EL6400

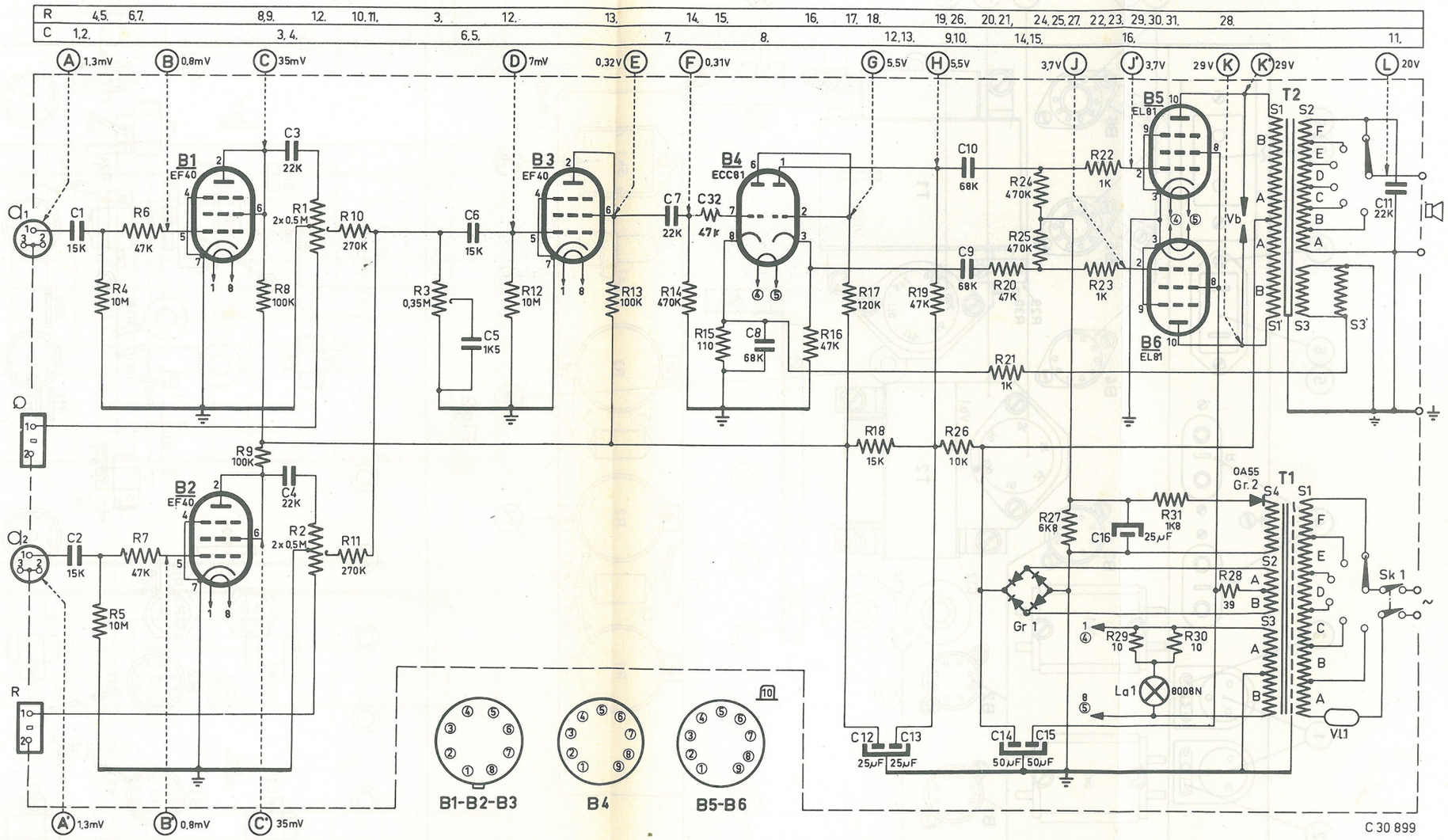
R 4,5. 6,7. 8,9. 12. 10,11, 3. 12. 13. 14, 15. 16, 17, 18. 19, 26. 20,21, 24,25,27. 22,23. 29,30,31. 28.
C 1,2. 3, 4. 6,5. 7. 8. 12,13. 9,10. 14,15. 16. 11.
A 1.3mV
B 0,8mV
C 35mV
D 7mV
0,32V E
F 0,31V
G 5,5V
H 5,5V
3,7V J
J' 3,7V
29V K
K' 29V
L 20V
B1 EF40
B2 EF40
B3 EF40
B4 ECC81
B5 EL81
B6 EL81
T2
T1
0A55 Gr.2
Gr 1
Sk 1
Vl1
La1 8008N
Vb
C1 15K
C2 15K
C3 22K
C4 22K
C5 1K5
C6 15K
C7 22K
C8 68K
C9 68K
C10 68K
C11 22K
C12 25µF
C13 25µF
C14 50µF
C15 50µF
C16 25µF
C32 47k
R1 2x0,5M
R2 2x0,5M
R3 0,35M
R4 10M
R5 10M
R6 47K
R7 47K
R8 100K
R9 100K
R10 270K
R11 270K
R12 10M
R13 100K
R14 470K
R15 110
R16 47K
R17 120K
R18 15K
R19 47K
R20 47K
R21 1K
R22 1K
R23 1K
R24 470K
R25 470K
R26 10K
R27 6K8
R28 39
R29 10
R30 10
R31 1K8
S1 S2 S3 S3' S4
B1-B2-B3
B4
B5-B6
C 30 899

Fig.1

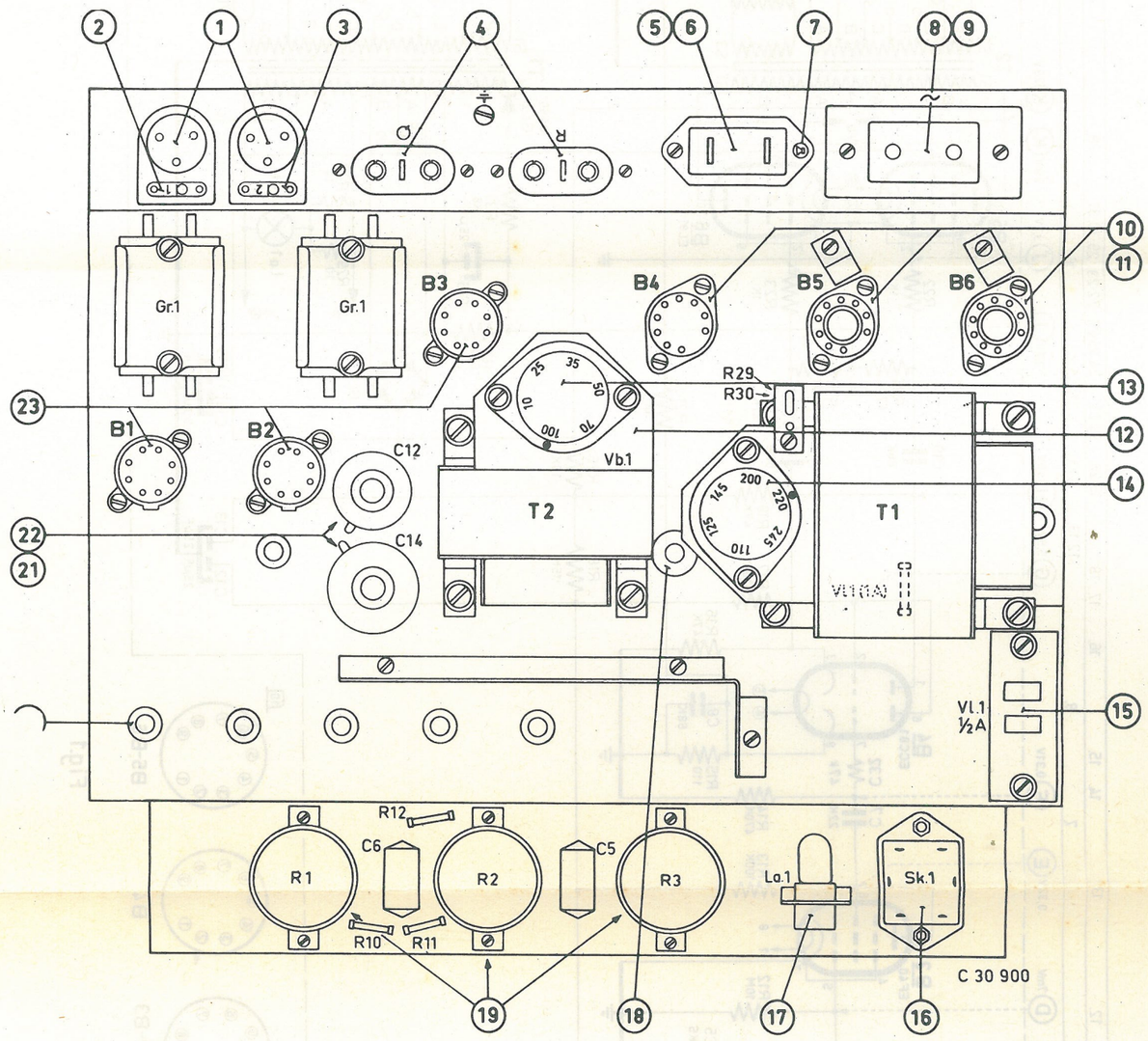

Fig.2

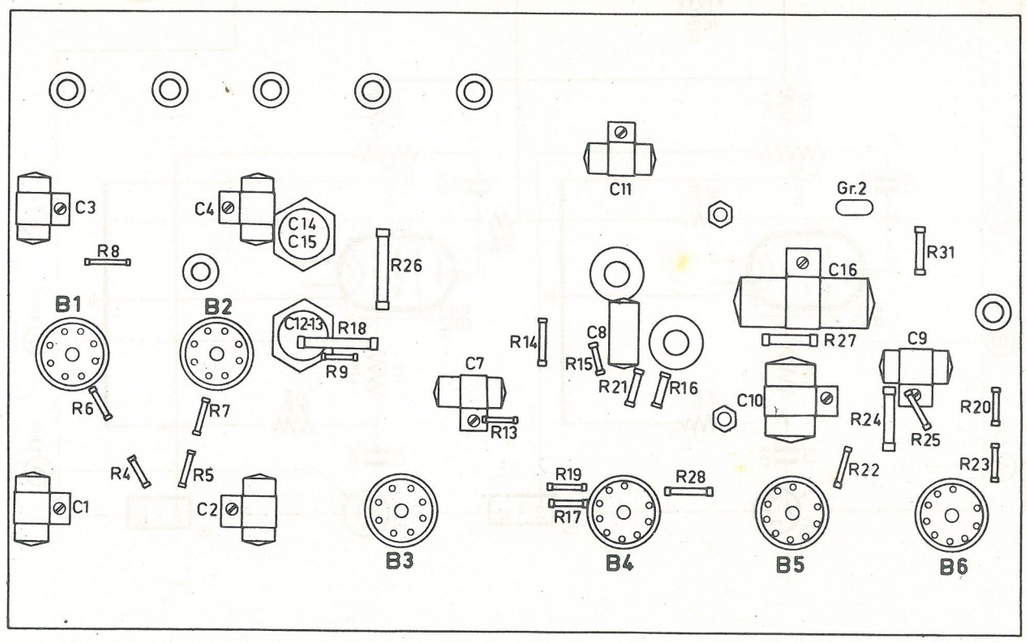

Fig.3

EL6400

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THE CENTRAL SERVICE DIVISION
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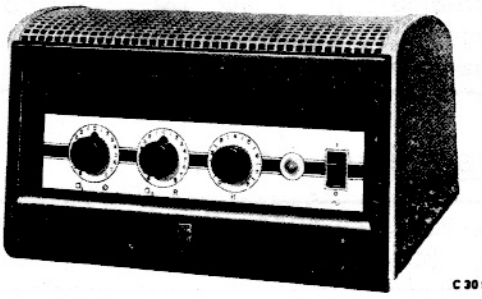
Eindhoven

PHILIPS

SERVICE NOTES

for the
20 W Amplifier


C 30 909

EL6400

1953

GENERAL

This amplifier has been designed for public address purposes. It is provided with four input channels, viz. 2 for microphone, 1 for gramophone and 1 for radio.

VERSIONS

EL 6400/00 Standard
EL 6400/01 Tropic-proof
EL 6400/06 Extra VL2 in HT.

WEIGHT

Complete with valves 8.9 kg

DIMENSIONS

Length : 335 mm
Width : 245 mm
Height : 190 mm

LIST OF DIAGRAMS

Printed in Holland

93 978 60.2.05

ELECTRICAL DATA

	mic. 1 and 2	P.U. input	radio input
Impedance	10 MΩ	230,000 Ω	230,000 Ω
Sensitivity	6.5 mV	172 mV	172 mV
Noise level	-55 dB	-65 dB	-65 dB

DISTORTION (fig.5)

from 200 - 6000 c/s	< 5 %
from 80 - 10,000 c/s	< 6 %

POWER CONSUMPTION

no signal	41 watts	cos φ 0.84
maximum signal	79 watts	cos φ 0.90

OUTPUT VOLTAGES

By means of a voltage adaptor the following output voltages can be obtained:
10V, 25V, 35V, 50V, 70V, 100V (see also under "loudspeaker matching").

MAINS VOLTAGES AND FREQUENCIES

This amplifier is suitable for mains voltages of:
110, 125, 145, 200, 220 and 245 volts with frequencies from 40 to 100 c/s.

VALVES, etc

3	Pre-amplifying valves	EF40
1	Phase inverting valve	ECC81
2	Output valves	EL81
1	Indicator lamp	8008N
1	Fuse (110 - 145 V)	08 140 39.3
1	Fuse (200 - 245 V)	08 118 40.0

CONNECTIONS (fig.2)

At the rear of the amplifier, from left to right, are the following connections:

a. Mains input
This is a recessed male socket with 6 mm pins.

b. Loudspeaker output
This is a special 2-pole socket into which a 13 mm plug with flat pins fits.

c. Radio input
Female socket

d. Earth terminal

e. Gramophone input
Female socket

f. Microphone input, channel 2
3-pin male socket

g. Microphone input, channel 1
3-pin male socket

The pins of the input sockets have the following functions:

1. Female socket "R" (radio)

The radio input socket takes a 19 mm plug with a flat middle pin. The left-hand contact (viewed from the back of the amplifier) is the "hot" side of the input (contact **grid valve** 33) and its impedance above earth is 230,000 Ω. The right-hand contact is earthed.

2. Female socket „Ω" (pick-up)

See under female socket "R". This input is suitable for the connecting of a crystal pick-up.

3. Male sockets (microphone) „Ω"

The pin designated "1" is the "hot" side of the input (control grid B1 and B2) and the input impedance is 10 MΩ. Pins 2 and 3 are earthed.

CONTROL KNOBS

Located along the front of the amplifier, from left to right are the following controls:

a. Volume control with zero in the middle
To the left the volume of microphone input 1 is adjusted. To the right, the volume of the pick-up is adjusted.

b. Volume control with zero in the middle
To the left, the volume for microphone input 2 is adjusted; to the right the volume for radio input.

It is thus possible to mix:

1. Microphone 1 and microphone 2
2. Microphone 1 and radio
3. Microphone 2 and pick-up
4. Pick-up and radio

c. Treble control
With this control turned fully counter-clockwise the response at 10,000 c/s is down approx. 18 dB. With this control turned fully clockwise the response curve is flat.

d. Mains switch
In position "0" the amplifier is switched off and in position "1" the amplifier is switched on. An indicator lamp which lights up when the amplifier is on, is located next to the mains switch.

VOLTAGE ADAPTORS

Two voltage adaptors for the output voltage and the mains voltage (items 13 and 14, fig.2) are fitted inside the amplifier. To adjust these adaptors it is necessary to remove the screening cover from the amplifier.

CIRCUIT ARRANGEMENT (fig.1)

The microphone inputs 1 and 2 are connected via the isolating capacitors C1 and C2 and the resistors R6 and R7 to the control grids of the valves B1 and B2 respectively (type EF40). The negative grid bias for B1 and B2 is obtained by using grid leak resistors (R4 and R5) of a high value (10 MΩ).

The amplified microphone voltages are coupled via C3 and C4 to the volume controls R1 and R2. These potentiometers have a centre tapping which is connected to earth. The moving contacts of the potentiometers are connected via R10 and R11 and C6 to the control grid of B3 (EF40). R10 and R11 have been connected in series with the moving contacts in order to prevent the signals from these potentiometers from affecting each other.

When the treble control (potentiometer R3) is turned to its minimum position, C5 is between the junction of R10-C6 and earth. The impedance which C5 offers to the high audio frequencies is low compared to its impedance at the middle and low frequencies. As a result, the high frequencies are attenuated more than the middle and low frequencies (± 18 dB). See fig.4B).

The anode of B3 is connected via C7 to the control grid of the phase-inverter (ECC81). Since the resistors R16 and R19 are of the same value and the same current flows through them, equal voltages which are opposite in phase will be developed across them. These voltages are applied to the control grids of the output valves B5 and B6.

The grids of B5 and B6 receive their negative bias via the resistors R24 and R25. This voltage is derived from the circuit S4-B7-R31. The diode GR2 functions as a rectifier, R27 presents a constant load, and C16 is the smoothing capacitor. S3, on the secondary side of the output transformer provides inverse feedback via R21 to the cathode of B4. This arrangement gives an inverse feedback of 2½ times.

Between both anodes of the output valves is a spark gap which is adjusted to 0.6 mm and sealed in the factory. This adjustment must not be altered. In this amplifier the anode voltage is supplied by a selenium rectifier (Gr1).

CHECKS AND MEASURFMENTS

Valve voltages and currents

Output voltage adaptor set to 100 V. Volume control turned to "0" (except for output valve measurements at maximum signal). Amplifier output loaded with a 500 Ω resistor (10 - 20 W).

	Valve B1, B2, B3, EF40	B4, ECC81	B5, B6 EL 81 no signal	B5, B6, EL81 full signal (Vo 100 V- 1000 c/s	La' 80081
Va	45 -59	35 - 49	280-298	250-268	-
Ia	0.9 - 1.15	0.9 - 1.15	10- 20	60- 84	-
Vg2	45 -49	-	140-149	125-135	-
Ig2	0.16- 0.24	-	0.3-0.6	5- 10	-
Va'	-	131 - 165	-	-	-
Ia'	-	0.88- 1.07	-	-	-
-Vg	-	-	-23.7- -24.9	-23.4- -24.6	-
Vf	6.15- 6.45	6.15- 6.45	6.15- 6.45	6.1- 6.4	5.4-5
Vk to earth	-	38 - 52	-	-	-

The figures listed on page 4 represent extreme values, and the [illegible] values measured must fall within these limits. When a fault in the [illegible]ifier cannot be located with the aid of the table on page 4, the gain [illegible]ch stage in the amplifier should be checked. For this purpose, use a [illegible] voltmeter e.g. type GM 4132 or GM 6005 and an A.F. oscillator e.g. [illegible] or GM 2307.

[illegible]URING THE STAGE GAIN

Connect a 500 Ω resistor (10 - 20 W) across the output of the [illegible]L 6400/00 and set the voltage adaptor to 100 V. Turn the volume control [illegible] maximum. Feed a 1000 c/s signal from the A.F. oscillator to the [illegible]icrophone input "⊂1". Adjust the strength of this input signal so that [illegible]he voltage across the 500 Ω load resistor measured with the valve volt-[illegible]eter is 20 V. This should correspond to an input voltage of ± 1,3 mV. [illegible]fter this, the valve voltmeter is connected to the points B-C-D-E-F-G-H-[illegible]-J'-K-K' and L in turn (fig.1). To measure at points B' and C', the A.F. [illegible]scillator has to be connected to the microphone input "⊂2" (A'). The [illegible]olume control R1 is turned to minimum and the volume control R2 to maximum. [illegible].F. oscillator set to 1000 c/s.

Point	Voltage
A	1.3 mV
A'	1.3 mV
B	0.8 mV
B'	0.8 mV
C	35 mV
C'	35 mV
D	7 mV
E	0.32 V

Point	Voltage
F	0.31 V
G	5.5 V
H	5.5 V
J	3.7 V
J'	3.7 V
K	29 V
K'	29 V
L	20 V

FREQUENCY RESPONSE MEASUREMENTS

Set the output voltage adaptor to 100 V. Connect a 500 Ω resistor (10 - 20 W) across the output of the amplifier.

Turn the volume control of the channel to be measured to maximum. Set the other volume control to minimum. The measuring instruments are the same as those mentioned under "Measuring the stage gain". For their connection see fig.6.

Channel	Ω flat	Ω-H	⊂1,⊂2 flat	R flat
40 c/s	-2.5 db	-	-5.2 db	-2.5 db
60 c/s	-1.5 db	-	-2.5 db	-1.5 db
120 c/s	-0.4 db	-	-1 db	-0.4 db
250 c/s	-0.3 db	+2 db	-0.3 db	-0.3 db
500 c/s	0 db	+1.6 db	0 db	0 db
1000 c/s	0 db	0 db	0 db	0 db
2000 c/s	0 db	-3.5 db	0 db	0 db
4000 c/s	-0.3 db	-8.5 db	-0.3 db	-0.3 db
6000 c/s	-0.4 db	-11.5 db	-0.4 db	-0.4 db
8000 c/s	-1 db	-14.2 db	-1 db	-0.4 db
10,000 c/s	-1.2 db	-16.5 db	-1.5 db	-1 db

IMPORTANT

When measuring via the two microphone channels or via the pick-up channel, a 12.000 Ω resistor has to be inserted in series with the measuring lead.

Fig. 4A gives the frequency curve for the microphone channel
Fig. 4B gives the frequency curve for the gramophone channel
Fig. 4C gives the frequency curve for the radio channel

LOUDSPEAKER MATCHING

The secondary winding of the output transformer is designed in accordance with the 100 V system. The output voltage adaptor is adjustable for 100, 70, 50, 35, 25 and 10 V. This range is so chosen that, when the output voltage is lowered by 1 step, the nominal loudspeaker power can be doubled. The reduction in sound intensity is then 3 db.

It is possible to connect a loudspeaker having a 100 V transformer, in which case the impedance of the loudspeaker voice coil is of no importance. Moreover, several loudspeakers can be connected to the amplifier provided the total power of the loudspeakers does not amount to more than 20 watts.

If the loudspeaker is connected to an output voltage that is lower than the voltage for which the speaker is intended, the speaker will consume less power, so that under these conditions more than one loudspeaker can be connected.

When the type 9844 loudspeaker, which has a power rating of 6 watts, is connected to the 100 V output of the amplifier, the loudspeaker impedance can be computed as follows:

$$Z = \frac{e^2}{W} = \frac{10.000}{6} = 1670\ \Omega$$

When the output voltage of the amplifier is set to 70 V the power applied to the loudspeaker is:

$$\frac{70^2}{1670} = 2.9 \text{ watts}$$

The amplifier can deliver a power of 20 watts. So, in the above ca

$\frac{20}{2.9} = 7$ loudspeakers can be connected.

With the output voltage adaptor set to 50V, 35V or 25V we find that 14, 28 or 56 type 9844 loudspeakers can be connected.

The 10 V tapping is used for feeding loudspeakers without transformer (voice coil connection) and for headphones.

The following table lists the various connection possibilities:

Voltage adaptor	Total nominal loudspeaker power	Number of loudspeakers
100 V	20 watts	e.g. 3x9844 or 2x9840
70 V	40 watts	6x9844 or 4x9840
50 V	80 watts	13x9844 or 8x9840
35 V	160 watts	26x9844 or 16x9840
25 V	320 watts	53x9844 or 32x9840
10 V	for headphones or direct connection to voice coil	

Obviously, many other loudspeaker combinations can be chosen (see last colur

T1	V3 616 51.0			
T2	V3 621 09.0			
C1	906/L15K	15000 pF	125 V	10 %
C2	906/L15K	15000 pF	125 V	10 %
C3	906/22K	22000 pF	400 V	20 %
C4	906/22K	22000 pF	400 V	20 %
C5	906/1K5	1500 pF	400 V	20 %
C6	906/L15K	15000 pF	125 V	10 %
C7	906/22K	22000 pF	400 V	20 %
C8	906/L68K	68000 pF	125 V	10 %
C9	906/68K	68000 pF	125 V	20 %
C10	906/68K	68000 pF	400 V	20 %
C11	906/22K	22000 pF	400 V	20 %
C12	912/L25+25	25+25 µF	300 V	
C14	912/P50+50	50+50 µF	350 V	
C16	910/F50	40 µF	50 V	
R1	49 501 43.0	2x0.5 MΩ	log	
R2	49 501 43.0	2x0.5 MΩ	log	
R3	915/L75K+275K	0.35MΩ	log	
R4	902/10M	10 MΩ	½ W	10 %
R5	902/10M	10 MΩ	½ W	10 %
R6	902/47K	47000 Ω	½ W	10 %
R7	902/47K	47000 Ω	½ W	10 %
R8	902/100K	100 kΩ	½ W	10 %
R9	902/100K	100 kΩ	½ W	10 %
R10	902/270K	270 kΩ	½ W	10 %
R11	902/270K	270 kΩ	½ W	10 %
R12	902/10M	10 MΩ	½ W	10 %
R13	902/100K	100 kΩ	½ W	10 %
R14	902/470K	470 kΩ	½ W	10 %
R15	901/110E	110 Ω	½ W	10 %
R16	901/47K	47000 Ω	½ W	5 %
R17	902/120K	120 kΩ	½ W	10 %
R18	900/15K	15000 Ω	1 W	10 %
R19	901/47K	47000 Ω	½ W	5 %
R20	902/47K	47000 Ω	½ W	10 %
R21	902/1K	1000 Ω	½ W	10 %
R22	902/1K	1000 Ω	½ W	10 %
R23	902/1K	1000 Ω	½ W	10 %
R24	902/470K	470 kΩ	½ W	10 %
R25	902/470K	470 kΩ	½ W	10 %
R26	900/10K	10000 Ω	1 W	10 %
R27	901/6K8	6800 Ω	½ W	5 %

R28
R29
R30
R31
R32
GR1
*VL2
VL1
VL1
VB1
LA1
* EL

	R28	902/39E	39 Ω	½ W	10 %
	R29	902/10E	10 Ω	½ W	10 %) par.
	R30	902/10E	10 Ω	½ W	10 %)
10 %	R31	901/1K8	1800 Ω	½ W	5 %
10 %	R32	902/47K	47000 Ω	½ W	10 %
20 %					
20 %					
20 %	GR1	SR 250 B100			2 par.
	*VL2	974/V500		0.5 A	
10 %	VL1	974/V1000	110-145 V		
20 %	VL1	974/V500	200-245 V		
10 %	VB1	V3 693 22			
20 %					
20 %	LA1	8008 N			
20 %					

* EL 6400/06

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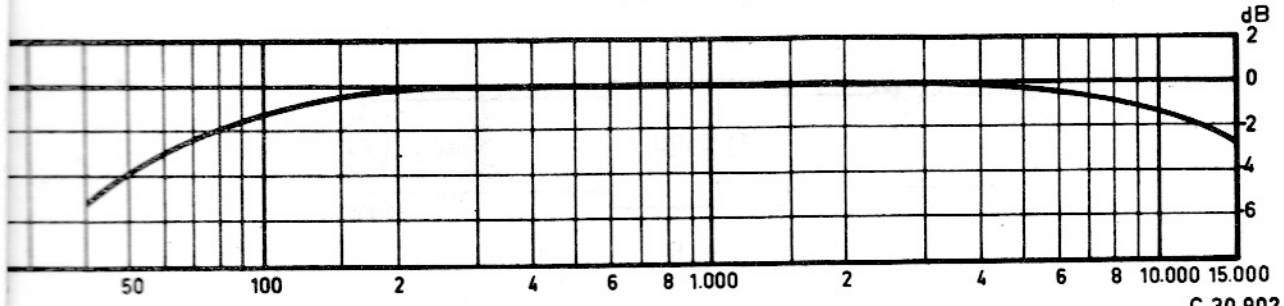


Fig.4[a]

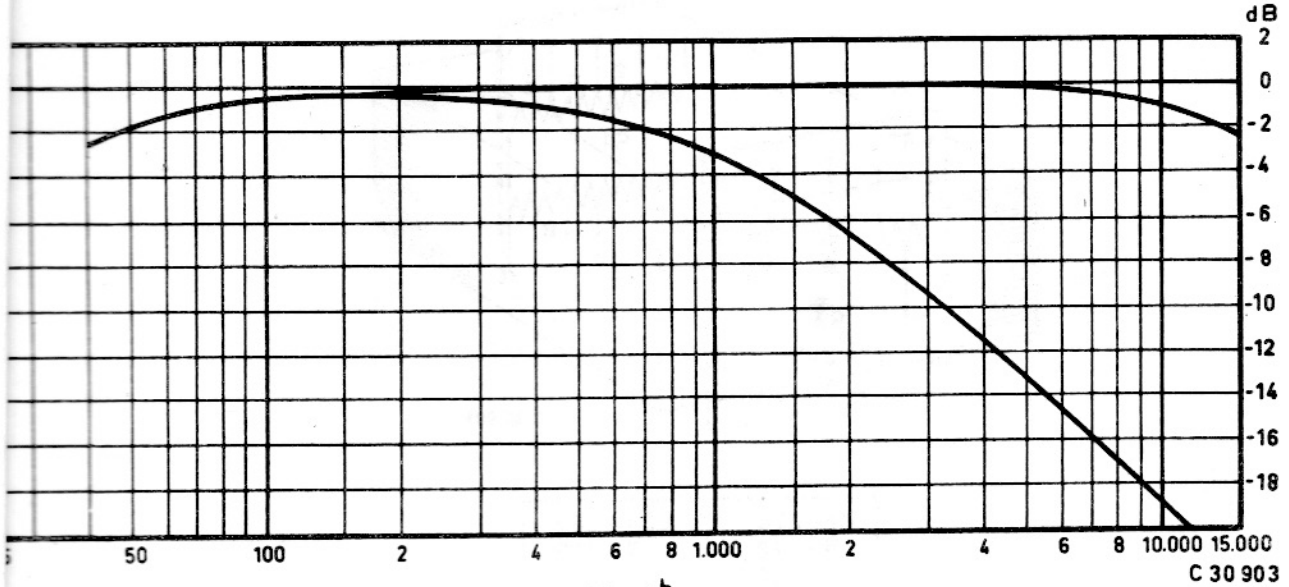


Fig.4[b]

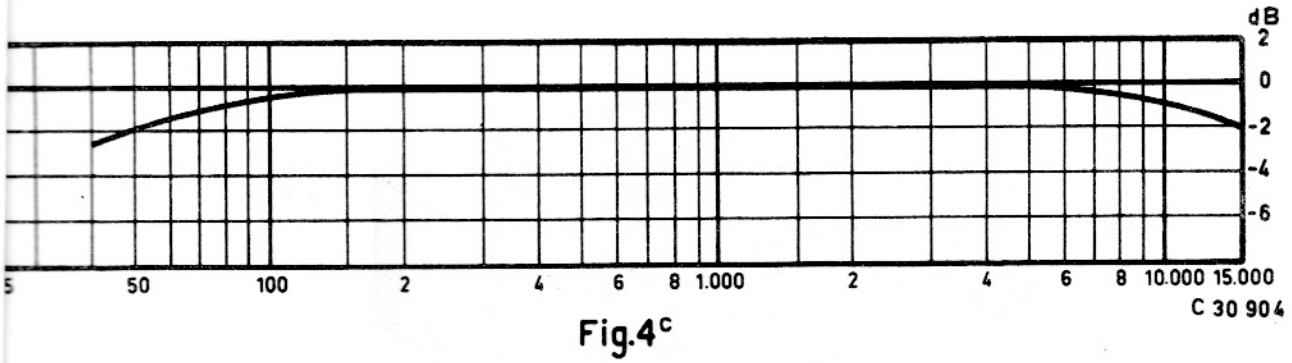


Fig.4[c]

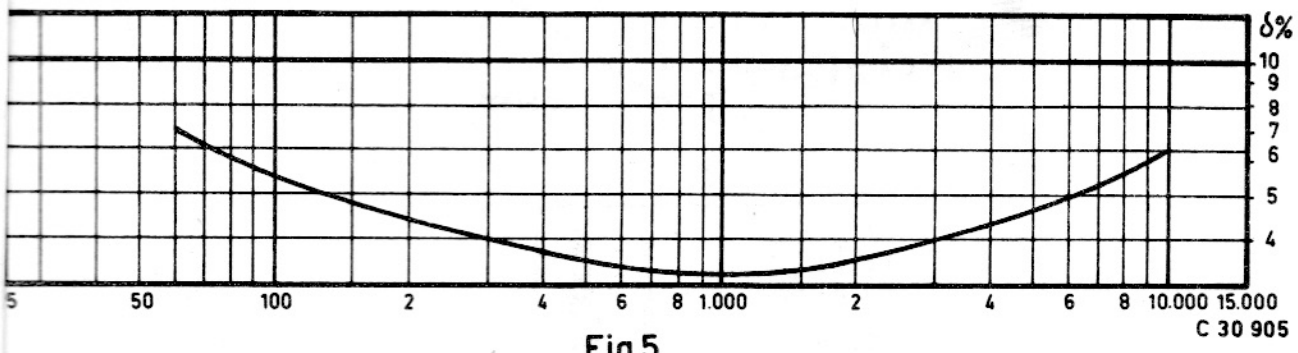


Fig.5

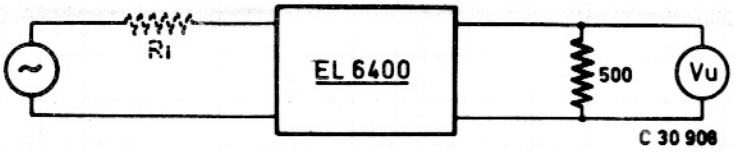
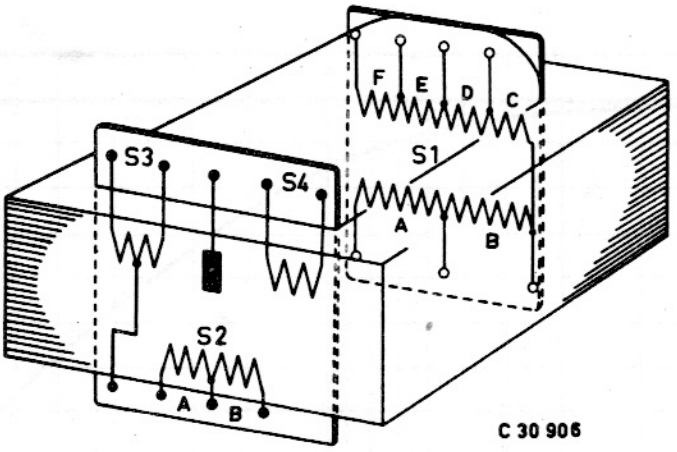
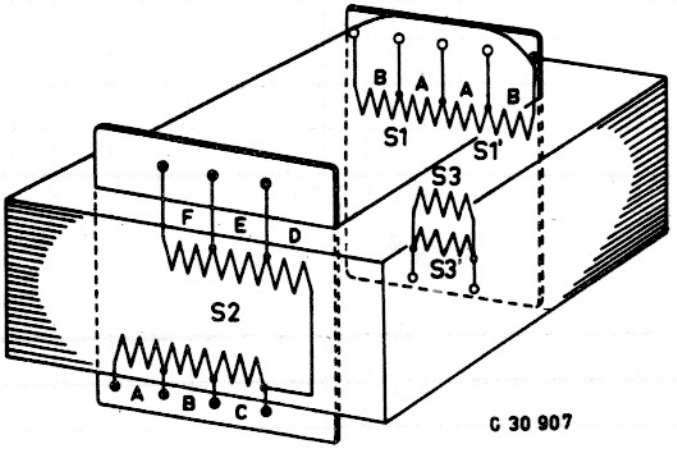


Fig.6



T 1

S1A - 276 B - 38 C - 50,5 D - 138 E - 50 F - 62	S2A - 288 B - 288 S3A - 8,5 B - 8,5 S4 - 100



T 2

S1A - 425 B - 425 S1'A - 425 B - 425 S3 - 60 S3' - 60	S2A - 64 B - 96 C - 64 D - 96 E - 128 F - 192

Fig.7