Published by
THE CENTRAL SERVICE DIVISION
N.V. Philips' Gloeilampenfabrieken
Eindhoven

PHILIPS

SERVICE NOTES

for the "Signal Tracer"

GM 7628-01

1957.

A. GENERAL.

A1. Purpose.

The apparatus GM 7628-01 is used for tracing faults in receivers and amplifiers, together with a service oscillator, e.g. GM 2883 or GM 2884. At the same time the sensitivity, amplification per stage, as well as the working of automatic volume contrd, the magnitude of an oscillator voltage and the leakage of a (coupling) capacitor can be measured. For handling the apparatus see directions for use.

A2. Figures

Fig. 1 Complete circuit diagram.
Fig. 2 Circuit diagram; measurement of an A.F. signal.
Fig. 3 Circuit diagram; measurement of a R.F. signal.
Fig. 4 Circuit diagram; measurement of oscillator voltage.
Fig. 5 Circuit diagram; measurement of A.V.C. voltage.
Fig. 6 Circuit diagram; measurement of the leakage of a (coupling) capacitor.
Fig. 7 Circuit diagram; output 10,000 Ω.
Fig. 8 Circuit diagram; output 2.5 Ω.
Fig. 9 Circuit diagram; output to oscillograph.
Fig. 10 Front view of the apparatus.
Fig. 11 Top view (without cabinet).
Fig. 12 Bottom view (without cabinet).
Fig. 13a Right half of the attenuator.
Fig. 13b Left half of the attenuator.
Fig. 14 Switch segments SK1.
Fig. 15 Switch segment SK2.
Fig. 16 Switch segment SK3.
Fig. 17 Switch segment SK4.
Fig. 18 Power transformer.
Fig. 19 Loudspeaker transformer.
Fig. 20 Measuring probe.

Printed in Holland

93 989 76.1.05

A3. Technical data.

a. Principle (fig. 1).

The apparatus consists of a two stage audio amplifier, valves B2-B4 (EF40 and EL41).
An EA50 diode, connected as a detector, is in the measuring probe (at the end of the measuring cord).
A modulated R.F. signal is rectified by the diode after which the detected A.F. signal is taken off from C2 and is amplified.
With the aid of a magic eye or a loudspeaker it can now be observed.

b. Measuring probe.

The maximum admissible voltage is 250 V + 100 V~.
The input capacitance is 10 pF.
The input resistance in position "A.V.C." is 12 MΩ, when nothin is connected to the output terminals.
The input resistance in position "L.F." is 1 MΩ.
The input damping in position "Osc." and "R.F." is 0.2 MΩ, at 1,5 Mc/s.

c. Input attenuator.

The attenuator has 8 positions viz. X1, X2, X5, X10, X25, X50, X100 and X150, and for R.F. voltage is set for a modulation depth of 30 % at a modulating frequency of 400 c/s, and complete closing of the cathode ray indicator. For A.F. voltage the attenuator is set for 400 c/s.
The accuracy of the attenuator is 20 % at 400 c/s.

d. Sensitivity.

With a R.F. signal of 100 kc/s, 30% modulated with 400 c/s the cathode ray indicator closes fully with 100 mV, and gives a perceptible closing with 15 mV.
With a A.F. signal of 400 c/s the indicator closes fully with 100 mV, and gives a perceptible closing with 2 mV.
In position "Osc." the indicator closes fully with an unmodulated 100 kc/s signal of 18 V, and gives a perceptible closing with 1 V.
In position "A.V.C." with SK4 at "-Ind" the indicator closes fully with a negative direct voltage of 18 V and gives a perceptible closing with -1V.
In position "A.V.C." with SK4 at "+Ind", the indicator gives maximum shadow with a positive direct voltage of 5 V and gives a perceptible opening (shadow) with + 1 V.

e. Output

SK4 on	Voltage on Bu1 - Bu2 with 400 c/s.
10,000 Ω	10 V
2.5 Ω	230 - 340 mV
Osc. gr.	120 - 180 mV

The maximum output that can be delivered to the loudspeaker is 0.9 W at 1000 c/s with 10 % distortion.

f. Hum voltage

With SK4 in position 2,5 Ω the hum voltage should be at maximum 15 mV.

g. Mains supply

The apparatus can be connected to supply voltages of 110 V, 125 V, 145 V, 200 V, 220 V and 245 V; 40 - 100 c/s.
The power used amounts to about 26 W. The primary current should be at maximum 150 mA at 220 V.

h. Valves: 1x EA50, 1x EF40, 1x AZ41, 1x EM4, 1x EL41.

j. Dimensions

260 x 187 x 152 mm (including knobs and handle).

k. Weight:

5.05 kg (11 lbs 3 oz).

When in the technical data of the Service Notes, features are expressed in figures with mention of a tolerance, then these are guaranteed by the factory. Figures without tolerances serve as a guide to the user and give the features of an average apparatus.

B. DESCRIPTION.

The apparatus consists of the following:

a. Two stage A.F. amplifier.
b. Measuring probe with built in detector.
c. A.F. attenuator.
d. R.F. attenuator.
e. A cathode beam indicator and a switchable loudspeaker.
f. The power supply.

These parts will be explained with the various positions of the switches SK1 to SK5.

1. A.F. signal

SK1 in one of the positions "X1" to "X150", SK2 and SK5 in position "A.F." SK3 in position "loudspeaker".
The A.F. signal to be measured, connected between Bu3 and Bu4, is first filtered by R1/C2 and then taken via C4 to a voltage divider. In position "X1" of the A.F. attenuator this voltage divider circuit consists of R14 and R2.
In positions "X2" to "X150" one of the resistors R9 to R3 are connected in parallel with R2, so that with each succeeding position of switch SK1 the voltage across R16 becomes lower.
After being amplified by the 2-stage A.F. amplifier (valves B2 and B4) the signal is supplied to the loudspeaker LS1 via the loudspeaker transformer T2 and at the same time to the grid of the indicator valve B5.

2. R.F. signal (fig. 3)

SK1 in one of the positions "X1" to "X150", SK2 and SK5 in position "H.F.", SK3 in position "R", SK4 in position "-Ind".
The R.F. signal to be measured is first detected by diode B1 and the A.C. component is removed by filter R1/C2.

The rest of the circuit is the same as described under "1" with the exception of the R.F. attenuator. For small signals between Bu3 and Bu4 the detection of B1 is quadratic (lower part of the characteristic), for larger signal linear. Therefore a second attenuator is provided for the small input signals (positions "X2" to "X25") to provide correction of the A.F. attenuator. This R.F. attenuator connects C15 in series with R13, R12, R11 or R10 respectively parallel to C11/R21, to attenuate the signal on the grid of the amplifier valve B4. In positions "X25" to "X150" R10 remains in series with C15, parallel to C11/R21 as the signal between Bu3 and Bu4 is so large that the diode B1 works in the linear part of the characteristic.
With the loudspeaker switch SK3 now in position "R", the loudspeaker LS1 is out of circuit and replaced by resistor R29.
The indicator valve B5 is connected as normally.

3. Oscillator voltage (fig. 4)

Switch SK1 of the R.F. attenuator and switch SK5 of the measuring probe in position "oscillator", and SK4 in "-Ind". The oscillator voltage to be measured is connected between Bu3 (pin of the measuring probe) and Bu4 (the earthscrew of the measuring probe). This voltage is detected by the diode B1 and the arising pulsating direct voltage passes through the filter R1/C2/C12 and R26/C19 where the A.C. component is removed. The remaining rectified voltage is taken from the voltage divider R38-R27 and applied to the grid of the indicator valve B5. The amount of closing of the magic eye is a measure of the R.F. voltage between Bu3 and Bu4.

4. A.V.C. voltage (fig. 5)

Switches SK1 and SK5 now in position "A.V.C.", and SK4 in "-Ind". The A.V.C. voltage to be measured is again connected to terminals Bu3 and Bu4. Since the voltage is a rectified alternating voltage, the diode B1 is superfluous and is switch ed out of circuit by SK5. The rest of the circuit is the same as described under "3".

5. Measurement of the leakage of a (coupling) capacitor

SK1 and SK5 in position "AVC".
SK4 in position "+Ind.".

The voltage to be measured is connected to Bu3 and Bu4. Because the cathode of the indicator-tube is connected to the cathode of the 2nd A.F. amplifier tube, it is possible to measure positive direct voltages for example the leakage of a coupling capacitor. The larger the shadow at the screen of the indicator-tube, the larger the leakage of the capacitor.

6. Matching switch (fig. 7, 8, 9)

Switch SK4 makes it possible to adjust the amplifier for various output indicators. In the positions "+Ind" and "-Ind" the magic eye is connected. (fig. 5 and 6). In position "10,000 Ω" a high resistance voltmeter can be connected between terminals Bu1 and Bu2, e.g. GM 6004, GM 6005, GM7635 (fig. 7).

In position "2.5 Ω" a low resistance voltmeter can be connected between Bu1 and Bu2, e.g. GM 4257 (fig. 8).
In position "osc.gr" an oscillograph can be connected between Bu1 and Bu2 e.g. GM 5655 (fig. 9).
Potentiometer R19 is connected in parallel with the heater winding S4 of T1 and serves to keep the hum level as favorable as possible. For adjusting this potentiometer see under the heading "checking".

C. "CHECKING".

1. Adjusting the hum potentiometer R19.

After changing or misadjustment of the humpotentiometer R19, it is adjusted as follows:

Attenuator SK1 in position "X1".
Switch SK4 in position "-Ind".
Switch SK2 in position "R.F."
Measuring probe short circuited (join Bu3 and Bu4).
With R19 adjust the shadow area of the EM4 to the maximum width as accurately as possible. After that seal it with sealing lacquer.

2. R.F. Sensitivity.

An input signal of 80 - 120 mV, 100 kc/s, 300 % modulated with 400 c/s (GM 2883) should, with SK1 on "X1", SK2 on "R.F." and SK4 at "-Ind", completely close the magic eye.

3. R.F. Attenuator.

SK1 on "X1", SK2 on "R.F."; SK3 on "R"; SK5 on "H.F.-OSC."
Connect a vacuum tube voltmeter across Bu1 and Bu2 (e.g. GM 6008 or GM 6015).
Connect the signal mentioned in point 2 to Bu3-Bu4. The amplitude must be such that the vacuum tube voltmeter reads 10 volts.
Switch SK1 to "X2". The output voltage should now be 5 V. Increase the input voltage so that the meter again reads 10 V.
Switch SK1 to "X5". Now the output voltage should be 4 V and so on.

SK1 on	Vo
X1	8 - 12 V
X2	4 - 6 V
X5	3.2 - 4.8 V
X10	4 - 6 V
X25	3.2 - 4.8 V
X50	4 - 6 V
X100	4 - 6 V
X150	5.4 - 8 V

Between points A and C (see fig. 12b) the following resistance values should be measured.

SK1 on	Resistance between A and C
X2	173 kΩ - 187 kΩ
X5	106 kΩ - 115 kΩ
X10	80 kΩ - 85 kΩ
X150	65 kΩ - 70 kΩ

4. A.F. Sensitivity

With SK1 on "X1" and SK2 on "A.F." an input signal of 80-120 mV, 400 c/s, should completely close the magic eye.

5. A.F. Attenuator.

SK1 on "X1"; SK2 on "A.F."; SK3 on "R"; SK5 on "A.F.-A.V.C"
Connect a 400 c/s signal across Bu3-Bu4 (GM 2308 or GM 2315).
Then apply the instructions as mentioned under point 3.
Between points A and B (see fig. 12a) the following resistance values should be measured.

SK1 on :	Res. between A and
X1	2.5 MΩ - 2.8 MΩ
X2	355 kΩ - 385 kΩ
X5	92,5 kΩ - 100 kΩ
X10	48 kΩ - 52 kΩ

SK1 on:	Res.between A and B
X25	19 kΩ - 20.5 kΩ
X50	9.5 kΩ - 10.3 kΩ
X100	4.8 kΩ - 5.2 kΩ
X150	3.1 kΩ - 3.4 kΩ

6. Distortion

SK1 on "X1"; SK2 on "L.F."; SK3 on "R"; SK4 on "10,000 Ω"; SK5 on "A.F.-A.V.C.".
Apply an input signal of 400 c/s, the amplitude of which must be so great that the output voltage on Bu1-Bu2 is 55 V.
The distortion of this voltage must be less than 10 % (check with the aid of an oscillograph e.g. GM 5655, GM 5659).

7. Microphony

SK1 on "X1"; SK2 on "R.F."; SK3 on "loudspeaker"; SK4 on "10,000 Ω".
Apply an input signal of 1000 c/s whose amplitude is such that the output-voltage on Bu1-Bu2 is 60 V.
Vary the frequency of the input signal between 0 and 5000 c/s.
No aggravating additional signal should be audible.

8. Checking SK4

SK1 on "X1"; SK2 on "A.F."; SK3 on "R"; SK4 on "10,000 Ω"; SK5 on "A.F. - A.V.C.".
Apply a 400 c/s input signal whose amplitude is such that the output voltage on Bu1-Bu2 is 10 V.
With SK4 on "2.5 Ω" the voltage on Bu1-Bu2 should be 230-340 mV
With SK4 on "osc.gr." the voltage on Bu1-Bu2 should be 120-180 mV.

9. Checking sensitivity in position "osc."

SK1 on "osc."; SK2 on "R.F."; SK3 on "R"; SK4 on "-Ind"; SK5 on "R.F.-OSC";
An unmodulated R.F. signal of 16 - 20 V, 100 kc/s, should completely close the magic eye.

10. Checking sensitivity in position "AVC"

a. SK1 at "AVC"; SK2 at "R.F."; SK3 at "R"; SK4 at "-Ind" and SK5 at "A.F.-AVC".
A negative direct voltage of 16_20 V should completely close the magic eye.

b. SK1 at "AVC"; SK2 at "R.F."; SK3 at "R"; SK4 at "+Ind" and SK5 at "A.F.-AVC".
A positive direct voltage of 3.5 - 6.5 V should give a maximum shadow at the screen of the magic eye.

D. DISMANTLING, CHANGING PARTS.

a. Remove the cabinet.

Undo the 6 screws on the 4 sides of the cabinet. Remove the cylindrical screws, the nut and the milled nut from the earth terminal at the back of the cabinet. The cabinet can now be removed from the apparatus.

b. Changing the switch segments.

If one of the switch segments on switch SK1 has to be replaced, proceed as follows:
If there is a hole in the chasis at the level of the switch shaft first unsolder the connections from the segment to be replaced.
Unscrew both screws "A" (fig. 12) and remove the strip. Then pull the flat shaft through the hole in the chasis out of the switch segments and remove the defective segment.
If there is no hole in the chasis, unsolder all the connections to the switch segments. Take off the knobs and the textplate and unscrew the screws fixing the switch.
Now the complete switch can be taken out.

c. Dismantling the measuring probe.

Unscrew the 2 screws at the end of the measuring probe (near the flex).
Remove the milled nut and the earth screw. Now the bush can be removed from the measuring probe and all parts inside are accessible.

d. Renewing the cable of the measuring probe.

When replacing the cable between the probe and the apparatus the shielded wire must be used for the connection between R1 and R14. The shielding is connected to Bu4 and the chasis.

e. Attenuator.

So as not to spoil the accuracy of the attenuator, it is neccessary, when repairing by replacing resistors, to use resistors with the same tolerance as given in the list of electrical parts.

E. VOLTAGES AND CURRENTS.

These are given in fig. 1 and serve only as a guidance. All voltages are measured against earth with a GM 7635. The voltages on the power transformer (see fig. 18) apply for the apparatus on load.

MECHANICAL PARTS LIST.

Fig.	Pos.	Qty.	Description	Code number
10	1	1	Bracket	E2 742 67.1
10	2	1	Handle	M7 076 00.0
10	3	1	Textplate	M7 189 18.0
10	4	1	Voltage adaptor	A3 228 85.0
20	5	1	Measuring probe (complete)	E3 465 46.1
20	6	1	Disc	23 686 97.2
20	7	1	Disc	E3 928 96.1
20	8	1	Contact spring	M7 213 79.0
20	9	1	Bush	E2 112 08.3
20	10	1	Disc	23 686 85.1
20	11	1	Rubber hose	M7 047 10
20	12	1	Measuring pin	M7 731 27.0
		1	Cone and coil, loudsp. LS1	49 981 13.1
		1	Linen centering disc	49 976 04.0
		1	Paper ring loudspeaker	28 451 26.1
		1	Clamping ring LS1	25 871 80.0

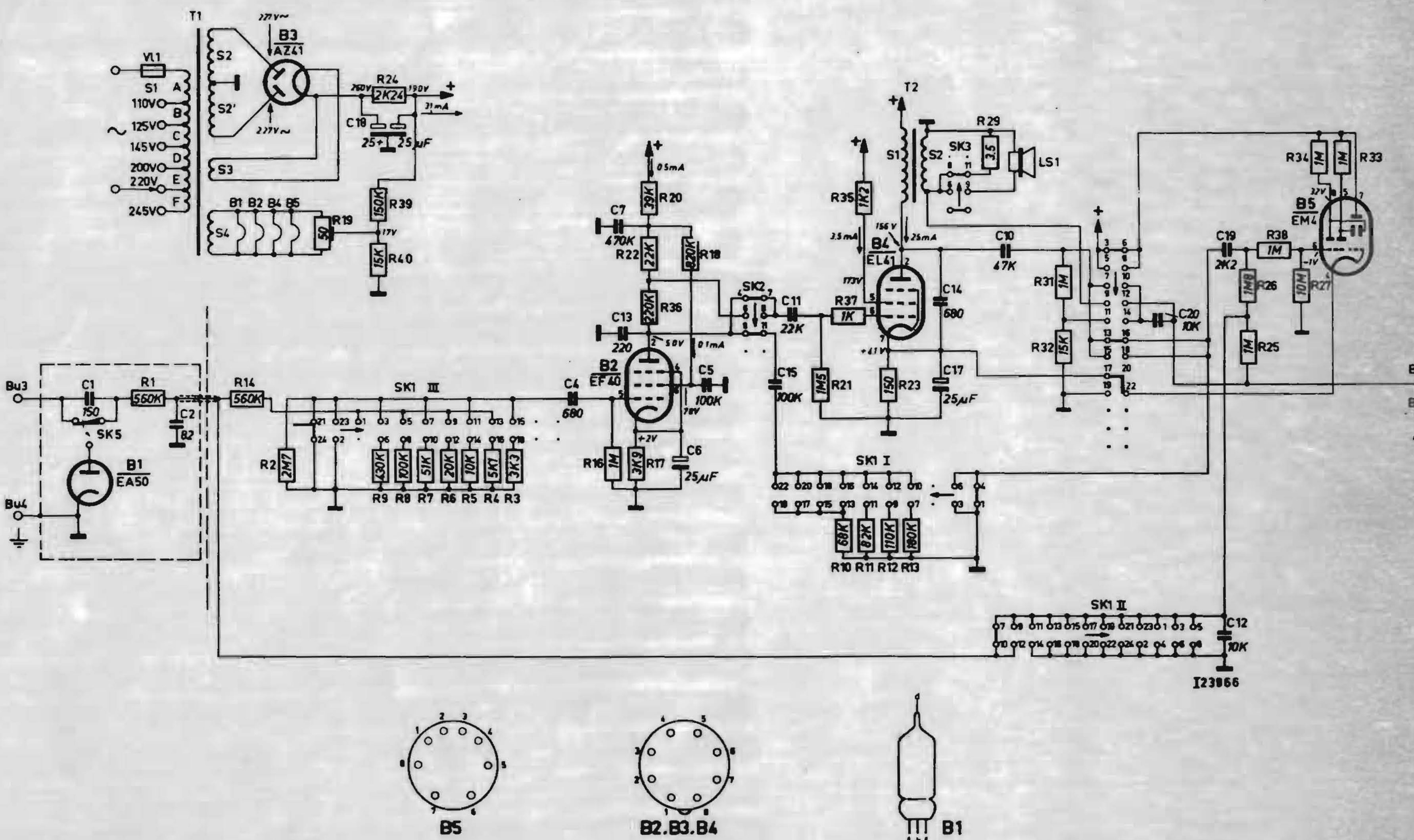
BH/GH

T1		E2 211 28
T2		M7 627 02
VL1		08 100 97
C1	150 pF	904/150E
C2	82 pF	904/82E
C4	680 pF	904/680E
C5	0,1 µF	906/100K
C6	25 µF	910/D25
C7	470 pF	906/470E
C10	47000 pF	906/47K
C11	22000 pF	906/22K
C12	10000 pF	906/10K
C13	220 pF	904/220E
C14	680 pF	904/680E
C15	0,1 µF	906/100K
C17	25 µF	910/D25
C18	25+25 µF	912/L25+25
C19	2200 pF	906/2K2
C20	10000 pF	906/10K
R1	0,56 MΩ	901/560K
R2	2,7 MΩ	901/2M7
R3	3300 Ω	901/3K3
R4	5100 Ω	901/5K1
R5	10 kΩ	901/10K
R6	20 kΩ	901/20K
R7	51 kΩ	901/51K
R8	0,1 MΩ	901/100K
R9	0,43 MΩ	901/430K
R10	68 kΩ	901/68K
R11	82 kΩ	901/82K
R12	110 kΩ	901/110K
R13	180 kΩ	901/180K
R14	560 kΩ	901/560K
R16	1 MΩ	902/1M
R17	3,9 kΩ	902/3K9
R18	820 kΩ	902/820K

R19	50 Ω	E3 133 29.1
R20	39 kΩ	902/39K
R21	1,5 MΩ	901/1M5
R22	22 kΩ	901/22K
R23	150 Ω	902/150E
R24	2240 Ω-10W	48 496 10/2K24
R25	1 MΩ	902/1M
R26	1,8 MΩ	901/1M8
R27	10 MΩ	900/10M
R29	3,5 Ω-8W	B8 300 31B/3E5
R31	1 MΩ	902/1M
R32	15 kΩ	902/15K
R33	1 MΩ	902/1M
R34	1 MΩ	902/1M
R35	1,2 kΩ	902/1K2
R36	0,22 MΩ	902/220K
R37	1 kΩ	902/1K
R38	1 MΩ	902/1M
R39	0,15 MΩ	902/150K
R40	15 kΩ	902/15K

1

C	1. 2. 18 4. 7. 13. 6. 5. 15. 11. 14. 17. 10. 20. 12. 19.
R	1 14 2 19.40.39.24 9. 8. 7. 6. 5. 4. 3. 16.17.36.22.20. 18. 21.37.35 10.11.12.13.23. 29. 31.32 25.26.38. 27.34. 33.



GM 7628-01

I

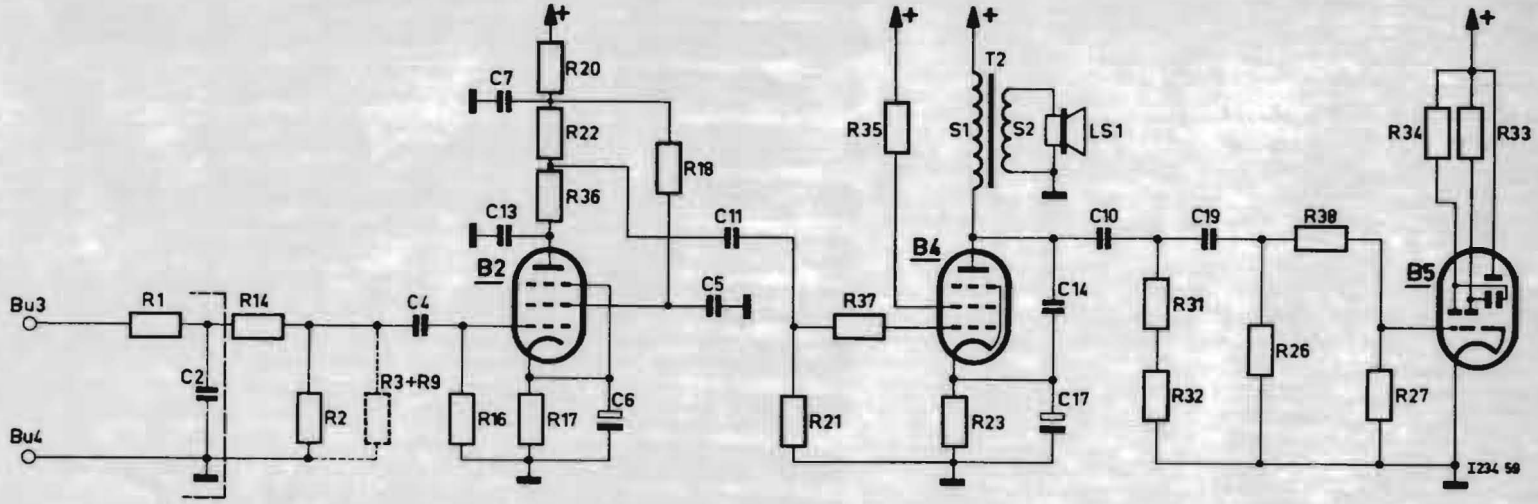

Bu3
Bu4
R1
C2
R14
R2
R3+R9
C4
B2
C7
R20
R22
R36
R18
C13
C11
C5
R16
R17
C6
R21
R35
T2
S1
S2
LS1
B4
R37
C10
C19
R38
C14
C17
R31
R32
R26
R23
B5
R34
R33
R27
I234 50

Fig.2

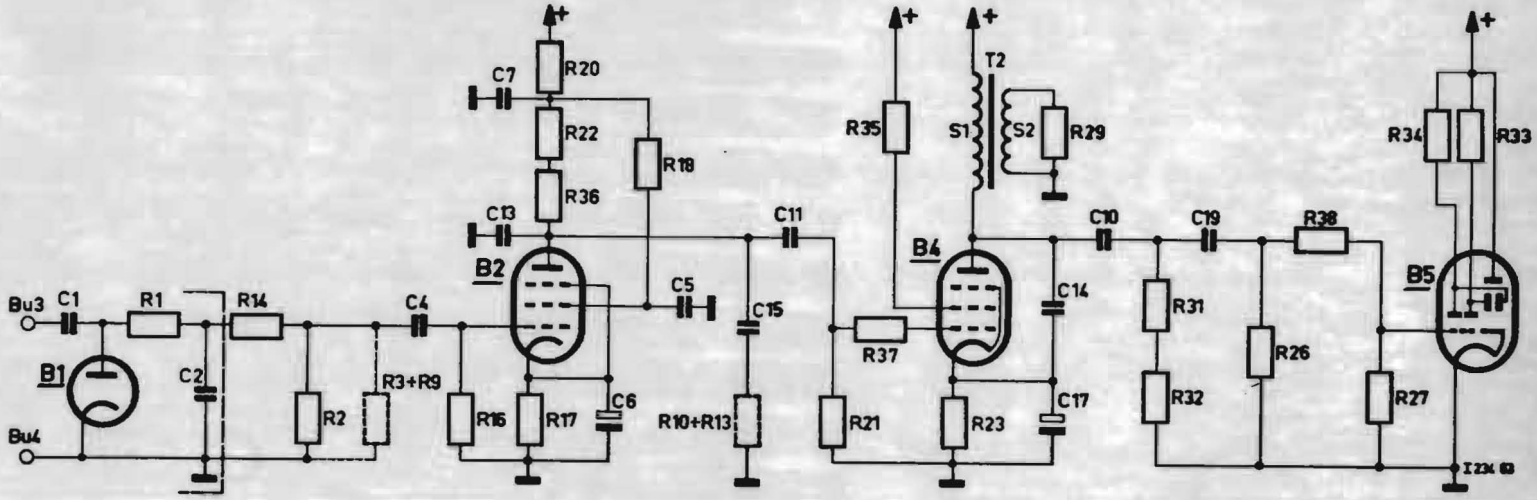

Bu3
Bu4
C1
B1
R1
C2
R14
R2
R3+R9
C4
B2
C7
R20
R22
R36
R18
C13
C11
C5
C15
R16
R17
C6
R10+R13
R21
R35
T2
S1
S2
R29
B4
R37
C10
C19
R38
C14
C17
R31
R32
R26
R23
B5
R34
R33
R27

Fig.3

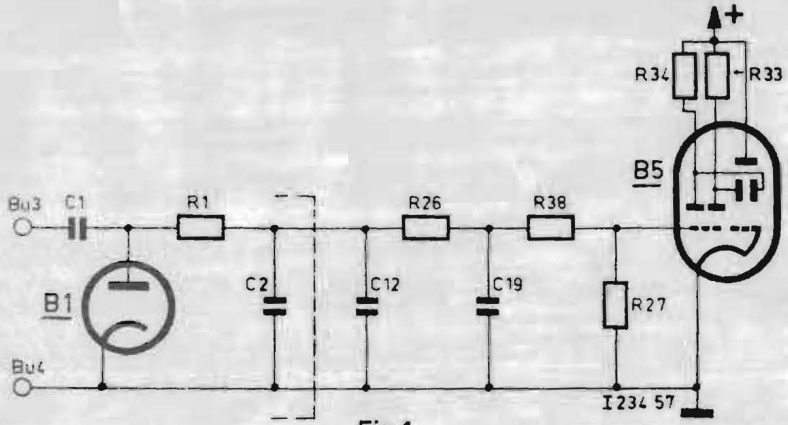


Fig.4

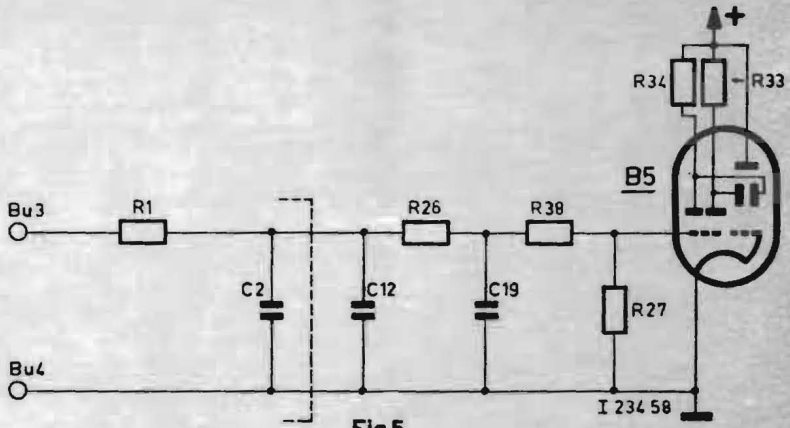


Fig.5

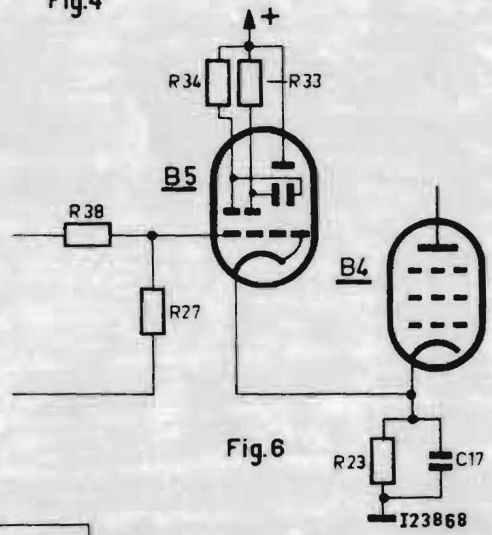


Fig.6

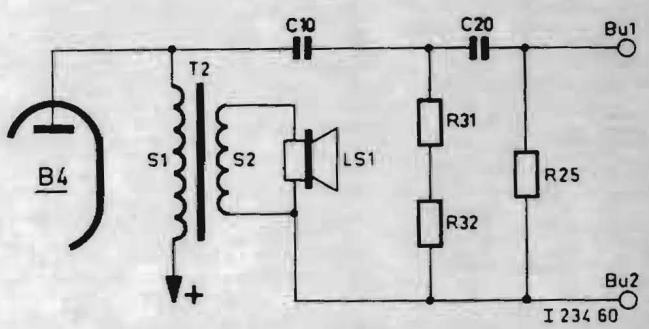


Fig.7

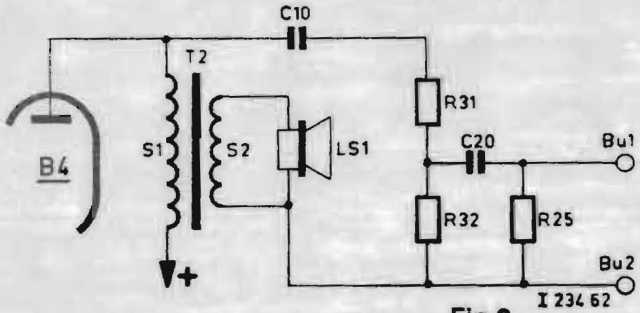


Fig.8

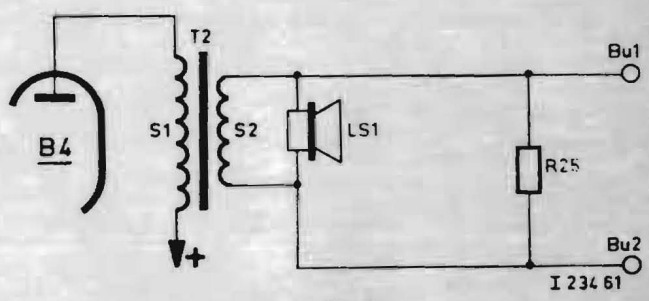


Fig.9

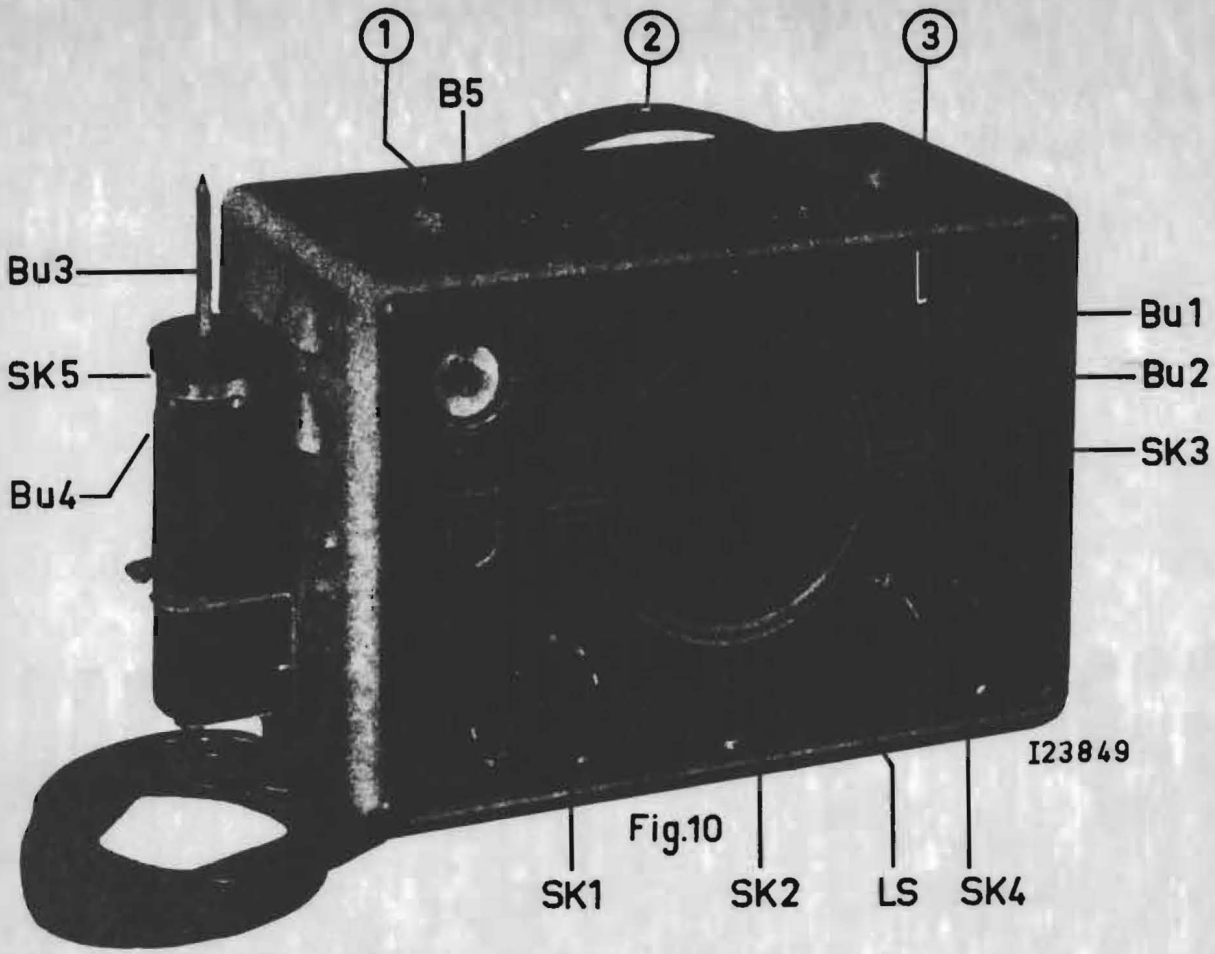

1
2
3
B5
Bu3
SK5
Bu4
Bu1
Bu2
SK3
SK1
SK2
LS
SK4
I23849

Fig.10

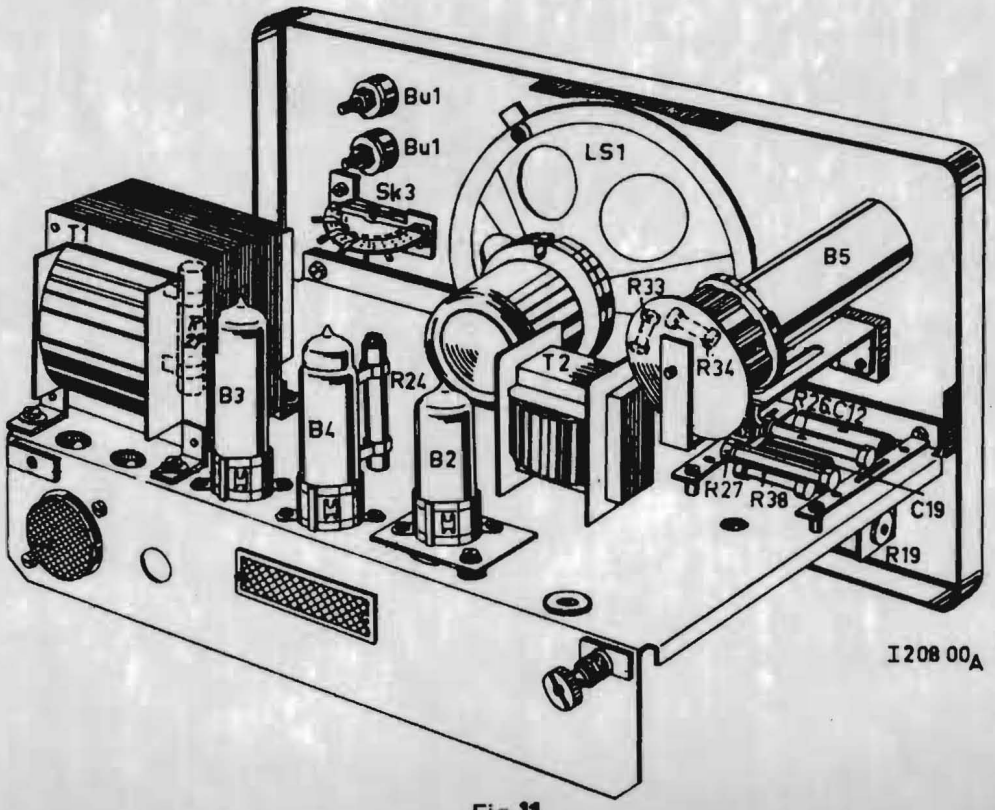
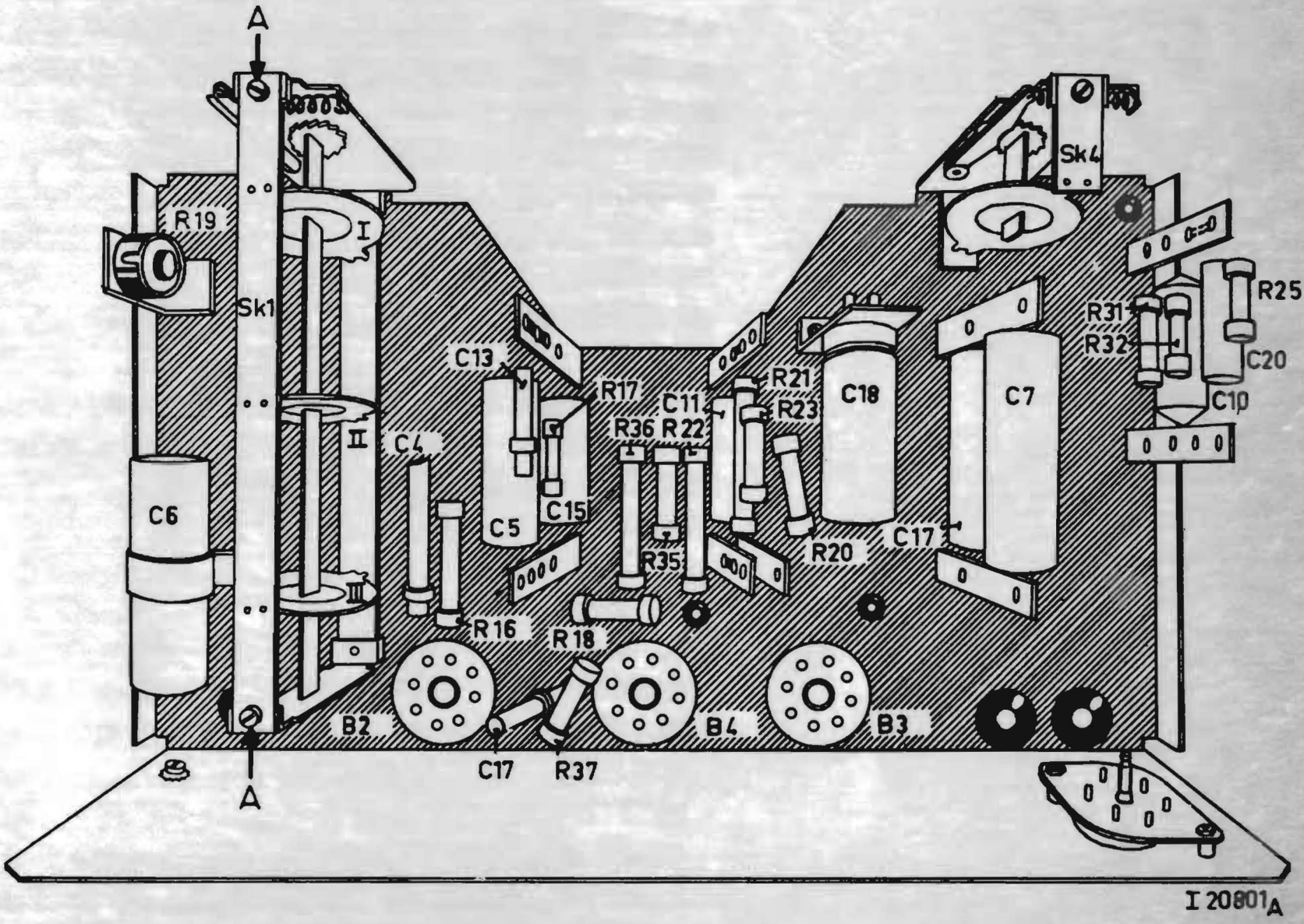

Bu1
Bu1
Sk3
LS1
T1
B5
R33
T2
R34
R24
B3
B4
B2
R26
C12
R27
R38
C19
R19
I208 00A

Fig 11



7628-01

Fig. 12

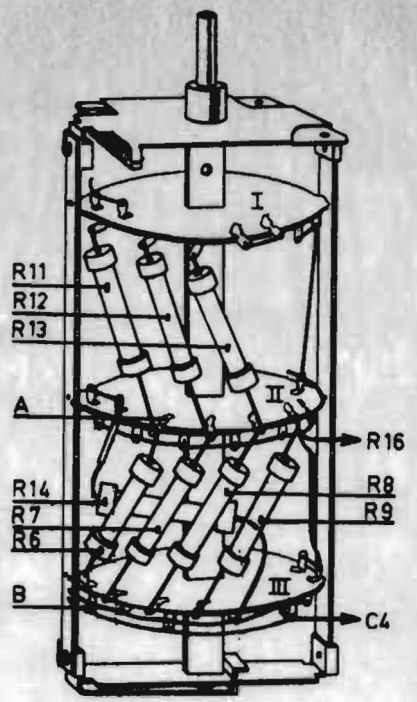


Fig.13

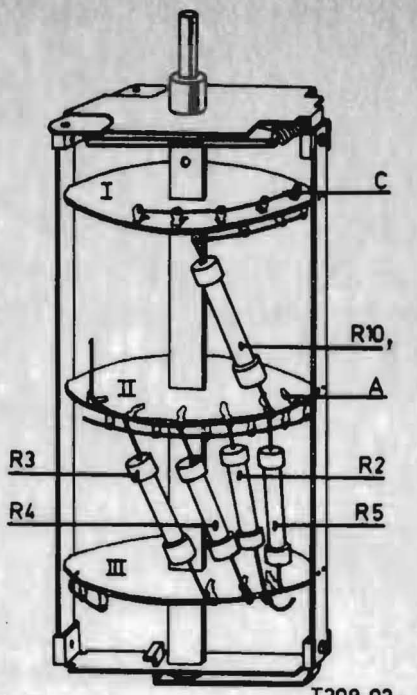


Fig.13a

Sk1

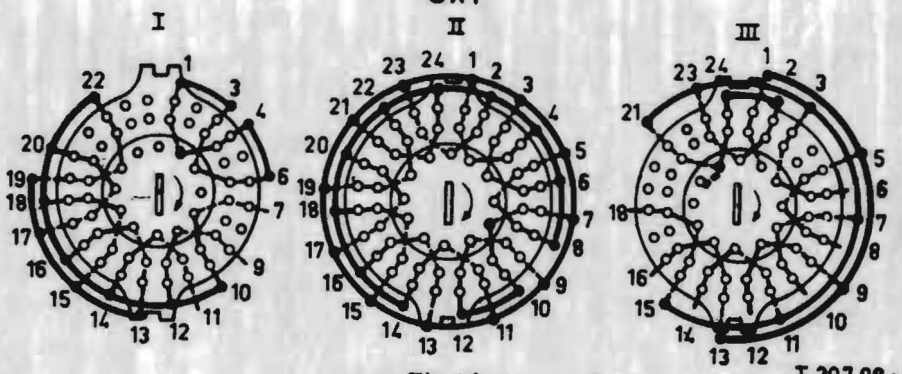


Fig.14

Sk2

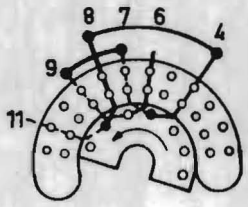


Fig.15

Sk3

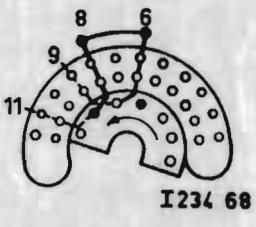


Fig.16

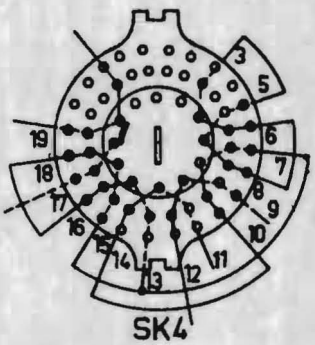
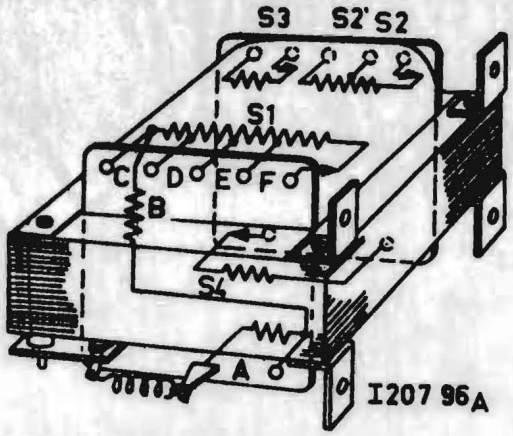


Fig.17



S1						S2	S2'	S3	S4
A	B	C	D	E	F				
110	15	20	55	20	24	225	225	4	63

Fig.18

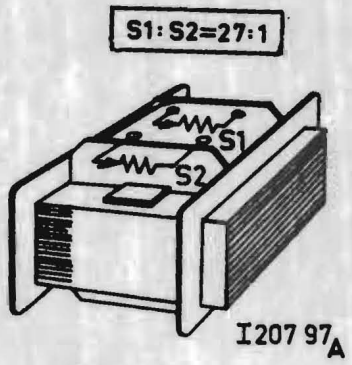


Fig.19

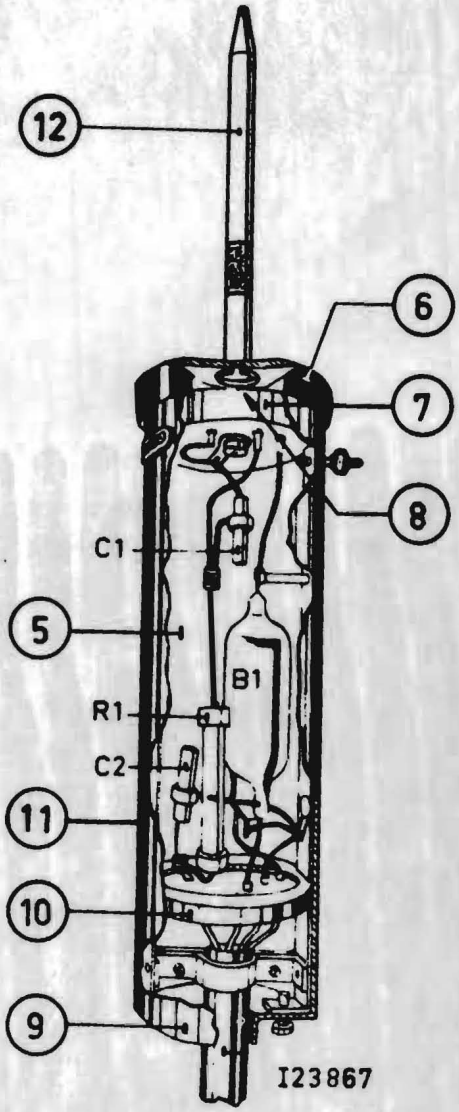


Fig.20

N.V. PHILIPS' GLOEILAMPEN-FABRIEKEN EINDHOVEN	**Delivery Test**	I
		DATE 31-10-57
CENTRAL SERVICE DIVISION	GROUP: P.I.T.-E.M.A. ARTICLE: Signal tracer TYPE: GM 7628-01	BH/GH

A. MECHANICAL

Check the equipment for the following points:

1. Damage.
2. Correct closing of the cabinet.
3. Fitting of the front plate against the cabinet.
4. Fixing of the knobs and caps.
5. The action of the toggle switches, the rotary switches and the switch in the measuring probe.
6. Presence of instruction manual.

B. ELECTRICAL.

1. Primary current.

Set the voltage adaptor to the local mains voltage and plug the apparatus into this voltage.
The primary current may be 150 mA at maximum (at 220 V).

2. Hum voltage.

SK1 in position X1.
SK2 in position A.F.
SK3 in position R.
SK4 in position 2.5 Ω.
SK5 in position A.F.-A.V.C.
With an A.F. millivoltmeter (e.g. GM 6015, GM 6017) measure the hum voltage on Bu1-Bu2. This may be 15 mV at maximum.

3. A.F. sensitivity

SK1 in position X1.
SK2 in position A.F.
SK3 in position R.
SK4 in position -Ind.
SK5 in position A.F.-A.V.C.
The voltage (400 c/s) required for the measuring probe that will close the magic eye completely should be between 80 and 120 mV.

4. A.F. attenuator.

SK2 in position A.F.
SK3 in position R.
SK4 in position 10,000 Ω.
SK5 in position A.F.-A.V.C.
Set SK1 to position X1 and connect a vacuum tube voltmeter (GM 6004, GM 6008, GM 6015, GM 7635) across Bu1-Bu2. Feed a 400 c/s signal (GM 2308, GM 2315, GM 2317) to the measuring probe with such an amplitude that the vacuum tube voltmeter reads 10 V. Now switch SK1 to position X2.

The meter should read 5 V. Increase the output voltage until the meter again indicates 10 V and switch SK1 to position X5. The meter should now read 4 V, and so on.
For 400 c/s the output voltage should lie between the following values.

SK1	Vm
X1	8 - 12 V
X2	4 - 6 V
X5	3.2 - 4.8 V
X10	4 - 6 V
X25	3.2 - 4.8 V
X50	4 - 6 V
X100	4 - 6 V
X150	5.4 - 8 V

5. R.F. sensitivity

SK1 in position X1.
SK2 in position R.F.
SK3 in position R.
SK4 in position -Ind.
SK5 in position R.F. - osc.
Apply a 0,1 Mc/s signal, modulated 30 % with 400 c/s (GM 2883), to the measuring probe. Check that not more than 80-120 mV is necessary to a complete close of the magic eye.

6. Secondary phenomena.

SK1 in position X1.
SK2 in position R.F.
SK3 in position loudspeaker.
SK4 in position 10,000 Ω.
Apply a 1000c/s signal to the measuring probe and set the output voltage on Bu1-Bu2 to 60 V.
Now vary the frequency of the audio generator from 0 - 5000c/s; no aggravating additional sounds should audible.

7. Checking SK4.

SK1 in position X1.
SK2 in position A.F.
SK3 in position R.
SK4 in position 10,000 Ω.
SK5 in position A.F.-A.V.C.
Apply a 400 c/s signal to the measuring probe. If the output voltage (Bu1-Bu2) is set on 10 V, in position "2,5 Ω" it should be 230 - 340 mV and in position "osc.gr" 120-180 mV.

8. Checking "Oscillator".

SK1 in position osc.
SK2 in position R.F.

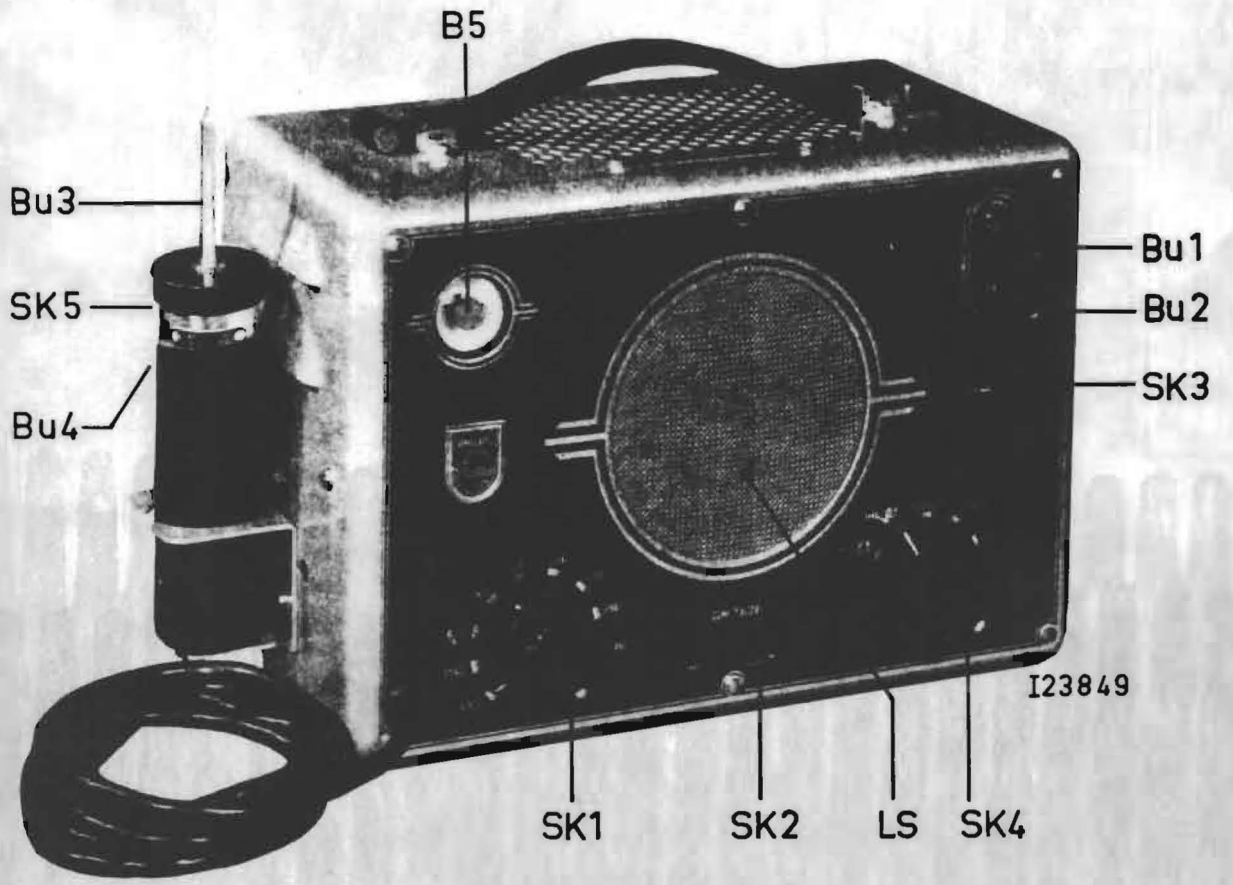
SK3 in position R.
SK4 in position -Ind.
SK5 in position R.F.-OSC.
The magic eye should be closed with an R.F. signal of 16-20 V at 0.1 Mc/s.

9. Checking A.V.C.

a. SK1 in position A.V.C.
SK2 in position R.F.
SK3 in position R.
SK4 in position -Ind.
SK5 in position A.F.-A.V.C.
A negative direct voltage of 16-20 V, when applied, should completely close the magic eye.

b. SK1 in position A.V.C.
SK2 in position R.F.
SK3 in position R.
SK4 in position +Ind.
SK5 in position A.F./.A.V.C.
A positive direct voltage of 3.5 - 6.5 V, when applied, should completely close the magic eye.

-o-o-o-o-o-


B5
Bu3
SK5
Bu4
Bu1
Bu2
SK3
I23849
SK1
SK2
LS
SK4