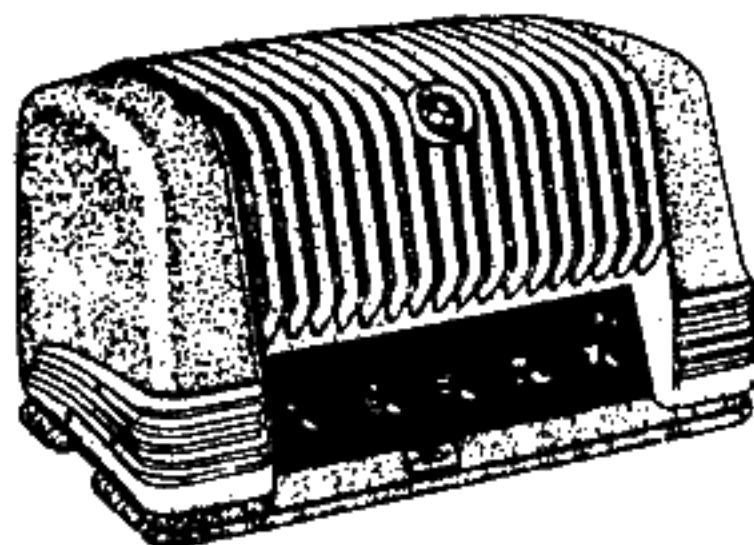


# PHILIPS

## SERVICE NOTES

for the  
70 W AMPLIFIER

**EL 6420**



1952

### GENERAL DATA

The amplifier is mounted on a chassis of cast aluminium and has a detachable cap. The whole is streamlined.

### WEIGHT

Incl. valves 20.2 kg

### DIMENSIONS

Length : 425 mm  
Width : 275 mm  
Height : 255 mm

### ILLUSTRATIONS

- Fig. 1 Circuit diagram
- Fig. 2 Detail drawing of tone control; R5 and R6 on +7
- Fig. 3 Detail drawing of tone control; R5 and R6 on -7
- Fig. 4 Phase-inverting circuit
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- Fig. 11 Microphone input characteristics
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### ELECTRICAL DATA

Input :	Q1 and Q2	Q and R
Input impedance	0.9 MΩ	70,000 - 100,000 Ω ±
Input sensitivity	1.55 mV	145 mV
Average hum level xx	- 56 dB	-66 dB
Average noise level	- 56 dB	-78 dB

- x Depending on the position of the volume controls.  
 xx The hum is measured via a special R-C filter giving about the same attenuation for the low frequencies as the ear ( $R = 33000 \Omega$  and  $C = 22000 \text{ pF}$ ). Thus the hum measured is the actual audible hum.

Distortion at 1000 c/s	
with the limiter switched off.....	max. 5%
with the limiter switched on.....	max. 7%
internal output resistance.....	40 $\Omega$ at 100 V
Power output at with the	
volume indicator begins to work.. ....	6 dB below maximum output
Maximum deflection of the	
sensitive part of the volume indicator	3 dB below maximum
Maximum deflection of the	
insensitive part of the indicator.....	1 dB below maximum
Mains voltages (40 - 100 c/s).....	100, 125, 200, 220 and 245 V
Power consumption	
in "filament heating" position.....	100 W
in working position without signal....	145 W
with signal.....	260 W

#### Valve complement

3 x EF40,      1 x EF22,      1 x ECC40,      2 x EL34,      2 x AX50,      1 x AZ41.  
 1 x EZ40,      1 x EM34.

#### CONNECTING THE LOUDSPEAKERS

The secondary winding of the output transformer is connected according to the 100 V system. A voltage adapter enables the output voltage to be adjusted to 100, 70, 50, 35, 25 or 10 V.

Thus loudspeakers with a 100 V matching transformer can be connected to the output (with the adapter set at 100 V). The impedance of the loudspeaker is of no consequence.

The total capacity of the loudspeakers may be about 70 W.

If it is desired to connect a total loudspeaker capacity of more than 70 W and 100 V matching transformers then the adapter has to be set to 70 V. The sound is then attenuated 3 dB per speaker and a loudspeaker capacity up to 140 W can be connected. For a still larger total loudspeaker capacity the adapter has to be set to 50 V, in which case the attenuation is 6 dB per speaker. For each step down to a lower voltage the attenuation is 3 dB more, except in the 10 V position.

The latter position is mainly for low-ohmic speakers and head-phones. Similar steps can be taken with loudspeakers having a 70 V matching transformer; with increased total loudspeaker capacity the voltage adapter is stepped down to 50 V and if necessary to 35 V.

The following table shows the possibilities

Output voltage amplifier	Maximum nominal capacity			Minimum load impedance
	100 V speakers	70 V speakers	50 V speakers	
100 V	70 W	-	-	142 $\Omega$
70 V	140 W	70 W	-	70 $\Omega$
50 V	280 W	140 W	70 W	35 $\Omega$
35 V	560 W	280 W	140 W	18 $\Omega$
25 V	1120 W	560 W	280 W	9 $\Omega$
10 V	Headphones and low-imp. speakers			1,4 $\Omega$

#### NOTE:

The quality of reproduction is not affected when too high a loudspeaker impedance is connected, thus with too few speakers.

#### DESCRIPTION OF CIRCUIT

The microphone terminals  $\text{Q}1$  and  $\text{Q}2$  are connected respectively to the control grids of B1 and B2 (EF40) via the separating capacitors C1 and C2 and the resistors R13 and R14. R11 and R12 are of such a value (10 M $\Omega$ ) that owing to the grid current the valves B1 and B2 automatically receive a negative grid voltage. The amplified microphone voltages are laid on to the potentiometers R1 and R2 via C5 and C6. When two microphones of different sensitivity are used these potentiometers serve to equalize the signal for both channels (with the volume controls R3 and R4 wide open). Further they can be so adjusted that when the volume controls (R3 and R4) are fully open there is no "acoustical feed-back"; adjustments are made with a screw-driver.

The sliding contacts of R1 and R2 are connected to the top half of R3 and R4 respectively. R3 and R4 are centre tapped to earth. The top half of R3 serves for regulating the volume of microphone 1 and the bottom half for the volume of the pick-up. The top half of R4 is for regulating the volume of the microphone 2, the bottom half for the volume of the radio input.

The sliding contacts of R3 and R4 are connected to the control grid of B3 via R19-R20 and C7. Thus the signals on R3 (microphone 1 or pick-up) can be mixed with those on R4 (microphone 2 or radio). R19 and R20 serve to prevent as far as possible the volume of one channel being affected by adjustment of the potentiometer in the other channel. When the limiter is switched off the bottom of R21 is earthed via R23 and SK2b.

B3 then receives a negative grid voltage via the cathode resistance R22. When the limiter is switched on, and the output signal is strong enough, a regulating voltage is fed to the control grid. The limiter circuit will be explained at greater length.

Between the anode of B3 and the control grid of B4 is the tone control. When the limiter switch SK2 is in the "off" position C12 is shorted and the signal is then laid on via C11 to the junction point C13-R27. When SK2a is opened a series capacitor C12 (820 pF) is out in and the low notes are attenuated.

The high and the low notes can be made stronger or weaker with the aid of R5 and R6 respectively. The working of the tone control is illustrated in fig. 2a, where the situation is drawn with R5 at +H and R6 at +B (maximum position).

The resistors R27-R6 and R28 form a potentiometer circuit. The capacitor C18 (3300 pF) however forms, for practically all frequencies occurring, such a small parallel impedance for R6 (2.5 MOhm) that the resistance R6 is negligible compared with C18. The branch R5 and C14/C15 in series has always at least an impedance of 2.5 MOhm and is therefore negligible compared with the branch R6/C18 with R28 in series.

A simplified diagram is given in fig. 2b.

Owing to the parallel capacitance of 220 pF the high notes are less attenuated than those in the middle and bass registers. The series capacitance of 3300 pF results in the low notes being attenuated less than those in the middle and treble registers. The whole gives a gain for the treble and bass notes compared with the middle register.

Fig. 3a shows the situation with R5 at -H and R6 at -B (minimum position). Again R6 is much greater than the impedance of C17, for practically all frequencies, and thus is negligible. The branch C13 (220 pF) in series with R5 (2.5 MOhm) is negligible compared with the branch R27 (390 KOhm) in series with R6 (2.5 MOhm) /C17 (820 uF). The circuit can then be simplified to that given in fig. 3b. Owing to the series capacitance of 820 pF the low notes are more attenuated than those in the middle and treble registers, while owing to the parallel capacitance of 1240 pF the high notes are more attenuated than the others. The whole gives an attenuation of the treble and bass notes compared with the middle register. The anode of the amplifying valve B4 (EF 40) is coupled via R42 - C23 to the upper control grid of B5 (ECC40). The filter C24/R45 has a stabilizing function.

The phase inverter B5 works as follows (see fig. 4):

The signal is amplified by the top half of B5. The common, unbypassed, cathode resistor R47 for the two triodes has been chosen very large (18000 Ohm) so that the voltage E2 across it is equal to about half the applied voltage E1. Since the alternating voltage E1 between grid and cathode of B5 is equal to the difference between the input voltage and the cathode voltage, E1 and E2 will be equal and in opposite-phase (short-circuits the alternating voltage). Thus there are two equal voltages in opposite-phase on the anode resistors R48 and R49. The two anodes of B5 are connected to the control grids of the output valves B6 and B7 (EL 34) via the coupling capacitors C26 and C27 and the resistors R52 and R53. The negative grid voltage for the output valves is in two parts, a fixed and a variable part.

The lower part of the rectifying valve B10 gives a direct voltage across R62, which is applied via R50 and R51 as a negative grid voltage to B6 and B7. Between R62 and earth is the resistor R61. Further, in the cathode lead of the output valves there is a transformer T2, so that across the coils S1 and S1' of T2 an alternating voltage is obtained which varies according to the output of the end valves.

The voltage induced across S2 comes to lie across R60 and thus also between the cathode and anode of the upper half of B10. Under the influence of this alternating voltage a rectified voltage is obtained across the resistor R61 which has an opposite polarity to the negative grid voltage across R62. As soon as the end valves begin to deliver a certain output the negative grid voltage therefore drops.

This is necessary because if the anode current rises much then the anode voltage drops too far, and this causes the valve to operate on a diffe-



ferent curve, with the result that there would be too much distortion. Some Ia-Vg characteristics are given in fig. 5 to show what is meant. With a given anode voltage  $V_a$  the valve is adjusted to a negative grid voltage  $-V_{g1}$ . When the anode voltage drops then the negative grid voltage must also drop to  $-V_{g1}'$ . Between the anodes of the output valves is a spark bridge for safeguarding the output transformer. This bridge is adjusted in the factory to 0.6 mm and then the adjusting screws are sealed.

The secondary of F3 is connected according to the 100 V system. The voltage on the feedback winding S3-S3' (p and q) is fed back via the parallel circuit C20-R40 and the resistor R39 to the resistor R38, which is in series with the cathode resistor of B4. The alternating voltage on S4 (r and s) is led via C22 to the rectifying valve B11 (EZ40), the cathode of which receives a positive voltage (VC32) via R36. The alternating voltage from S4 is applied across the resistor R35, which is in series with R30 and R31 between the cathode and the anodes of B11. As soon as this alternating voltage reaches an amplitude greater than the positive voltage on the cathode of B11, this valve begins to draw anode current and a negative voltage arises across R30 and R31. The negative voltage across R30 is applied to the control grid of the tuning indicator B12 (EM34). As soon as the output voltage reaches a certain value the tuning indicator shows a deflection. In this way the output voltage can be determined roughly according to the deflection of the indicator. When the limiter switch SK2 is turned on (position "Lim" fig. 1) the negative voltage across R30 and R31 is laid on the control grid of B3 (EFF22-10). Thus B3 receives more and more negative grid voltage and the amplification of this valve is reduced. When the input voltage is raised above a certain threshold value the total gain is thus reduced. In fig. 8 the output is given as a function of the input voltage; 8a with the limiter switched off and 8b with the limiter switched on.

The anode voltage for the output valves is supplied by a voltage doubler (fig. 6).

During the negative phase of the alternating voltage on S2 of T1, thus when the cathode of B9 is negative with respect to the anode, the rectifier B9 is in action and the capacitors C29, C30 and C31 are charged to a voltage  $V_b$ . During the next phase the anode of B8 becomes positive with respect to the cathode and this valve comes into action, C28 being then charged to  $V_b$  in the direction indicated. The total voltage across R69 and R70 is then  $2 V_b$ .

The voltage  $2 V_b$  is led on the anodes of the output valves, the voltage  $V_b$  to the screen grids.

The mains switch SK1 has three positions:

- 1: off
- 2: heating ("standby"), in which position only the filaments are connected;
- 3: high tension switched on.

The purpose of position 2 is to enable the rectifier to be switched on for immediate use at any moment. When switching back from position 3 to position 2, owing to the slow discharge of the high-tension capacitors a "dying-off" sound may be heard, but this is prevented by short-circuiting the output in position 2.

CURRENTS AND VOLTAGES, measured with the GM 4257 (10000  $\Omega/V$ )

	B1-B2 EF40(1)	B3 EF22(1)	B4 EF40(1)	B5 ECC40(1)	B6-B7 EL34(1)	B6-B7 EL34(2)	B12 EL34(1)
Va	70-94	110-150	108-132	145-180	800-850	650-720	Va1=15-35
Ia	0.9-1.15	2.0-2.6	0.95-1.2	0.95-1.2	18-26	76-95	Ia1=0.13-0.21
Vg2	41-55	47-63	65-90		375-415	275-315	Va2=12-26
Ig2	0.15-0.25	0.57-0.75	0.17-0.23		1.7-2.8	14-19	Ia2=0.13-0.19
Va'				150-190			V <sub>L</sub> =160-200
Ia'				0.65-0.85			I <sub>L</sub> =0.95-1.2
Vk	0	1.1-1.65	1.1-2	30	-Vg=36-40 $\pi$	Vg=30-34 $\pi$	

- (1) without signal  
(2) at maximum output

I in mA  
V in volts

\* measured at the junction point R50-R51

MEASURING SENSITIVITIES PER STAGE

If a defect cannot be traced with the aid of the table of currents and voltages, the sensitivities can be measured stage for stage.

Instruments required:

A valve voltmeter, e.g. GM 4132 or GM 6005  
\* A.F. generator, e.g. GM 2315 or GM 2307

How sensitivities are measured

Connect to the loudspeaker terminals a resistor of 143 ohms and a power rating of 20 to 50 watts. Set the loudspeaker adapter to 100 V and switch the limiter off. Tone controls B and H at 0, f = 1000 c/s.

Set the potentiometers R1 and R2 and the volume control Q1 to maximum. Apply to the microphone input Q1 a signal of such a value as to give a voltage of 50 V at the loudspeaker terminals (measured with the valve voltmeter). Disconnect the voltmeter from the loudspeaker terminals and connect it in succession to the points A, B, C, D to O (fig. 1).

Compare the measurements with the voltages given in the table. In this way also the gain per stage can be determined. Deviations of more than 20% may indicate a defect in the stage concerned.

Point	Voltage measured
A	0,3 mV
B	60 mV
C	28 mV
D	1,75 mV
E	0,33 mV
F	1,2 V
G	1,15 V

Point	Voltage measured
H	0,45 V
K	11 V
L	11 V
M	10,5 V
N	10,5 V
O	35 V

## MEASUREMENTS OF THE FREQUENCY RESPONSE (see fig. 9)

Set the output adapter to 100 V. Connect to the output terminals a resistance of 143 ohms and a power rating of 20-50 W. Set the potentiometer of the channel under test to maximum and the potentiometers of the other inputs at minimum. The potentiometers "B" and "H" have first to be adjusted for a linear response, this being done as follows:

Set B to +3 and H to 0. With the A.F. generator apply the pick-up input via a resistor of 12000 ohms a signal of 1000 c/s and of such an amplitude that a voltage of 20 V is obtained on the load resistor of 143 ohms. The output of the A.F. generator, should in that case be about 35 mV.

Then apply a signal of 10,000 c/s and turn knob H until the valve voltmeter shows 20 V again.

Change the signal to 50 c/s and turn knob B until the voltmeter again indicates 20 V.

By varying the frequency of the input signal and adjusting the knobs according to the table it should then be possible to obtain approximately the responses given in fig. 12.

When testing the responses for microphone and pick-up the value of  $R_i$  (fig. 9) should be 12000 ohms.

When measuring the response for radio  $R_i$  is shorted.

Fig. 11 gives the response curves for the microphone inputs (amplifier adjusted for linear response). The dotted line represents the response after switching on the limiter.

### Summary of response measurements

Input	Q1 or Q2	Q1 or Q2	Q	Q	Q	Q	Q
B at	R	R	R	R	R	+7	-1
H at	R	R	R	+7	-7	R	R
Limiter	off	on	off	off	off	off	off
Fig.	10	10	11	11	11	11	11
Response	RR	Lim	RR	R+H	R-H	+BR	-BR

"R" is the position for linear response.

### MOUNTING THE MICROPHONE TRANSFORMER EL 6802/01

For connecting low-ohmic microphones it is necessary to have a microphone transformer. Space has been left beside the smoothing capacitors for mounting two transformers of the EL 6802/01 type. Threaded holes are provided in the chassis for easy mounting. In the apparatus with serial numbers higher than 1603 a tag strip is provided at each microphone input to simplify the changing of the wiring.

The circuit is given in fig. 10. The dotted resistance of 1 M $\Omega$  is used with this apparatus.

The apparatus with serial numbers from 600 to 1603 are not provided with tag strips, so the mounting is not so simple. It is done in the following way:

- Remove the connections 1 and 2 from the three-pole pin socket for Q1 or Q2.

- b. Remove the 10 M $\Omega$  and 1 M $\Omega$  resistors and the 0,1  $\mu$ F capacitor; the 1 M $\Omega$  resistor is no longer used. See fig. 10.
- c. Draw up the screened cable connected with the valve EF40 (B1 or B2), through the opening in the chassis.
- d. Lay the 0.1  $\mu$ F capacitor and the 10 M $\Omega$  resistor side by side against the base plate of the transformer and solder them together at one end. The free end of the capacitor is connected to point 9 and that of the resistor to point 6 (earthing point). The interconnecting point is on the slanting side of the metal base plate.
- e. Interconnect points 7 and 8 of the transformer.
- f. Connect the screened cable (see under c) to the junction of capacitor and resistor; connect the screening to point 6 of the transformer.
- g. Connect the points 1 and 2 of the pin socket to the primary winding of the transformer by means of a two-core screened cable (code number 34 090 00.1); earth the screening to point 6 of the transformer and point 3 of the pin socket.
- h. Mount the transformer on the chassis with three 4 mm screws 30 mm long and three spacers about 22 mm long (inside diameter about 4.2 mm).  
For instance the screw with code number 07 804 35 and the spacer 07 005 55 can be used, but these have to be shortened.

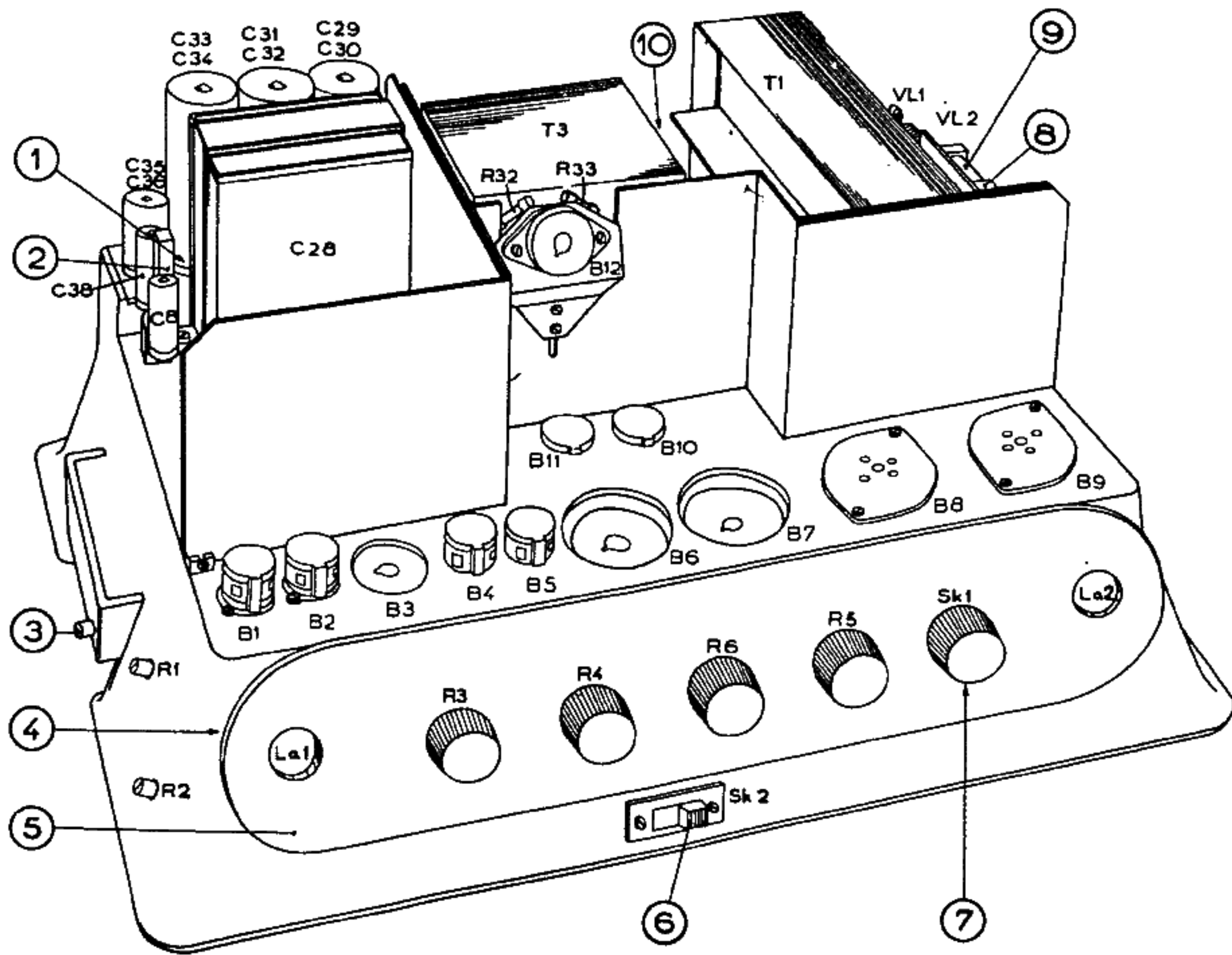
#### NOTES:

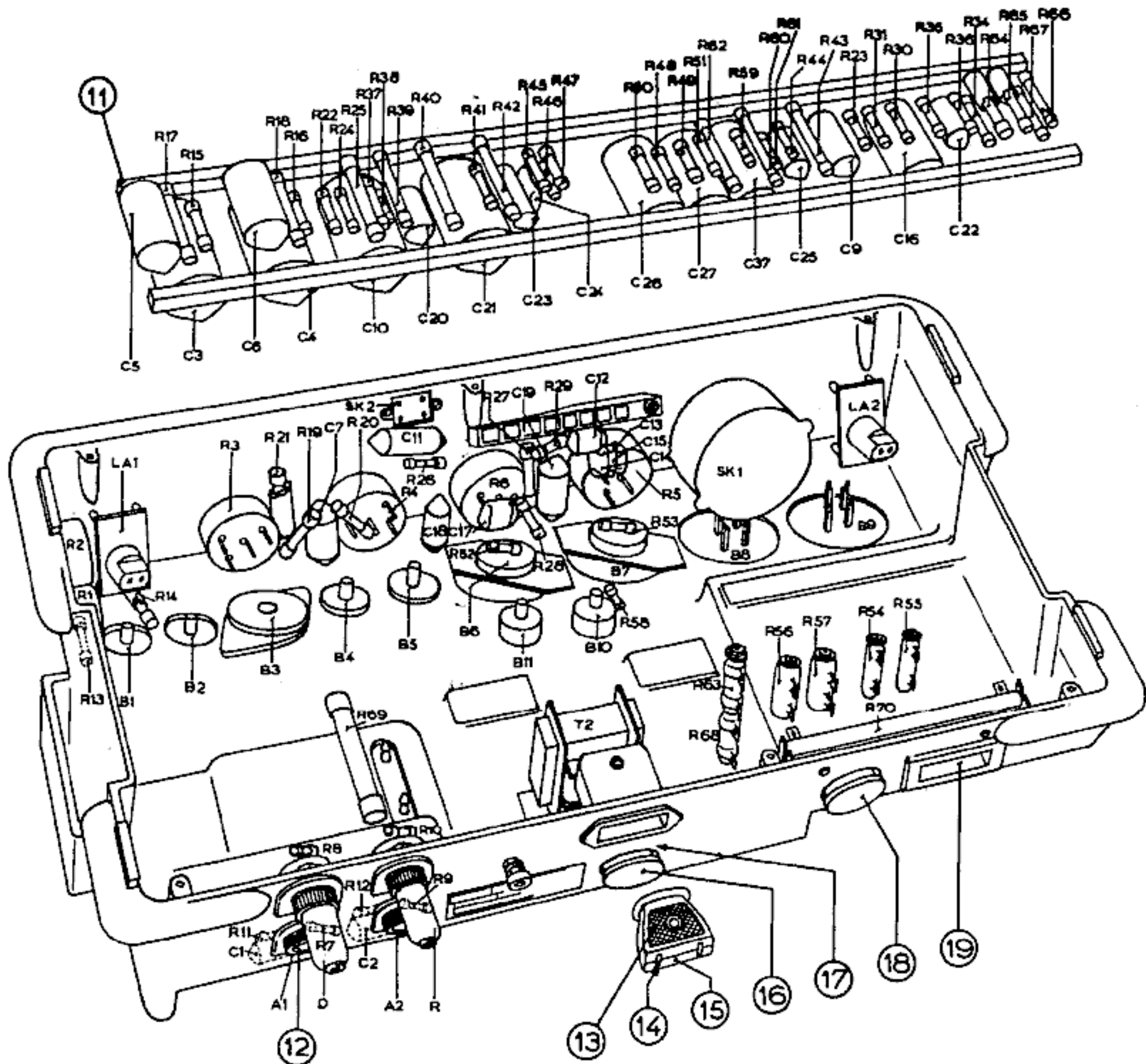
- a. In the apparatus with serial number 600 to 1603 the value of the capacitor C1 is 0,1  $\mu$ F, and in those with higher serial numbers it is 68000 pF. In the event of the 0,1  $\mu$ F capacitor becoming defective it can be replaced by one of 68000 pF (its code number is given in the list of parts).
- b. In the apparatus with serial number higher than 1603 the pick-up and radio inputs have been made suitable for magnetic and crystal pick-ups by connecting a carbon resistor of 0,22 M $\Omega$  between the points 1 and 2 and removing the connection between the points 2 and 3. Magnetic pick-ups must be connected between 1 and 3 (resistors in parallel), crystal pick-ups between 2 and 3 (resistor in series). Code-number resistor 48 555 10/220 K.



## Mechanical parts list

Pos.	Description	Code number
1	Soldering tag	960/29
2	Tag strip	967/8
3	Fixing screw for cap	999/5x12
4	Text plate	V3 320 14.0
5	"Plastic" plate	23 688 90.1
6	Limiter switch	970/29
7	Mains switch	B1 570 08.0
8	Clamping spring	A1 349 74.0
9	Safety fuse	971/T125
10	Spark bridge	V3 693 24.0
11	Component supporting rod	23 647 95
12	Male socket	977/M05
13	Insulating piece	978/2X12
14	Leaf spring	978/12
15	Insulating piece	978/2X12
16	Voltage adaptor	23 723 16.1
17	Plate with pins for adaptor	A3 228 85
18	Voltage adaptor	A3 228 85
19	Male socket	978/M2X19
	Valve socket for B1,B2,B4,B5,B10,B11	976/8X12
	Valve socket for B3	976/8X17
	Valve socket for B6,B7,B12	976/V8X17
	Valve socket for B8,B9	976/4X16
	Knob	973/16
	Fixing screw for knob	997/4X10
	Amplifier cap	V3 125 25.3
	Text plate	V3 335 73.0
	Pilot lamp holder	976/1X9
	Plug for	978/2X12





C1	906/68K	68000	pF	125	V
C2	906/68K	68000	pF	125	V
C3	906/V220K	0.22	$\mu$ F	600	V
C4	906/V220K	0.22	$\mu$ F	600	V
C5	906/V68K	68000	pF	600	V
C6	906/V68K	68000	pF	600	V
C7	906/22K	22000	pF	125	V
C8	910/C100	100	$\mu$ F	25	V
C9	906/100K	0.1	$\mu$ F	125	V
C10	906/V220K	0.22	$\mu$ F	600	V
C11	906/V10K	10000	pF	600	V
C12	905/820E	820	pF	500	V
C13	905/220E	220	pF	500	V
C14	905/560E	560	pF	500	V
C15	905/680E	680	pF	500	V
C16	906/470K	0.47	$\mu$ F	125	V
C17	905/820E	820	pF	500	V
C18	906/3K3	3300	pF	400	V
C19	906/22K	22000	pF	125	V
C20	906/10K	10000	pF	125	V
C21	906/V220K	0.22	$\mu$ F	600	V
C22	906/22K	22000	pF	400	V
C23	906/V1K5	1500	pF	600	V
C24	905/270E	270	pF	500	V
C25	906/10K	10000	pF	125	V
C26	906/V68K	68000	pF	600	V
C27	906/V68K	68000	pF	600	V
C28	48 118 10/E16M	16	$\mu$ F	500	V
C29	912/R25+25	25+25	$\mu$ F	500	V
C30					
C31	912/R25+25	25+25	$\mu$ F	500	V
C32					
C33	912/R25+25	25+25	$\mu$ F	500	V
C34					
C35	912/R12.5+12.5	12.5+12.5	$\mu$ F	500	V
C36					
C37	906/470K	0.47	$\mu$ F	125	V
C38	910/G25	25	$\mu$ F	150	V
R1	B1 639 81	0.35	M $\Omega$		
R2	B1 639 81	0.35	M $\Omega$		
R3	49 501 43.0	2x0.5	M $\Omega$		
R4	49 501 43.0	2x0.5	M $\Omega$		
R5	915/L2M5	2.5	M $\Omega$		
R6	915/L2M5	2.5	M $\Omega$		
R7	902/1M	1	M $\Omega$	0.5	W
R8	902/100K	0.1	M $\Omega$	0.5	W
R9	902/1M	1	M $\Omega$	0.5	W
R10	902/100K	0.1	M $\Omega$	0.5	W
R11	902/10M	10	M $\Omega$	0.5	W
R12	902/10M	10	M $\Omega$	0.5	W
R13	902/10K	10000	$\Omega$	0.5	W
R14	902/10K	10000	$\Omega$	0.5	W
R15	902/1M	1	M $\Omega$	0.5	W
R16	902/1M	1	M $\Omega$	0.5	W
R17	901/300K } par.	150	K $\Omega$	1	W
	901/300 }				



R18	901/300K } par.	150 k $\Omega$	1 W
	901/300 }		
R19	902/220K	0.22 M $\Omega$	0.5 W
R20	902/220K	0.22 M $\Omega$	0.5 W
R21	902/1M5	1.5 M $\Omega$	0.5 W
R22	902/680E	680 $\Omega$	0.5 W
R23	902/470K	0.47 M $\Omega$	0.5 W
R24	902/330K	0.33 M $\Omega$	0.5 W
R25	901/110K } par.	56000 $\Omega$	0.5 W
	901/120K }		
R26	902/1M	1 M $\Omega$	0.5 W
R27	902/390K	0.39 M $\Omega$	0.5 W
R28	902/100K	0.1 M $\Omega$	0.5 W
R29	902/2M7	2.7 M $\Omega$	0.5 W
R30	902/390K	0.39 M $\Omega$	0.5 W
R31	902/390K	0.39 M $\Omega$	0.5 W
R32	902/1M	1 M $\Omega$	0.5 W
R33	902/1M	1 M $\Omega$	0.5 W
R34	900/100K	0.1 M $\Omega$	1 W
R35	902/220K	0.22 M $\Omega$	0.5 W
R36	902/820K	0.82 M $\Omega$	0.5 W
R37	902/1K8	1800 $\Omega$	0.5 W
R38	902/12E	12 $\Omega$	0.5 W
R39	900/100E	100 $\Omega$	1 W
R40	900/120E	120 $\Omega$	1 W
R41	902/1M	1 M $\Omega$	0.5 W
R42	900/150K	0.15 M $\Omega$	1 W
R43	900/1M	1 M $\Omega$	1 W
R44	902/100K	0.1 M $\Omega$	0.5 W
R45	902/15K	15000 $\Omega$	0.5 W
R46	902/820K	0.82 M $\Omega$	0.5 W
R47	902/18K	18000 M $\Omega$	0.5 W
R48	902/120K	0.12 M $\Omega$	0.5 W
R49	902/150K	0.15 M $\Omega$	0.5 W
R50	902/330K	0.33 M $\Omega$	0.5 W
R51	902/330K	0.33 M $\Omega$	0.5 W
R52	902/1K2	1200 $\Omega$	0.5 W
R53	902/1K2	1200 $\Omega$	0.5 W
R54	938/47E	47 $\Omega$	8 W
R55	938/47E	47 $\Omega$	8 W
R56	931/F120E	120 $\Omega$	16 W
R57	931/F120E	120 $\Omega$	16 W
R58	902/100E	100 $\Omega$	0.5 W
R59	902/22K	22000 $\Omega$	0.5 W
R60	900/1K	1000 $\Omega$	1 W
R61	902/68K	68000 $\Omega$	0.5 W
R62	901/33K	33000 $\Omega$	0.5 W
R63	930/F8K2	8200 $\Omega$	10 W
R64	900/4K7	4700 $\Omega$	1 W
R65	902/4K7	4700 $\Omega$	0.5 W
R66	900/18K	18000 $\Omega$	1 W
R67	900/18K	18000 $\Omega$	1 W
R68	930/F680E	680 $\Omega$	10 W
R69	2x901/220K } par.	0.22 M $\Omega$	2 W
	2x901/220K }		
R70	932/F39K	39000 $\Omega$	25 W
R71	902/220K	0.22 M $\Omega$	0.5 W
R72	902/220K	0.22 M $\Omega$	0.5 W

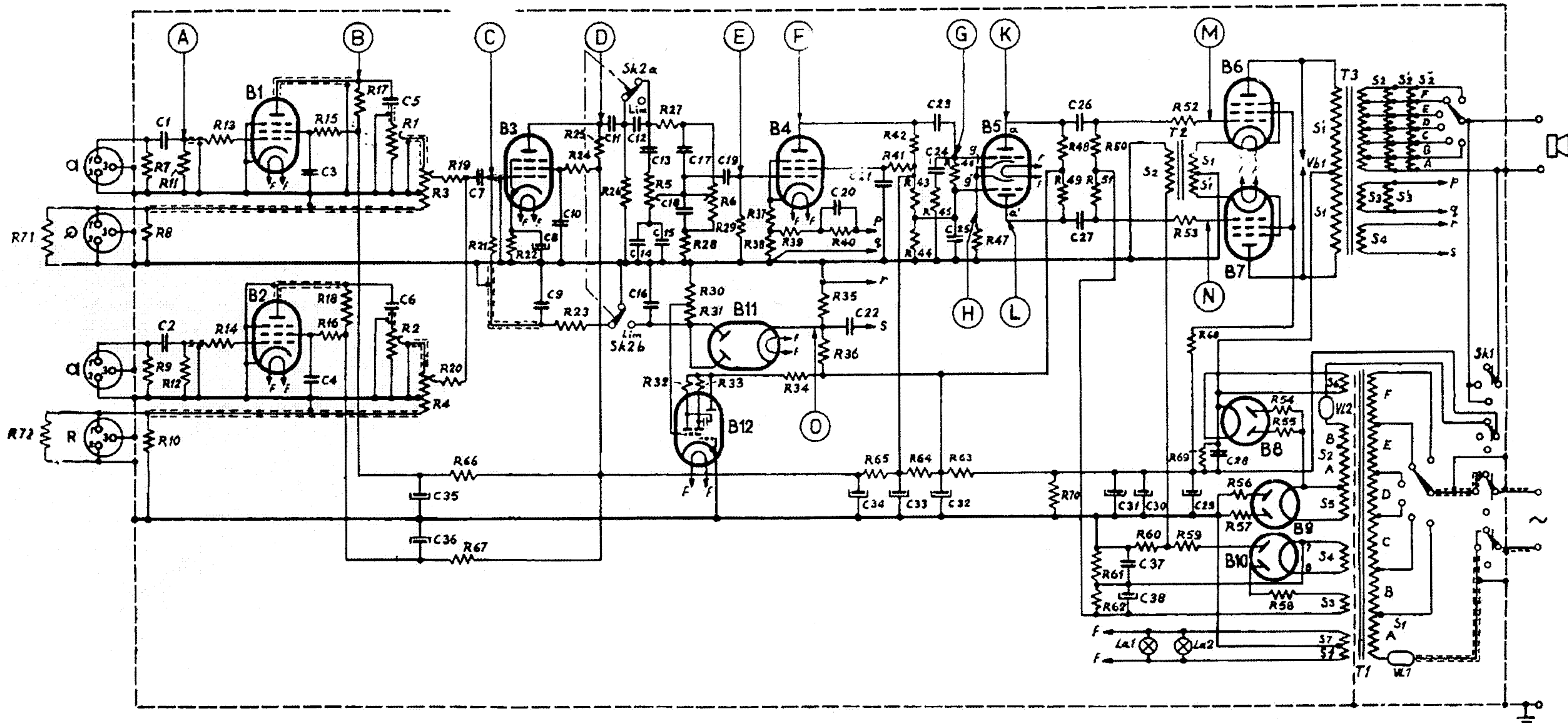


Fig1

T1	S1A=110 V	T2	S1-S1' = 120W	V3 620 15.0	S1 -S1' = 735W	V3 620 14.0	VL1	08 100 97
	S1B= 15 V		S2 =1200W				VL2	08 140 47
T1	S1C= 20 V	V3 616 03.0		T3	S2A-S2'A-S2'1'A= 18W		La1	8008N
	S1D= 55 V				S2B-S2'B-S2'1'B= 26W		La2	8008N
	S1E= 20 V				S2C-S2'C-S2'1'C= 18W			
	S1F= 25 V				S2D-S2'D-S2'1'D= 26W			
	S2A=305 V				S2E-S2'E-S2'1'E= 35W			
	S2B=16,2 V				S2F-S2'F-S2'1'F= 53W			
	S3 =34,8 V				S3 =S3' = 20W			
	S4=S5=S6=4,64 V				S4 = 123W			
	S7=S7'=3,48 V							

W = windingen - turns - enroulements - Windungen - arrollamientos