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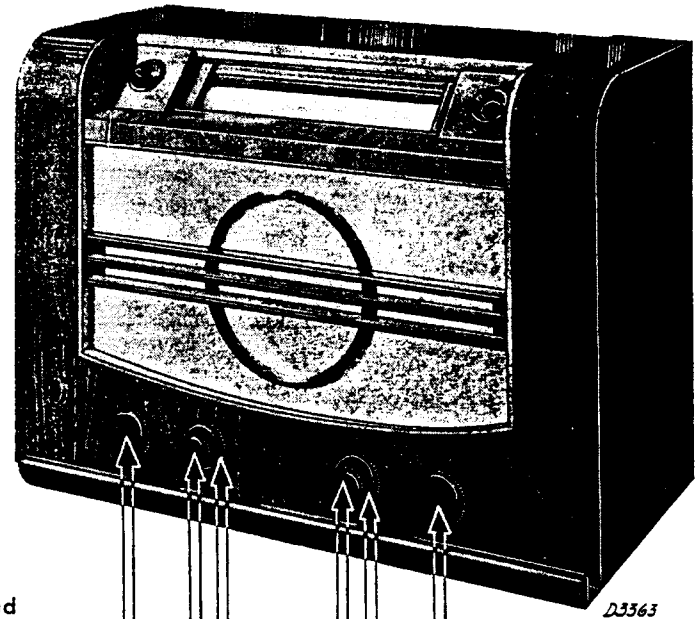
PHILIPS

SERVICE DOCUMENTATION

for the receiver

291 A



SUITABLE FOR FEEDING BY A.C. MAINS

GENERAL DATA

This Superhet comprises:
Seven tuned circuits;
Rotating dial, operated by waverange switch;
Band-spread, which means that the different broadcast bands in the short wave region are spread over the whole dial, making tuning easy;
Performance switch combined with variable bandwidth;
Continuously variable tone filter;
Performance selection by means of L.F. inverse feed-back;
Optical tuning indication;
Automatic volume control;
Moving coil loudspeaker (type 9632) with sound diffuser;
Connection for extension speaker (low-ohmic);
Speaker switch;
Connection for gramophone pick-up;
Wavetrap for suppressing troublesome I.F. signals;
Voltage adjusting device;
Safety contact.

Wavebands:

11—	18 m	(27·3—	16.7	Mc/s)
18—	30 m	(16·7—	10.0	„)
30—	52 m	(10.0—	5.77	„)
52—	170 m	(5.77—	1.76	„)
170—	570 m	(1760 —	526	Kc/s)
750—2100 m		(400 —	143	„)

Band-spread on the following broadcast bands:

14 m (21.6 Mc/s); 17 m (17.8 Mc/s); 20 m (15.22 Mc/s); 25 m (11.8 Mc/s); 31 m (9.6 Mc/s); 49 m (6.1 Mc/s).

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I.F. bandwidth:
In position „Foreign": 9.5—11 kc/s.
In positions "Normal" and "Local": 13.5—15 kc/s.

Dimensions:

Height: 44 cm
Width: 63 cm
Depth: 30 cm.

Weight: 25.6 kg (net)

Operation of the knobs

Single knob on the left: Gramophone and performance switch.
Successive positions:
„Foreign" — red disc behind the righthand window next to the dial;
"Normal" — white disc behind the righthand window next to the dial:
"Local" — green disc behind the righthand window next to the dial:
"Gramophone"

Twin knob on the left:
Small knob: Volume control.
Large knob: Tone control.

Twin knob on the right
Small knob: Tuning of the wavebands.
Pressed in: Reception of the wavebands.
Pulled out: Reception of the broadcast bands (red light under the dial).
Large knob: Tuning of the broadcast bands. (Bandspread.) (This is possible when the green light burns under the dial).

Single knob on the right: Waverange switch
Knob on left side panel: Mains switch
Switch on rear panel: Loudspeaker switch

* * *

DESCRIPTION OF CIRCUITS

I. High frequency part
In order to facilitate orientation in the circuit diagram a list is first given below of the coils used in the different wavebands and broadcast bands. (The wavebands run from 11—18 m, 18—30 m, 30—52 m, 52—170 m, 170—570 m and from 750—2100 m; the broadcast bands lie at 14 m, 17 m, 20 m, 25 m, 31 m and 49 m).

	Wavebands						Band-spread					
	11-18 m	18-30 m	30-52 m	52-170 m	170-570 m	750-2100 m	14 m	17 m	20 m	25 m	31 m	49 m
Aerial coil	S7	S9	S11	S13	S15	S17	S7	S7	S9	S9	S11	S11
Grid coil from L1	S8	S10	S12	S14	S16	S18	S8	S8	S10	S10	S12	S12
Anode coil from L1	S19	S21	S23	S25	S27	S29	S19	S19	S21	S21	S23	S23
Grid coil from L2	S20	S22	S24	S26	S28	S30	S20	S20	S22	S22	S24	S24
Oscillatorcoil from L3	S32	S34	S36	S37+S38	S39+S40	S42	S45+S32	S45+S32	S34+S32	S34+S32	S36+S34	S36
Reaction coupling coil from L3	S31	S33	S35	S37	S40	S41	S59+S31	S59+S31	S33	S33	S35	S35

Description of circuits for the different wavebands.

A. **11—18 m waveband** (The circuit diagram on page S1 is drawn in this position).

Aerial circuit: Aerial, points y and m of switch 7, S7, earth.

Grid circuit of L1: C4 with C15 in series, points y and m of switch 6, S8 and C9. This circuit is coupled with the first grid of L1 via C16 and by means of inductive coupling between S7 and S8 with the aerial circuit.

Anode circuit of L1: Anode L1, points y and m of switch 5, S19, C32, earth.

Control grid circuit of L2: C5 with C33 in series, points y and m of switch 4, S20 and C26. The circuit is coupled directly with the control grid of L2 and inductively with the anode circuit of L1.

Oscillator circuit of L3: C6 with C54 in series, points k and y of switch 12, y and m of switch

For small alterations in the circuits see pag. G 4

2, S32 and C41. This circuit is coupled with the grid of L3 via C52.

Reaction coupling circuit of L3: Cathode of L3. points y and m of switch 3, S31. S31 and S32 are inductively coupled with each other. S31 is coupled via points m and x of switch 3, points u and j of switch 12 and C38 with the 3rd grid of L2.

A1. **Bandspread on 14 m.** In this case the circuit is as indicated in the circuit diagram, except switch 12, which is turned one position to the left. In connection herewith the oscillator circuit and reaction coupling coil of L3 change as follows:

Oscillator circuit of L3: C7 with C61 and C98, in parallel with which are:
1. S32, C41 (via m and y of switch 12 and y and m of switch 2).
2. S45 (via y and k of switch 1).
3. C57 (via y and a of switch 1).
4. C58 (via y and a of switch 1 and u and h of switch 8).

The circuit is coupled via y and m of switch 12 and C52 with the 1st grid of L3 and via y and j of switch 12 and C38 with the 3rd grid of L2.

Reaction coupling coil of L3: 1st: cathode of L3, points y and m of switch 3, S31, earth. 2nd: anode of L3, S59, points h and u of switch 1, C40, earth.

A2. **Bandspread on 17 m.** The circuit corresponds to that of the circuit diagram, except that switch 12 is turned one position to the left and switch 8, two positions to the right.

Oscillator circuit of L3: C7 with C61 and C98, in parallel with which are:
1. S32 and C41 (via m and y of switch 12, y and m of switch 2).
2. S45 (via y and k of switch 1).
3. C57 (via y and a of switch 1).
4. C60 and C59 (via y and a of switch 1. u and k of switch 8).

Reaction-coupling circuit of L3:
1. Cathode of L3, y and m of switch 3, S31, earth.
2. Anode of L3. S59, h and u of switch 1. C40, earth.

B. **18—30 m waveband** (switches 1 to 7 inclusive turned one position to the right).

Aerial circuit: aerial, y and a of switch 7, S9, earth.

Grid circuit of L1: C4 and C15 in series, y and a of switch 6, S10, C10.
This circuit is coupled via C16 with the 1st grid of L1 and by inductive coupling between S9 and S10 with the aerial circuit.

Anode circuit of L1: Anode, y and a of switch 5, S21. C32, earth.

Control grid circuit of L2: C5 and C33, y and a of switch 4, S22, C27. The circuit is directly coupled with the control grid of L2 and by inductive coupling between S21 and S22 with the anode circuit of L1.

Oscillator circuit of L3: C6 with C54 in series, k and y of switch 12, y and a of switch 2. S34, C42. Coupling with the grid of L3 via C52.

Reaction coupling circuit of L3: Cathode L3. y and a of switch 3, S33. S33 and S34 are inductively coupled with each other. S33 is coupled to the 3rd grid of L2 via a and x of switch 3, u and j of switch 12 and C38.

B1. **Bandspread on 20 m.** The switches 1—7 inclusive are turned one position to the right, switch 12 one position to the left. Consequently the oscillator part is altered as follows:

Oscillator circuit of L3: C7 with C61 and C 98, in parallel with which are:
1. S34, C42 (via m and y of switch 12, y and a of switch 2).
2. S32, C41 (via y and l of switch 1).
3. C67 (via y and b of switch 1).
4. C62 (via y and b of switch 1, y and m of switch 8).

S34 is coupled with the 3rd grid of L2 via a and y of switch 2, y and j of switch 12 and C38.

Reaction coupling circuit of L3: Cathode of L3, y and a of switch 3, S33, earth.

B2. **Bandspread on 25 m:** The switches 1 to 7 inclusive are turned one position to the right. switch 12 one position to the left and switch 8 two positions to the right.

Oscillator circuit of L3: C7 with C61and C98. in parallel with which are:
1. S34, C42 (via m and y of switch 12, y and a of switch 2).
2. S32, C41 (via y and l of switch 1).
3. C67 (via y and b of switch 1).
4. C63, C64 (via y and b of switch 1, y and b of switch 8).

S34 is coupled with the 3rd grid of L2 via a and y of switch 2, y and j of switch 12 and C38.

Reaction coupling circuit of L3: Cathode of L3, y and a of switch 3, S33, earth.

C. **30—52 m waveband.** Switches 1 to 7 inclusive are turned two positions to the right.

Aerial circuit: Aerial, y and b of switch 7, S11, earth.

Grid circuit of L1: C4 with C15 in series. y and b of switch 6, S12, C11. This circuit is coupled via C16 with the 1st grid of L1 and with the aerial circuit by inductive coupling between S11 and S12.

Anode circuit of L1: Anode, y and b of switch 5, S23, C32, earth.

Control grid circuit of L2: C5 and C33 in series. y and b of switch 4, S24, C28. The circuit is directly coupled with the control grid of L2

and with the anode circuit of L1 by inductive coupling between S23 and S24.

Oscillator circuit of L3: C6 and C54 in series, **k** and **y** of switch 12, **y** and **b** of switch 2, S36, C43. Coupling with the grid of L3 via C52.

Reaction coupling circuit of L3: Cathode of L3, **y** and **b** of switch 3, S35, earth.
S35 is coupled with the 3rd grid of L2 via **b** and **x** of switch 3, **u** and **j** of switch 12 and C38.

C1. **Bandspread on 31 m.** In the circuit diagram switches 1—7 inclusive are turned two positions to the right and switch 12 one position to the left.

Oscillator circuit of L3: C7 with C61 and C98, in parallel with which are:
1. S36, C43 (via **m** and **y** of switch 12, **y** and **b** of switch 2).
2. S34, C42 (via **y** and **m** of switch 1, **q** and **d** of switch 8, **d** and **q** of switch 1).
3. C65, C66 (via **y** and **m** of switch 1, **q** and **d** of switch 8). The circuit is coupled with grid of L3 via C52.

S36 is coupled with the 3rd grid of L2 via **b** and **y** of switch 2, **y** and **j** of switch 12 and C38.

Reaction-coupling circuit of L3: Cathode of L3, **y** and **b** of switch 3, S35, earth.

C2. **Bandspread on 49 m.** In the circuit diagram switches 1 to 7 inclusive are turned two positions to the right, switch 12 one position to the left, switch 8 two positions to the right.

Oscillator circuit of L3: C7 with C61 and C98, in parallel with which are:
1. S36, C43 (via **m** and **y** of switch 12, **y** and **b** of switch 2).
2. C68 (via **y** and **m** of switch 1, **q** and **f** of switch 8).

The circuit is coupled via C52 with the grid of L3. S36 is coupled with the 3rd grid of L2 via **b** and **y** of switch 2, **y** and **j** of switch 12 and C38.

Reaction coupling circuit of L3: Cathode of L3, **y** and **b** of switch 3, S35, earth.

D. **52—174 m waveband.** In the circuit diagram the switches 1—7 inclusive are turned three positions to the right.

Aerial circuit: Aerial, **y** and **c** of switch 7, S13, earth.

Control grid circuit of L1: C4, **p** and **c** switch 6, S14, C12. The circuit is coupled with the control grid of L1 via C16 and with the aerial circuit by inductive coupling between S13 and S14.

Anode circuit of L1: Anode, **y** and **c** of switch 5, S25, C32, earth.

Control grid circuit of L2: C5, **p** and **c** of switch 4, S26, C29.
The circuit is directly coupled with the control grid of L2 and with the anode circuit of L1 by coupling between S25 and S26 (inductive) and by C23 (capacitive).

Oscillator circuit of L3: C6, **p** and **c** of switch 2, C45, S37, S38, C44. Coupling with the grid of L3 via C52.

Reaction coupling circuit of L3: Cathode of L3, **y** and **c** of switch 3, S37, earth. S37 is coupled with the 3rd grid of L2 via **c** and **x** of switch 3, **u** and **j** of switch 12 and C38.

E. **170—570 m waveband.** In the circuit diagram switches 1 to 7 inclusive are turned four positions to the right.

Aerial circuit: Aerial, **y** and **d** of switch 7, S15, earth.

Control grid circuit of L1: C4, **p** and **d** of switch 6, S16, C13. For the function of R4 see under "Performance switch".
The circuit is coupled with the control grid of L1 via C16 and with the aerial circuit by coupling between S15 and S16.

Anode circuit of L1: Anode, **y** and **d** of switch 5, S27, C21, C32, earth.

Control grid circuit of L2: C5, **p** and **d** of switch 4, S28, C30. For the function of R10 see under "Performance switch".
The circuit is coupled directly with the control grid of L2 and with the anode circuit of L1 by coupling between S27 and S28 (inductively) and by C24 (capacitively).

Oscillator circuit of L3: C6, **p** and **d** of switch 2, C46, C48, S39, S40, C47. The circuit is coupled with the grid of L3 via C52.

Reaction coupling circuit of L3: Cathode of L3, **y** and **d** of switch 3, S40, earth. S40 is coupled with the 3rd grid of L2 via **d** and **x** of switch 3, **u** and **j** of switch 12 and C38.

F. **750—2100 m waveband.** Switches 1—7 inclusive are turned 5 positions to the right in circuit diagram.

Aerial circuit: Aerial, **y** and **e** of switch 7, S17, earth.

Control grid of L1: C4, **p** and **e** of switch 6, S18, C14. For the function of R4 see under "Performance switch". The circuit is coupled with the control grid of L1 via C16 and with the aerial circuit by coupling between S17 and S18.

Anode circuit of L1: Anode, **y** and **e** of switch 5, S29, C22, C32, earth.

Control grid circuit of L2: C5, **p** and **e** of switch 4, S30, R47[1]) C31.
For the function of R10 see under "Performance switch". The circuit is directly coupled with the control grid of L2 and with the anode circuit of L1 by coupling between S29 and S30 (inductively) and by C25 (capacitively).

Oscillator circuit of L3: C6, **p** and **e** of switch 2, C76, C49, S42, C50, C51. The circuit is coupled with the grid of L3 via C52.

Reaction coupling circuit of L3: Anode of L3, S59, S41, C40, earth. S41 is coupled with

[1]) R47 is connected in series with S30 (not indicated in the diagrams).

the 3rd grid of L2 cia C39, h and x of switch 3, u and j of switch 12 and C38. The cathode of L3 is earthed.

G. **I.F. aerial filter.** This filter shorts the aerial for signals on the I.F. to avoid whistling notes.

II. **Intermediate frequency part.**

First I.F. transformer: S46, C55, S47 (S48), C56 (see also under "Performance switch"). I.F. amplifier lamp: L4
Second I.F. transformer: S49, S58, C78; S50, S57, C79.

III. **Detector (L5).**

Detector circuit: First diode-anode of L5, cathode L5, R25, R23, S57, (S50, C79), (C81).

IV. **L.F. Amplifier.**

The L.F. voltage originating on R25 through detection is conducted via R45, C97, C77 and the tone filter R32, R33, C84, C85 to the control grid of L6. The amplified L.F. voltage on R36 is applied via C88, (R31), R37 to the control grid of L7 (see under "Performance switch"). The voltage again amplified reaches via R40 and the output transformer S52, S53, S54 the speaker S55. On switching off the speaker the resistance R43 is switched on, as otherwise L7 may become overloaded.
R37, R40, R41 serve for preventing oscillation on the ultra short wave. C89 serves for suppressing whistling noises and rustling.

V. **Automatical volume control.**

When tuning to a signal an I.F. voltage comes on the detector diode of L5 which when detected gives a D.C. voltage across R22+R27. A part of this voltage is conducted via R26, R2 to the control grid of L1 and via R18(S48) S47 to the control grid of L4.
In this way the bias and thus also the amplification of L1 and L4 are controlled.

VI. **Performance switch** (Switching segments 9, 10 and 11).

The Performance switch (which is at the same time the gramophone switch) has four positions: Foreign, normal, local and gramophone. The circuit in these different positions is described below:

A. **"Foreign" position** (indicator red).
1. The resistances R4 and R10 are short circuited, so that during reception on long and medium waves the control grid circuits of L1 and L2 are not damped, which is to the advantage of selectivity.
2. The second circuit of the first I.F. transformer is formed by S47, C56, in which way selectivity is as good as possible.
3. The resistance R31 is not short-circuited, causing amplification to be reduced in order to prevent overloading of L7.
4. For inverse feed-back in this position see under the heading "Inverse feed-back".
5. S53 is connected via S61, R42 to earth, causing the lowest tones to be suppressed.

B. **„Normal" position** (indicator white).
1. The resistances R4 and R10 are no longer short-circuited, so that when receiving on short and long waves the control grid circuits of L1 and L2 are damped, and consequently the H.F. amplification is reduced.
2. The second circuit of the first I.F. transformer is formed by S47, S48. C56. As both S47 and S48 are coupled with S46 the coupling between the first and the second circuit becomes tigther and consequently the tuning curve wider, in which way the quality is improved.
3. R31 is short-circuited.
4. For inverse feed-back see under the heading "Inverse feed-back".

C. **"Local" position** (indicator green).
1. The resistances R4 and R10 are not short-circuited.
1a. The aerial is connected to earth via C95, as a consequence of which the H.F. amplification is reduced still further.
2. The circuit of the first I.F. transformer is the same as in the "normal" position.
3. R31 remains short-circuited.
4. For inverse feed-back see under the heading "Inverse feed-back".

D. **"Gramophone" position**
1. The connecting point between S57 and R22 is earthed via points v and j of switch 9; an incoming aerial signal is not passed on.
2. The connecting socket for the gramophone pick-up is connected to the volume control R25 via the points g and f of switch 9.
3. R31 is short-circuited.
4. For inverse feed-back see under heading "Inverse feed-back".

VII. **Inverse feed-back.**

By leading part of the L.F. voltage back to preceding circuits the distortion of the output voltage is reduced.
At the different positions of the performance switch the inverse feed-back is obtained as follows:

A. **"Foreign" position**

As the cathode resistances of L6 (S51, R34, R28, S60) and L7 (R39) are not decoupled by condensers, part of the

anode A.C. voltages is led back to the grid circuits.

B. **"Normal" position**

The inverse feed-back described under "A" remains. Moreover the tension on the speaker is led back via S61, R42 to the resistance R34+R28 and consequently to the input grid circuit of L6. By means of the different coils the inverse feed-back for the various frequencies is adjusted in such a way that the characteristic of the L.F. amplifier is as favourable as possible.

C. **"Local" position.**

The inverse feed-back is exactly as with the "Normal" position.

D. **„Gramophone" position.**

The tension on the speaker is led back to R28 via S61, R42, making the inverse feed-back less powerfull than with radio reception in the "Normal" and "Local" positions.

VIII. **Whistle filter** (S56, R46[1]) C91, C90).

By the introduction of this filter possible interfering tones, caused by two stations with a frequency difference of 9 kc/s, are suppressed.

IX. **Optical tuning indication.**

When a signal is being received the d.c. voltage produced by detection is led via R22 to the control grid of L8. In this way the anode current of L8, and therefore also the tension across R21, diminishes. The voltage difference between the deflection plates connected to the anode and the screen becomes reduced as a consequence, causing the spots that light up to become larger. The receiver is correctly adjusted when the spots that light up are as large as possible.

X. **Feeding.**

Feed transformer: S1, S2, S3, S4.
Rectifier tube: L9.
Anti-hum condenser: C96, C102[2]).
Smoothing filter: C1, S5, C2, R5, C2 A.
The positive voltages for the different valves are tapped from C2 A.

Voltages for L1:

V_a : from the potentiometer R7, R8; via R9; decoupled by C32.
V_{g3} : from the potentiometer R7, R via R6; decoupled by C19.
$V_{g2,4}$: voltage drop across R3.
V_{g1} : voltage drop across R3+R44; pa tially decoupled by C82.
See also under "Automatic volun control".

Voltages for L2:

V_a : from potentiometer R7, R8; vi R16, S46; decoupled by C20.
$V_{g2,4}$: from potentiometer R7, R8; vi R12; decoupled by C36.
V_{g1} : voltage drop across R11; decouple by C37.

Voltages for L3:

$V_{a,g2,3}$ from potentiometer R7, R8; vi R15, (S41), S59; decoupled b C40.
V_{g1} : No fixed negative bias.

Voltages for L4:

V_a : Via R19, S58, decoupled by C7(
V_{g2} : from potentiometer R7, R8; vi R20, decoupled by C72.
V_{g1} : voltage drop across R17; decou pled by C69. See also unde "Automatic volume control".

Voltages for L5:

V_a : No fixed bias.

Voltages for L6:

V_a : from potentiometer R7, R8; vi R36; decoupled by C3.
V_{g2} : from potentiometer R7, R8; vi R35; decoupled by C87.
V_{g1} : voltage drop across R5; via R3(R32, R33; decoupled by C86.

Voltages for L7:

V_a : via S52, R40; decoupled by C2 A
V_{g2} : via R41, decoupled by C2 A.
V_{g1} : voltage drop across R39.

Voltages for L8:

V_a : via R21; decoupled by C2 A.
V_{screen}: decoupled by C2 A.
V_{g1} : no fixed bias. See under "Optica tuning indication".

[1]) R46 is connected in parallel with S56.
[2]) C102 is an anti-hum condenser over the second part of S2

ADJUSTING THE RECEIVER.

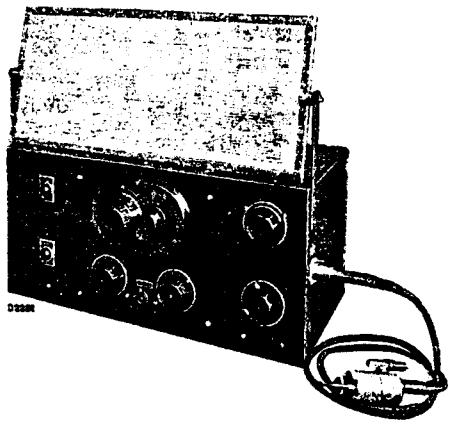

Fig. 1

For effecting adjustments it is generally not necessary to take the chassis out of the cabinet. By placing the set on its right side on a piece of felt and removing the base and rear panel all points necessary for trimming are accessible.

Readjustment is necessary:

1. After renewal of coils or condensers in the H.F. or L.F. part.
2. When the set is not sufficiently sensitive or selective.

During adjustment use is made of:

1. Service oscillator GM 2880 F (fig. 1) with artificial aerial.
2. Output indicator: Universal measuring apparatus 4256 or 7629.
3. Auxiliary receiver or aperiodic amplifier GM 2404.
4. Insulated trimming plug-in key 6 mm.
5. Insulated screwdriver.
6. "Kokerkit" for sealing the coil cores of the I.F. transformers.
7. "Philitine 110" for sealing the trimmers.
8. Condenser of 25 $\mu\mu$F.
9. Condenser of 32.000 $\mu\mu$F.
10. Trimming transformer.

As artificial aerial are used:

for I.F.: a condenser of 32,000 $\mu\mu$F.

for long and medium waves a standard dummy aerial.

for short waves a short-wave dummy aerial (=red spot on standard dummy aerial).

Always use the customer's valves when trimming. If during trimming the converter or oscillator valve becomes defective trim afresh (Pre-heat the new valve).

A. **Adjusting the I.F. circuits.**

1. Set waveband switch to 170-570 m band. Small tuning knob must be in pressed-in position.
   Turn the pointer to minimum (under 170 m).
   Set the performance switch to "foreign" (red indication).
   Turn the tone control to "high".
2. Short-circuit C6.
3. Connect the output indicator to additional speaker sockets via the trimming transformer.
4. Apply a modulated signal of 452 kc/s to the control grid of L2 via 32000 $\mu\mu$F.
5. Next adjust successively S50/S57, S49/S58. S47 and S46/S48 to maximum output (see fig. 2).
6. Seal the coil cores with "kokerkit". Remove the short-circuit of C6.

B. **Adjusting the I.F. wave trap**

1. Adjust the waveband switch to the 170-570 m band.
   Turn the pointer to maximum (above 570 m).
2. Apply a modulated signal of 452 kc/s to the aerial socket via the standard aerial.
3. Adjust S6 to minimum output (see fig. 2).
4. Seal S6 with "kokerkit".

Remark: after changing L2 or L3, C9 must be adjusted. (See under G, page C4).

C. **Adjusting the H.F. circuits of the wavebands.**

While these circuits are being trimmed:
the performance switch at "foreign" (red indication);
the small tuning knob pressed in.

I. **11-18 m waveband.**

1. Set the waveband switch at 11-18 m band.
2. With the aid of a small mirror adjust the triple condenser accurately to the mark (smallest capacity) (see fig. 2).
3. Connect the output indicator via the trimming transformer.
4. Apply a modulated signal of 25 Mc/s to the aerial socket via the short-wave dummy aerial.
5. Adjust C41, C26, C9, C41, C26 in succession to maximum output (see fig. 3).
   Remark: When adjusting C41 two maxima will be found; the maximum at the smallest capacity (trimmer turned out) is the right one.

6. Seal C9, C26 and C41 with "Philitine 110" and cover with a layer of "kokerkit".

Adjustment of the remaining wavebands is the same as the adjustment of the 11-18 m waveband, except that the trimming frequencies and the trimmers to be adjusted are different (see table below):
Next the padding condensers of the medium and long wave bands are adjusted as follows:

VA. **Adjustment of the padding condenser of the medium wave band (170-570 m).**

1. Short-circuit C6.
2. Connect the anode of L2 via a condenser of 25 μμF to the aerial socket of the auxiliary receiver or of the aperiodic amplifier. Connect the output indicator after the auxiliary receiver.
3. Apply a modulated signal of 550 kc/s to the aerial socket of the set to be trimmed via the standard dummy aerial.
4. Tune the auxiliary receiver (about 545 m).
5. Adjust the receiver to be trimmed to maximum output voltage with the aid of the small tuning knob (about 545 m.) **After this the small tuning knob must not be turned any more.**
6. Remove the auxiliary receiver and the short-circuit of C6.
   Connect the output indicator via the trimming transformer to the receiver to be trimmed.
7. Adjust C46 to maximum output (see fig. 3). Next trimmers C47, C30, C13 are adjusted once again (see under V), after which the trimmers C13, C30, C46 and C47 are sealed with Philitine 110, on top of which comes a coating of kokerkit.

VIA. **Adjusting the series padding condenser of the long wave band (750-2100 m).**

1. Short-circuit C6.
2. Connect the anode of L2 via a condenser of 25 μμF to the aerial socket of the auxiliary receiver or of the aperiodic amplifier. Connect the output indicator after the auxiliary receiver.
3. Apply a modulated signal of 150 kc/s to the aerial socket of the set to be trimmed, via a standard dummy aerial.
4. Tune the auxiliary receiver (to about 2000 m).
5. Adjust to maximum output voltage the receiver to be trimmed, by means of the small tuning knob (about 2000 m).

After this the small tuning knob must not be turned any more.

6. Remove the auxiliary receiver and the short circuit of C6.

	Waveband	Trimming Frequency	To be adjusted in succession
II	18— 30 m	15.5 Mc/s	C42, C27, C10, C42, C27
III	30— 52 m	9.6 Mc/s	C43, C28, C11, C43, C28
IV	52— 170 m	5.15 Mc/s	C44, C29, C12, C44, C29
V	170— 570 m	1550 Kc/s	C47, C30, C13, C47, C30
VI	750—2100 m	370 Kc/s	C49, C31, C14, C49, C31

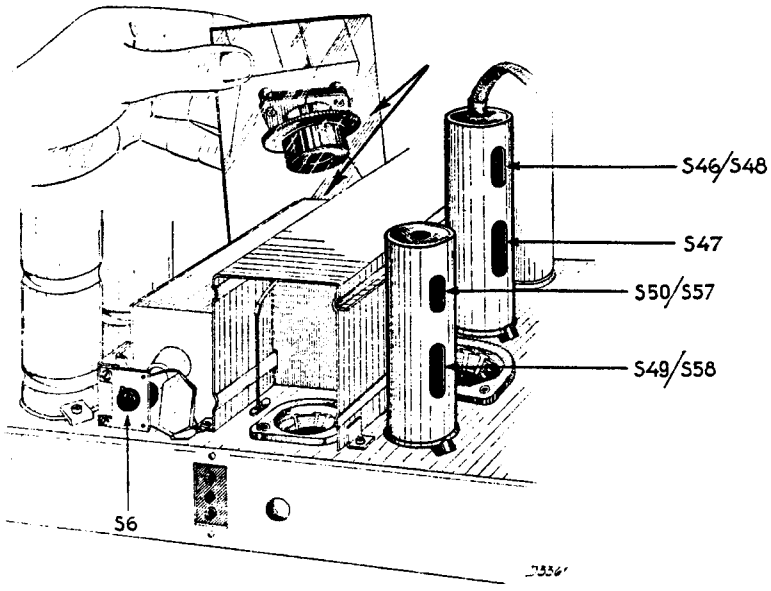

Fig. 2

Connect the output indicator via the trimming transformer to the receiver to be trimmed.

7. Tune C51 to maximum output (see fig. 3).
   After this the trimmers C49, C31 and C14 are readjusted (see under VI). Next the trimmers C14, C31, C49, C51 must be sealed with Philitine 110 over which a coating of kokerkit is applied.

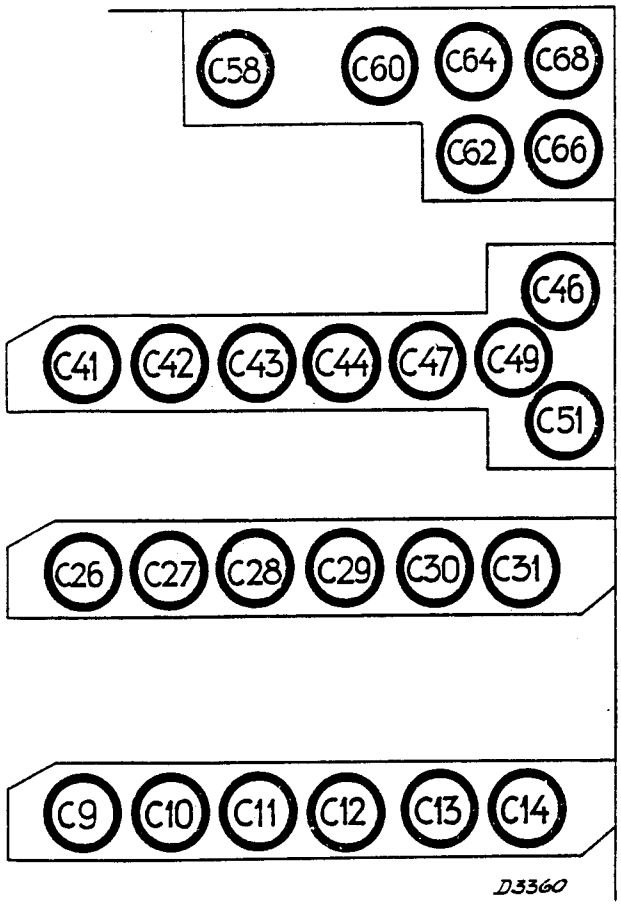

Fig. 3

D. **Adjusting the H.F. broadcast bands.**

I. **14 m broadcast band.**

a. **Provisional adjustment with the aid of a service oscillator.**

1. Connect output indicator via trimming transformer.
2. Set waveband switch to 11-18 m band.
3. Accurately adjust single slide condenser C7 to the mark by means of a small mirror.
4. Apply a modulated signal of 21.6 Mc/s to the aerial socket via the short wave dummy aerial.
5. Press in the small tuning knob and tune to maximum output. (Take care that the large tuning knob is not turned).
6. Pull out the small tuning knob.
7. Adjust C58 to maximum output (see fig. 3). Two maxima will be found: the maximum at the smallest capacity (trimmer turned out) is the correct one.

b. **Accurate adjustment with the aid of transmitting station.**

1. Adjust the receiver for reception on 14 m broadcast band (bandspread) and connect to outdoor aerial.
2. Look for a station with a known frequency that is as close as possible to 21.6 Mc/s.
3. Turn the lower pointer to the spot where the station should lie (the frequency can be read on the dial).
4. Adjust C58 till the transmitter comes through as powerfully as possible. Two maxima will be found: the maximum at the lowest capacity (trimmer out) is the correct one.
5. Seal C58.

The adjustment of the remaining broadcast bands is effected in the same way as for the 14 m broadcast band, except that the trimming frequency and the trimmers adjusted are different (see table below).

Broadcast band	Trimming frequency	Trimmer to be adjusted
17 m	17.8 Mc/s	C60
20 m	15.22 Mc/s	C62
25 m	11.8 Mc/s	C64
31 m	9.6 Mc/s	C66
49 m	6.1 Mc/s	C68

E **Adjustment of the pointers.**

I. **Upper pointer.**

1. Connect the output indicator via the trimming transformer.
2. Apply a modulated signal of 857 kc/s (350 m) to the aerial socket via the standard dummy aerial.
3. Tune the receiver accurately to maximum output.
4. Adjust the pointer to 350 m with the aid of the milled screw.

II. **Lower pointer.**

If the broadcast bands are adjusted as indicated in paragraph D, there is no longer any need to adjust this pointer.

F. **Adjustment of the discs that control the green lamp.**

I. If by turning the small tuning knob the green lamp does not ignite when the pointer comes near a broadcast band, the contact A (fig. 9, at the right) must be bent slightly more.

II. If on the 14 m broadcast band the green lamp lights up at the wrong moment proceed as follows:

1. Take the set out of its cabinet.
2. Set the waveband switch at 11-18 m band.
3. Turn the upper pointer to 21.6 Mc/s.
4. Slightly loosen adjusting screws of disc I (see fig. 6). (Take care that the spindle of the discs is not displaced).
5. Turn disc I until the green lamp burns.
6. Fix the adjusting screws again.

If with the other broadcast bands the green lamp lights up at the wrong moment proceed in the same way as mentioned above, except that the upper pointer is turned to a different frequency whilst the other discs are being adjusted (see table below).

Band-spread	Frequency at which the green lamp must burn	Disc that controls the green lamp
17 m	17.8 Mc/s	Disc I
20 m	15.22 Mc/s	Disc II
25 m	11.8 Mc/s	Disc II
31 m	9.6 Mc/s	Disc III
49 m	6.1 Mc/s	Disc III

G. **Adjusting of C98 after changing of L2 or L3.**

When L2 or L3 have been replaced by a new one. the pointer will in general not indicate correctly at bandspread. To correct this C98 must be adjusted as follows:

1. Adjust the receiver for reception on 14 m broadcast band (bandspread) and connect to outdoor aerial.
2. Look for a station with a known frequency that is as close as possible to 21.6 Mc/s.
3. Turn the lower pointer to the spot where the station should lie. (The frequency can be read on the dial).
4. Adjust C98 till the transmitter comes through as powerfully as possible. (C98 is connected at the top of the single slide condenser C7).
5. Seal C98.

H. **Use of the frequencymodulator GM 2881 and cathoderay-oscillograph GM 3153 or GM 3152.**

If the quality or the sensibility of the receiver are not sufficient after having adjusted in the above-mentioned manner, the tuning-curves can be checked with the aid of the frequencymodulator GM 2881 and the cathoderay-oscillograph GM 3153 or GM 3152.

When checking the I.F.-tuningcurve the service-oscillator GM 2880 F is connected to the inputgrid of L2 via 32,000 $\mu\mu$F; when checking the tuning curves for I.F. + H.F. the oscillator is connected to the aerial-socket via the standard dummy aerial; the socket K5 of the oscillograph GM 3153 is in both cases connected to the variabel contact of R25. For further inquires see the Manuel of the GM 2881.

When adjusting the foregoing assembly of apparatus can furthermore be used as an outputindicator. For this purpose the time-base of the oscillograph must be switched off and the modulation of the oscillator switched on. Adjusting is just the same as described in the foregoing C-sheets. but for the outputindicator. for which the length of the vertical line of the oscillograph is used.

FAULT FINDING

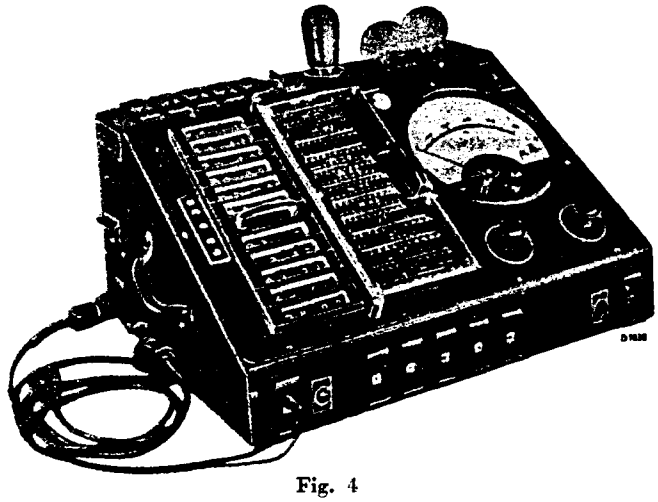

Fig. 4

For proper fault finding a good measuring instrument is indispensable; the Universal Measuring Apparatus GM 4256 or GM 7629 should therefore always be used.
In order to locate a fault it is generally unnecessary to take the set out of its cabinet. By removing the bottom and rear panel all points are accessible.
Never unsolder any connections before the fault has been located.
As combination cases may occur this manual is of course not complete.

I. **Connect the set to the right voltage and test it on an outdoor aerial with its own valves.**
   a. Set is working normally; leave it in operation and keep it under observation.
   b. Set is working badly or not at all; replace the valves by a set from a properly functioning receiver and if need be try another loudspeaker.

II. **Receiver still not functioning normally.**
   N.B. Below a distinction is made between **wave bands** and **broadcast bands.** The wave bands are the 11-18 m, 18-30 m, 30-52 m, 52-170 m, 170-570 m and 750-2100 m bands.
   The broadcast bands are the 14, 17, 20, 25, 31 and 49 m bands.
   a. Radio reception on all wavebands in order but not in all broadcast bands; see under XIII.
   b. Radio reception in a few wavebands in order, but not in all; See under XII.
   c. Radio reception in all wavebands, but with certain faults; gramophone reproduction good; see under XVIII.
   d. Radio reception and gramophone reproduction, but both with certain faults; see under XVII.
   e. No or very weak radio reception; gramophone reproduction good: see under VI.
   f. No or very weak gramophone reproduction: see under III.

III. **No or very weak gramophone reproduction.**
   Measure the voltage over C2 A.
   a. Voltage over C2 A abnormal: see under IV (Normal = 270 V).
   b. Voltage over C2 A normal: see under V.

IV. **Voltage over C2 abnormal.**
   1. Safety contact, voltage change-over switch, mains switch defective (Measure the voltage over S1).
   2. Feed transformer defective (measure the secondary voltages).
   3. Bad contact in valve holder of rectifier tube.
   4. C1, C2, C2 A, C96, C102[1]) short-circuited.
   5. S5, R5 interrupted.
   6. Primary winding of speaker transformer short-circuited against the secondary or against the core.
   7. C3 short-circuited.

V. **Voltage over C2 A normal, but no or only weak gramophone reproduction.**
   a. Filament-leads of one of the valves interrupted or short-circuited against the chassis or screening.
   C53, C92, C99, C100, C101[1]) interrupted.
   b. Currents and voltages of L7 abnormal. (Normally V_a = 245 V; V_{g2} = 265 V; $V_{cathode}$ = 7.8 V; I_a = 70 mA; I_{g2} = 8.4 mA).
      1. No I_a: R40, S52, R39 interrupted.
      2. No V_{g2}: R41 interrupted.
      3. R37, R38 interrupted; C88 short-circuited.
   c. Currents and voltages of L6 abnormal. (Normally V_a = 70 V; V_{g2} = 80 V; I_a = 1.8 mA; I_{g2} = 0.62 mA).
      1. No I_a: R36, R8, S51 interrupted: C3 short-circuited.
      2. I_a too high: C86 short-circuited.
      3. No V_{g2}: R35 interrupted; C87 short-circuited.
      4. R33, R32, R30 interrupted.
   d. Currents and voltages of L6 and L7 nor-

[1]) See pag. G 4

mal, but no or only weak gramophone reproduction.
1. Bad contact at points g and f of switch 9.
2. R25, R45, C77, R33 interrupted.
3. C88, R37 interrupted.
4. C89 short-circuited.
5. Loudspeaker transformer defective.
6. Loudspeaker switch defective.

VI. **Gramophone reproduction good, no or only very weak radio reception in one, some or all wavebands.**
a. An I.F. signal applied via 32000 μμF to the control grid of L4 reproduced very weakly or not at all: See under VII.
b. An I.F. signal applied to the control grid of L4 is reproduced, but not when applied to the control grid of L2: See under VIII.
c. An I.F. signal applied to the control grid of L2 is reproduced, but not an H.F. signal. Oscillator not functioning: See under IX and XII.
d. An H.F. signal applied to the control grid of L2 is reproduced, but not when applied to the control grid of L1: see under X and XII.
e. An H.F. signal applied to the control grid of L1 is reproduced, but there is no radio reception: See under XI and XII.

VII. **An I.F. signal applied via 32000 μμ F to the control grid of L4 is reproduced very weakly or not at all.**
a. Currents and voltages of L4 abnormal. (Normally: V_a = 250 V; V_{g2} = 110 V; $V_{cathode}$ = 2 V; I_a = 5.7 mA; I_{g2} = 1.7 mA).
1. No anode current: S58, R19, R17 interrupted; C70 short-circuited.
2. Anode current too high: C69 short-circuited.
3. No V_{g2}: R20 interrupted; C72 short-circuited.
4. S47 (S48), R18 interrupted.
b. Currents and voltages of L4 normal.
1. S58, S49, C78 short-circuited or interrupted.
2. S50, S57, C79 short-circuited or interrupted.
3. R23 interrupted; C81 interrupted or short-circuited.

VIII. **An I.F. signal applied via 32000 μμF to the control grid of L2 is not reproduced or only very weakly.**
a. Currents and voltages of L2 are abnormal. (Normally: V_a = 230 V; V_{g2} = 85 V; $V_{cath.}$ = 2.1 V; I_a = 2.1 mA; I_{g2} = 3.4 mA).
1. No anode current: S46, R16, R11 interrupted; C20 short-circuited.
2. Anode current too high: C37 short-circuited.
3. No V_{g2}: R12 interrupted; C36 short-circuited.
4. R13 interrupted.
b. Currents and voltages of L2 normal.
1. S46, C55 short-circuited or interrupted.
2. S47, S48, C56 interrupted or short-circuited.

IX. **An I.F. signal applied via 32,000 μμF to the control grid of L2 is reproduced, but an H.F. signal is not reproduced (in none of the wavebands).**
a. Currents and voltages of L3 abnormal. (Normally V_a = 145 V; $I_a + I_{g2}$ = 4.6 mA).
1. No I_a: S59, R15 interrupted; C40 short-circuited.
2. R14 interrupted.
b. Currents and voltages of L3 normal.
1. Bad contact at points y, k, j, u of switch 12 or point y of switch 2.
2. C52, C38 interrupted.
3. C6 interrupted or short-circuited.

X. **An H.F. signal applied to the control grid of L1 is not reproduced in any of the wavebands.**
a. Currents and voltages of L1 abnormal. (Normally V_a = 235 V; V_{g2} = 245 V; $V_{cathode}$ = 0.45 V; I_a = 7.3 mA; I_{g2} = 0.2 mA).
1. No I_a: R9, R44, R3 interrupted; C32 short-circuited; bad contact at point y of switch 5.
2. I_a too high: C82 short-circuited.
3. No V_{g2}: R6 interrupted; C19 short-circuited.
4. R2, R26 interrupted.
b. Currents and voltages of L1 normal.
1. C5 interrupted or short-circuited.
2. Bad contact at point y of switch 4.

XI. **No radio reception in any of the wave bands.**
1. Bad contact at point y of switch 7 or 6.
2. C4 interrupted or short-circuited.
3. C16 interrupted.

XII. **Radio reception, but not in all wavebands.**
a. No radio reception in the three shortest wavebands.
1. C15, C33, C54 interrupted or short-circuited.
2. Bad contact at the points p of the switches 6,4 or 2, at point k of switch 12.
b. No radio reception in the 11-18 m waveband.
1. S7, S8, S19, S20, S31, S32 interrupted or short-circuited.
2. C9, C26, C41 interrupted or short-circuited.
3. Bad contact at one of the points m of switches 7, 6, 5, 4, 3, 2.
c. No radio reception in the 18-30 m waveband.
1. S9, S10, S21, S22, S33, S34 interrupted or short-circuited.
2. C10, C27, C42 short-circuited or interrupted.
3. Bad contact at one of the points a of the switches 7, 6, 5, 4, 3, 2.
d. No radio reception in the 30-52 m waveband.

1. S11, S12, S23, S24, S35, S36 interrupted or short-circuited.
2. C11, C28, C43 interrupted or short-circuited.
3. Bad contact at one of the points b of switches 7, 6, 5, 4, 3, 2.

e. No radio reception in the 52-170 m waveband.
1. S13, S14, S25, S26, S37, S38 interrupted or short-circuited.
2. C12, C23, C29, C44, C45 interrupted or short-circuited.
3. Bad contact at one of the points c of switches 7, 6, 5, 4, 3, 2.

f. No radio reception in the 170-570 m waveband.
1. S15, S16, S27, S28, S39, S40 interrupted or short-circuited.
2. C13, C21, C24, C30, C46, C47, C48 interrupted or short-circuited.
3. Bad contact at one of the points d of switches 7, 6, 5, 4, 3, 2.

g. No radio reception in the 750-2100 m waveband.
1. S17, S18, S29, S30, R47[1]) S41, S42 short-circuited or interrupted.
2. C14, C22, C25, C31, C50, C51, C76, C49 short-circuited or interrupted.
3. Bad contact at one of the points e of switches 7, 6, 5, 4, 3, 2.

XIII. Radio reception in all wavebands, but not in all broadcast bands.

a. Radio reception in none of the broadcast bands: see under XV.
b. No reception in one or a few of the broadcast bands: see under XVI.

XV. No radio reception in any of the broadcast bands.

1. C61, C7, C98 interrupted or short-circuited.
2. Bad contact at point y of switch 1.

XVI. No radio reception in one or a few broadcast bands.

Check whether the band-spread switch is switched over at the right time by the pin on the metal driving drum.

a. No radio reception in the **14 and 17 m** broadcast bands.
1. S45, S59 short-circuited or interrupted.
2. C57 short-circuited or interrupted.
3. Bad contact at one of the points m, j of switch 12; y, a, k, h, u of switch 1; u of switch 8.

b. No radio reception in the **20 and 25 m** broadcast bands.
1. C67 short-circuited or interrupted.
2. Bad contact at one of the points l, b of switch 1; y of switch 8.

c. No radio reception in the **31 and 49 m** broadcast bands.
1. Bad contact at one of the points m of switch 1; q of switch 8.

d. No radio reception on the **14 m** broadcast band.
1. C58 short-circuited or interrupted.
2. Bad contact at point h of switch 8.

e. No radio reception in the **17 m** broadcast band.
1. C59, C60 short-circuited or interrupted.
2. Bad contact at point k of switch 8.

f. No radio reception in the **20 m** broadcast band.
1. C62 short-circuited or interrupted.
2. Bad contact at point m of switch 8.

g. No radio reception in the **25 m** broadcast band.
1. C63, C64 short-circuited or interrupted.
2. Bad contact at point b of switch 8.

h. No radio reception in the **31 m** broadcast band.
1. C65, C66 short-circuited or interrupted.
2. Bad contact at point d of switch 8, points d and q of switch 1.

j. No radio reception in the **49 m** broadcast band.
1. C68 short-circuited or interrupted.
2. Bad contact at point f of switch 8.

XVII. Gramophone reproduction with certain faults.

a. Quality bad.
1. R32, R30 interrupted: C86 short-circuited.
2. R38 interrupted.
3. C73, R24 interrupted or short-circuited.
4. C97, R45, C77, R33, C84, C85 interrupted or short-circuited.
5. S51, S60, R34, R28 interrupted or short-circuited.
6. R42, S61 short-circuited or interrupted.
7. S56, R46[2]) C90, C91 short-circuited or interrupted.
8. Bad contact at points q, g of switch 10.

b. Reproduction weak.
1. C86 interrupted.
2. Bad contact at points k, w of switch 10.

c. Hissing and whistling noises.
1. C89 interrupted.
2. S56, R46[2]) C90, C91 short-circuited or interrupted.

d. Hum.
1. C1, C2, C2 A, C96, C102 interrupted.
2. S5 short-circuited.

e. The receiver crackles.
1. Bad contact at a soldering place, switch or coil box.

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[1]) R47 is connected in series with S30.
[2]) R46 is connected in parallel with S56.

f. Resonances.
These may be caused by loose parts. When the resonating part has been found it must be fixed, possibly with the aid of a piece of felt.

XVIII. **Gramophone reproduction good, but radio reception with certain faults.**

a. Automatic volume control working badly or not at all.
1. R22, R27, R26, R2, R18 interrupted.
2. C71, C93, C17, C16 short-circuited.

b. Insufficient selectivity.
1. Set out of adjustment - requires trimming.

c. Reproduction weak.
1. Set out of adjustment - requires trimming.
2. Bad contact at points t, g, p, c of switch 11.
3. C23, C24, C25, C32 interrupted.
4. C38, C39 interrupted.
5. One of the I.F. transformers defective.
6. C93, C81 interrupted.
7. Bad contact at points b, c, o of switch 9.

d. Hum.
1. S43, S44 short-circuited.
2. C53, C92, C99, C100, C101 interrupted.

e. Set howls, whistles or motor-boats.
1. C19, C32, C3, C36, C20, C72, C87, C40, C93, C71, C81 interrupted.

f. Optical tuning indicator functioning badly or not at all.
1. R22, R27, R21 interrupted.

FAULT-FINDING IN ACCORDANCE WITH THE POINT-TO-POINT SYSTEM

If a test instrument, type 4256 or 7629 is available, faults may be easily localised by following the point-to-point system.

In the first stages this method corresponds with the system described in page E1,so that a commencement may be made with the operations mentioned in Section I of those sheets.

After having done this, proceed as follows:

1. All valves are removed from the receiver. The universal test apparatus is connected and set for resistance testing (position 12). The positive pin on the test lead is so extended that the various contacts of the valveholders can be reached easily, the other pin being inserted in the earth socket of the receiver.
2. Place in the valveholder of the rectifier a valve base with the contacts of filament and anodes interconnected.
   This also protects the meter, as otherwise the smoothing condenser might load up during testing, and this might involve burning out of the meter.
3. The various resistances between the points indicated in the accompanying table and the chassis are measured by touching the points indicated with the positive pin. The deflection of the meter is compared with the values given in the table. 13 indicates that a test must be made between contact 13 and earth, etc. 11/12 means that the test is made between points 11 and 12. Differences of 10 per cent may be met with, but this does not necessarily indicate that the relative component is faulty.
4. When the resistance tests have been completed the test apparatus is switched over for capacity testing, the values given in the corresponding table being checked.

By testing all the different circuits of the receiver in this manner the fault must ultimately come to light and the particular component concerned is then ascertained with the aid of the theoretical circuit. Should the fault not be located, however, it is advisable to repeat the investigations suggested in pages E.

The contacts of the valveholders are numbered systematically as follows:

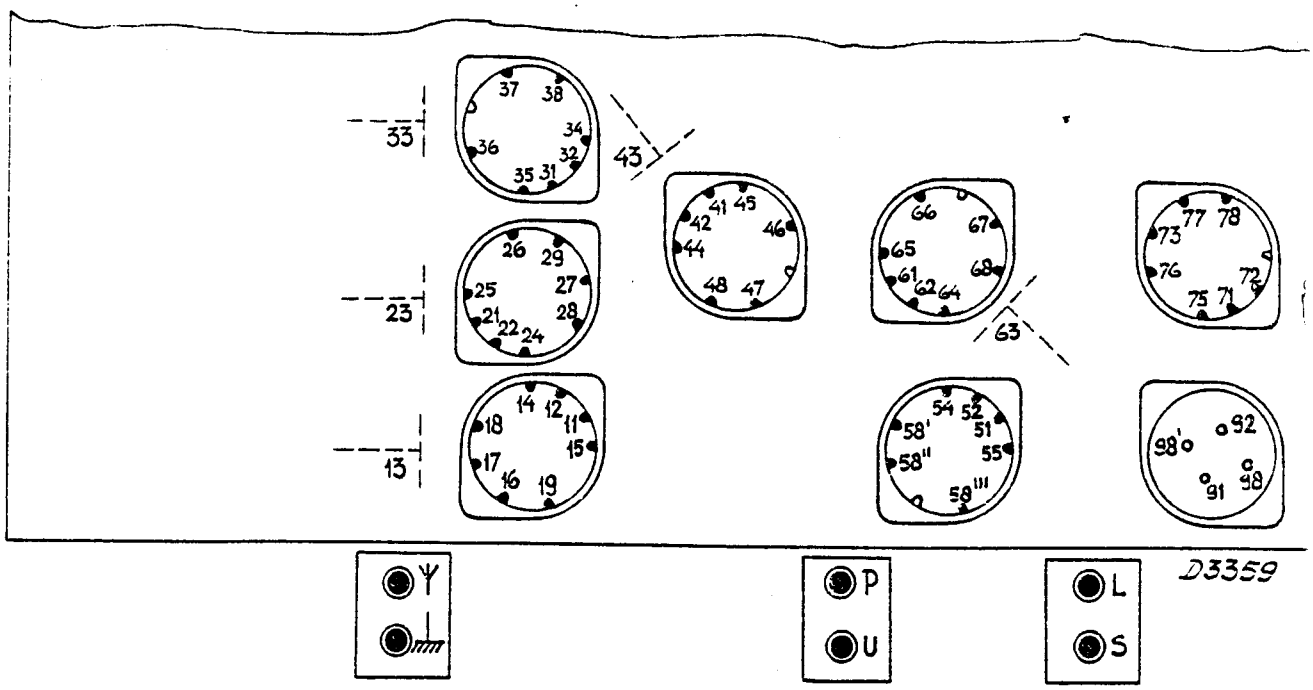
The first figure indicates the valveholder, the second as follows:

1 and 2 = Filaments (heaters).
3 = control grid.
4 = metallising (if connected to separate contact).
5 = cathode.
6 = extra grid.
7 = screen grid.
8 = anode.
9 = extra grid.

It is necessary for various tests to change the position of the wavelength switch, and this in indicated in the table in the following manner:

$$6 \times 23$$

In testing an electrolytic condenser (resistance tests), it will be found that the deflection drops back to a certain value by reason of the fall in the leak current. It may happen that the value found is very much too high, due to the condenser in the receiver not having been used for some time, so that a certain amount of care should be exercised when testing electrolytic condensers.



RESISTANCE

12	11/12	21/22	31	32	41/42 ... 91/92			14 ... 64			L/s	6 × Y [1]					
	5	5	45	45	5 ... 5			5 ... 5			45	460	365	215	160	135	95
12	6 × 23 [1]						2 × 23 [2]	6 × 35 [1]				36/38	37/38	55			
	470	115	55	30	10	10	470	260	5	105	20	40	35	35	5	5	5
11	15	16	19	25	45	46	75	77	78	[3] 98	[3] 98′	12	58′	58‴	65	66	
	245	215	215	330	305	305	165	300	365	290	290		5	5	360	360	
10	17	6 × 18 [1]						26	27	28	29	33	6 × 38 [1]		47	48	28 [3]
	250	440	445	450	450	450	450	80	140	430	140	140	240		100	450	125
9	13	43	43 [4]	43 [5]	58″	[5] 58″	63	63 [6]	67	68	73	U [5]					
	65	90	90	100	245	500	85	65	305	395	180	265					

CAPACITY

12									10	28	67						
										320	250						
11	47	27							9	87							
	160	170								460							

Measured with:
Waverangeswitch on 750—2100 m.
Small tuningknob pushed in.
Tuning condensers on minimum.
Volume control on minimum.
Tone control on high notes.
Performance switch on „sensibility" (red).

[1] Successively LW; MW; SWI; SWII, SWIII; SWIV.
[2] Performance switch on „Normal" (white). Waverangeswitch successively on LW and MW.
[3] Without short-circuiting valve base.
[4] Performance switch on „Normal" (white).
[5] Position „Gramophone".
[6] Tone control on low notes.

REPAIRS AND CHANGING PARTS

ttention must always be paid to the following oints when effecting repairs:

. After repair. wires and screenings must always be returned to their original position.
. Elastic rings. lock rings and insulation material must be fitted exactly as before repairs.
. Rivets can be replaced by bolts and nuts.
. If necessary. moving parts can be greased with a little pure vaseline.
. Condensers dipped in compound must be soldered at least 1 cm from the compound.
. Condensers dipped in compound must be suspended free from the other wiring.
. Resistances must always be suspended freely (heat development!).
. When despatching the set the packing material (also that in the case) must always be placed in the original positions and the base screws tightened.

aking the set out of the cabinet

efore taking the set out of the cabinet first examine hether it is not sufficient to remove the bottom nd rear panels.

. Remove the knobs.
. Unscrew the mains switch (two screws on either side of the knob).
. Unsolder the loudspeaker.
. Take the green and red signal lamps from their fixing braces.
. Loosen the base screws.
. The chassis can now be slid out of the cabinet.

enewing the dial.

. Take the chassis out of the cabinet.
. Slightly loosen screws A (fig. 5). Take the strings off the wheels B and D (let them rest on the spindle behind the wheels).
. Remove the brown window round the scale (8 screws).
. Unscrew the strap at the left (at the side of the tuning indicator) in which the dial revolves, push it to the left for about 1 cm and fix it again with one screw. Take care that the cables don't get removed from the wheels.
. Unscrew the setting screws in the drum at the right side of the dial.
. Push the dial as far as possible to the left, so as to remove the drum from its axe. The drum also stays in its initional position.
. The dial can now be removed.
. Loosen the covers on both sides of the dial.
. Cement the covers to the new dial.
0. Mounting of a new dial is effected in the reverse order.

riving strings and Bowden cables.

hese are supplied per metre.
efore proceding to cut off the strings or inner ables tin locally with the aid of acid-free soldering ux and cut in the middle of the tinned part. This done to prevent relaxation.
ut off the outer cable with a pair of tongs and then nish with a file: remove burrs on the inside.

The Bowden cables must always be handled with great care. Even a slight kink may cause stiff running and backlash.
The nipple of the stretching device of the pointer strings must be fitted in such a way that the thin end falls into the central hole of the plate before it. This plate must slide lightly over the hairpin on the stretching plate. If necessary slightly bend the hairpin. The run of the cables is shown in fig. 5 and 6.

Cable lengths

String for upper pointer	1180+745 mm
String for lower pointer	985+875 mm
Inner cable for driving the scale (P) .	590 mm
Outer cable for „ „ „ (P) .	250 mm
Inner cable for „ „ „ (Q) .	657 mm
Outer cable for „ „ „ (Q) .	260 mm
Inner cable for performance switch .	580 mm
Outer cable for „ „ .	470 mm
Driving string for bandspread	676 mm
Driving string for normal tuning . . .	820 mm

The driving strings of the pointers can be stretched by unscrewing the screws A and pushing aside the strap E. Also by pushing aside the wheels at the left of the chassis, after having unscrewed the fixing screws.

Switches in the circuit diagram.

A switch is drawn as seen from the side of operation. with the receiver upright. The switching elements are numbered from the side of operation.
At the first switching element is indicated the position of the arresting ball. In the case of several switching elements the outer side of the stator plate is indicated 90° to the left of the ball.
A small circle represents a contact spring; a black spot an open place on the stator. The outer ring of circles indicates the contact springs on the side of the arresting plate, the inner ring of circles the contact springs on the side facing away from the arresting plate.
The rotor contacts are represented by arcs and radial lines: continuous on the side of the arresting plate and broken on the side facing away from the arresting plate.
The switching elements are renewed completely (For code numbers see the 0-sheets).

Repairing a waveband switch.

1. Unsolder the connections of the stator to be renewed.
2. Remove the spring behind the flat spindle at the back of the chassis.
3. Slide the flat spindle through the hole in the rear of the chassis.
4. Bend slightly the brace in which the stator is mounted and renew the stator with rotor.
5. Solder connections to the stator.
6. Fit the flat spindle and compression spring.

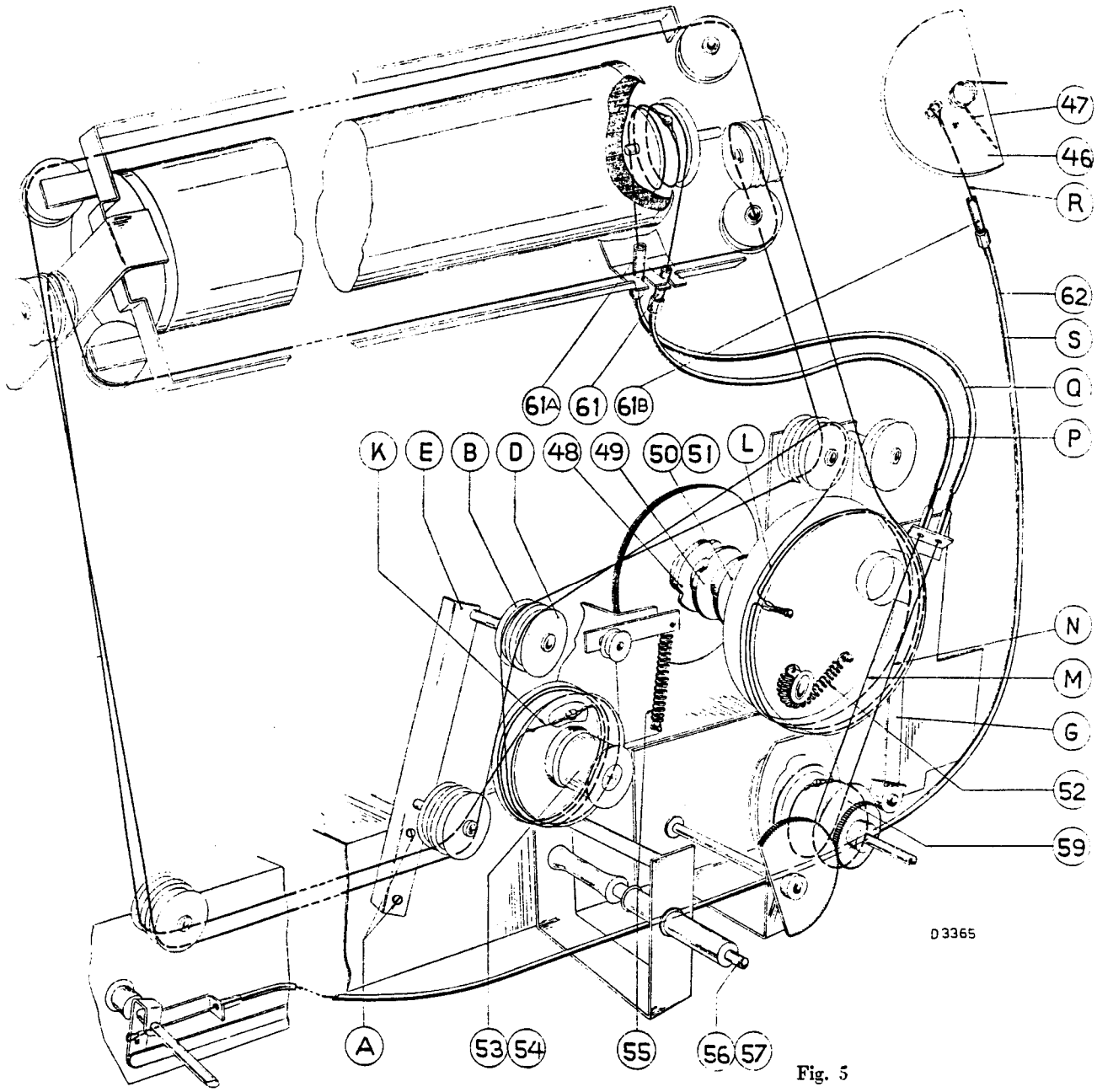


Fig. 5

The upper pointer is indicating on the long wave end of the dial and the lower one on the short wave end.

The wire which runs from the dial to the drum of the triple tuning condenser is wound one turn less around the drum than indicated in fig. 5.

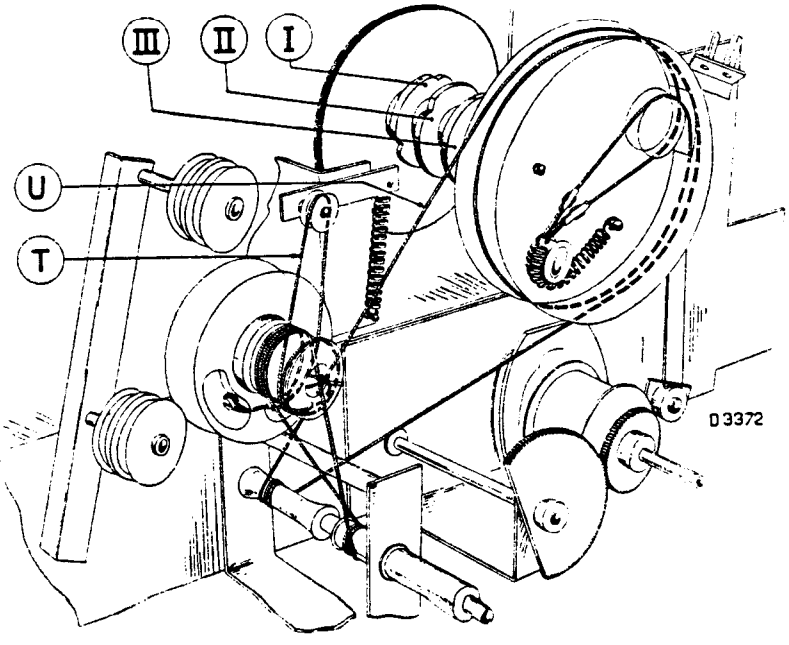


Fig. 6

The upper pointer is indicating on the long wave end of the dial and the lower one on 25 m.

The cord fixed on the screw on the driving drum of the single tuning condenser is wound one turn less around said drum than indicated in fig. 6.

epairing the gramophone-,performance and band-read switches.

Unsolder the connections of the stator to be renewed.
Unscrew one of the two fixing strips.
Renew the stator with rotor.
Solder the connections.
Fit the fixing strip.

ote: When effecting repairs to switches take care that none of the parts are turned 180°.

enewing I.F. coils.

Unsolder connections.
Bend slightly upwards the tags by which the coil box is fixed to the chassis.
Take the coil box upright out of the chassis.
Insert a new coil box and press the tags home with a special lever.
Solder the connections.

ıould the tags of the chassis be broken off the ils are then fixed by means of a clamping plate.

enewing H.F. coils.

hese coils are mounted in units on a brace along ith their trimmers and switching segments.
hese braces are removed as follows for renewing ıe coils:

Aerial coils.

1. Unsolder the connections to the unit, two from the circular strip, two from the performance switch.
2. Take the flat spindle out of the waveband switch.
3. Undo the four 3 mm screws with which the brace is fixed to the chassis.
4. Take out the unit.

Plate coil L1, grid coil L2.

1. Unsolder the connections to the unit, two from the circular strip.
2. See a2 up to and including a4.

Generator coils.

1. Unsolder the connections on the circular connecting strips (three connections) and also the connection to the band switch.
2. Unsolder the connections from stator 2 to stator 1 of waveband switch.
3. Unsolder the connection of C6 to the stator 2 of waveband switch.
4. Unscrew 3 fixing screws from the brace on the chassis.
5. Take out the unit.

When mounting take care that the soldering tags are again screwed under the fixing scews of the unit.

Next:

1. Unsolder the connections of the coil to be renewed.
2. Unscrew the clamping plates.
3. Take out the coil box.
4. Fix a new coil and solder the connections.

Renewing variable condensers.

Under no pretext may the driving mechanism be taken off the variable condenser. The "Philite" driving drum (on the single condenser) and the cogwheel (on the triple condenser) may on the other hand be renewed.

Backlash may be caused by:

1. Too weak a compression spring after the variable condenser (change the condenser).
2. Spring in the fork-shaped brace of the driving mechanism does not press sufficiently against the guide track.
3. Tension springs of driving strings too slack.

Loudspeaker (type 9632)

Defects

1. No reproduction: short-circuit or interruption in voice-coil.
2. Reproduction too weak and distorted: coil jammed.
3. Rustling: dirt in the air-gap, distorted coil, injured cone or too loose connections.

Important

1. When repairing take care for dust and iron-parts.
2. The front and rear plates may not under any circumstances be pulled off from the magnet.
3. Replace dust-cover after repair.

Centring the cone

This can be done with 4 pertinax calibers which can be inserted between the coil and the core. A new cone can be centered with 4 calibers and fixed with a clamping ring with incisions.
For renewing the cone-carrier a special gauge is required which is placed in the air-gap before loosing the three nuts.

Alterations, that were made after the diagrams were printed:

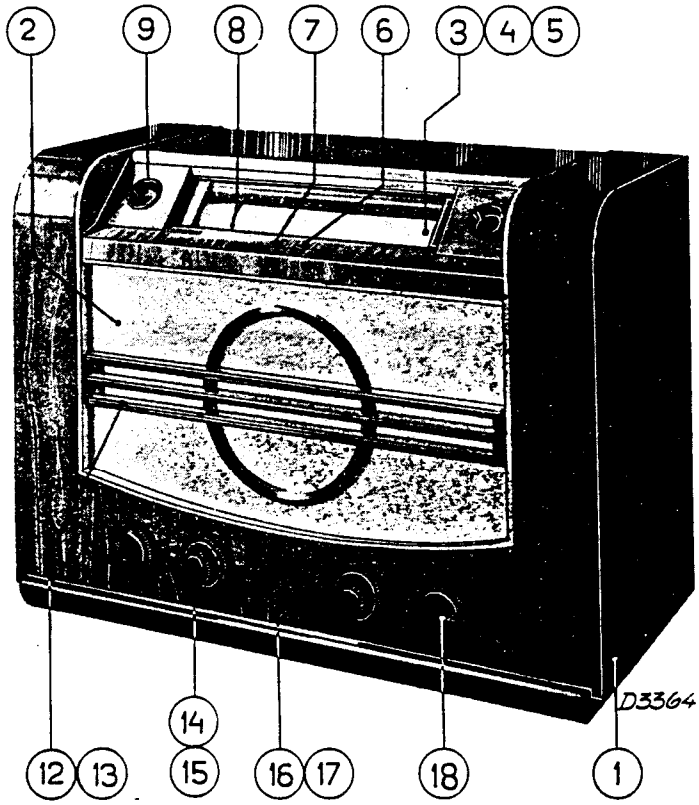
1. A resistance R47 is connected in series with S30.
2. A resistance R46 is connected in parallel with S56.
3. C99 en C100 are connected between the filamentleads and earth (Mounted on the pover transformer).
4. C101 is connected between Sk. A and earth (Mounted between the chassis and the middle contact of the strop at the right of fig. 9).
5. C102 is mounted in parallel with the second part of S2.
6. In the List ef Parts are mentioned a white and a red pointer. This must be altered into Upper and Lower pointer resp., as the pointers are not coloured.
7. When placing the valves into set, take care that L3 is not changed for the other valve EF6. For this purpuse L3 is marked with a blue dot. When L3 has to be changed for a new one, mark the new valve.

LIST OF SPARE PARTS AND TOOLS

When ordering Parts, please always mention.
1. Codenumber.
2. Description.
3. Type of the receiver.

Fig.	Pos.	Description	Codenumber	Price
7	1	Cabinet	28 246 59.0	
7	2	Loudspeakercloth	06 601 14.0	
7	3	Glass cylinder with station-names	A1 891 40.1	
7	4	Glass plate before the station-name dial	28 405 62.1	
7	5	Sponge-rubber behind the foregoing plate		
7	6	Little bush with red glass before lighting valve	A9 861 04.0	
7	7	The same with green glass	A9 861 05.0	
7	8	White pointer	A1 314 03.1	
		Red pointer	A1 314 02.1	
7	9	Ring before the tuning-indicator (colour 038)	23 996 80.0	
8	10	Cap for mains-switch (colour 038)	28 856 45.0	
8	11	Screw for fixing the mains-switch	07 720 44.0	
7	12	Ornamental band (with metal bands; colour 038)	23 684 64.0	
7	13	Ornamental band (metal)	28 433 87.0	
7	14	Knob for volume-control (colour 038)	23 610 54.1	
7	15	Spindle for volume-control	28 005 90.0	
7	16	Knob for tone-control (colour 038)	23 610 55.1	
7	18	Knob for sensibility-switch (colour 038)	23 611 87.2	
8	19	Mains-switch	28 650 25.0	
8	20	Loudspeakerswitch	28 653 00.0	
8	21	Plate with pins for mains-connection	28 875 04.0	
8	22	Spring for fixing the rear panel	28 752 07.2	
8	23	Valveholder for rectifier	28 225 90.0	
8	24	Plug socket plate	28 874 52.0	
8	25	Valve hood	28 838 74.1	
8	27	Valve cap	28 906 02.3	
		Valveholder for L2 and L3 (H.F.-philite)	28 839 81.0	
8	28	Spring behind switch no. 11	49 542 86.0	
8	31	Little plate for fixing the coil-boxes	28 051 09.0	
8	32	Bottomtulle	28 725 37.2	
8	33	Bracket for bottomtulle	28 081 54.2	
8	34	Threaded socket for bottomtulle	28 146 40.1	
8	35	Screw for bottomtulle	28 646 53.2	
8	36	Spring for turning the pointer-frame	A1 973 04.0	
8	37	Drum near the stationname-dial	23 681 02.0	
8	38	Grub-screw on the foregoing drum	07 854 12.0	
8	39	Screw on the foregoing drum	28 647 38.0	
8	40	Double cogwheel for driving the triple condenser	A1 346 00.0	
8	41	Little spring on foregoing cogwheel	28 731 29.0	
8	42	Ligthingvalveholder	08 515 21.1	
8	43	Spring for fixing the rear panel (above)	28 750 04.0	
8	44	Knurled screw for tuning-indicator	07 742 02.0	
8	45	Valveholder for tuning-indicator	28 226 10.0	
		Marking-disc	28 713 27.1	
		Rear panel	A9 861 06.0	
		Safety-contact	28 839 51.0	
		Parts of the safety-contact: Box	23 660 59.2	
		Parts of the safety-contact: Cover	28 713 24.0	
		Parts of the safety-contact: Spring	28 753 02.1	
		Parts of the safety-contact: Spring	28 753 03.1	
		Parts of the safety-contact: Screw 3 × 20 mm	07 803 20.0	
		Rod to which pos. 27 is connected	23 681 03.1	

Fig.	Pos.	Description	Codenumber	Price
		Mains-flex	33 983 24.0	
		Soldering-tag under the electrolytic condensers	08 532 47.0	
5	46	Indicationplate for the sensibility-switch	28 876 71.1	
5	47	Spring behind the foregoing plate	28 760 40.0	
		Knurled screw behind the pointers	07 742 01.0	
		Spring behind the pointers	A1 973 03.0	
		Camwheel on spindle of triple condenser	23 687 09.0	
5	48	Disc with incissions before the double camwheel (for the waverange from 11—18 m)	23 684 74.0	
5	49	The sam efor the waverange from 18—30 m	23 684 62.0	
5	50	The same for the waverange from 30—52 m	23 684 63.0	
5	51	Grub-screw on the foregoing discs	07 852 20.0	
		Contact-spring for the green dial lamp	A1 349 01.0	
5	52	Spring on driving-drum of the triple condenser	28 740 81.0	
5	53	Drum on spindle of C7	23 687 10.0	
5	54	Screws on the foregoing drum	A1 854 06.0	
5	55	Spring for stretching the driving-cord of C7	28 740 79.1	
5	56	Spindle of waverange-tuning	28 005 97.2	
5	57	Screw at the end of the foregoing spindle	A1 854 00.0	
		Plate H.F.-philite for fixing C41-C49	28 899 68.1	
5	59	Drum on the spindle of the waverange-switch	23 681 04.1	
		Switch-element no. 1	28 899 51.0	
		Switch-element no. 2, 4, 6	28 899 52.0	
		Switch-element no. 3	28 899 53.0	
		Switch-element no. 5	28 899 54.0	
		Switch-element no. 7	28 899 55.0	
		Switch-element no. 8	A9 860 27.0	
		Switch-element no. 9	A9 860 28.0	
		Switch-element no. 10	A9 860 29.0	
		Switch-element no. 11	28 899 97.0	
		Switch-element no. 12	A9 860 30.0	
		Ball for the arresting-devices	89 205 80.0	
5	61	Threaded socket at the end of the outer-cables	28 647 00.1	
5	62	Outer cable	08 009 79.0	
		Rubbertulle	28 725 43.0	
		Rubbertulle	25 655 43.0	
		Spindle with three flat springs for controling the green valve (near pos. 48, 49, 50)	28 863 56.1	
		Spring behind the flat spindle of switch-elem. no. 10	28 751 45.1	
		Grub screw 4 × 10 mm	07 854 10.0	
		Plush band round the scale	06 295 20.0	
		Loudspeaker: Cone carrier (chassis)	28 256 08.2	
		Loudspeaker: Clamping ring	28 446 75.0	
		Loudspeaker: Paper ring	28 445 88.0	
		Loudspeaker: Cone with speaker coil	28 220 61.0	
		Loudspeaker: Sound-diffusor	23 666 60.2	
		TOOLS		
		Service oscillator	GM 2880	
		Universal Measuring Apparatus	GM 4256	
		Universal- and Valvemeasuring Apparatus	GM 7629	
		Insulated trimming key	23 685 66.0	
		Insulated trimming screwdriver	M 646 38.2	
		15°-gauge	09 992 44.0	
		Philitine 110	02 771 34.0	
		Trimming transformer	09 992 22.0	
		Lever for fixing coils	09 991 56.0	
		Clamping plate for fixing coils	28 080 87.0	
		Centring gauge for loudspeaker	09 992 41.0	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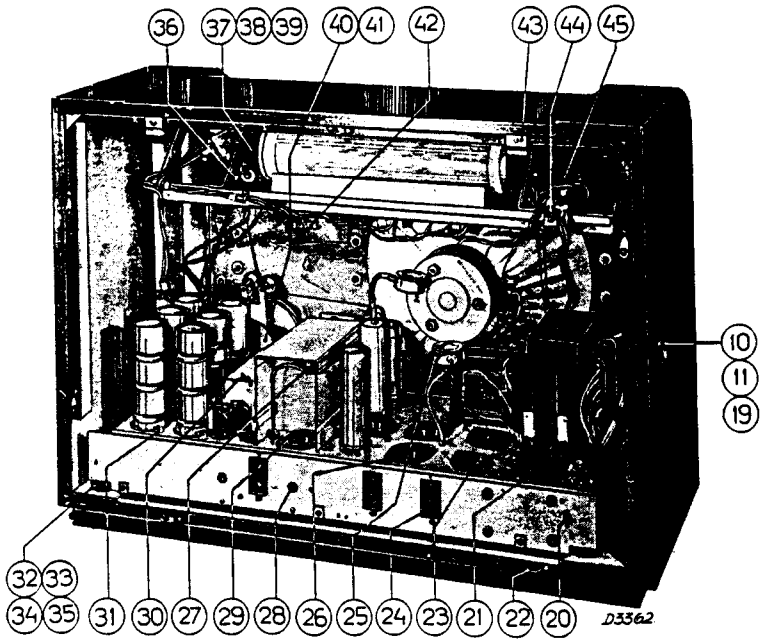
1

Fig 7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D3362

Fig. 8

291 A

TENSIONS AND CURRENTS

	L1	L2	L3	L4	L6	L7	L8
Va	240	240	145	260	70	245	—
Vg3	245						
Vg2		85		110	80	265	250
Vcath.	0.4	2.0		2.0		7.0	
Ia	7.3	2.0		5.7	1.8	70	0.3
Ig3	2.1						
Ig2				1.7	0.6	8.3	0.4
Ig2+4.		3.4					
Ia+Ig2+3			4.6				

Vc1 = 300 V. Imains = 435 mA (when Vmains = 220 V.).
Vc2 = 275 V Primary consumption = 90 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 used and the current consumption of the meter itself. The values given above are the mean of several measurements, therefore, some readings obtained may differ appreciably 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.

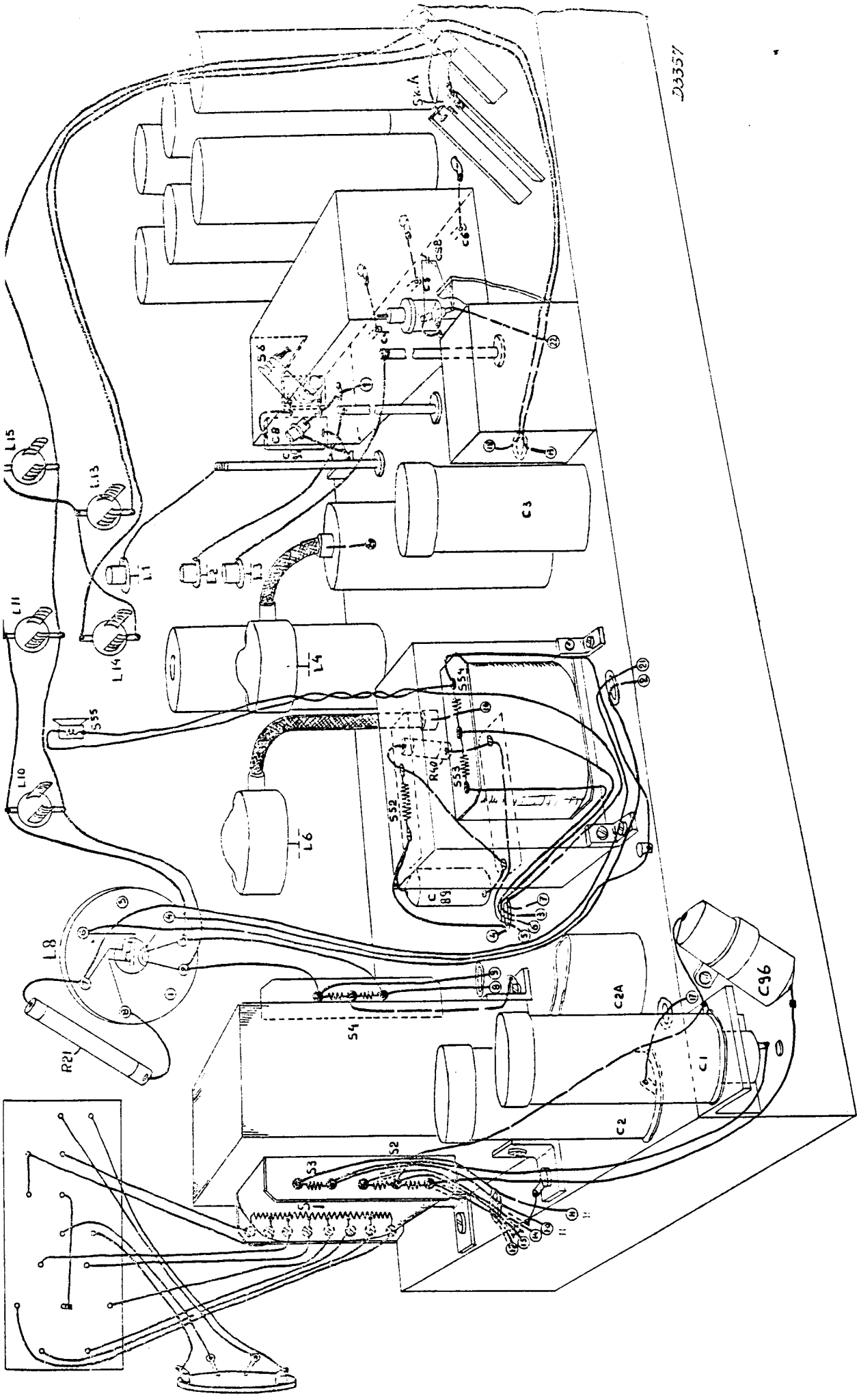

D3357
SK.A
L15
L13
L1
L2
L3
L11
L14
L4
S55
L10
L6
S54
S53
S52
R40
C
89
L8
R21
S4
C2A
C96
C1
C2
S3
S2
S5
C3

Fig. 9

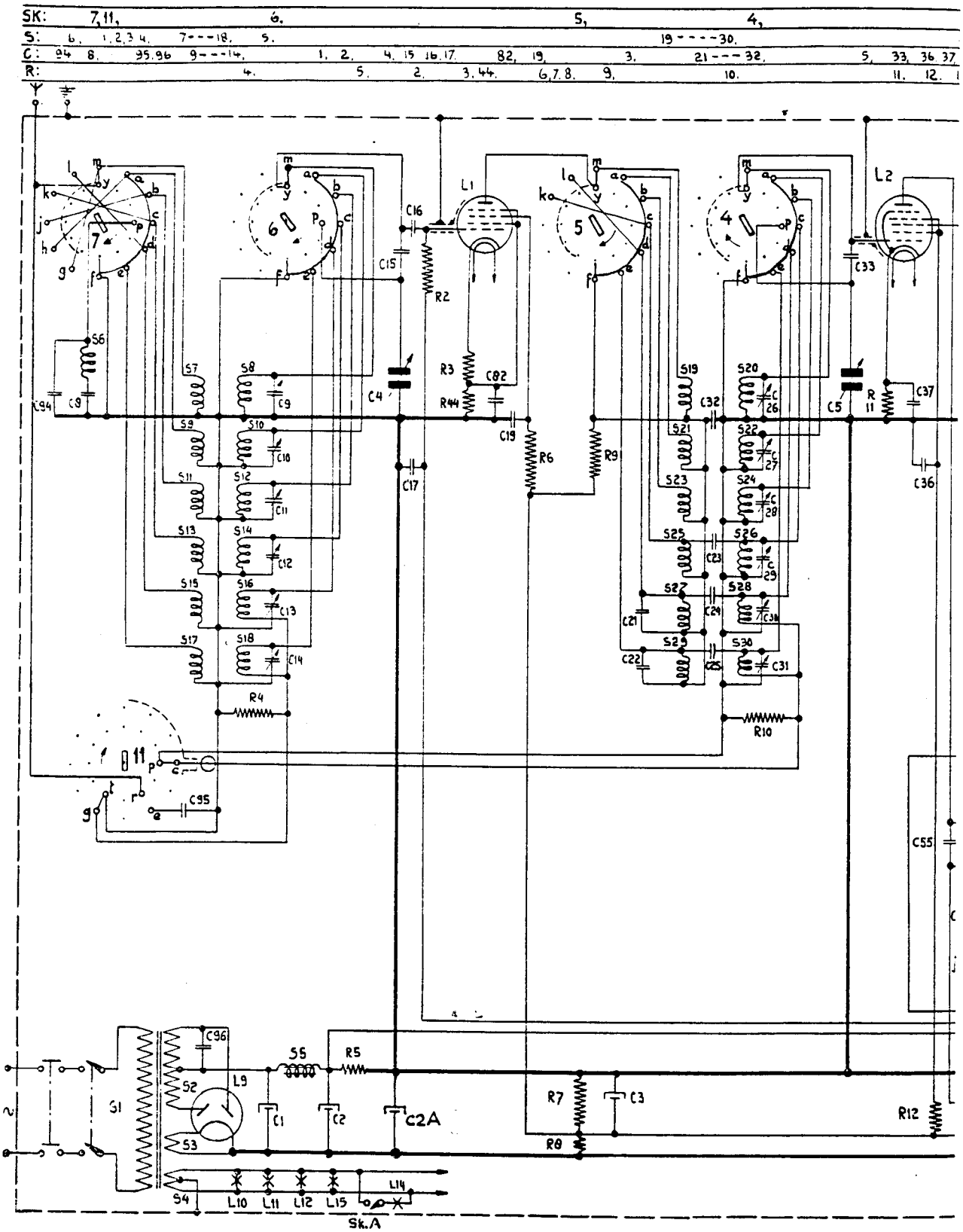
COILS

	Resistance	Codenumber	Price
S1	—		
S2	120 ohm	28 538 28.1	
S3	<0.5 ohm		
S4	<0.5 ohm		
S5	220 ohm	28 546 95.0	
S6	10 ohm	A1 000 18.0	
S7	2.5 ohm		
S8	<0.5 ohm		
S9	3.5 ohm	28 574 25.0	
S10	<0.5 ohm		
S11	4.5 ohm		
S12	0.5 ohm		
S13	7.5 ohm		
S14	1 ohm		
S15	28 ohm	28 574 28.0	
S16	3 ohm		
S17	120 ohm		
S18	50 ohm		
S19	1 ohm		
S20	< 1 ohm		
S21	1.5 ohm	28 574 26.0	
S22	< 1 ohm		
S23	1.5 ohm		
S24	< 1 ohm		
S25	70 ohm		
S26	1 ohm		
S27	280 ohm	28 574 29.0	
S28	3 ohm		
S29	440 ohm		
S30	45 ohm		
S31	< 1 ohm		
S32	< 1 ohm		
S33	< 1 ohm	28 574 27.2	
S34	< 1 ohm		
S35	< 1 ohm		
S36	< 1 ohm		
S37	< 1 ohm		
S38	< 1 ohm		
S39	6 ohm	28 574 30.1	
S40	2.5 ohm		
S41	4.5 ohm		
S42	20 ohm		
S43	< 1 ohm	28 589 00.0	
S44	< 1 ohm		
S45	< 1 ohm	A1 000 06.1	
S59	< 1 ohm		
S46	10 ohm		
S47	10 ohm		
S48	< 1 ohm	28 574 37.1	
C55	100 $\mu\mu$F		
C56	103 $\mu\mu$F		
S49	—		
S50	4.5 ohm		
S57	6 ohm	28 574 38.1	
S58	6 ohm		
C78	113 $\mu\mu$F		
C79	117 $\mu\mu$F		
S51	20 ohm	A1 000 15.0	
R34	4 ohm		
S52	230 ohm	28 537 90.2	
S53	< 1 ohm		
S54	5 ohm		
S55	1 ohm	28 220 61.0	
S56	15 ohm	A1 000 16.0	
S57	6 ohm	See S50	
S58	6 ohm	See S50	
S59	< 1 ohm	See S45	
S60	15 ohm	28 547 00.3	
S61	170 ohm	28 587 93.0	

VALVES

L1	L2	L3	L4	L5	L6	L7	L8	L9
EF8	EH2	EF6	EF9	EAB1	EF6	EL6	EM3	1561

L10	L11	L12	L13	L14	L15
8045D-07	8045D-07	8073D-07	8073D-07	8091D-07	8045D-07



Wavebandswitch at position 11-18 m.
Switch no. 12 at position „Normal".
Performance switch at position „Foreign".

	Value	Codenumber	Price		Value
R2	0.8 M.Ohm	28 773 99.0			
R3	40 ohm	28 770 11.0		R12	2×0.1 M.Ohm par.
R4	10 ohm	28 773 50.0		R13	0.1 M.Ohm
R5	25 ohm	28 770 09.0		R14	50000 ohm
R6	20000 ohm	28 770 38.0		R15	2×40000 ohm par.
R7	2×0.125 M.Ohm par.	28 771 11.0		R16	2000 ohm
R8	2×2000 ohm	28 770 93.0		R17	320 ohm
R9	1000 ohm	28 773 70.0		R18	50000 ohm
R10	10 ohm	28 773 50.0		R19	2000 ohm
R11	400 ohm	28 770 21.0		R20	80000 ohm

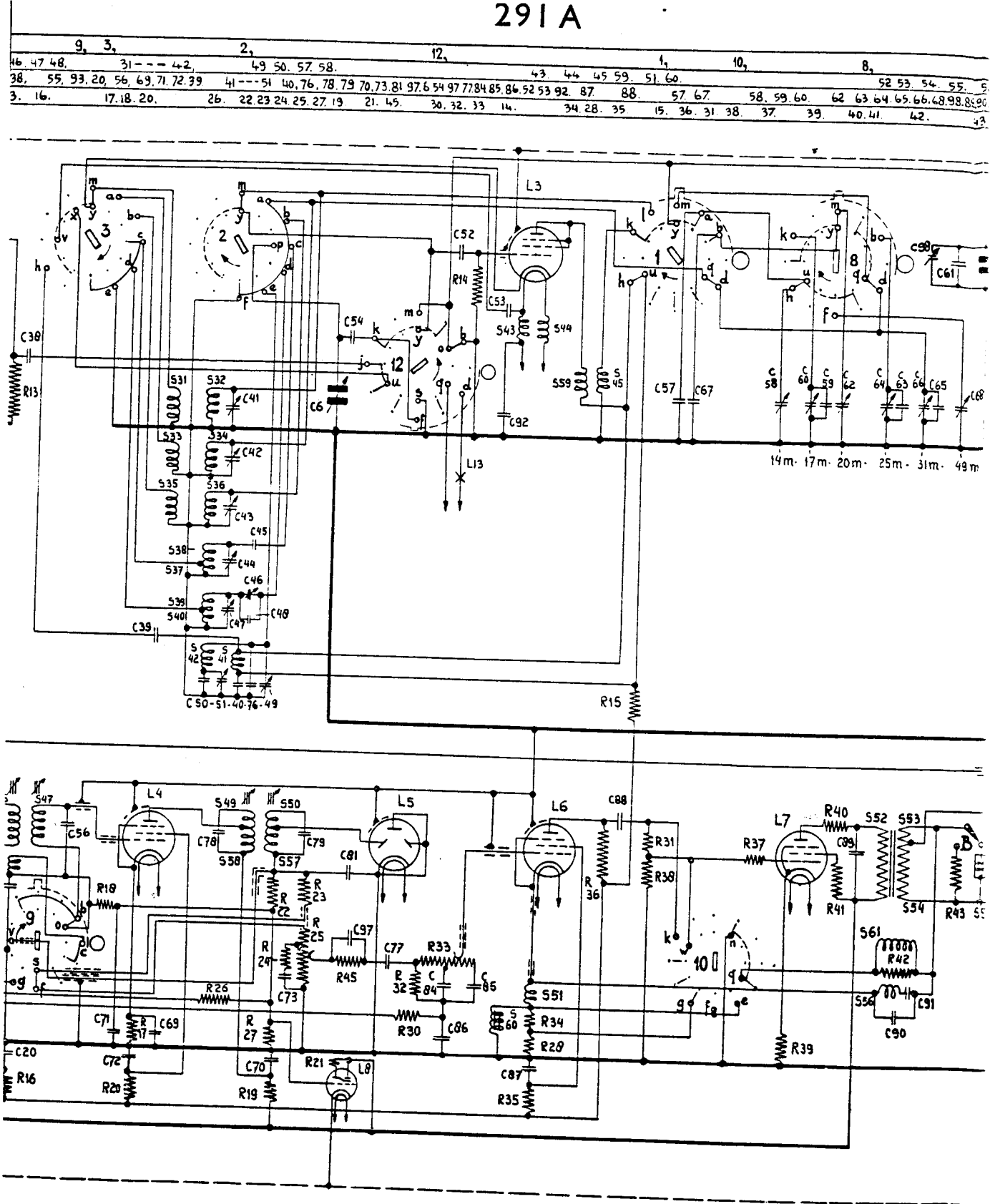


Fig. 10

D3350

RESISTANCES

odenumber	Price		Value	Codenumber	Price		
3 771 10.0		R21	0.8 M.Ohm	28 770 54.0		R30	0.6
3 770 45.0		R22	2 M.Ohm	28 771 23.0		R31	0.6
3 770 42.0		R23	50000 ohm	28 770 42.0		R32	1.2
3 771 06.0		R24	25000 ohm	28 770 39.0		R33	0.3+0.
3 770 28.0		R25	0.28+0.07 M.Ohm	49 470 52.0		R34	
3 770 20.0		R26	50000 ohm	28 770 42.0		R35	0.25
3 770 42.0		R27	5 M.Ohm	28 771 27.0		R36	0.
3 770 28.0		R28	10 ohm par. 20 ohm	28 773 50.0		R37	
3 770 44.0				28 770 08.0		R38	0.6

CONDENSERS

	Value	Codenumber	Price
C1	16 μF	28 182 56.0	
C2	28 μF	28 182 54.0	
C2A	28 μF	28 182 54.0	
C3	28 μF	28 182 54.0	
C4	12-500 μμF		
C5	12-500 μμF	49 000 05.0	
C6	12-500 μμF		
C7	18 μμF	49 000 07.0	
C8	170 μμF	28 195 78.0	
C9	3-30 μμF	28 212 32.0	
C10	3-30 μμF	28 212 32.0	
C11	3-30 μμF	28 212 32.0	
C12	3-30 μμF	28 212 32.0	
C13	3-30 μμF	28 212 32.0	
C14	3-30 μμF	28 212 32.0	
C15	165 μμF	49 080 44.0	
C16	100 μμF	28 206 27.0	
C17	50000 μμF	28 199 06.0	
C19	50000 μμF	28 199 06.0	
C20	50000 μμF	28 199 06.0	
C21	25 μμF	28 206 21.0	
C22	100 μμF	28 206 27.0	
C23	6.4 μμF	28 206 32.0	
C24	2 μμF	28 205 88 0	
C25	2 μμF	28 205 88 0	
C26	3-30 μμF	28 212 32.0	
C27	3-30 μμF	28 212 32.0	
C28	3-30 μμF	28 212 32.0	
C29	3-30 μμF	28 212 32.0	
C30	3-30 μμF	28 212 32.0	
C31	3-30 μμF	28 212 32.0	
C32	50000 μμF	28 199 06.0	
C33	165 μμF	49 080 44 0	
C36	50000 μμF	28 199 06 0	
C37	50000 μμF	28 199 06 0	
C38	100 μμF	28 206 27.0	
C39	250 μμF	28 206 46.0	
C40	32000 μμF	28 199 04 0	
C41	3-30 μμF	28 212 32.0	
C42	3-30 μμF	28 212 32 0	
C43	3-30 μμF	28 212 32 0	
C44	3-30 μμF	28 212 32 0	
C45	1735 μμF	28 195 76 0	
C46	3-30 μμF	28 212 32 0	
C47	3-30 μμF	28 212 32 0	
C48	575 μμF	49 080 84 0	
C49	3-30 μμF	28 212 32.0	
C50	136 μμF	28 195 43.0	
C51	3-30 μμF	28 212 32.0	
C52	100 μμF	28 206 27.0	
C53	2000 μμF	28 190 26.0	
C54	165 μμF	49 080 44.0	
C55	100 μμF	See S48	
C56	103 μμF	See S48	
C57	109 μμF	28 194 44.0	
C58	3-30 μμF	28 212 32.0	
C59	117 μμF	28 194 46 0	
C60	3-30 μμF	28 212 32.0	
C61	50 μμF	49 055 01.1	
C62	3-30 μμF	28 212 32.0	
C63	140 μμF	28 195 26.0	
C64	3-30 μμF	28 212 32.0	
C65	64 μμF	28 195 07.0	
C66	3-30 μμF	28 212 32.0	
C67	100 μμF	28 194 41.0	
C68	3-30 μμF	28 212 32.0	
C69	50000 μμF	28 199 06 0	
C70	50000 μμF	28 199 06 0	
C71	0.1 μF	28 199 09.0	
C72	50000 μμF	28 199 06.0	
C73	50000 μμF	28 199 06.0	
C76	25 μμF	28 192 37.0	
C77	20000 μμF	28 199 02.0	
C78	113 μμF	See S57	
C79	117 μμF	See S57	
C81	100 μμF	28 206 27.0	
C82	50000 μμF	28 199 06 0	
C84	400 μμF	28 190 19 0	
C85	400 μμF	28 190 19.0	
C86	0.5 μF	28 199 16 0	
C87	0.5 μF	28 199 16 0	
C88	800 μμF	28 192 52 0	
C89	2000 μμF	28 201 48 0	
C90	5000 μμF	28 198 96.0	
C91	serie 64000 μμF	28 202 03 0	
	serie 64000 μμF	28 202 04 0	
C92	10000 μμF	28 198 99.0	
C93	50000 μμF	28 199 06 0	
C94	80 μμF	28 206 26 0	
C95	2000 μμF	28 198 92 0	
C96	20000 μμF	28 201 65 0	
C97	3200 μμF	28 198 94.0	
C98	0-20 μμF	49 005 03.0	
C99	50000 μμF	28 199 06.0	
C100	50000 μμF	28 199 06.0	

C99 and C100 are connected between the filament leads and earth.
R46 is connected in parallel with S56.
R47 is connected in series with S30.

	Codenumber	Price		Value	Codenumber	Price
hm	28 773 98.0		R39	par. { 200 ohm	28 770 83.0	
hm	28 773 98.0			200 ohm	28 770 83.0	
hm	28 770 56.0		R40	50 ohm	28 773 57.0	
hm	49 472 50.0		R41	50 ohm	28 773 57.0	
hm	See S51		R42	250 ohm	28 770 19.0	
hm	28 770 49.0		R43	5×100 ohm	28 770 80.0	
hm	28 770 45.0		R44	160 ohm par.	28 770 17.0	
hm	28 770 28.0		R45	0.25 M.Ohm	28 770 49.0	
ım	28 773 98.0		R46	16000 ohm	28 770 37.0	
			R47	200 ohm	28 770 18.0	

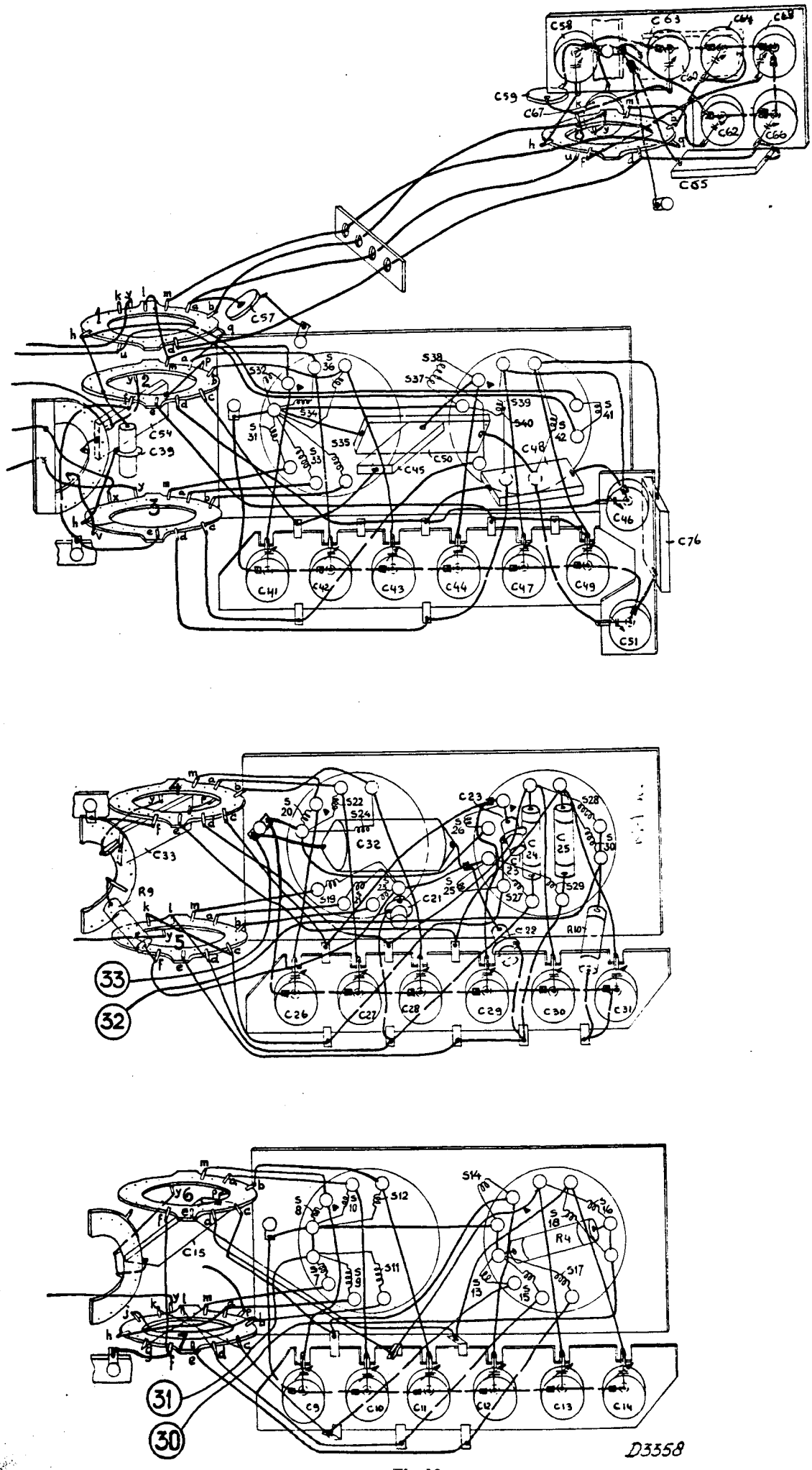
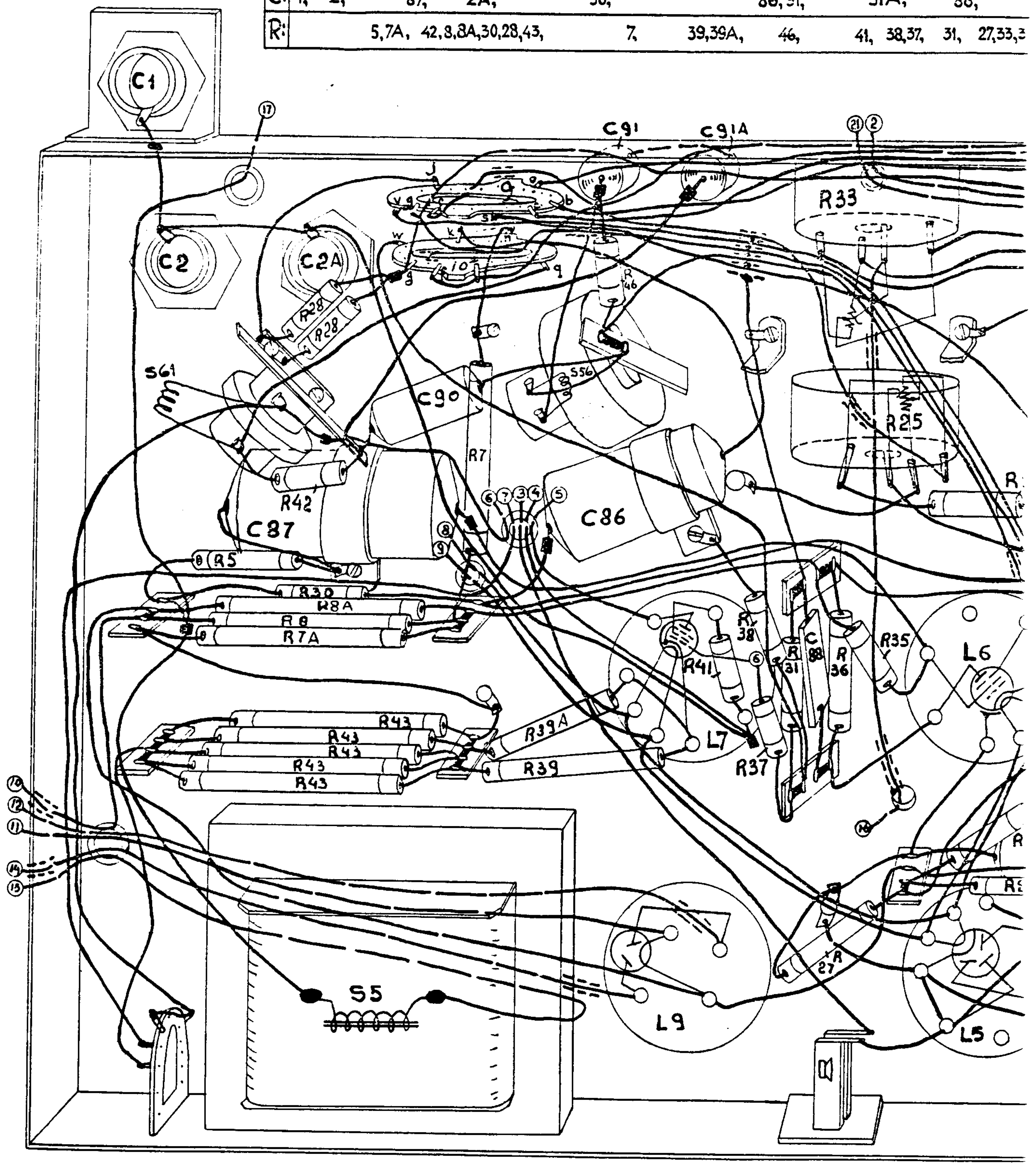

C58
C63
C64
C68
C60
C59
C67
C62
C66
C65
C57
C54
C39
S32
S36
S38
S37
S34
S39
S40
S41
S42
S31
S33
S35
C50
C45
C48
C46
C76
C41
C42
C43
C44
C47
C49
C51
C33
S20
S22
S24
C32
C23
S28
S26
C24
C25
S30
R9
S19
S25
C21
S27
S29
C22
R10
C26
C27
C28
C29
C30
C31
33
32
C15
S8
S10
S12
S14
S18
R4
S16
S7
S11
S13
S15
S17
C9
C10
C11
C12
C13
C14
31
30
D3358

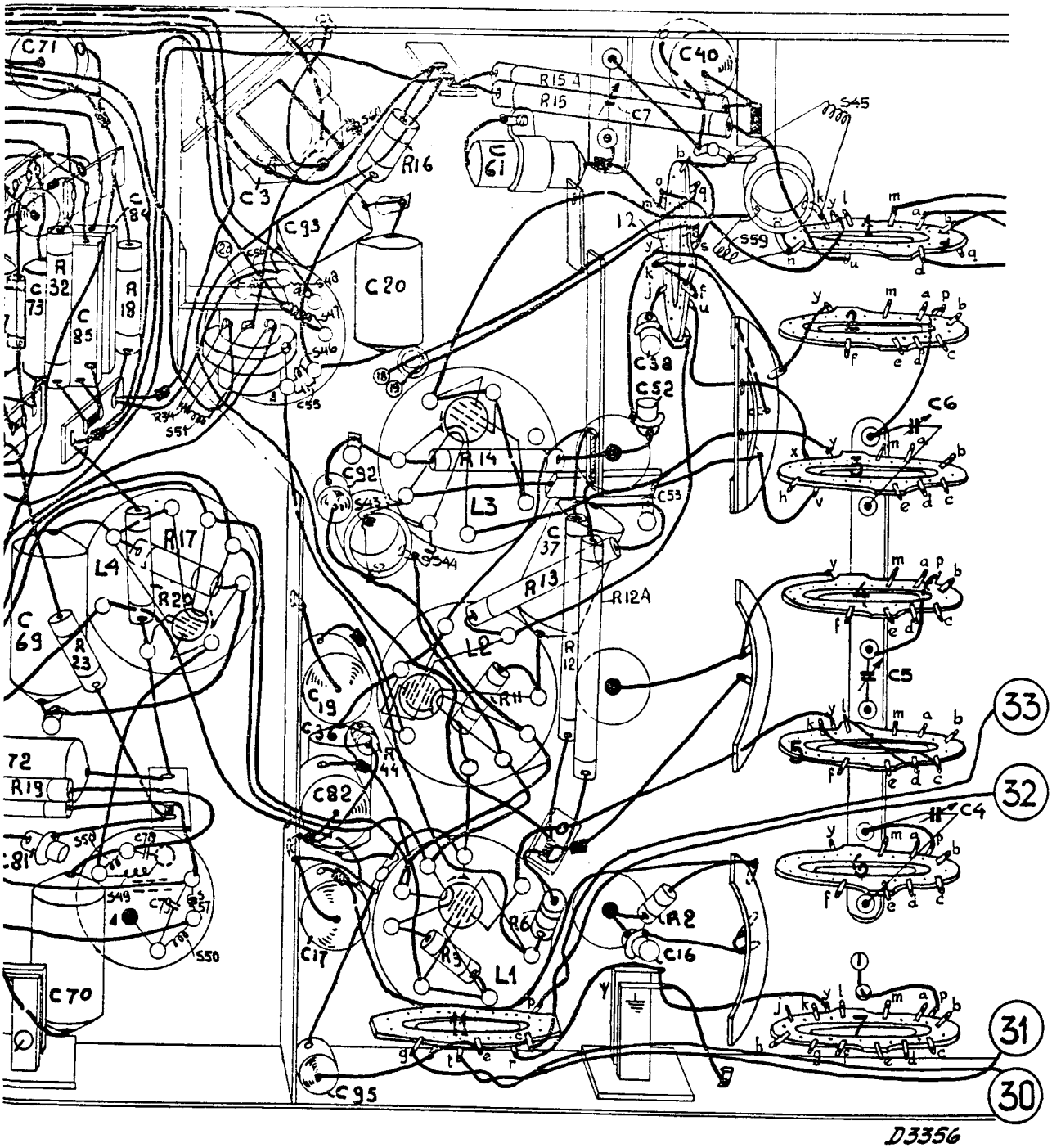
Fig. 12

S:	61, 5, 56,
C:	1, 2, 87, 2A, 90, 86, 91, 91A, 88,
R:	5,7A, 42,8,8A,30,28,43, 7, 39,39A, 46, 41, 38,37, 31, 27,33,3



The coloured markings under the coil-boxes are indicated by small triangles.
In parallel with S56 is connected a resistance R46.
In series with S30 is connected a resistance R47.
Between the filament-leads and earth are connected the condensers C99 and C100

58, 49, 51, 57, 50, 46, 47, 48, 43, 60,	59, 45,
77, 97, 72, 81, 69, 73, 71, 69, 85, 79, 84, 78, 76, 3, 55, 93, 92, 95, 20, 17, 32, 36, 19, 20, 61,	37, 7, 38, 52, 53, 40, 16,
22, 24, 26, 45, 19, 32, 23, 18, 34, 17, 20,	44, 16, 3, 14, 11, 6, 13, 15, 15A, 12, 12A, 2,



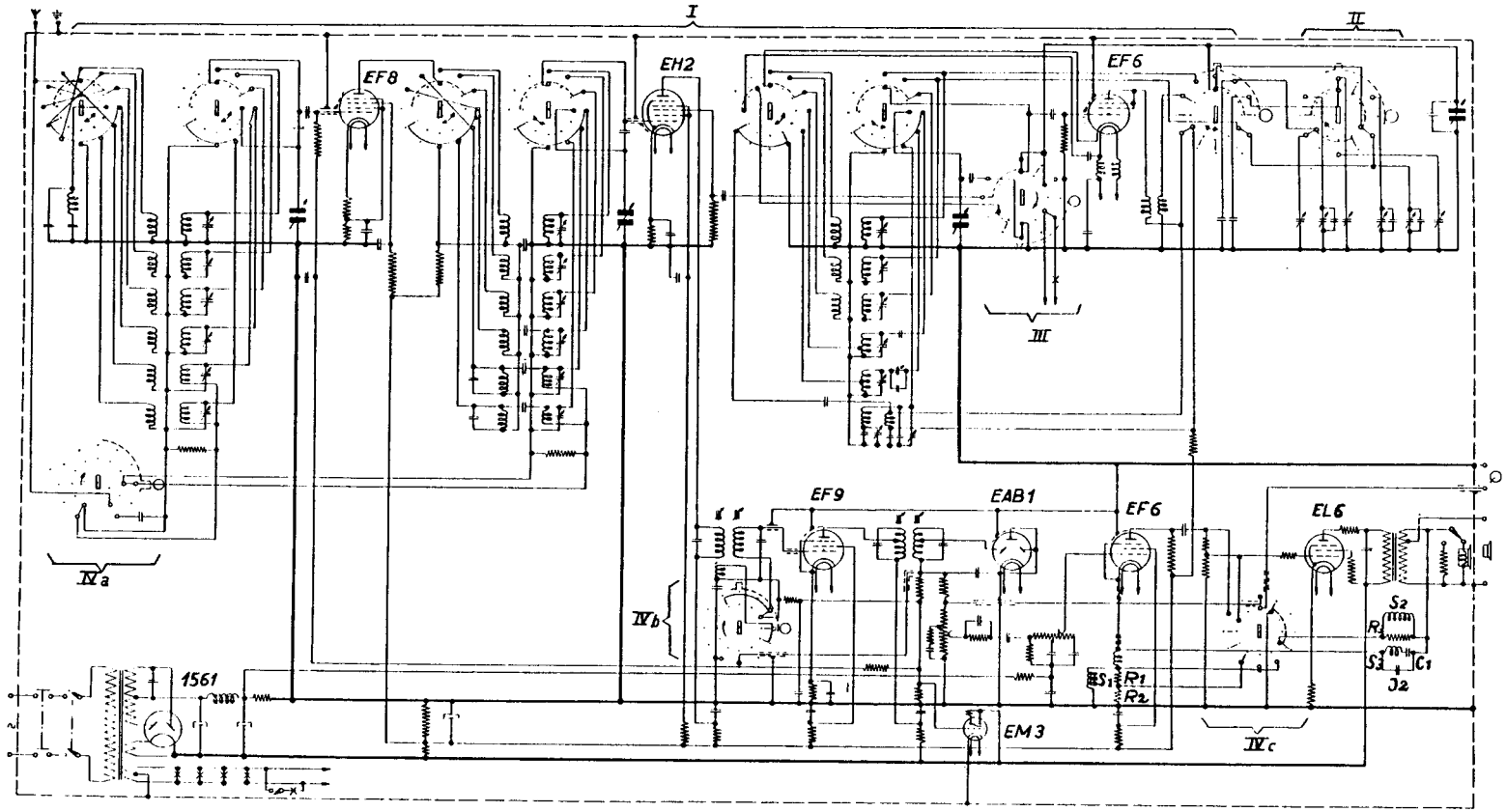


Fig. 7

Circuit diagram of the 291.

I = wave-change switch.

II = band-spread switch automatically operated by turning the normal tuning knob.

III = band-spread switch operated by pushing in or pulling out the normal tuning knob.

IV a, b & c = performance and gramophone switch.

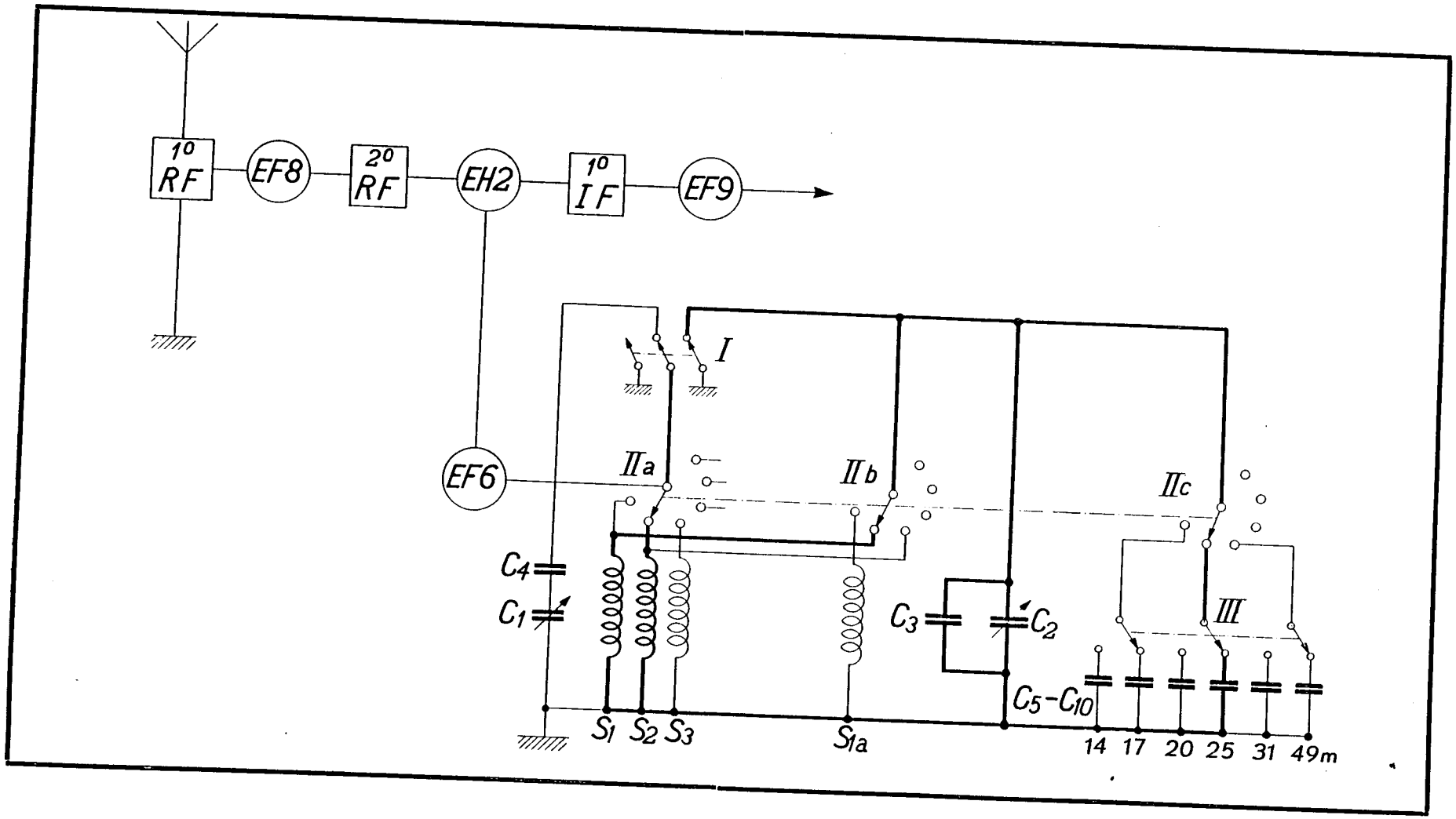


Fig. 4
The band-spread circuit