to the anode are also smaller, with a correspondingly lower screening effect of the deflectors, and the size of the light bands increases. The receiver is correctly tuned when the bands of light are at their maximum.

H. Pick-up Switch.

When the receiver is adjusted for radio, the screen grid of L3 is earthed across C37 for alternating voltage.
On "gramophone" the voltage from the pick-up is applied to the control grid of L3 through S26. L3 then functions as an A.F. amplifier triode in which the screen grid acts as anode. The amplified A.F. voltage on the screen grid passes across C37 to the volume control R22, R64 for amplification by L4. Moreover, the anode circuit of L2 is broken to prevent any incoming signals from breaking through.

K. Push-button Tuning.

See G Sheets.

L. Feeding.

Mains transformer: S1, S2, S3, S4.
Rectifier valve: L5.
Smoothing filter: C1, S5, C2.
The positive voltages are taken from C2.
Note.—A portion of the positive voltage is tapped from the potentiometer R8, R9, R10. When the receiver is adjusted for S.W. reception, the resistances R14 and R15 are coupled in parallel with R8, thus reducing the voltages taken from the potentiometer.

Voltages for L1.

Va: via R37 (S16, S14, S12), decoupled by C49.
Vg3: from potentiometer R8, R9, R10, decoupled by C24.

Vg1 : voltage drop across R2, decoupled by C19. See also A.V.C.

Voltages for L2.

Va : from potentiometer R8, R9, R10, through S24, decoupled by C24. On gramophone, the anode circuit of L2 is broken.

Vg3,5 : from potentiometer R8, R9, R10, decoupled by C23.

Vg2 : from potentiometer R8, R9, R10, via S19, S21, S23 (R35), decoupled by C24.

Vg4 : voltage drop produced by the cathode current of L2 across R11 + R15, decoupled by C22. See also A.V.C.

Vg1 : voltage drop caused by the cathode current of L2 across R11 + R15, decoupled by C22.

Note.—When the receiver is switched to S.W., a current passes through the potentiometer R10, R9, R14, R15. The voltage drop produced by this current across R15 increases the negative voltages Vg1 and Vg4 for L2.

Voltages for L3.

Va : via S28, decoupled by C2.

Vg2 : from potentiometer R8, R9, R10, via R18 ; on pick-up, decoupled by C37.

Vg1 : voltage drop produced by the cathode current across R17, decoupled by C32.

Voltages for L4.

Va : through S31, decoupled by C2.

Vg2 : Decoupled by C2.

Vg1 : voltage drop due to the cathode current across R30.

Va (2nd anode) : voltage drop across R30 + R31, decoupled by C46.

Voltages for L7.

Va : via R36, decoupled by C2.

Vscreen : decoupled by C2.

Vg1 : see visual tuning.

Fig. 9a shows the difference between the U and A types of receiver. See also Service Manual for the 7880C/7881C Converter Unit.

650U.

See also Service Manual for 7880/7881C Converter Unit.

TRIMMING THE RECEIVER.

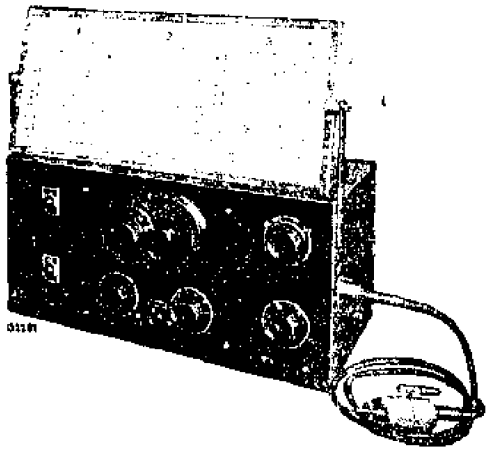


Fig. 1.

General.

It is not necessary to uncase the chassis to trim the receiver. When the bottom and backplates are removed all trimming points are accessible.

Retrimming is necessary—

1. After changing coils or condensers in the I.F. or R.F. sections.
2. When the receiver is not sufficiently sensitive or selective (see E sheets).

The following equipment is required for trimming—

1. Service oscillator, type 2880F (see Fig. 1).
2. Output indicator: universal testboard, types 4256 or 7629.
3. Aperiodic amplifier GM2404.
4. Test bridge GM4140.
5. Insulated trimming spanner.
6. Insulated trimming screwdriver.
7. Trimming transformer.
8. Tuning tester.
9. Condenser of 25 $\mu\mu$F.
10. Condenser of 80 $\mu\mu$F.
11. Condenser of 32,000 $\mu\mu$F.

Artificial Aerials.

1. For I.F.: a 32,000 $\mu\mu$F condenser.
2. For M.W. and L.W.: standard artificial aerial supplied with GM2880F.
3. For S.W.: a S.W. artificial aerial; this is the red spot on the standard artificial aerial.

Always trim the receiver with its own valves.

Before trimming is commenced, the locking wax must be removed from the trimmers with a pair of tweezers and the trimmers moved up and down a few times to remove all traces of the wax. After trimming these must again be locked with wax, e.g., by holding the wax against a warm iron so that a few drops of the wax fall on to the centre of the trimmer.

Wire-wound Trimmers.

These consist of bushes of R.F. insulating material sprayed internally with a layer of metal and covered on the outside with a winding of copper wire, the capacity being reduced as required by unwinding the wire. In trimming, the wire is unwound until the output indicator, after having reached maximum deflection, commences to drop back; turns are then replaced, the wire being clipped off and the end fixed with a little wax.

If maximum cannot be obtained by unwinding the wire, this means that the capacity is too small and a new trimmer must be fitted. Extra wire must not be added to the trimmers to increase the capacity that is too small, as it is possible that the extra turns would not be tight enough and would cause instability. If it is necessary to renew C15 or C16, one-third of C15 and one-quarter of C16 must be unwound before trimming.

The oscillator frequency is **higher** than the tuning frequency of the R.F. circuits on all wave-bands. The I.F. is 470 K.C.

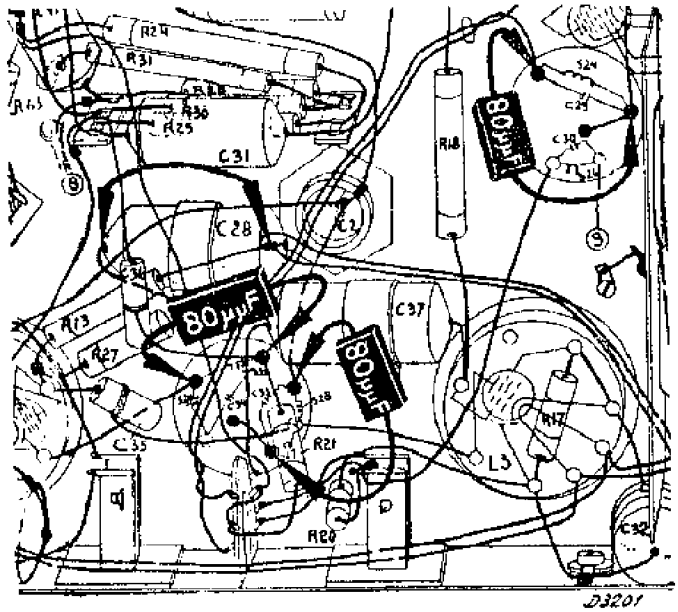


Fig. 2.

A. Aligning the I.F. Circuits.

1. Set wavelength switch to M.W. and earth the receiver. Turn variable condenser to minimum.
2. Turn volume control to maximum and cut out the A.V.C. by short-circuiting C28 (see Fig. 2).
3. Apply modulated signal of 470 K.C. to the 4th grid of L2 across 32,000 $\mu\mu$F condenser.
4. Connect output indicator across trimming transformer to the extension speaker sockets.
5. Detune the 3rd I.F. circuit with a condenser of 80 $\mu\mu$F in parallel with S27 + S28 (Fig. 2) and adjust S29, S30 in the 4th I.F. circuit (Fig. 4).
6. Detune the 4th I.F. circuit with 80 $\mu\mu$F in parallel with S30 (Fig. 2) and adjust S27, S28 in the 3rd I.F. circuit (Fig. 4).
7. Detune 1st I.F. circuit with 80 $\mu\mu$F in parallel with S24 (Fig. 2) and adjust S26 in the 2nd I.F. circuit (Fig. 4).
8. Detune 2nd I.F. circuit with 80 $\mu\mu$F between top of L3 and chassis and adjust S24 in the 1st I.F. circuit (Fig. 4).
9. Seal the coil cores, remove short-circuit from C28 and disconnect 80 $\mu\mu$F condenser.

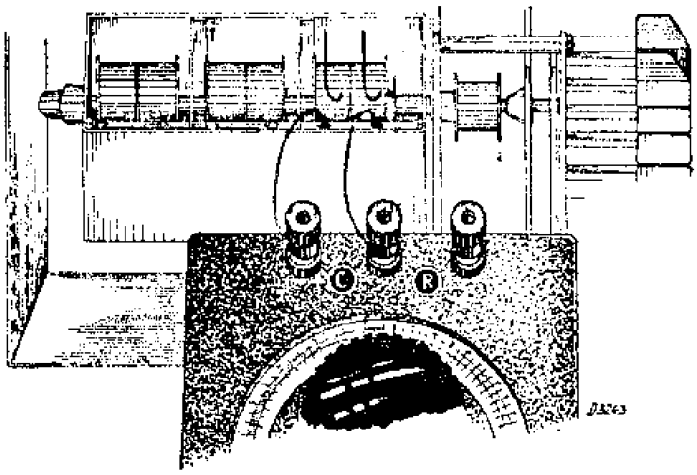


Fig. 3.

B. R.F. and Oscillator Circuits.

Before trimming is commenced on the R.F. and oscillator circuits, it is necessary to set the tuning condenser to a certain capacity by depressing one of the push-buttons, in the following manner :—

1. Unsolder the leads on C5 (see Fig. 3).
2. Connect GM4140 Capacity Resistance Tester to C5 by means of the shortest possible lead (about 3 in.)
3. Set variable condenser to minimum.
4. Depress the second push-button from the right (top) and by means of the push-button setting key (for code number see Sheet O1) **accurately** adjust C5 to 28.3 $\mu\mu$F.
5. Disconnect GM4140 and resolder the leads to C5.

Remark.—Do not disturb the setting of the push-button until the whole receiver has been retrimmed.

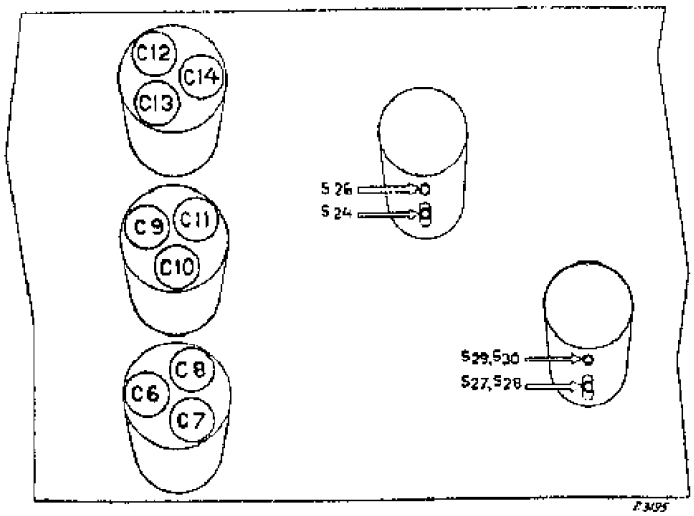


Fig. 4.

C. M.W. Range (198—585 m.).

1. Set wavelength switch to M.W. and volume control to maximum.
2. Turn variable condenser to minimum and depress the pre-set push-button.
3. Connect output indicator to the extension speaker sockets across trimming transformer.
4. Apply modulated 1420 K.C. signal to aerial socket across standard artificial aerial.
5. Trim successively C13, C10, C7 for maximum output.
6. Set receiver for manual tuning by pulling out the knob.
7. Connect auxiliary receiver to anode of L2 across 25 $\mu\mu$F condenser and output indicator to the auxiliary apparatus.
8. Short-circuit the oscillator by connecting a wire across C5 (Fig. 5).
9. Apply modulated 546 K.C. signal to the aerial socket of the receiver to be trimmed across standard artificial aerial.
10. Tune auxiliary receiver to about 550 m.
11. Tune the receiver to be trimmed.
12. Disconnect auxiliary apparatus and condenser short-circuit ; connect output indicator to receiver.

Do not disturb setting of variable condenser.

13. Trim C15 for maximum output (Fig. 5).
14. Turn variable condenser to minimum and depress the pre-set push-button.
15. Apply modulated 1420 K.C. signal to aerial socket via standard artificial aerial.
16. Retrim C13 for maximum output.
17. Set receiver for manual tuning by pulling out the knob. Lock the trimmers.

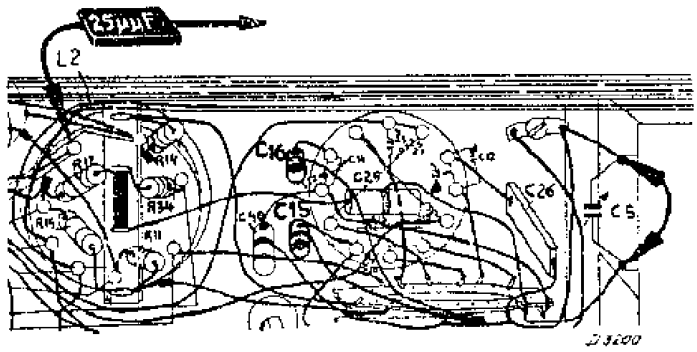


Fig. 5.

D. L.W. Range (708—2,000 m.).

1. Set variable condenser to minimum and depress the pre-set push-button.
2. Switch receiver to L.W. and turn volume control to maximum.
3. Apply modulated 390 K.C. signal to aerial socket across standard artificial aerial.
4. Successively trim C14, C11, C8 for maximum output.
5. Set receiver for manual tuning by pulling out knob.
6. Connect auxiliary receiver to anode of L2 across 25 $\mu\mu$F condenser and connect output indicator to the auxiliary apparatus.
7. Short-circuit the oscillator by connecting the wire across C5 (Fig. 5).
8. Apply modulated 160 K.C. signal to aerial socket or receiver to be trimmed across standard artificial aerial.
9. Tune both receivers to about 1,875 m.
10. Disconnect auxiliary receiver and condenser short-circuit. Connect output indicator to receiver.

Do not turn the variable condenser.

11. Trim C16 for maximum output (Fig. 5).
12. Set variable condenser to minimum and depress the pre-set button.
13. Apply modulated 390 K.C. signal to aerial socket across standard artificial aerial.
14. Retrim C14.
15. Set receiver for manual tuning by pulling out the knob. Lock the trimmers.

E. S.W. Range (16.7—51 m.).

1. Set variable condenser to minimum and depress the pre-set button.
2. Switch receiver to S.W.
3. Apply modulated 15.8 M.C. signal to aerial socket across S.W. artificial aerial (standard artificial aerial with red spot).
4. Successively trim C12, C9 and C6 for maximum output (C12 to the first peak from minimum position).
5. Set receiver for manual tuning by pulling out knob. Lock the trimmers.

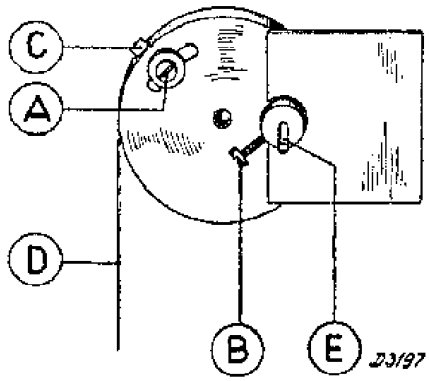


Fig. 6.

Calibration (2-point).

Before calibration of the scale is undertaken, the tuning indicator and pilot lamps must be placed outside the cabinet and the H.T. section so arranged that none of the parts which are under voltage can be touched.

1. Connect output indicator to the extension speaker terminals across the trimming transformer. Set wavelength switch to M.W.
2. Apply modulated signal of 588 K.C. (510 m.) across standard artificial aerial to the aerial socket.
3. Carefully tune the receiver by means of the manual tuning knob.
4. Loosen screw A (Fig. 6) and turn the pointer drum so that the pointer indicates exactly 510 m., holding the lug C to keep the driving cord D taut. Take care that the tuning does not alter and again tighten screw A.
5. Apply modulated signal of 1,200 K.C. (250 m.) to the aerial socket.
6. Tune the receiver.
7. If the pointer does not tally with the 250 m. mark, adjust screw A to the extent of half the amount of deviation, on the other side of the 250 m. For instance, if the pointer shows 230 m., adjust the pointer by means of screw A to 256 m.
8. Loosen screw B, turn the pointer spindle E until the pointer indicates 250 m. and tighten screw B.
9. Check the indication at 510 m. and, if necessary, repeat the above operations.

Note.—If screw A cannot be moved far enough, drum G (Fig. 8) should be turned slightly, in the following manner :—

1. Remove the knobs.
2. Loosen the bottom screws.
3. Tilt the chassis slightly to the rear.
4. Loosen the two grub screws holding the drum on the spindle.
5. Turn the drum, taking care that the spindle does not move.
6. Refix the drum.

Before proceeding with calibration of the scale, replace the chassis in its original position.

Setting the Push Buttons.

1. Remove the ornamental cap from the button concerned. This can be done easily by depressing the buttons on each side of the one to be set.
2. Tune the receiver by means of the manual knob to the required station (push-buttons out).
3. Depress the push-button required.

4a. If the tuning is exact, the set-screw A (Fig. 8) should be adjusted with the aid of a screwdriver until the tuning is slightly offset. See also paras. 5 and 6.

b. If the tuning of the receiver changes, set-screw A (Fig. 8) is slackened off until the required station is again audible.

5. Move the pointer to the extreme left (keyboard tuning) by turning the manual control knob.
6. Adjust set-screw A so that the receiver is tuned exactly to the desired station.

FAULT FINDING.

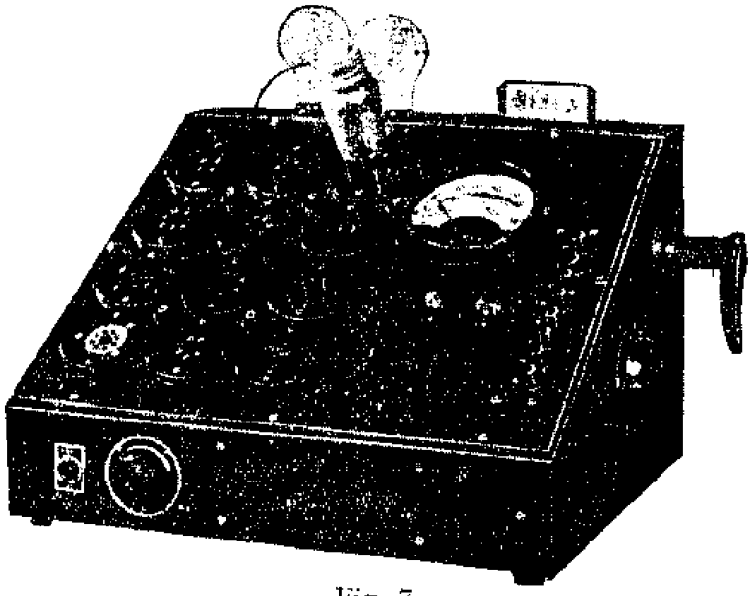


Fig. 7.

A good measuring instrument is essential for efficient fault finding, and use should, therefore, be made of universal testboard type 4256 or 7629. In order to localise faults, it is advisable to remove the bottom plate of the cabinet when all components will be accessible.
No connections must be unsoldered before the fault has been localised by measurements.
These instructions are not comprehensive, seeing that any combination of faults may occur.

I. Connect receiver to the correct voltage and test with its own valves on outside aerial or service oscillator.
   (a) If the receiver works normally, leave it working under observation.
   (b) If the receiver works badly or not at all, see below.

II. Replace the valves by a set taken from a good receiver and, if necessary, try out with another speaker.
Faults in valves or speaker are thus eliminated or localised.

III. Test for Gramophone Reproduction.
   (a) If reproduction is possible the fault will be found in the I.F. or R.F. section (see Para. IV. C).
   (b) If no reproduction obtained, the fault is to be found in the A.F. or feed section (see Para. IV. A and B).

IV. A. Abnormal voltage across C2 (normal = 275 v.).
   1. Mains tapping plate wrongly set.
   2. Mains switch and safety contact defective.
   3. S5 open.
   4. C1, C2, C62 short.
   5. S1, S2, S3, S5 defective.
   6. C24, C49 defective.
   7. Shorting speaker transformer.
   8. S24, S27, S28 shorting to earth.

B. Voltage across C2 normal (275 v.) but no gramophone reproduction.
Check position of switch on backplate.

(a) L4 giving abnormal currents and voltages. Normal: Va = 235 v., Vg2 = 260 v., Vcath = 14.5 v., Ia = 34 ma., Ig2 = 5.5 ma., —Vg1 = 6.7 v.
   1. No anode current: S31, R31, R30 open.
   2. Anode current too high: C41, C46, short.
   3. R29, R28 open.

(b) L3 giving abnormal currents and voltages. Normal: Va = 260 v. approx., Vg2 = 90 v., —Vg1 = 1.8 v., Ia = 6.3 ma., Ig2 = 2 ma.
   1. No screen grid current: R10, R18, R17 open; C24 short.
   2. Screen current too high: C32 short.
   3. R20, S26 open.

(c) L3 and L4 giving normal currents and voltages but no gram. reproduction.
   1. C37, C41, R22, R64, R29, S32 open; C47 short.

C. Reproduction but no radio reception.

Note.—Do not forget to inspect the switch contacts in respect of each component.

(a) L3 giving abnormal currents and voltages. Normal: Va = 260 v., Vg2 = 90 v., Vcath = 1.8 v., Ia = 6.3 ma., Ig2 = 2 ma.
   1. No anode current: S28, R17 open.
   2. Anode current too high: C32 short.
   3. R8, R9, R10, R18, S26 open; C24, C35, C37 short.

(b) L2 giving abnormal currents and voltages. Normal: Va = 190 v., Vg3,5 = 90 v., Vg2 = 180 v., Vcath = 4.4 v., Ia = 2.2 ma., Ig3,5 = 1.3 ma., Ig2 = 3.5 ma.
   1. No anode current: S34, R10, R15, R11 open, C24 short:
   2. R8, R9, R10, R14, R35, R6, R7, R13, R27, R12, R34 open.
   3. S19, S21, S23 open.
   4. C23 short.

(c) L1 giving abnormal currents and voltages. Normal: Va = 265 v., Vg3 = 190 v., V = 1.8 v., Ia = 4.3 ma., Ig3 = 0.08 ma.
   1. No anode current: R2, S12, S14, S16, R37 open; C49 short.
   2. Anode current too high: C19 short.
   3. R1, R13, R27, R10 open; C24 short.

(d) L1, L2 and L3 giving normal currents and voltages but no radio reception.
   1. No reproduction of a modulated 470 K.C. signal applied to the control grid of L3 across a 32,000 $\mu\mu$F condenser: S27, S28, S29, C33, C34 open or short; C36 open, R21 open.
   2. No reproduction of modulated 470 K.C. signal applied to 4th grid of L2 across 32,000 $\mu\mu$F condenser: S24, S26, S29, C30 open or short.

3. Reproduction of a modulated 470 K.C. signal applied to the 4th grid of L2 across 32,000 $\mu\mu$F condenser but not of R.F. signal :—
   In all ranges : R34, R12 open, C24, C25 short ; C5 open or short.
   In one range only : defective oscillator coil or condensers in that range.
4. Reproduction of modulated R.F. signal applied to 4th grid of L2 but not when applied to 1st grid of L1.
   In all ranges : C4 open or short ; C21 open ; R6 open.
   In one range only : defective coils or condensers between L1 and L2 in that particular range.
5. Reproduction of modulated R.F. signal applied to 1st grid of L1 but not when applied to aerial socket.
   In all ranges : C3 open or short ; C18 open.
   In one range only : defective pre-selector coils or condensers in that range.

D. Radio reception possible but faulty.

1. Reproduction too weak : receiver out of alignment ; C33 open or short ; I.F. transformers defective ; C42, C50 short.
2. Bad quality : C50, C42, R32, R33, R60, R61, R62, R63, S40, S41, C32, C46, C70, C71 open or short.
3. A.V.C. not working : C35, R27, R13, R7, R6, R1 open ; C28 short.
4. If receiver hums : C1, C2, C62 open ; S5 defective.
5. Heavy background noise : receiver out of alignment—retrim ; C50, C24, C47 open.
6. Visual tuning working badly or not at all : R24, R25, R26 open ; C31 open or short.
7. Crackle : bad contact in soldered joint or switch.
8. Receiver microphonic : chassis not resting on the rubber bushes, e.g., knobs or spindles. Rubber bushes perished. Variable condenser or valves defective.
9. Resonances : these are caused by loose components such as valve caps, rings, strips, etc. When the vibrating part has been located, it may be fixed, if necessary, with a piece of felt.

FAULT FINDING. "POINT TO POINT" SYSTEM.

If either of the testboard types 7629 or 4256 is available, faults can be easily localised by making use of the "Point to Point" system. The preliminary operations in this case are practically the same as those mentioned in the E sheets, to which reference should be made, see Paras. I and II. Then proceed as follows :—

1. Disconnect the receiver from the mains and remove all the valves. Connect the universal testboard type 7629 or 4526 and adjust the testboard for resistance testing, successively to positions 12, 11, 10 and 9. The positive pin on the test lead should be extended to reach the various valveholder contacts without difficulty, the negative pin being connected to earth socket of the chassis.

2. The contacts of the rectifier socket must be shorted. This also protects the meter as otherwise there would be a risk of the smoothing condensers becoming charged, with consequent damage to the meter.

3. The various resistance values between the points indicated in the accompanying table and the chassis are measured by touching the point indicated with the positive pin, the meter deflection being compared with the value given in the table. P indicates that the test must be made between the pick-up sockets and earth, etc., 11/12 means that the test is to be made between points 11 and 12. Differences of 10 per cent. may be met with, but these do not necessarily indicate that the particular component is defective.

4. When all the resistances have been measured, the testboard switch is set for capacity testing and the various capacities are then measured in accordance with the table.

As practically all circuits are measured in this way, the fault will usually be found and the faulty component can, in most cases, be identified by means of the circuit. If the fault is still undetected, it is advisable to repeat the tests indicated in the E sheets. The valveholder contacts are numbered systematically in the following manner.

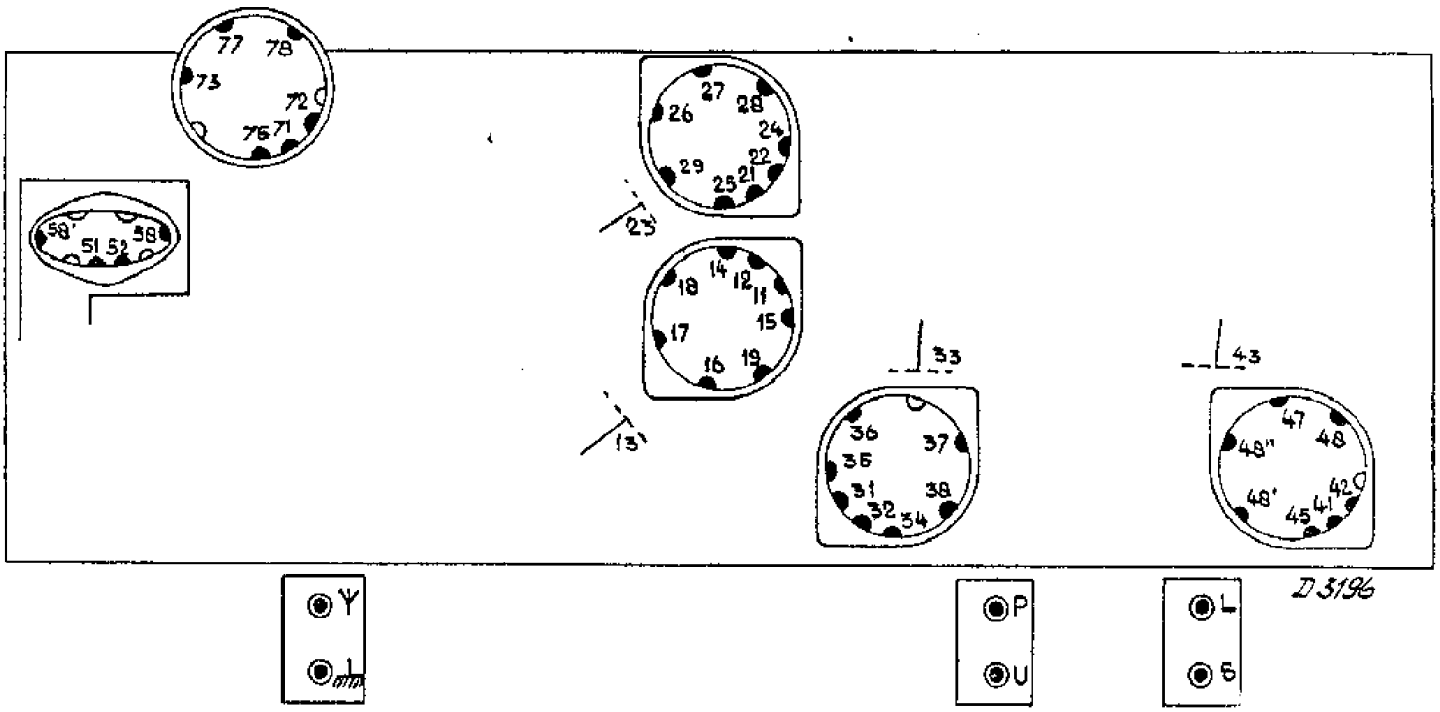
The first figure indicates the valveholder and the second figure one of the following :—

1 & 2 = filament.
3 = control grid.
4 = contact for metallising (if separate).
5 = cathode.
6 = extra grid.
7 = screen grid.
8 = anode.
9 = extra grid (e.g., in octode).

It is necessary for some of the tests, to change the setting of the wavelength switch, and this is indicated in the table as follows : —

3 x 18

In testing electrolytic condensers (resistance tests), it will be found that the deflection drops back to a certain value due to the fall in the leak current. The value obtained may be much too high owing to the condenser being defective, but may also be due to the fact that the receiver has not been used for a considerable time. It is, therefore, necessary to exercise some care in judging the condition of these condensers.



RESISTANCES.

12	11 / 12	21 / 22	31 / 32	41 / 42	51 / 52	71 / 72	11	3 × Aerial			14	24	34	33	P/U	S	L/S
	10	10	10	10	10	10	10	SW 130	MW 365	LW 455	10	10	10	R 210	R 10	10	35
11	15	16	19	25	35	36	38	45	47	48	75	77	47 / 51	58 / 58'	58	58'	
	330	330	330	390	305	305	370	320	370	420	320	370	325	335	255	255	
10	3 × 18			26	3 × 27			2 × 28		37	3 × 29			47*			
	SW 435	MW 435	LW 435	140	SW 335	MW 250	LW 250	R 350	G 0	140	SW 370	MW 345	LW 345	130			
9	13	2 × 23			43	48'	48"	U	73	78							
	60	SW 175	MW 65	LW 65	140	250	195	G 230	210	85							

CAPACITIES.

12	43																
	100																
11	27	37															
	280	G 170															
10																	
9	17	45	47	51													
	475	465	475	465													

* Without shorting plug in L5. Volume Control at minimum. G = Gram position, R = Radio position } Gram Switch.

REPAIRS AND REPLACEMENTS OF COMPONENTS.

The following points must always be borne in mind :—

1. When completing repairs always restore wiring and screening to their original positions.
2. Replace spring washers, washers and insulating material as they were before repairs were started.
3. Rivets which have been removed may be replaced by screws and nuts.
4. Lubricate moving parts with a little pure vaseline where necessary.
5. Solder all compounded condensers at least 1 cm. from the compound.
6. Compounded condensers must be suspended free from all other wiring.
7. Always adjust resistances clear of other components (development of heat).
8. Condensers of which the outer plate is indicated in the circuit by a thick line must always be mounted in the set in the same manner as those replaced. The outer plate is that one which is connected to the wire end on the left of the printing and, in the case of mica condensers, is on the same side as the printing.

UNCASING THE CHASSIS.

Before the chassis is uncased, it is advisable to ascertain whether the work can be done by removing the back and bottom plates only.

1. Remove the backplate.
2. Remove the knobs.
3. Unscrew the brackets holding the leads to the bottom of the cabinet.
4. Loosen tuning indicator and pilot lamps.
5. Slacken off screws B (Fig. 6).
6. Detach cord from pointer drum.
7. Unsolder the speaker.
8. Remove bottom screws.
9. Slightly push out the chassis.
10. Detach indicator cable from scale.
11. Remove chassis from the cabinet.

Reassembly of the chassis in the cabinet presents no difficulties except in regard to the fixing of the cord to the pointer drum. This is done in the following manner.

1. Set variable condenser to maximum.
2. Wind up pointer drum about 4 turns (direction from 200 m. through 300 m. to 500 m.).
3. Attach cord to the drum.

RENEWING SCALE AND POINTER.

1. Uncase the chassis.
2. Take out the eight wood screws holding the screen box to the cabinet. The screen box is removed and both scale and pointer can then be easily renewed.

WAVELENGTH SWITCHES IN THE THEORETICAL CIRCUIT.

The switches are drawn as seen from the control end, the chassis being vertical. The switch units are numbered from the control end and the position of the stop ball is indicated in the diagram of the first switch unit.

The outline of the stator of each of the units is shown at 90° to the left of the stop ball. Rotors are drawn in the extreme left-hand position, as shown by the arrows drawn round the hole in the rotor. Contact springs are represented by circles, and open points on the stator by dots. The outer ring of circles indicates the contact spring on that side which is facing the stop plate and the inner ring of circles those on the remote side. The rotor contacts are represented by arcs and radial lines—as full lines on the same side as the stop plate and as dotted lines on the remote side. Switch units are replaced complete (for code numbers see O sheets).

RENEWING R.F. COILS AND WAVELENGTH SWITCH UNITS.

The coil and switch units are demounted from the chassis in the following manner :—

1. Loosen the bottom plate.
2. Remove spring (Fig. 10, Item 18) from behind spindle bar of wavelength switch.
3. Remove the spindle bar through the hole at the back.
4. Unsolder the leads from the chassis to the coil unit.
5. Unscrew and remove the unit.

To renew the stator and rotor unsolder the leads to the stator and replace by a new unit. For renewal of coils, see below.

RENEWING COILS.

1. Unsolder the leads to the coil.
2. Slightly open up the lugs holding the coil to the chassis.
3. Remove the coil.
4. Fit new coil.
5. Press down the lugs by means of a lever.

If the lugs are broken off, the coils may be fixed by means of a special repair clip. (For code number, see O sheets.)

CONTROL CABLES.

Both the inner and outer control cables are supplied per metre.

Before cutting the inner cable, tin the cable, using acid-free soldering grease to prevent the wire from unravelling.

The outer cable is cut with a pair of cutters, after which all burr must be removed.

The control cables must always be handled with great care seeing that only a slight kink will cause heavy running and backlash.

Length of inner cable for wave-range indicator : 34.2 cm.

Length of outer cable for wave-range indicator : 21.5 cm.

Length of cord for pointer : 28.4 cm.

These lengths are taken between the fixing points, and a little extra should be allowed for the looped ends.

LOUDSPEAKER. TYPE 9636.

Before repairs to the loudspeaker are undertaken, it should be definitely ascertained that the speaker is at fault (try out with other speaker and transformer). Rattling and resonances may be caused by the following :—

1. Loose components in the cabinet.
2. Leads too slack.
3. Leads too taut.

If repairs are found necessary, the following must be borne in mind :—

1. The bench must be quite free from dust.
2. The front and backplates of the magnet must never be removed.
3. The cause of the trouble may be due to :—
   (a) Dirt in the air gap.
   (b) Jammed or distorted speech coil.
4. The dust cover must be replaced as soon as repairs are completed.

Four feeler gauges must be used if the speech coil is to be recentred in the air gap.
For replacement of the speaker chassis or recentring of the core in the air gap a special centring jig is required. When the cone is moved up and down with the speaker held close to the ear, no sound must be audible.

TO DEMOUNT TUNING UNIT WITH VARIABLE CONDENSER FROM THE CHASSIS.

1. Uncase the chassis.
2. Unsolder the leads to the variable condenser.
3. Loosen the bolt holding the condenser to the back of the chassis.
4. Loosen the three bolts by which the unit is held to the front plate of the chassis and remove the unit.

TO RENEW THE VARIABLE CONDENSER.

1. Demount the tuning unit with variable condenser from the chassis in the above manner.
2. The variable condenser is fixed to the backplate of the tuning unit with three hex.-headed screws. Upon removal of the latter, the condenser can be removed and replaced.

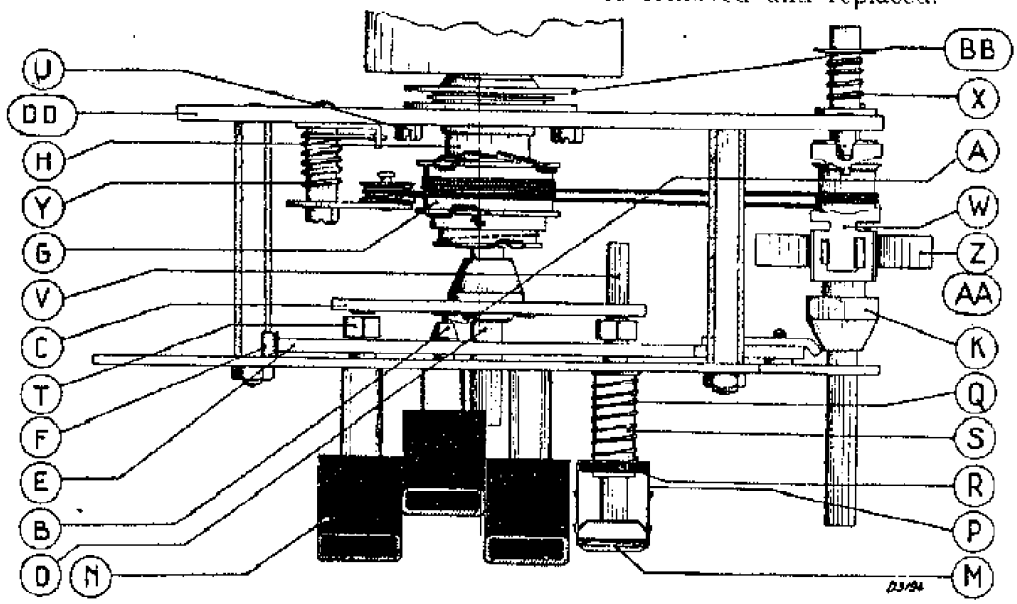


Fig. 8.

DESCRIPTION OF THE TUNING MECHANISM (Fig. 8).

A. Push-Button Tuning.

Before tuning can be effected by means of the push-buttons, the pointer must be moved to minimum wavelength (keyboard tuning) by turning the knob. When one of the push-buttons is depressed, the tapered end of the plunger B first pushes stop-plate E to the left. This stop-plate is then pressed back by the spring F and engages in the groove in the plunger B and retains the push-button.
In the meantime set-screw A, at the end of the plunger B, moves the thrust-plate C forward, this movement being transmitted to the variable condenser by the spindle D.
Depression of another push-button again pushes stop-plate E to one side, thus releasing the first button which returns to its normal position.

B. Manual Tuning.

To tune the receiver by means of the manual tuning knob, the knob must always be pulled out so that lug K pushes the stop-plate E and releases any push-buttons that may already be depressed.
The rotary movement of the knob is transmitted to the drum G by the driving cord and a worm converts this rotary movement to a lateral movement of the hollow spindle H, thus opening or closing the condenser.

Care must be taken that the spring on the fork mounted on the driving spindle is fitted into the fork inside the condenser housing. The other side of the fork lies outside the housing.

TO RENEW PARTS OF PUSH-BUTTONS.

A. Ornamental Cap (N).

This cap is simply pulled off the button. To facilitate this adjustment, the two adjacent buttons should be depressed.

B. Plunger (B).

The plungers can be removed by straightening the lugs in the plate M. It is not necessary to uncase the chassis to do this.

C. Bronze Flat Spring (P) under Ornamental Cap and Spiral Spring (Q) behind Push-button.

1. Uncase the chassis.
2. Remove plunger B (see above).
3. Clip through plate R and flat spring P and discard.
4. Renew the spiral spring Q.
5. Fit new flat spring P to the bush.
6. Place rubber washer on the bush.
7. Fit new plate R.
8. Close up aperture in Plate R with solder.

Note 1.—The new flat spring P is not the same as the old type, the corners being filed out, while,

further, the plate R is cut open at one side. This has been done to make it possible to slide the spring and plate over the square head of the bush S.

Note 2.—In some receivers plate R and the ring behind it have been omitted, but a new plate R should, nevertheless, be fitted when repairs to push-buttons are carried out.

VERNIER UNIT.

The heavy movement of the tuning spindle may be remedied by lubricating with castor oil.
If the vernier unit slips the steel flat springs should be reversed. If the mechanism is defective, the whole unit must be changed as follows :—

1. Uncase the receiver.
2. Remove the clamping ring at the end of the spindle.
3. Detach the driving cord.
4. Remove the three nuts on the front plate of the tuning unit.
5. Remove front plate taking care of spring F (Fig. 8).
6. Take off the vernier unit.

BACKLASH ON MANUAL TUNING.

This may be caused by :—

1. Defective vernier unit.
2. Weak spring at the back of the vernier unit which is then no longer drawn back.
3. Cord tensioning bracket not tight enough.
4. Fork at the bottom of the variable condenser not gripping the fork on hollow spindle H (Fig. 8). See also renewal of variable condenser.
5. Defective or weak spring at the back of the variable condenser for closing up the latter. This spring is found inside the cap at the rear of the condenser and should be renewed.
6. Worm drive defective. Renew backplate with transmission and thrust plate C.

Depressed Push-button does not return to neutral when a second button is operated.

This may be caused by the cap being too large or an incorrect setting of the stop plate. In the latter case the two nuts between the rows of push-buttons should be loosened slightly and the stop-plate so adjusted that the trouble is removed. The nuts must be properly tightened again. In the second case, sandpaper can be used.

LIST OF COMPONENTS AND TOOLS.

When ordering, please always state :—

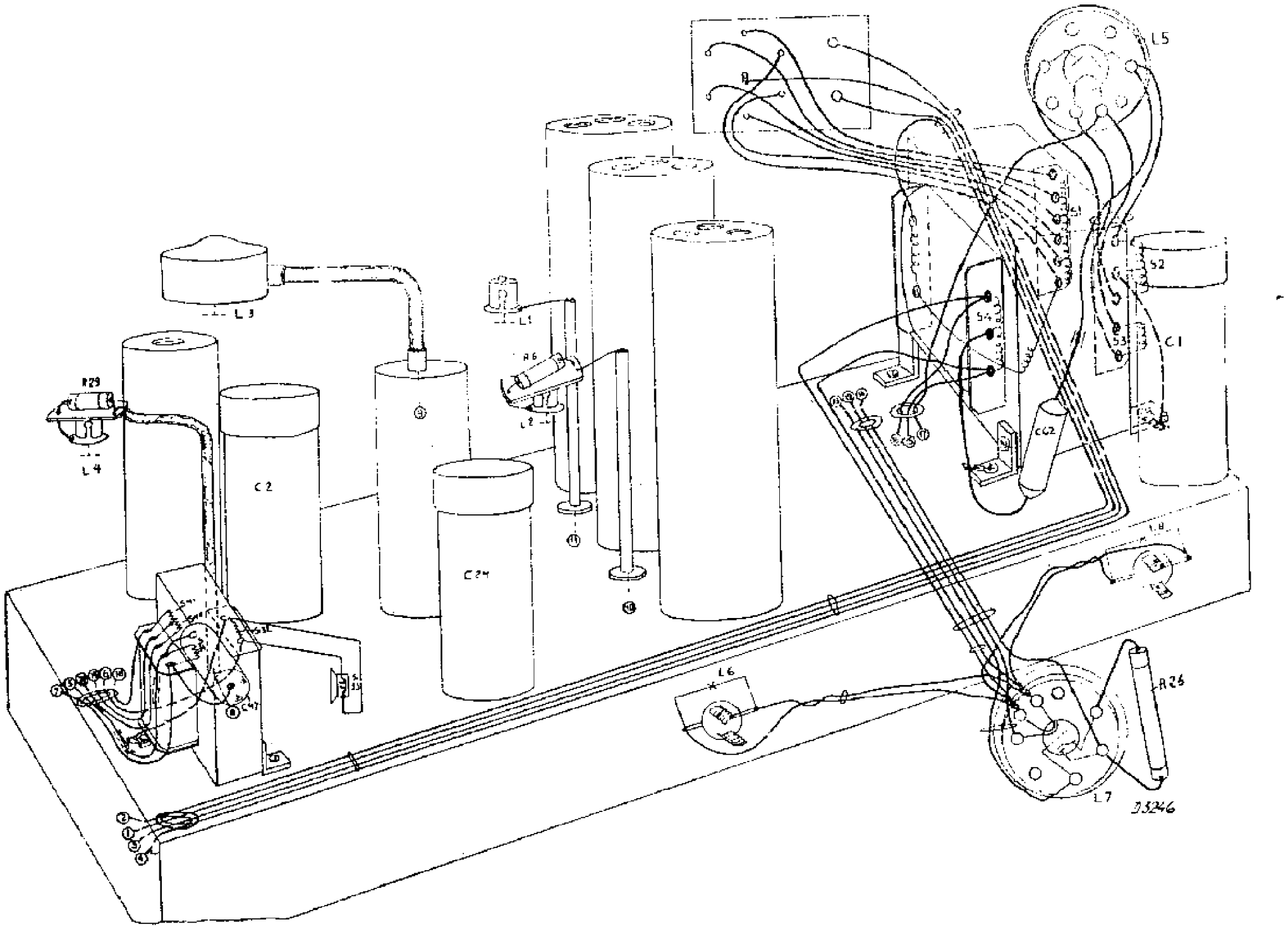
1. Code No.
2. Description.
3. Type No. of Receiver : 660A or 660U.

Fig.	Pos.	Description.	Code No.
9	1	Cabinet	28.246.433
9	2	Speaker silk	06.601.140
9	3	Station scale	A1.890.702
9	4	Ornamental plate behind buttons	23.678.062
9	5	Knob, front panel (colour code 038)	23.611.660
9	6	Knob, side panel	23.611.700
9	7	Pointer	28.897.541
9	8	Torsion spring behind pointer	28.760.420
9	9	Wave-range pointer	28.316.120
9	10	Spring for wave-range pointer	28.740.750
10	13	Knurled screw	07.742.000
10	14	Valveholder	28.226.100
10	15	Set-screw for fixing scale	07.803.310
10	16	Plate with pins	28.875.390
10	17	Plug socket plate	28.875.190
10	18	Spring behind wavelength switch	28.753.440
10	19	Valve cap	28.906.023
10	20	Valve cap	28.838.741
10	21	Valve cap with strip	28.898.530
		Backplate (660A)	28.405.371
		Backplate (660U)	28.405.421
		Safety contact (660U)	28.839.510
		Safety contact (660A)	28.837.830
		Components for safety contact (660U only) — Housing	23.660.592
		Components for safety contact (660U only) — Plate	28.713.240
		Components for safety contact (660U only) — Flat spring	28.753.021
		Components for safety contact (660U only) — Flat spring	28.753.031
		Components for safety contact (660U only) — Ch.-head screw	07.803.200
		Trade mark disc	28.713.271
		Volume control spindle	28.004.470
		Pilot lampholder	08.515.211
		Grub screw, 4 × 5 mm.	07.854.050
		Clip for backplate fixing	28.752.072
		Spring for backplate fixing	28.750.040
		Earth spring for volume control spindle	28.942.740
		Mains lead, per length	33.981.080
		Bush (fixing rear end of variable condenser, etc.), 7 × 1 mm.	25.655.460
		Bush	25.655.570
		Outer control cable	08.009.790
		Ball for stop mechanism	89.205.800
		Bush	28.146.912
		Push-button strip	A1.860.331
		Screwdriver for setting push-buttons	28.914.691
		Gram. switch (complete)	28.652.240
		Stator + rotor No. 3	28.899.610*
		Stator + rotor No. 2	28.899.590*
		Stator + rotor No. 1	28.899.630*

LIST OF COMPONENTS AND TOOLS—continued.

Fig.	Pos.	Description.	Code No.
7	A	Grub screw	28.647.463
7	B	Tumbler pin with plate	28.828.240
7	F	Flat spring for stop disc	28.753.392
7	N	Ornamental cap for push-button	23.667.052
		Celluloid plate for push-button	28.286.713
7	P	Bronze flat spring under push-button cap (corners of holes to be filed out square where they fit over the bush)	28.086.518
7	Q	Spiral spring behind push-button cap	28.731.234
7	R	Plate behind push-button cap (cut plate open and resolder when assembled)	28.287.640
7	T	Short set-screw for stop disc	28.647.643
7	U	Hex.-headed screw for fixing sliding condenser	07.840.290
7	V	Long set-screw for stop disc	28.647.532
7	W	Vernier unit	28.882.830
7	X	Spiral spring behind vernier unit	28.731.241
		Clamping ring behind vernier unit	07.891.031
7	Y	Spring for cord tensioning bracket	28.760.431
7	Z	Steel flat spring for vernier unit	28.751.811
		Presspahn strip for vernier unit	28.681.111
		Repair clips for coils	
		COMPONENTS FOR LOUDSPEAKER.	
		Chassis	28.256.170
		Clamping ring	25.871.810
		Paper ring	28.451.540
		Anti-directional cone	23.666.661
		TOOLS.	
1		Service oscillator	GM.2880F
5		Universal testboard	GM.4256
		Universal and valve testboard	GM.7629
		Capacity resistance tester	GM.4140
		Aperiodic amplifier	GM.2404
		Insulated trimming key	M.646.565
		Insulated trimming screwdriver	M.646.382
		Trimming transformer	09.992.220
		Circuit tester	09.991.590
		Lever for fixing coils	09.991.560
		Clamping plate for fixing coils	28.080.870
		Centring jig for speaker	09.991.530
		Philitine 110 for locking trimmers	02.771.340
		Locking wax for I.F. coils	02.851.360
		Universal cradle	09.991.380

* For numbers of stator and rotor, see theoretical circuit.


L5
L3
L1
L4
L2
L6
L7
R29
R6
R26
C2
C24
C1
C62
S2
S4
S3
35246

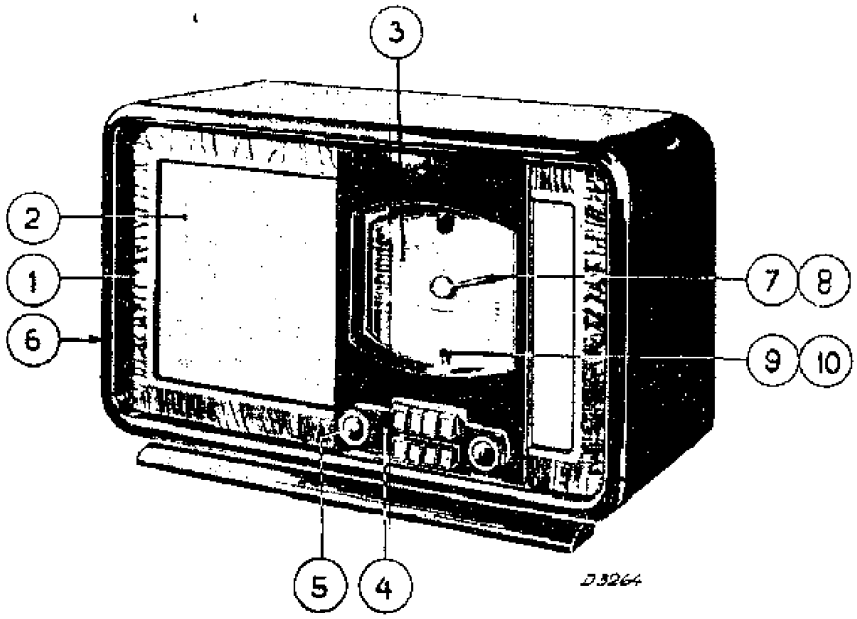


Fig. 9.

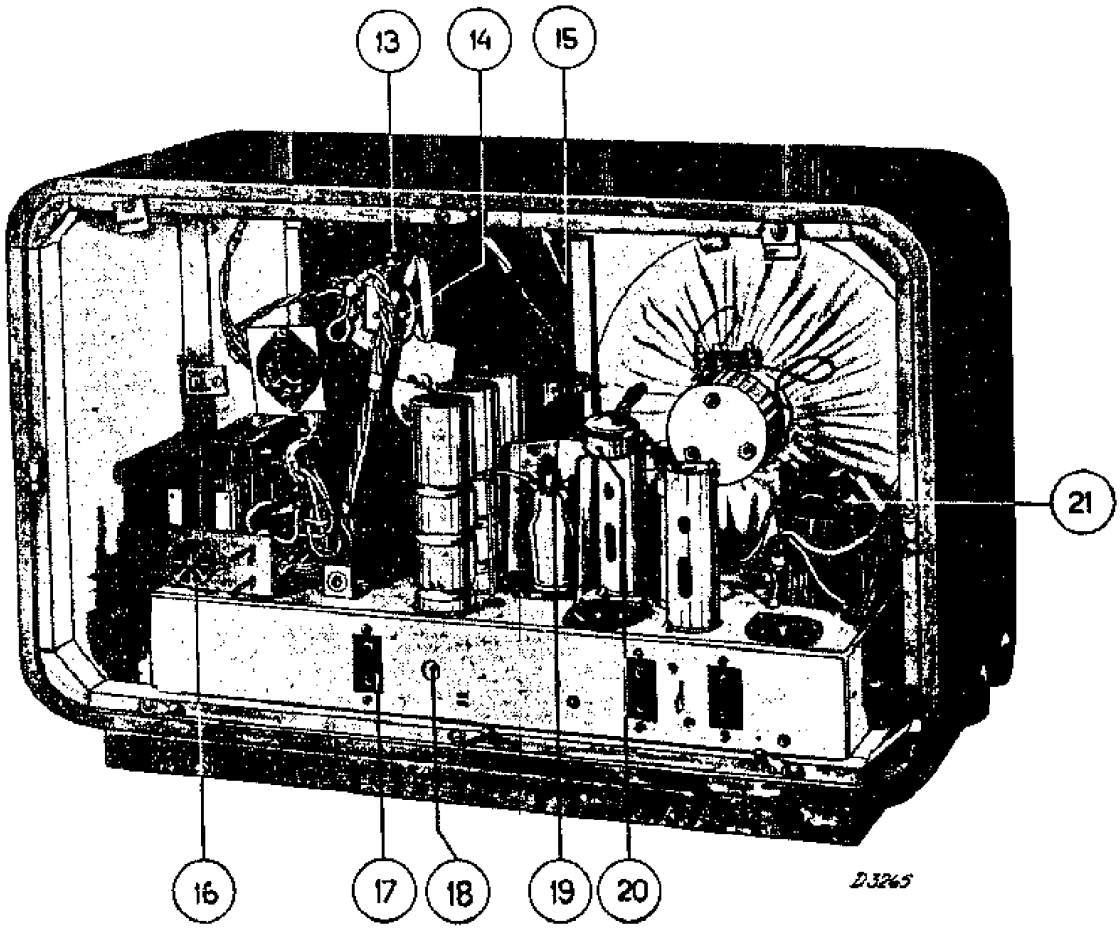


Fig. 10.

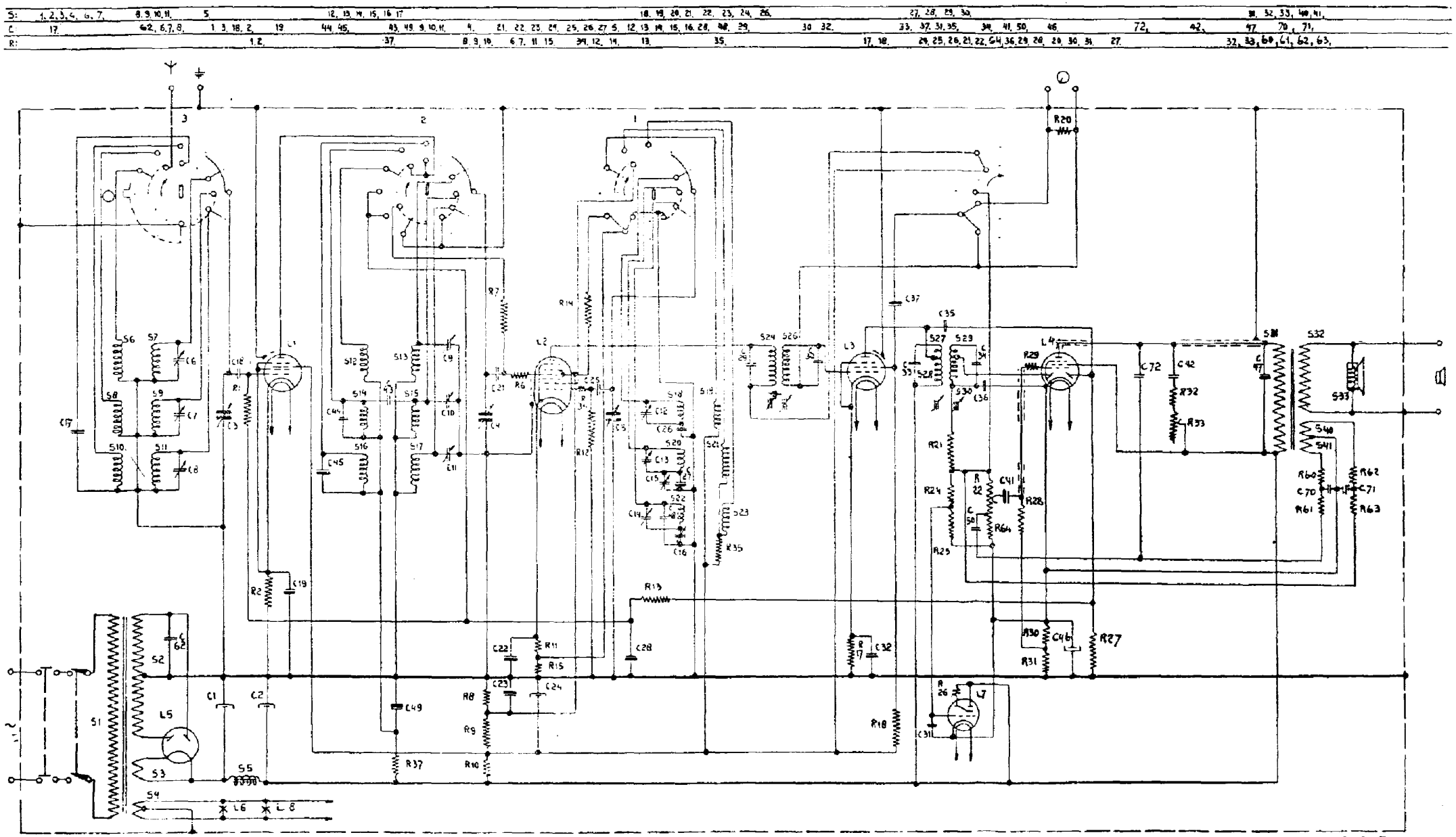

S: 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 5, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 40, 41,
C: 17, 62, 6, 7, 8, 1, 3, 18, 2, 19, 44, 45, 43, 49, 9, 10, 11, 4, 21, 22, 23, 24, 25, 26, 27, 5, 12, 13, 14, 15, 16, 28, 48, 29, 30, 32, 33, 37, 34, 35, 38, 41, 50, 46, 72, 42, 47, 70, 71,
R: 1, 2, 37, 8, 9, 10, 6, 7, 11, 15, 39, 12, 14, 13, 35, 17, 18, 29, 25, 26, 21, 22, 64, 36, 24, 20, 28, 30, 31, 27, 32, 33, 60, 61, 62, 63,
R20
R7
R14
C37
C35
R29
C72
C42
R32
R33
S32
S33
S40
S41
R60
R62
C70
C71
R61
R63
R21
R24
R22
C41
R28
R64
R25
R13
R30
C46
R27
R31
C22
R11
C28
C23
R15
C24
R8
R9
R10
R37
C49
R18
C32
R17
R26
L7
C31
S1
S2
S3
S4
S5
L5
L6
L8
C1
C2
C62
S6
S7
S8
S9
S10
S11
C6
C7
C8
C17
C18
C3
R1
R2
C19
S12
S13
S14
S15
S16
S17
C9
C10
C11
C44
C45
R6
C21
R12
S25
C5
C12
C26
C13
C15
C14
C16
S20
S22
S21
S23
R35
L1
L2
L3
L4
S24
S26
S27
S29
S28
S30
C33
C34
C36
S31
S38
D3245

Fig. 11.

CONDENSERS.

Designation.	Value.	Code No.
C1	28 μF	28.182.540
C2	32 μF	28.182.400
C3	11—490 μμF	
C4	11—490 μμF	28.216.020
C5	11—490 μμF	
C6/14		See Coils
C15	200 μμF	28.212.080
C16	200 μμF	28.212.080
C17	80 μμF	28.206.260
C18	100 μμF	28.206.270
C19	0.1 μF	28.201.180
C21	100 μμF	28.206.270
C22	0.1 μF	28.201.180
C23	0.1 μF	28.201.180
C24	32 μF	28.182.400
C25	50 μμF	28.200.240
C26	4,750 μμF	49.080.240
C27	400 μμF	49.080.010
C28	0.1 μF	28.201,180
C29	91 μμF	See Coils
C30	97 μμF	See Coils
C31	50,000 μμF	28.201.150
C32	50,000 μμF	28.201.150
C33	103 μμF	See Coils
C34	103 μμF	See Coils
C35	8 μμF	28.206.330
C36	50 μμF	28.206.240
C37	50,000 μμF	28.199.060
C41	3,200 μμF	28.198.940
C42	50,000 μμF	28.201.640
C43	2 μμF	28.205.880
C44	50 μμF	28.206.240
C45	200 μμF	28.190.160
C46	25 μF	28.182.240
C47	2,000 μμF	28.201.480
C48	40 μμF	28.206.230
C49	50,000 μμF	28.199.060
C50	50,000 μμF	28.201.150
C62	20,000 μμF	28.201.650
C70	64,000 μμF	28.201.160
C71	2,000 μμF	28.198.920
C72	125 μμF	49.055.000
C80	Only 20,000 μμF	28.199.780
C81	for 20,000 μμF	28.199.780
	660U.	

PILOT LAMPS AND VALVES.

L1	L2	L3	L4	L5
EF8	EK2	EF9	EBL1	AZ1

L6	L7	L8
8045D-00	EM1	8045D-00

Z.2 Fuse for 660U 08.140.391

VOLTAGES AND CURRENTS.

	L1 (EF8)	L2 (EK2)	L3 (EF9)	L4 (EBL1)	L7 (EMI)
Va (v.)	265	190	260	235	260
Vg2 (v.)	190	180	90	260	—
Vg 3.5 (v.)	—	90	—	—	—
Vcath (v.)	1.8	4.4	1.8	14.5	—
Ia (m.A.)	4.3	2.2	6.4	34	0.1
Ig2 (m.A.)	0.1	3.5	2	5.5	0.3
Ig3.5 (m.A.)	—	1.3	—	—	—

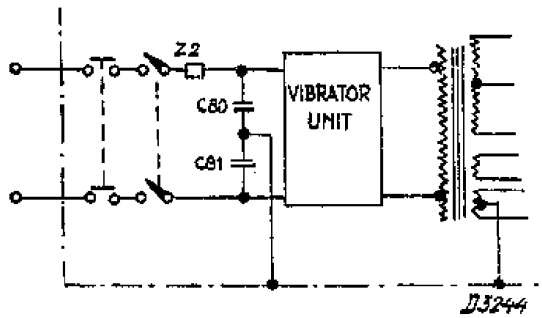
Voltage across C1 = 290 volts.
Voltage across C2 = 275 volts.

Primary consumption for 650A = 56 watts.
Primary consumption for 650U = 56 watts.

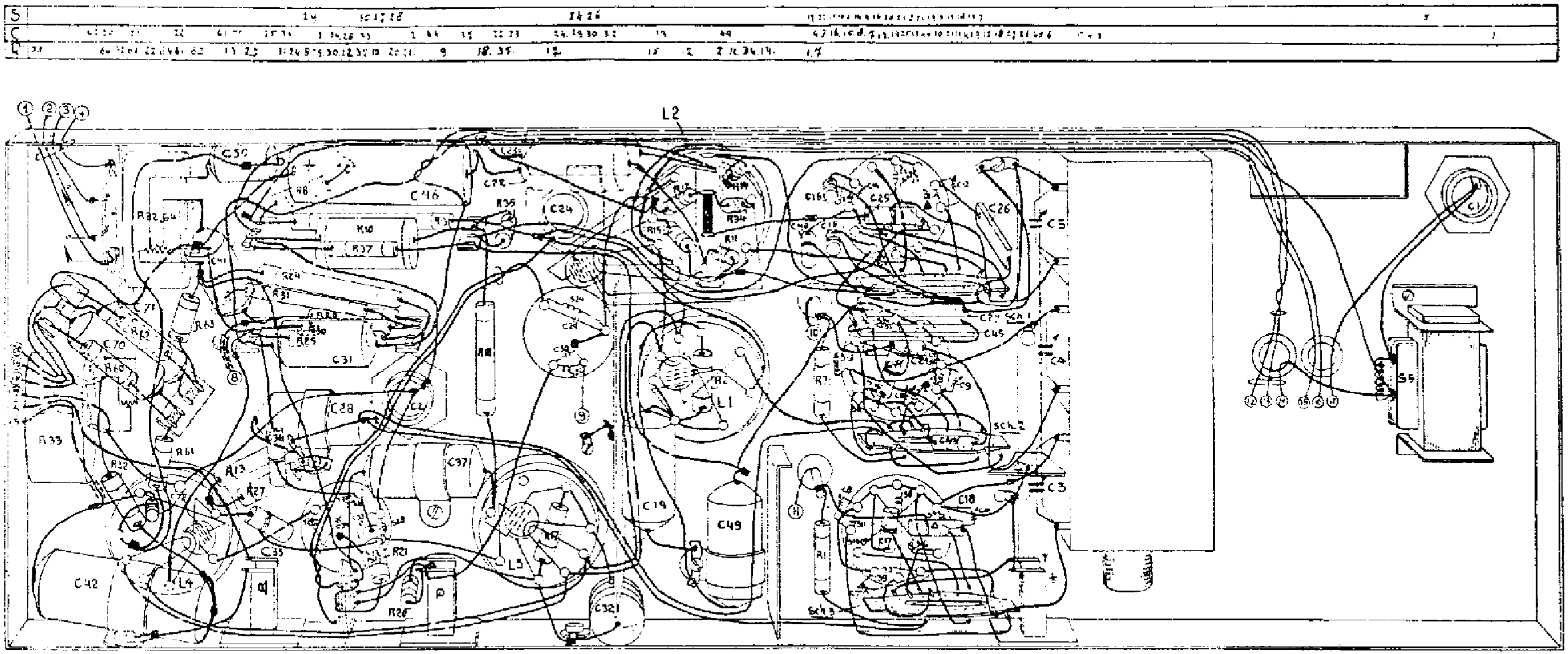
The voltages are measured with voltmeters having a resistance of 2,000 ohms per volt. Moving coil voltmeters give readings which depend upon the resistance in circuit and the current consumption of the meter itself. The values given are the mean of several measurements, therefore some readings obtained may differ appreciably, particularly as variations may arise due to the tolerances 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.

The above values were measured without signal at the aerial socket, the measurement being made between the point indicated and the cathode.

The test apparatus used was type 4256 or 7629; the resistance of the voltmeters in these testboards is 2,000 ohms per volt, and if voltmeters having lower internal resistance are used, the results obtained will, generally speaking, also be lower. The above values are averages taken from a large number of receivers so that discrepancies may be met with which do not necessarily indicate a fault.



For 660U only.



D3193

The coloured spots on the Coils are indicated by triangles.

Points to be watched in regard to replacement of wiring.

All wiring must be replaced in their original positions.

Note :

(a) Connections to sliding condenser to be as short as possible.

(b) Wiring of C72 to be as short as possible.

(c) Leads between C35, R13 and R27 to be as short as possible.

(d) Condensers must be mounted in the same manner as the condensers to be replaced. The end edges connected to the outer plate (to the left of the printing) is drawn thick.