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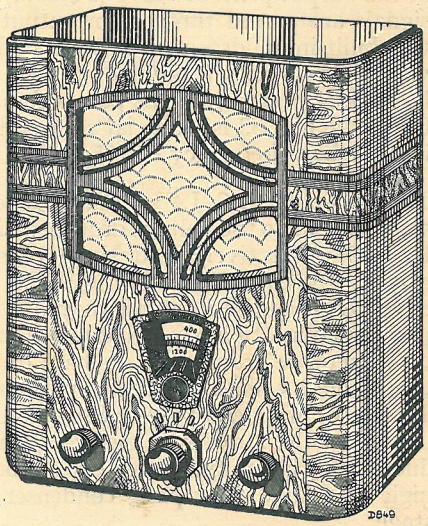
SERVICE DOCUMENTATION

" SUPERHETERODYNE "

RECEIVER

FOR A.C. MAINS.

Type 522/588 A



General Remarks.

This receiver is designed on the superheterodyne principle. There are four knobs on the front of the cabinet. The left-hand knob is for the volume control and the right-hand knob for the continuously adjustable tone-filter ; the two knobs which are mounted in the centre of the cabinet are for the following use. The circular knob is for tuning, and the octagonal knob is for operating the mains switch and waveband switch. The latter knob has three positions ; counting from left to right they are as follows :—position I, the receiver is out of action, position II, is for the medium wave band and position III is for the long wave band. A mains socket on the back panel (safety switch) is provided which automatically renders the receiver electrically dead when the back is removed.

Description of Circuits.

When describing circuits etc., the components that serve for one wave-band only, are indicated in brackets.

The octode frequency change valve L1 (FC4) is connected to the aerial by two H.F. tuned circuits namely C9, S6, (S7, C18) C19, C10, S8 (S9, C18), C19 which are trimmed by the small condensers C12 and C13 respectively. Both circuits have the condensers C18, C19 (direct capacity current coupling) and constitute a band pass filter. The oscillator circuit C11, S10 (S11, C15), C16 is connected to grid 1 and is inductively coupled to S12, (S13). This winding is connected to number 2 grid of the octode valve. The values of the self inductance and capacity in the oscillating circuit are such that a frequency difference can be obtained having a wave length of 115 KC. The octode valve has six grids and an anode. The two grids nearest the cathode namely grid one and grid two form the triode heterodyne oscillator while the third grid (grid 3) acts as a screen between the oscillator and the mixer portions of the valve. The remaining three grids together with the anode form an H.F. pentode with the suppressor (grid 6) which is internally connected to the cathode. The auxiliary grid of the pentode (grid 5) and the screen (grid 3) are also connected together. Between screen (grid 3) and the control grid of the pentode (grid 4) there exists what may be called a " virtual cathode." This is formed by a cloud of electrons which has been accelerated by the high potential screen and repulsed by the negative control grid of the pentode. The heterodyne frequency is

super-imposed on the electron stream in the oscillating portion and the resultant pulsating electron cloud of the "virtual cathode" is modulated by the signal frequency applied to the grid of the pentode. The FC4, therefore, acts as an electron coupling frequency changer. This intermediate frequency of 115 K.C. is passed to the circuits C22—S14, C23—S15, C24—S16 and C25—S17. Following the I.F. amplifying stages is the diode, and the super-imposed A.C. potential on the D.C. component across the resistance R14—R15 are transferred via R13—C26—R8 to the control grids of the valves L1 (FC4) and L2 (VP.4A) so that these valves have a varying negative grid bias voltage applied to them. Therefore when a sufficiently powerful signal is received any variation of signal is practically non-existent. Following the diode detector the voltage is applied to the grid of the valve L4 (SP4) via R15 and C29 and this voltage is amplified by a stage of resistance capacity which is passed to the grid of the output pentode valve (PM24M). Finally these signals are passed through an output transformer to the built-in loudspeaker. The condenser C34 and variable resistance R17 form the tone filter which can be varied according to the personal tastes of the user. Circuit S21—C33 is a special aerial filter tuned to the intermediate frequency of 115 K.C.

The valves L1, L2, L4 and L5 receive their negative grid bias due to the voltage drop on resistance R5, R16, R6, R7 respectively and these resistances are decoupled by C5, C32, C6 and C7. C6 and C7 are dry electrolytic condensers and they are polarised. The positive connection is painted red. Gramophone pick-up sockets are provided at the back of the receiver and the manual volume control is resistance R15.
The third intermediate frequency circuit is shorted by C35 when the receiver is used for gramophone reproduction so that radio signals cannot be heard. C4 is a high frequency decoupling condenser for the output stage.

Trimming the Receiver.

If the screened tuning coils, the 3-gang variable condenser or the trimmers of the receiver are replaced or if the receiver is out of balance so that the selectivity has been reduced the instrument must be re-balanced. It may not be necessary to retrim all circuits. For instance if one of the I.F. transformers is replaced it will be only necessary to retrim this part of the circuit. If other parts of the tuned circuits are changed it may also only be necessary to retrim the part of the receiver affected.

1. The test apparatus required will be as follows :— A Service oscillator similar to Type 4028.
2. An output meter. This will have to be substituted for the loudspeaker.
3. A screwdriver which should be insulated except for the extreme end.
4. An insulated spanner (alternatively screwdriver and spanner, code No. 09.901.050) supplied by Philips.

The method of rebalancing the I.F. and Oscillator circuits is as follows :—

Rebalancing I.F. Circuits.

1. Place a signal of 115 KC. via a condenser of 200 m.m.f. to the grid 4 of the octode valve FC4. (This grid is connected to the top of the valve).
2. Connect the output indicator.
3. Turn the volume control to maximum. If the output is found to be too large the volume control of the oscillator must be reduced and not the volume control of the receiver.
4. Short circuit R1 which will cause L1 (FC4) to cease oscillating.
5. Earth the chassis. Turn the variable condenser to minimum and place the wave band switch to long wave.
6. Short circuit S14 and S17 with a resistance of 10,000 ohms and trim C23 and C24 until the maximum output from the indicator is obtained.
7. Disconnect the resistance from S14 and S17 and place them across S15 and S16 and trim with C22 and C25 until the maximum output is obtained. It will be found that C22 and C23 are fitted on one common insulated plate. C24 and C25 are similarly fitted. C22 and C24 should be adjusted with a spanner and C23 and C25 with a screwdriver.
8. It will only be necessary to adjust the circuit S21—C23 if any alteration has been made to this part of the circuit and the points mentioned in 9 and 11 give the method of adjusting.
9. A frequency of 115 KC. should be applied to the aerial socket.
10. Adjust the variable condenser to 1900 metres.
11. Adjust C33 until output indicator shows a minimum.
12. Screws and nuts should be sealed with sealing wax.

Trimming the H.F. and Oscillator Sections.

1. Adjust the receiver to the medium wave band and connect a resistance of 10,000 ohms in parallel with S14 and remove the short circuit on R1. (The 10,000 ohm resistance should be left connected throughout the whole of the operation).
2. Adjust C14 trimming condenser until the vanes have an opening of 1 m.m.
3. Place a weak signal on the grid of L1 (FC4) having a wave length of 225 metres (1333 K.C.).
4. When the variable 3-gang condenser is tuned it will be found that two maximums on the indicator will be obtained. One will have an oscillator frequency at 1333 K.C. plus 115 K.C. (approximately 207 metres) and one at 1333 K.C. minus 115 K.C. (approximately 247 metres).
5. Trim the oscillator circuit until the maximum output is obtained.
6. Leave the variable condenser in this position until point 11.
7. Place the signal of 225 metres to aerial socket.

8. Trim the circuit with condensers C12 and C13 until the maximum output is obtained on the indicator.
9. Short circuit resistance R1 by earthing the grid of L1 (FC4) to the chassis.
10. Place the waveband switch to long wave and pass a signal of 900 metres to the aerial socket. Since the intermediate frequency cannot pass this wave length because the oscillator has been placed out of action by shorting R1 it will be necessary to use a separate receiver. This can be done by connecting a condenser of 25 m.m.f. between the anode of L1 (FC4) and the aerial socket of another receiver which has been accurately tuned to 900 metres. It will be necessary to connect the output meter to this receiver.
11. Tune the receiver accurately to 900 metres.
12. Remove the short circuit from R1 and also connect the output indicator to the receiver which is to be trimmed.
13. Obtain a maximum output by trimming C17.
14. Seal the screws and nuts with sealing wax.
15. Place a wave length of 350 metres to the aerial socket. Tune the receiver and if necessary readjust the **dial** to the correct reading.

HOW TO TRACE FAULTS.

General Remarks.

1. The following data is as complete as possible but some of the cases may not occur in practice.
2. This list cannot be complete as there may be compound faults.
3. In general it may be said that the majority of faults are due to short circuits in the bare wires or to open or short circuits in one of the component parts. These are indicated as R... or C... shorted or open circuit as the case may be.
4. Always carry out, first of all, test measurements so as to find the cause of the fault.

The method of procedure is as follows :—

I. **Equip the receiver with a set of standard valves (or valves from a receiver that functions satisfactorily) and if necessary try a different loudspeaker.**
If no result is obtained see under II.

II. **Check up to see if gramophone reproduction is possible.**
If it is see under V, if it is not see under III.

III. **Measure the voltage across C2.**
If this voltage is normal see under IV. If it is abnormal then look for the following faults.

1. Fault in the mains or safety switch ; measure the primary voltage of the transformer.
2. Fault in the secondary side of the transformer ; measure secondary voltage.
3. Loose link on the voltage change plate.
4. A bad contact in the valve-holder of L6.
5. C1, C2, C4 short circuited.
6. S22 open circuited.
7. Disconnection or short circuit in the heater leads or a short circuit across the pilot lamp holder.
8. A short circuit between the primary and secondary winding of the I.F. transformers.
9. Short circuit between the primary and secondary winding of the loudspeaker output transformer.
10. Short circuit on C28.

IV. **Voltage across C1 is normal but no gramophone reproduction.**

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

1. R10 or R6 open circuited ; no anode current.
2. R4 open circuited ; no screen grid voltage.
3. C3 short circuited.
4. C6 short circuited.
5. R9 open circuited.
6. Bad contact in the valve-holder.

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

1. S18 or R7 open circuited.
2. C7 or C27 short circuited ; anode current too high.
3. R11 open circuited.
4. Faulty contact in valve-holder.

C. **If L4 and L5 have normal current and voltages.**

1. R15 open circuited or bad contact.
2. Short circuit in the screen lead between R14, R15 or between R15, C29.
3. C29 open circuited.
4. C30 short circuited.
5. C27 or R12 open circuited.
6. Open circuit in either the loudspeaker output transformer or speech coil winding

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

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

1. S16 or R16 open circuited.
2. C32 short circuited.
3. R13, R14, S15 open circuited.
4. C26 short circuited.
5. Faulty contact in valve-holder.

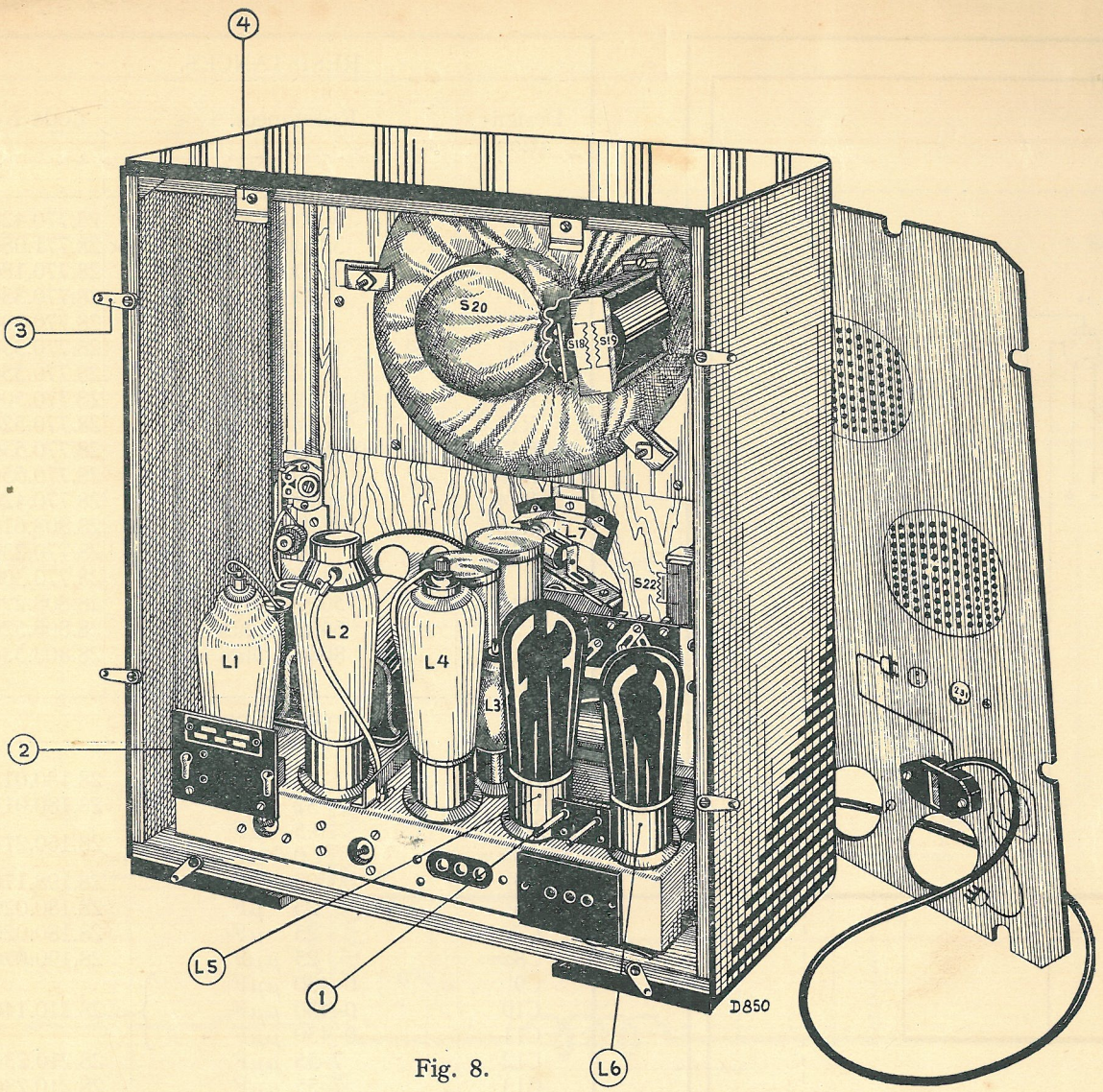

4
3
2
1
L5
L6
S20
S18
S19
L7
S22
L1
L2
L4
L3
D850

Fig. 8.

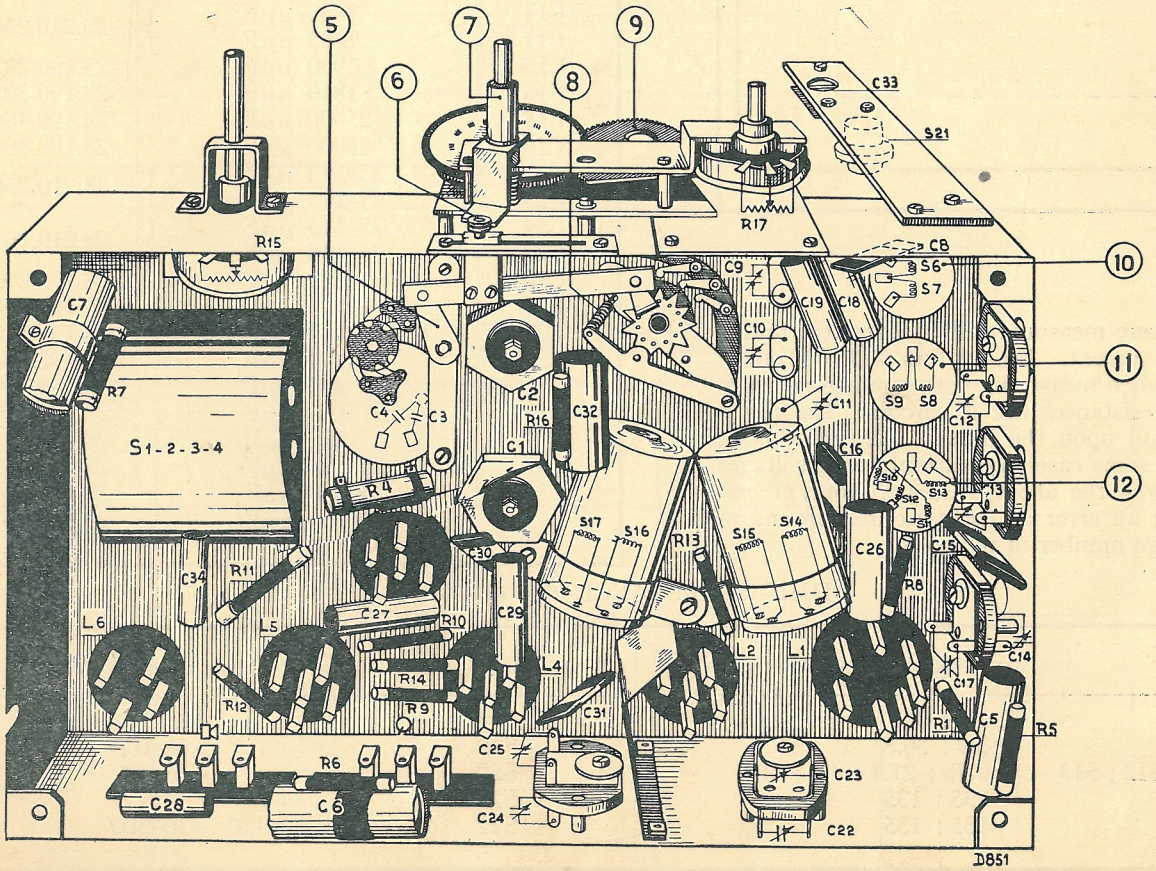

5
7
9
6
8
10
11
12
C33
S21
R17
R15
C8
S6
S7
C9
C19
C18
C10
C7
R7
S1-2-3-4
C4
C3
C2
R16
C32
C1
C11
S9
S8
C12
C16
S10
S12
S11
S13
C13
R4
S17
S16
R13
S15
S14
C26
C15
C34
R11
C30
R8
L6
L5
C27
R10
C29
L4
L2
L1
C14
R14
C17
R12
R9
C31
R1
C5
R5
C25
R6
C23
C28
C6
C24
C22
D851

Fig. 9.

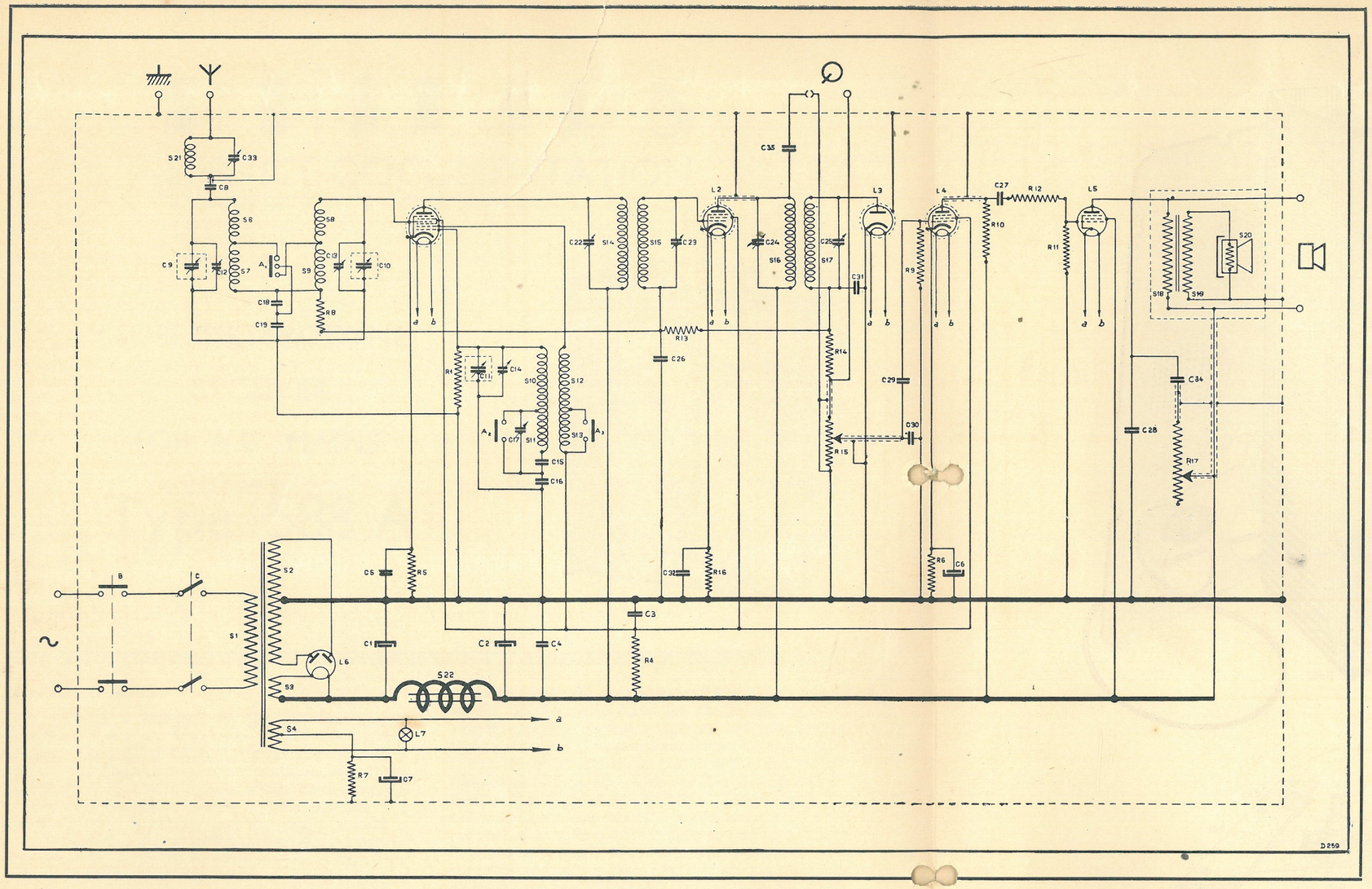


Fig. 7.

VOLTAGES AND CURRENTS

	L1.	L2.	L4.	L5.	
Va	245	245	160	210	Volts
Vg′	65 voltage grid 2–3–5	65	65	225	Volts
–Vg	1.0 voltage over R5	1.15 voltage over R16	2.5 voltage over R6	19.5 voltage over R7	Volts
Ia	0.56	1.3	0.3	22.6	mA
Ig′	Ig2=1.35 Ig3=Ig5=2.9	0.57	0.12	4.25	mA

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

RESISTANCES.

Design-ation	Resistances.	Code No.
R1	50000 Ohm	28.770.420
R4	32000 Ohm	2× 28.771.080
R5	200 Ohm	28.770.180
R6	6400 Ohm	28.770.330
R7	800 Ohm	28.770.890
R8	10000 Ohm	28.770.350
R9	1 M. Ohm	28.770.550
R10	0.32 M. Ohm	28.770.500
R11	0.5 M. Ohm	28.770.520
R12	0.64 M. Ohm	28.770.530
R13	1 M. Ohm	28.770.550
R14	50000 Ohm	28.770.420
R15	0.5 M. Ohm	28.808.610
R16	640 Ohm	28.770.230 or
	3200 Ohm	28.770.300
R17	50000 Ohm	28.808.290 or
	64000 Ohm	28.808.520 or
	80000 Ohm	28.808.530

CONDENSERS.

C1	32 μF	28.180.011
C2	32 μF	28.180.011
C3	0.5 μF	28.160.211
C4	1.0 μF	
C5	50000 μμF	28.198.170
C6	25 μF	28.180.020
C7	25 μF	28.180.020
C8	25 μμF	28.190.070
C9	0–430 μμF	28.210.140
C10	0–430 μμF	
C11	0–430 μμF	
C12	7–55 μμF	28.210.230
C13	7–55 μμF	28.210.230
C14	7–55 μμF	28.210.250
C17	7–55 μμF	
C15	930 μμF	28.190.291
C16	1810 μμF	28.190.302
C18	25000 μμF	28.198.400
C19	25000 μμF	28.198.400
C22	25–145 μμF	28.210.260
C23	25–145 μμF	
C24	25–145 μμF	28.210.260
C25	25–145 μμF	
C26	0.1 μF	28.198.200
C27	10000 μμF	28.198.100
C28	2000 μμF	28.198.570
C29	10000 μμF	28.198.100
C30	200 μμF	28.190.160
C31	100 μμF	28.190.130
C32	0.1 μF	28.198.200
C33	25–145 μμF	28.210.240
C34	32000 μμF	28.198.150
C35	10000 μμF	28.198.100

OHMIC RESISTANCE OF COILS.

Coil	Resistance (Ohms.)	Coil	Resistance (Ohms.)
S6 ; S7	3.9 ; 36.8	S18	480–590
S8 ; S9	3.9 ; 36.8	S19	0.66–0.78
S10 ; S11 ; S12 ; S13	9.75 ; 27.4 ; 4.1 ; 10.7	S20	4.35–5.3
S14 ; S15	135 ; 135	S21	127
S16 ; S17	135 ; 135	S22	410–500