Service Manual 643WK

Siemens-Telefunken, Choral (Dutch version)

Year of manufacture: 1936/1937

Warning: *This service manual is designed primarily for advanced collectors and repairers. The author is not liable for any damages, which may arise from the use of the reader of this information or instructions and procedures referred in this guide. When working with electronics is required to comply with all safety regulations, as it works with the high mains voltage. Turn the Radio on the mains voltage of 230V only through a separate insulating transformer.*

1. Description of the receiver

This is a fairly popular receiver, which is among the collectors very often occurs.
It is the first stations and frequency adjusting MF super heterodyne receiver.
For the function super heterodyne and mixing are used separate tubes AH1 AC2 (later is no longer manufactured and used the combined tubes, for example the ACH1).
The MF amplifier is used a band filter with a dual rotary capacitor that changes the bandwidth.
Dual diode AB2 is used to produce and detect. NF signal is then directly amplified with power tube AL4.
This is not possible without a preamp for a maximum amplify performance, so with today's weak performance of transmitters broadcasting radio provides the only average volume (max 1 w).
AZ1 is used as a two-way rectifier, DC voltage is filtered by the winding magnet for the speaker. The speaker is a relatively large, thereby guaranteeing a high-quality reproduction.
This radio is mounted in a vertical cabinet with very attractive appearance.
The rear wall is of one piece and must fork out upwards and attached with two leather hinges.

The power supply is AC power from the mains to the voltage from 110V to 240V. Were still two versions with different planting: Choral (CH1; CC2; CF7; CBC1; Cl2; CY1; EU0; U1220-5) and Choral (B) (CC2; KF3; KBC1; KC3; KDD1). In Germany sold under the name Telefunken Choral receiver 643WK and in the Netherlands Telefunken super 643WK. It is interesting that this type of scheme is not in the famous book, Band IX Empfanger Schaltungen (there are models 642WLK, 642GLK, 644W and 644GW).

2. The installation and function of the tubes

	Tube	Feature tubes
E1	AH1	RF amplifier (g1) and Mixer (g3)
E2	AC2	Oscillator
E3	AF3	MF amplifier
E4	AB2	D Detector (right section) and the AVC voltage (left section)
E5	AL4	The end NF amplifier
E6	AZ1	Two-way rectifier

Tesla AF3

We give to the attention that the vacuum tube Tesla is produced in two versions.
AF3 format is similar to the tubes from other manufacturers, (Telefunken, Philips) with a smaller format and similar to the tube series E21. Both series have the same socket.

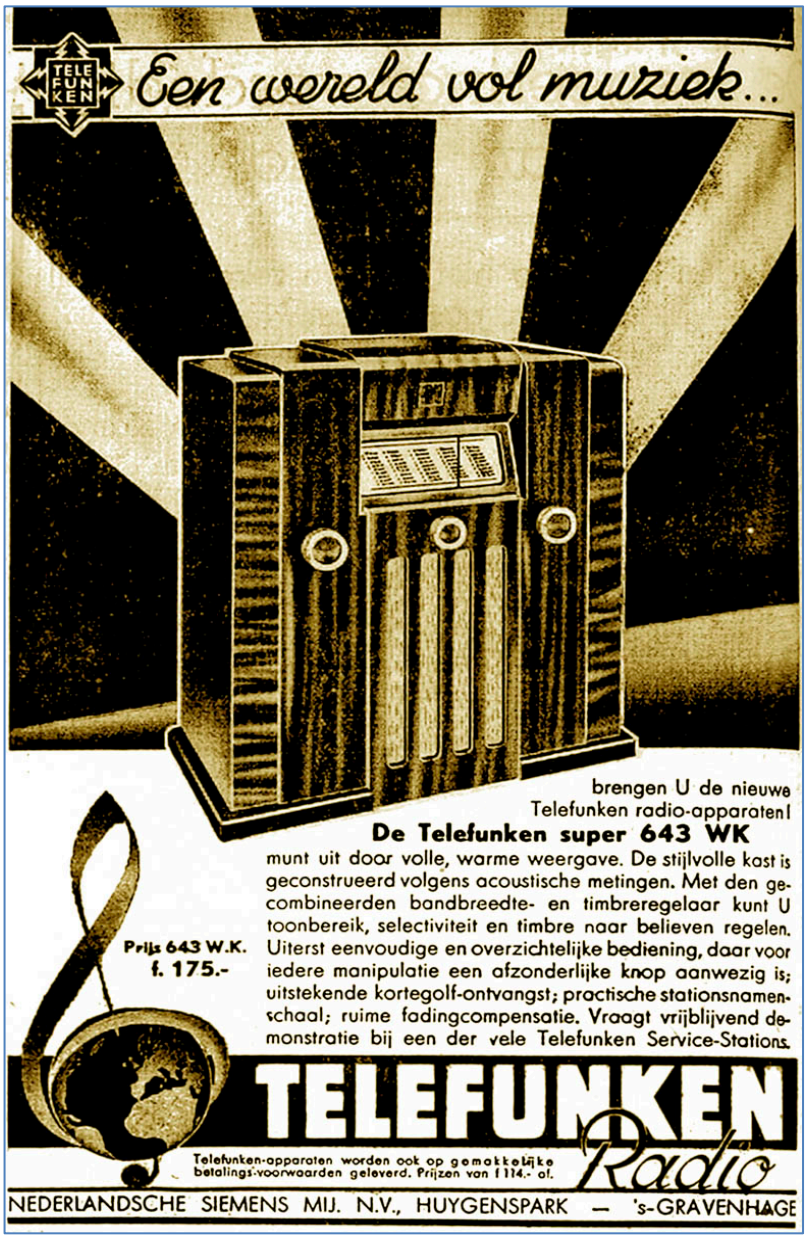
From the scheme can be seen that all tubes are manufactured by using the negative cathode resistors, capacitors of the lattice to preload the bridged.
Therefore, these resistors and capacitors must have the correct values and must not be defective.
When you repair these parts carefully check defective and replace.

3. Original documentation

Schedule:
Ing. M. Baudyš, Czech receiver, ESČ, 1946 (the numbering and information's are in schematic).
In this service manual individual components and the numbering of the annex supplemented, so it is referenced in the text and graphics. (www.radiohistoria.sk)
Ben van der Klugt, the Netherlands 2017 some shared information received from the NVHR. (www.nvhr.nl)
This service manual is translated and corrected for the Dutch receiver with changes in schematic:

The socket at the back of the speaker are connected in parallel connection with the secondary winding of the transformer output. The pinning will by connected parallel to the built-in loudspeaker.
From the power supply (item 34) +285V, a connection through the 10 k resistor and the mf transformer AH1 made a loop outsight the chassis. This make it able to measure gain and adjustment indication.

Advertising Telefunken, Chant
(The Czech Republic, Balek)



Advertising Leidse Courant 1936
(newspaper The Netherlands)

4. Disassembly

Disassembly of the unit is not complicated:
1.The back wall, remove two slide springs and two nuts which are held the wall, the wall rises up and then remove the two leather brackets on the top.
2. The front buttons have a small screw behind the knob. The right side knob on the outside have a small screw in the center, remove this and pull the knob out.
3. The four wires to the speaker; two for the magnet and two from the output transformer, mark them with a sticker.
4. The radio chassis is mounted on a wooden plate, which is attached to the cabinet, this wooden plate can by sliding out with the chassis.
5. At the bottom of the wooden plate are four screws holding the chassis on rubber plates, remove them.
6. Then we recommend to take off the transmitter scale, it is attached by two screws and carefully pull out the scale. (Don't try to clean the text side of the scale, it's always damage if you touch it.)
The chassis is now accessible from each side, clean it and proceed with the repair.

5. Power supply

You will need the following tools;
Load resistor 22 kΩ 10W and 1 kΩ resistor 10W wire wound, instead of the magnet winding.
Remove all tubes and check the electrolyte capacitors, C30/C31, probably someone has already changed.
The first capacitor, the voltage must have at least a voltage of 450V. The operation of the high voltage is about 340V. The second filter capacitor voltage is sufficient to 350V.
I have not yet seen the capacitors intact, I do not consider to use the original double capacitor.
In the hole was mounted a large electrolyte capacitor C30/C31 2x16 µF /450V.
I placed two capacitors under the chassis 2x 22 µF / 450V. Do not put a larger capacity with give a problem of the high charging current when switching on the receiver, it could mess up the AZ1.
Possible is to put a resistor of 100Ω in serial with C30 to compensate the starting current.

Question remains, on the next chassis hole there was possible one capacitor for AH1 planned (C22).
The second hypothesis is that it is a vent for resistors R7 and R4 self-heating.

Check all wires from the mains cord to the transformer, primary is the side of the fuse.
Put the transformer switch to 240V on the primary winding. Then check the secondary winding (see table).
Don't forget to ground the middle of the winding of the anode voltage, this is the center of 2x 334V.
Then turn on the radio with no load (without all the tubes) on the mains and measure the voltage (see table).

Between the plus poles of C30 and C31 capacitors, put an 1 kΩ 10W resistor (this simulates the coil speaker).
Ad between the plus pole of C30 and chassis a load resistor 22 kΩ 10W.
Also check the voltage divider, resistors R7, R8, R9, R14 the must be intact, do not forget to their appropriate dimensioning (nap. R7 12 k/5W, etc).
After this composition, checking and observe an increase the voltage to measuring point 34 (plus pole of the second capacitor), the value should stabilize at about 344V.
Other voltage for the receiver are listed in the following table:

Description of variables	**Value**
Ohm resistance of the transformer primary coil on 220V	24 Ω
Ohm resistance of the transformer primary coil to 240V	30 Ω
Ohm resistance of the secondary winding coil anode	198, 188 Ω
AC voltage with no load on the secondary winding when switching to 240V AC Glow wire	2 x 335V~ 4,4V~
The collector voltage: + first electrolyte to chassis (22 k Ω load at a time, instead of winding resistance 1 k Ω electrolyte-inspiring)	378 V=
The collector voltage: + second electrolyte to chassis (22 k Ω load at a time, instead of winding resistance 1 k Ω electrolyte-inspiring)	344 V=
Divider voltage with no load (no-tubes)	(31): 160V (41): 2,2V
The resistance of the winding Ohm-magnet speaker	1240 Ω

Measured with a digital volt and ohmmeter with input resistance of 10 mΩ.

Note: in the illustrative schedules in this manual are NOT the glow wires in order to simplify the drawing. The two parallel wires are in the following order, left from the transformer to tubes, E3, E4, E5, E1, E2.

6. Low frequency loudspeaker box

Before startup the radio check all resistors in the circuit AL4, especially cathode R14 and replace if necessary. Cathode capacitor C29 with a new 10 µF/15V. (the founding of placing in the old housing may by difficult)
The capacitor may be even or greater, value is not critical. Certainly with the new capacitors C28 2,5nF between anode and g2 from AL4. Also the capacitor for the binding C26, which have at least voltage 5nF by 630V.
Check the circuit 1M and 0,2M (R12 R13) to the cathode otherwise the grid on tube AL4 could go wrong.
Check primary the output value, if it is OK as resistive value (see table) and it is plugged between the anode and the plus (g2, point 34). Only after all these checks and repairs, you can startup and place the tube AL4.
In the pickup function is g1 touch-sensitive with a hum sound. High frequencies will be with the middle knob C27 (g1 of AL4) cropped. On this double capacitor is also C34 connected and this one is changing the bandwidth.

Description of variables	**Value**
Ohm resistance of the output transformer primary coil	520 Ω
Ohm resistance secondary output transformer	2 Ω

Measured with a digital ohmmeter.

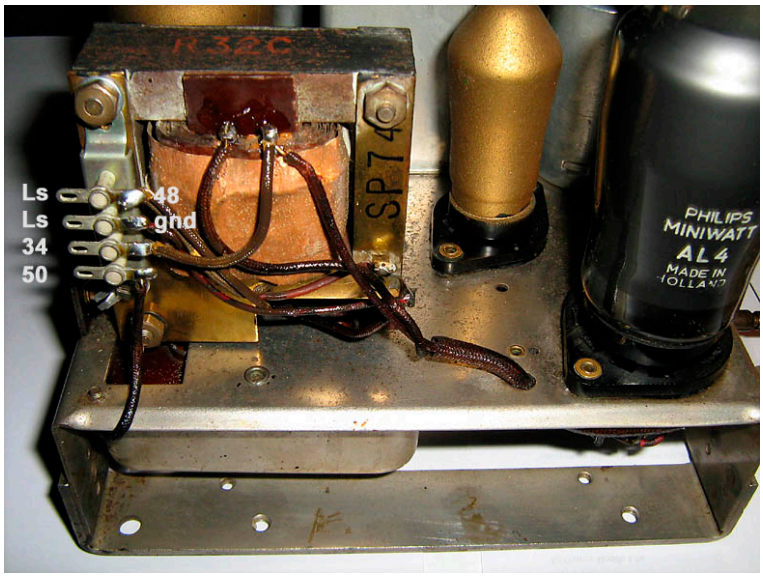
7. The MF and the detector

Middle frequent has two band pass filters, it has a double filter trough AH1 connected to the middle button double capacitor tuning and changing the width of the transmitted bandwidth.
The second circuit is tuned to the MF in the anode, where they it signal through RF AF3 (C25 25pF) detects and is taken by NF through L18 signal.

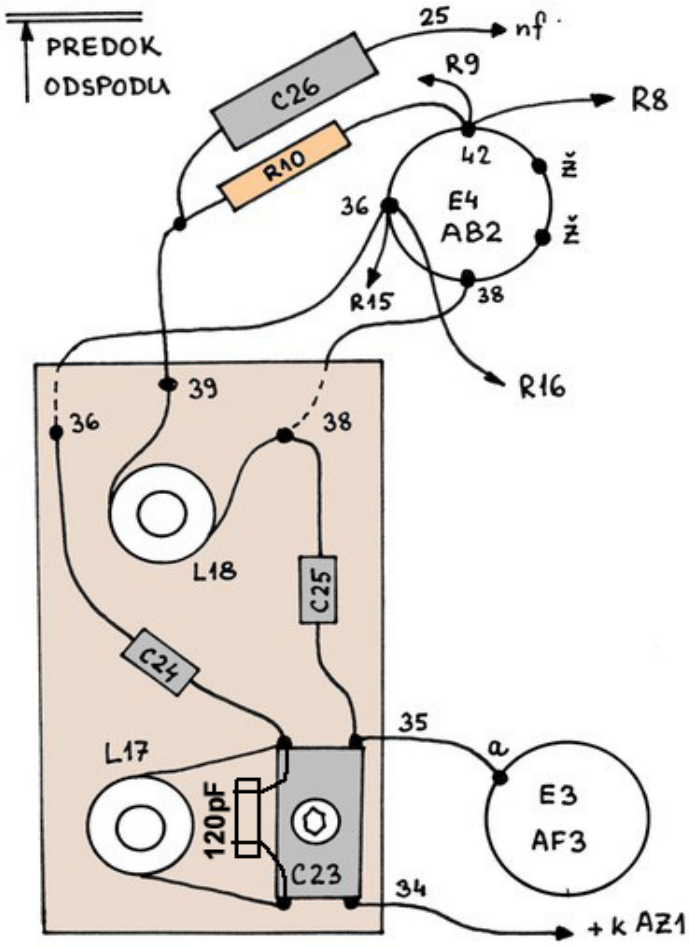
Description of variables	**Value**
The intermediate frequency	484 kHz
L15 L16 L17 = Ohm / The inductance measured at L17	4,2 Ω / 664
L18 Ohm resistance	394 Ω
The voltage at the anode of the detect diode – against the chassis (38)	27,8 V
The voltage at the anode of the AVC diode – against the chassis (36)	0,65 V

Measured in the State without an transmitter, digital voltmeter with the input resistance of 10 m Ω).

View of the detector and output transformer, I found the original long wire's not handy and make a support for this wires on the chassis. (Testing and connection make that easier.)



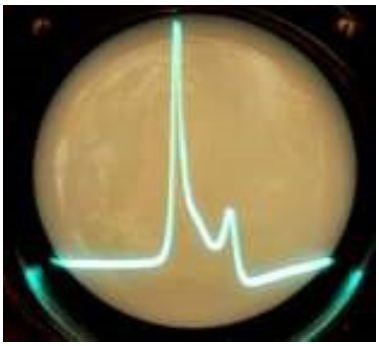
The design of the MF band filter in the anode AF3



In this pictures are the graphics MF filter illustrated and the cover of the detector circuit.
C23 was probably defective because it was necessary to connect a capacitor of 120pF parallel to it, with the C23 exactly match L17 on 484 kHz.
In this original version, the circuit are in an aluminum shielding enclosure. Inside the trim hole you can see the ceramic capacitor..

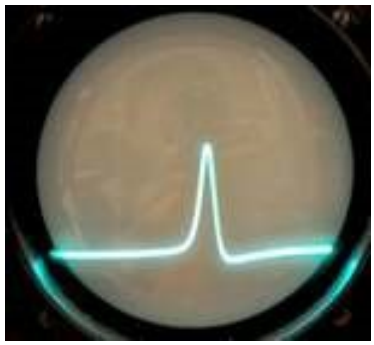
Tuning band MF filters

Tuning band MF-filters took place in the following steps.
1. First, in any circuit L17/C23. Trimmer C23 was mysteriously without capacity, the coil L17 which was calculated to 664µH on the MF frequency 484kHz capacitor C23 = approx. 162pF.
I estimate the Trimmer on 50pF and put a 120pF ceramic capacitor in parallel. The picture is the inside of the filter under the aluminum housing and feeding the modulated 484kHz on the grid.
Detected by measuring the voltage on g1 AF3, NF is adjusted to the maximum value.
2. Then the oscillator (C17 capacitor) and introducing the same modulated signal at the g1 AH1, first tuned the MF filter circuits. Band filter is dialed to the far right (wide band).
Match the two capacitors with the bottom up C18 and C19. To illustrate the progress of the MF filter with constricted zone you see on the following oscilogram.



MF Filter

Tuned (wide band)



Tuned (narrow band)

8. RF level and oscillator

After tuning the amplifier using the MF to inspection, repair the input devices and circuits of RF oscillator. First with a Ohmmeter, measure switches and contacts. In this device one contact switch (c) with a bad rivet, so I made it in the correct position. Refine contacts very gentle (grain 1000) and clean the pertinax. Because the oscillator was not working. Frequency adjusting rates for the oscillator check and calculation given in the table.

Antenna circuits

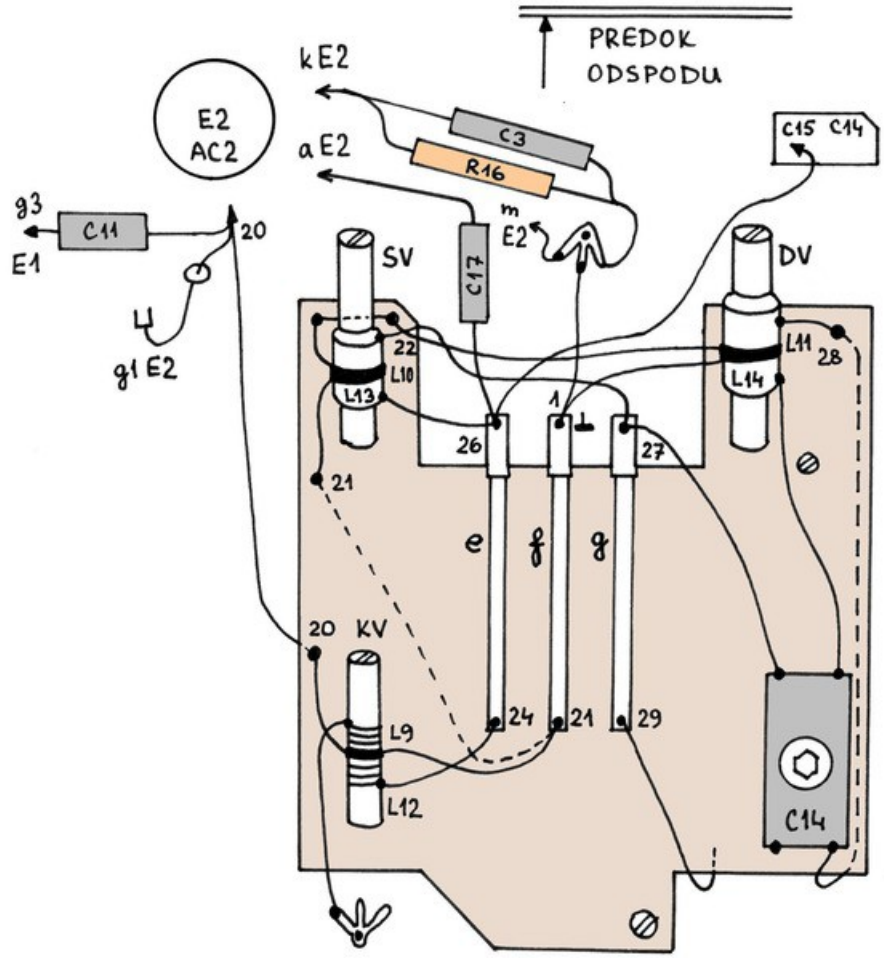
Coil	Ohm	Induction
L1	2,6 – 4,1 Ω	
L2	56 Ω	
L3	47 Ω	2.200 µH
L4	86 Ω	6.500 µH
L5	11 Ω	
L6	<1 Ω	
L7	3,5 Ω	242 µH
L8	27 Ω	2.620 µH

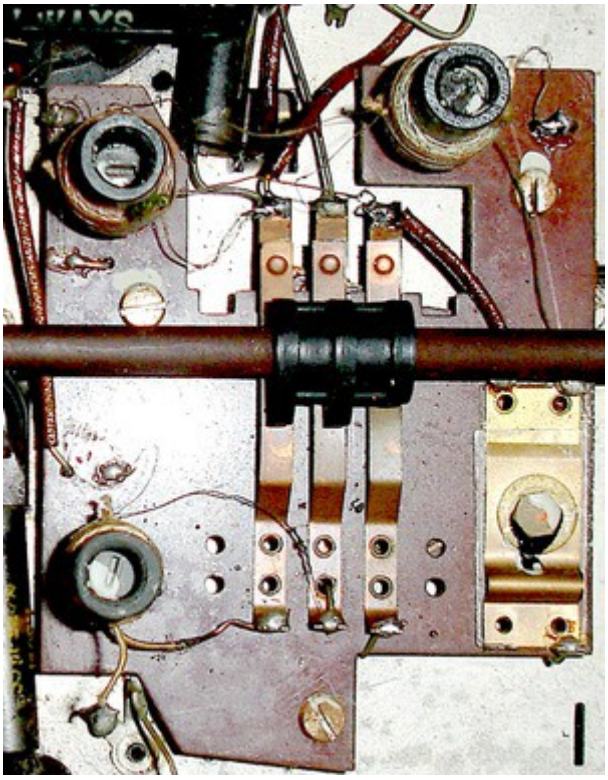
Oscillator circuits

Coil / Cap.	Ohm	Induction
L9	<1 Ω	
L10	1,6 Ω	
L11	5,5 Ω	
L12	<1 Ω	
L13	2,8 Ω	125 µH
L14	6 Ω	364 µH
C14 min	52 pF	
C14 max	550 pF	

When measuring inductance and capacities, one end of the measured parts is disconnected from the circuit. Measuring the resistance in Ohm witch a suitable display to an element/coil.

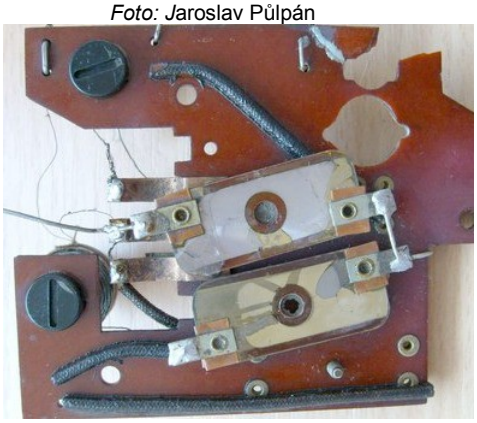
Organize of contacts, coils and construction Oscillator block.



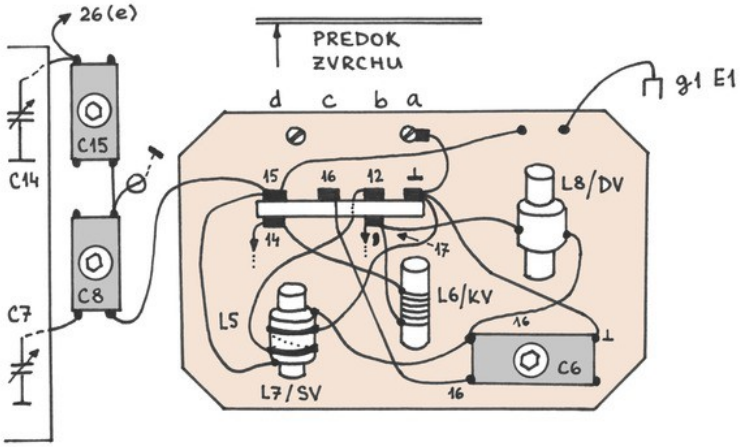


In this left block you not see the capacitors C12- 496pF and C13- 316pF, they are under the pertinax plate. (see image below). 28 and 29 of the contact driver C14 (g) are also under the plate.
For control of these you have been disconnect the contacts and the capacity checked "hidden away". Capacities were measured with a deviation of about 5% is no problem.
Resistors and inductance in this circuits are shown in the table above.

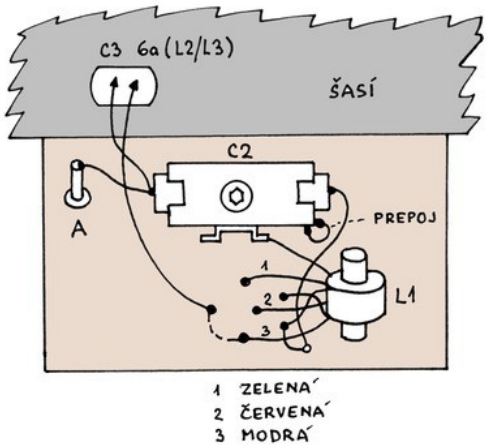
Foto: Jaroslav Půlpán

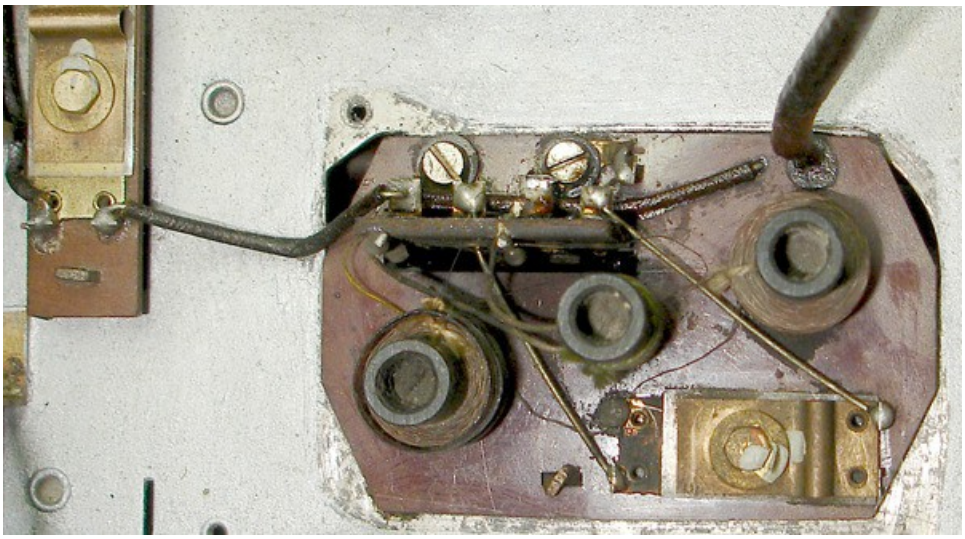


The design of the antenna switch circuit and waveband

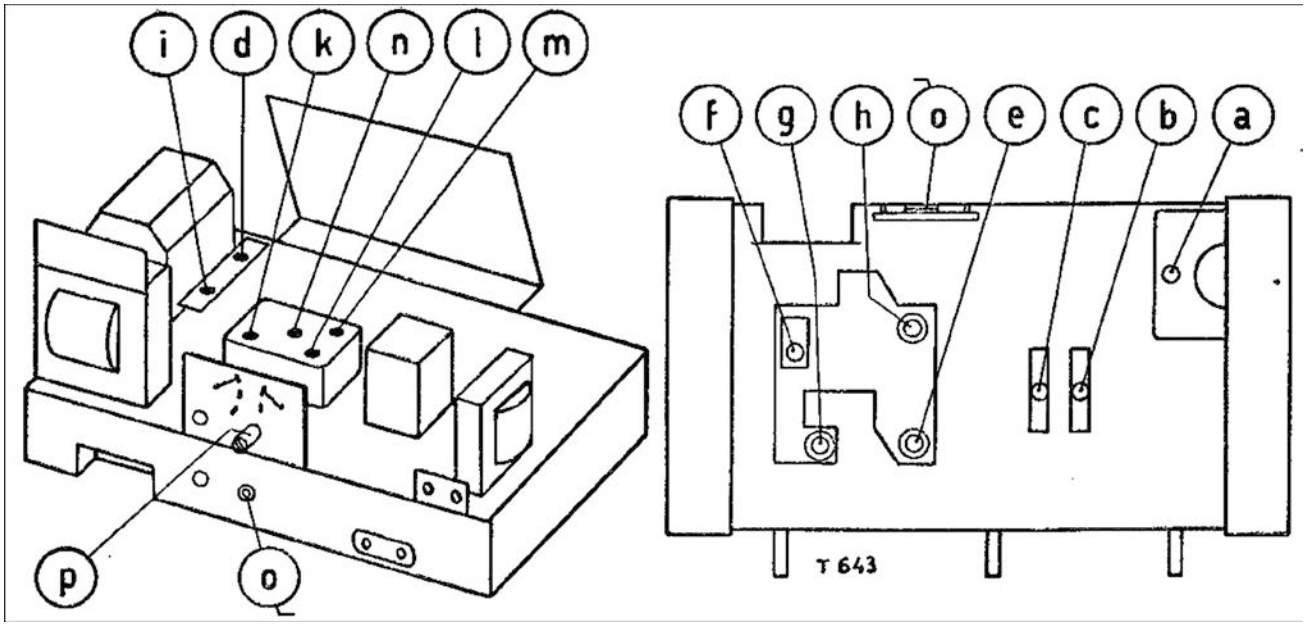


Input antenna circuit





9. Wave ranges, mf and adjusting rates



Trim prescription adjusting Telefunken 643WK

Setting the pointer.

Turn set the condenser top edges of rotor-and stator plates on the same level; check with piece a of pertinax by slot in hood. The condenser disk should be against the stop and the benchmarks of the pointer on the scale.

Setting the midrange.

Inactivate AVC by a negative voltage of -10V with 500 kΩ to the AB2 diode (the connection is located opposite of the filament connectors) and plus pole to chassis.
Disconnect the top of the modulator AH1 and connect this top via 500 kΩ to chassis.
Connect a trim-transmitter on top of AH1 and the earth bus.
Connect an output meter on the extra speaker connection.
Volume control on full; selectivity control on approx 20 degrees from left blocking.
Golf switch on M.W.; pointer in the middle of the scale.

(a) Trim channel on 480kHz. Point (a) adjusting.
(c, b) Point (c) with 200pF to chassis, adjust point (b);
(b, c) Point (b) with 200pF to chassis, adjust point (c).

Setting the oscillator.

Golf switch on M.W.
(d) Pointer on scale 1300kHz, trim-transmitter on 1300kHz, adjust trimmer (d);
(e) Pointer on scale 650kHz, trim-transmitter on 650kHz, adjust coil (e).
Golf switch on L.W.
(f) Pointer on scale 300kHz, trim-transmitter on 300kHz, adjust trimmer (f);
(g) Pointer on scale 150kHz, trim-transmitter on 150kHz, adjust coil (g).
Golf switch on S.W. (no mirror frequency !)
(h) Pointer on scale 40 mHz, trim-transmitter on 40 mHz, adjust trimmer (h).

Setting the pre-circuit.

Remove top 500 kΩ resistance AH1 and connect this back to normal.
Trim-transmitter over 250pF connecting to the antenna bus.
Golf switch on M.W.
(i) Pointer on scale 1300kHz, trim-transmitter on 1300kHz, adjust trimmer (i);
(k) Pointer on scale 650kHz, trim-transmitter on 650kHz, adjust coil (k).
Golf switch on L.W.
(l) Pointer on scale 300 kHz, trim-transmitter on 300 kHz, adjust trimmer (l);
(m) Pointer on scale 150 kHz, trim-transmitter on 150 kHz, adjust coil (m).
Golf switch on S.W. (no mirror frequency !)
Trim station over 100 Ω connecting to antenna bus.
(n) Pointer on scale 40 MHz, trim-transmitter on 40 MHz, adjust coil (n).

Setting the M.F. suction-circuit.

Trim-transmitter over 250pF connecting to antenna bus.

Golf switch on M.W.; pointer in the middle of the scale.

(o) Trim-transmitter on 480kHz; adjust trimmer (o) to minimum output.

Setting the blocking-circuit.

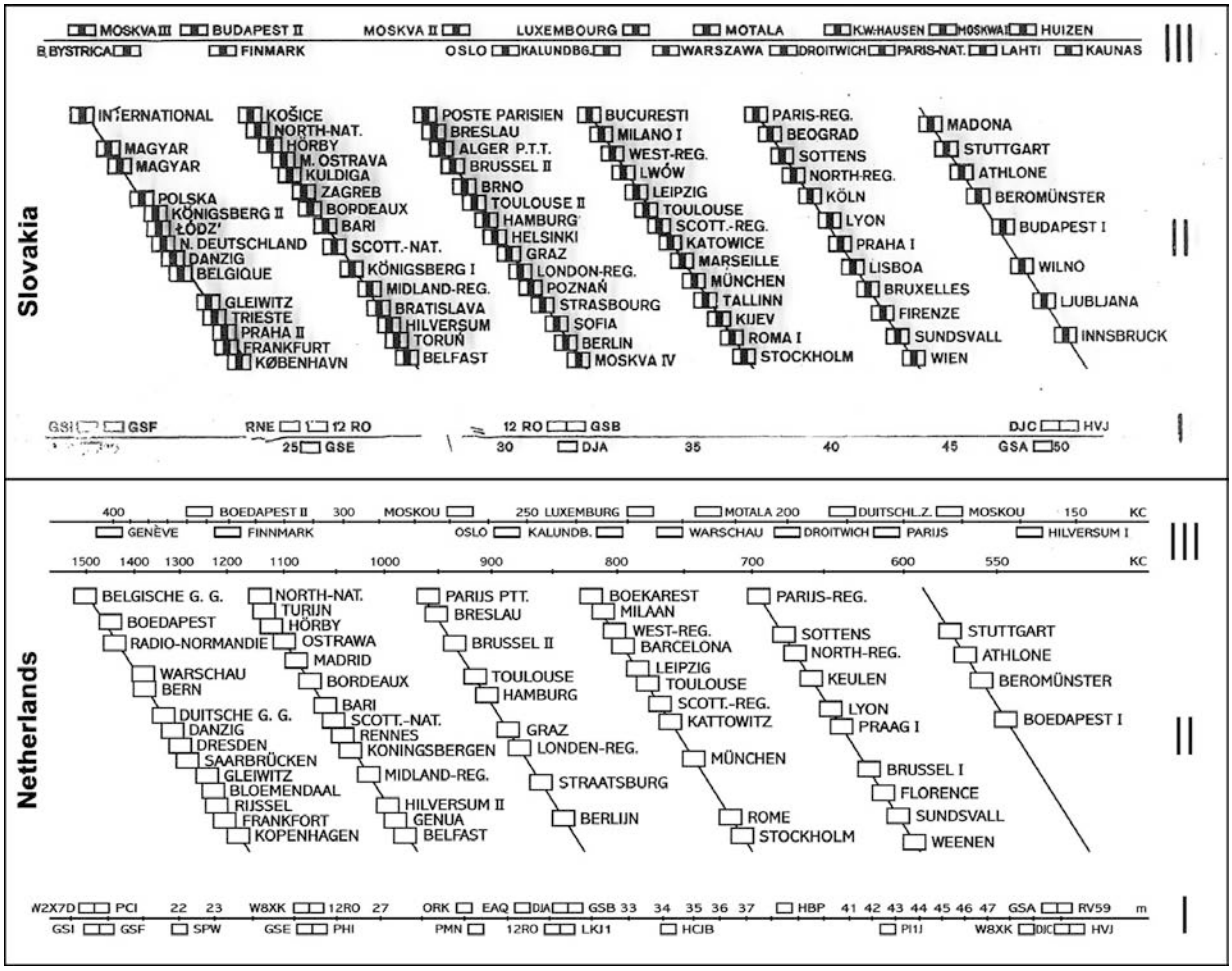
Golf switch on M.W.; pointer in the middle of the scale.

(p) Trim-transmitter on 480kHz; adjust trimmer (p) to minimum output.

(The blocking-circuit can be set on any other frequency, e.g. of a local interfering transmitter, use therefore the switches on the rear).

Resuming AVC by removing the 500 kΩ resistor.

Different types of the scale.



10. The measured values in resting State

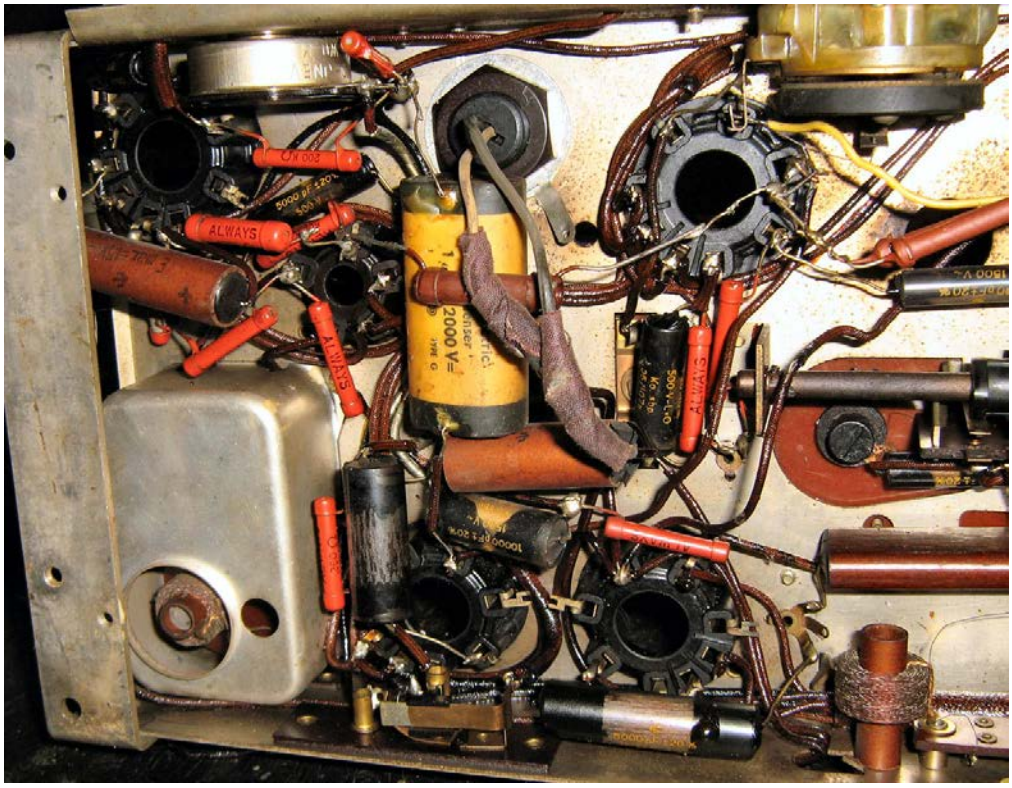
The radio is turned on and measured after 5 minutes of operation with no antenna signal.
Voltage at the first electrolytic condenser (50); 317V, and the second electrolytic capacitor (34); 245V

	Tube	**Anode**	**Cathode**	**G1**	**G2**	**G3**	**G4**
E1	AH1	210V	1,6V	0,44V	78V	-13V	78V
E2	AC2	64V	6,8V	-	-	-	-
E3	AF3	245V	2V	-	78V	0	-
E5	AL4	234V	5,9V	-	245V	-	-
			Cathode	**D left**	**D right**		
E4	AB2		27,8V	0,65V	26,5V		

Measured against chassis, *digital voltmeter with an input resistance of 10 m Ω*

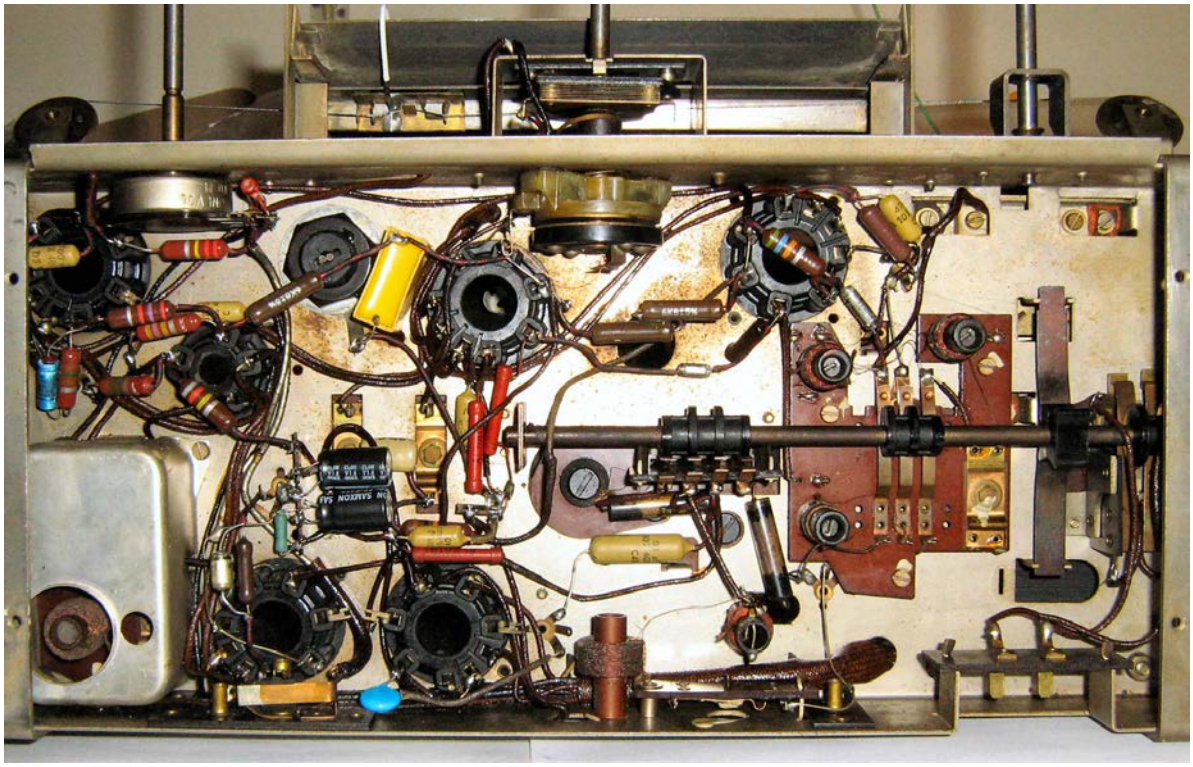
11. Parts and device info

Item	Manufacturer	Dimensions
Resistors	Always	Ø 4 x 28 mm 0,5W, Ø 6 x 28 mm (R8) 1W, Ø 6 x 36 mm (R9) 3W - Red
Capacitors	Always	Ø 8 x 31mm, Ø 12 x 47mm, Ø 14 x 36mm Ø 22 x 56mm (C22), 9 x 16 x 45 mm (C5),papier, asfalt
Buttons		Bakelite, Ø 47,5 x 17mm, finely serrated Aluminum looking edge.



Chassis part, before replacing anything.

Chassis after replacing defective components.

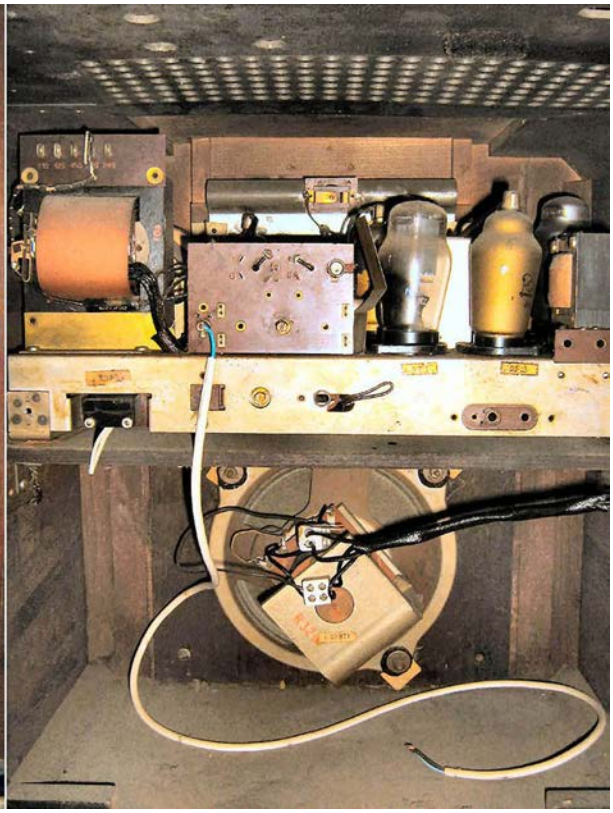


(Defect components are placed in a box inside the cabinet, for future replacing in original look.)

12. the Cabinet mechanical

Looking inside the device you can see what type of speaker is used in the receiver, and the attachment of its chassis on a wooden board.

First pictures with details of its initial state.

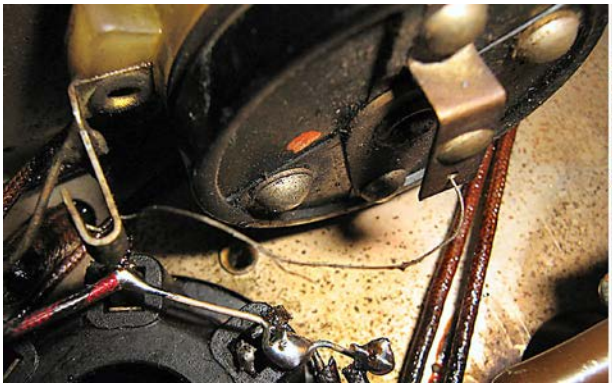


Licence on wooden cabinet

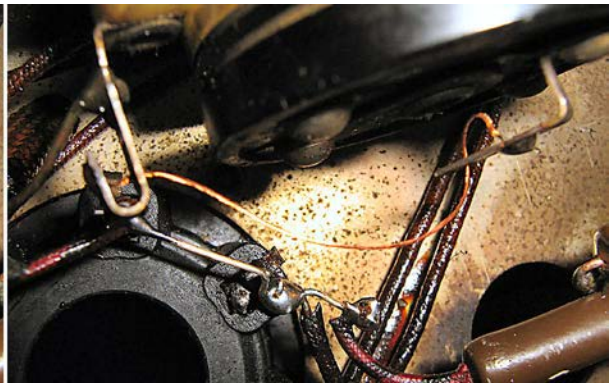
Serial numbers

The following pictures are repairing details.

C34 with defect metal center wire.

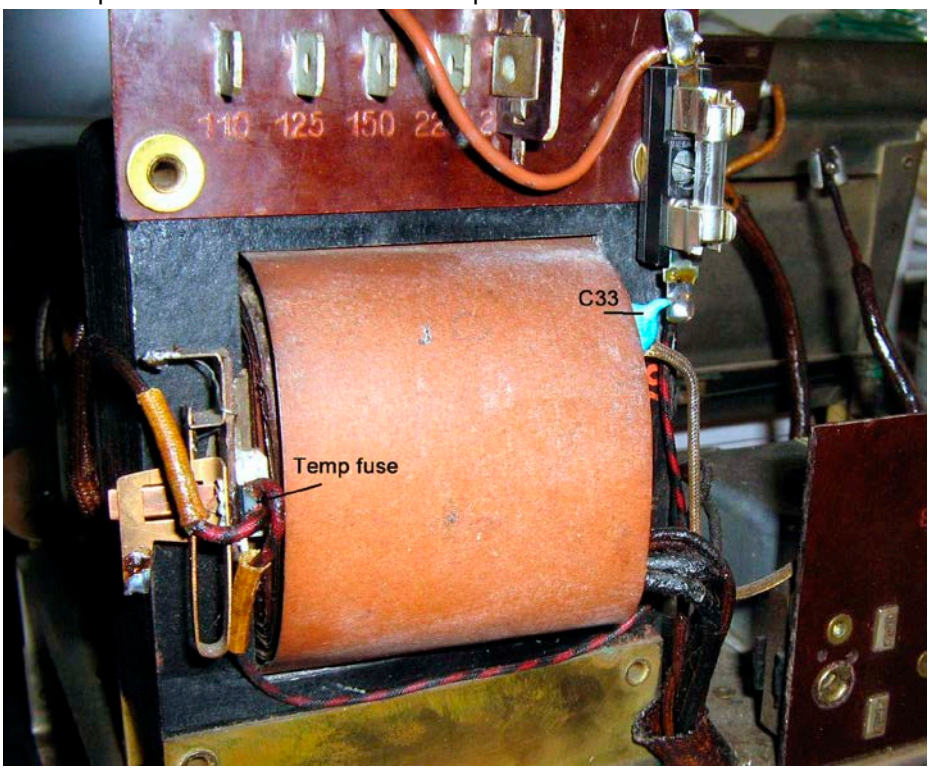


C34 with litze wire replacement.



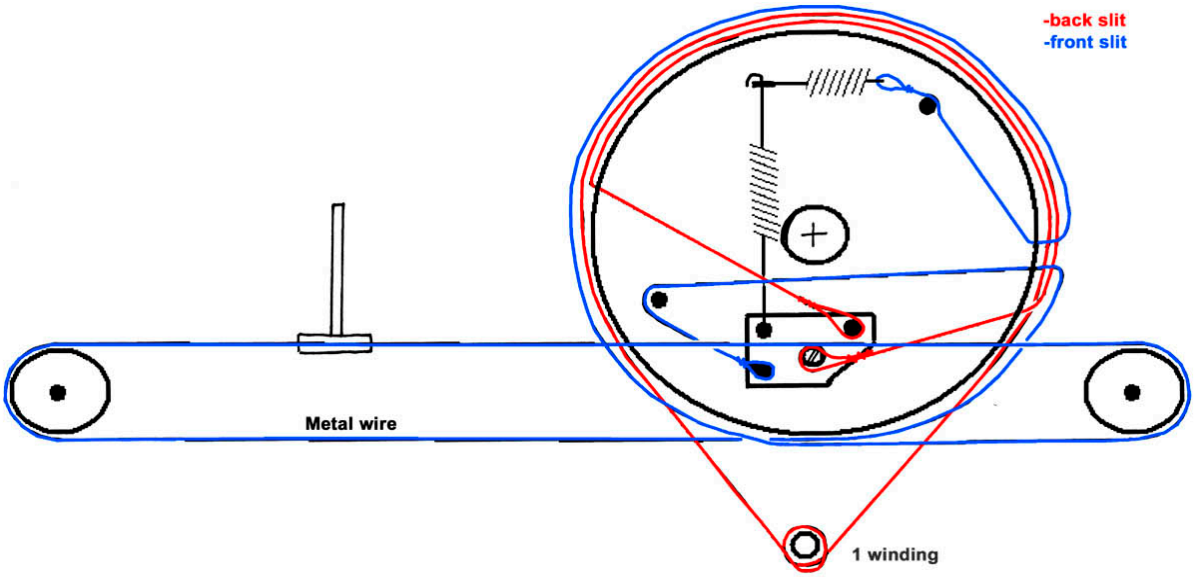
Shielding of AH1 and AC2 were bad, repair with conductive paint and gold paint, not nice but efficient.

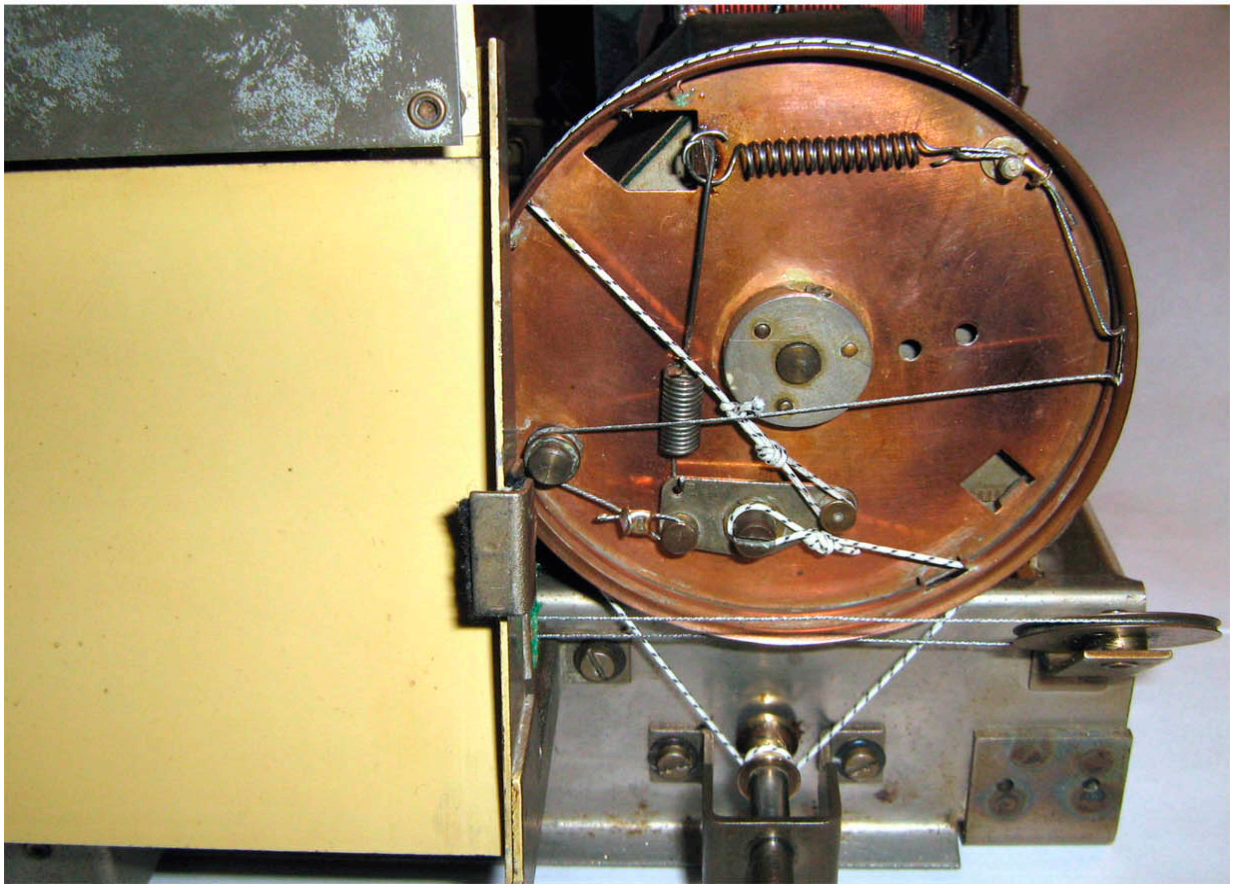
View of the mains transformer with extra fuse and a safe C33. (net antenna)
The temperature fuse was defect and replaced with a modern one.



13. Tuning wire

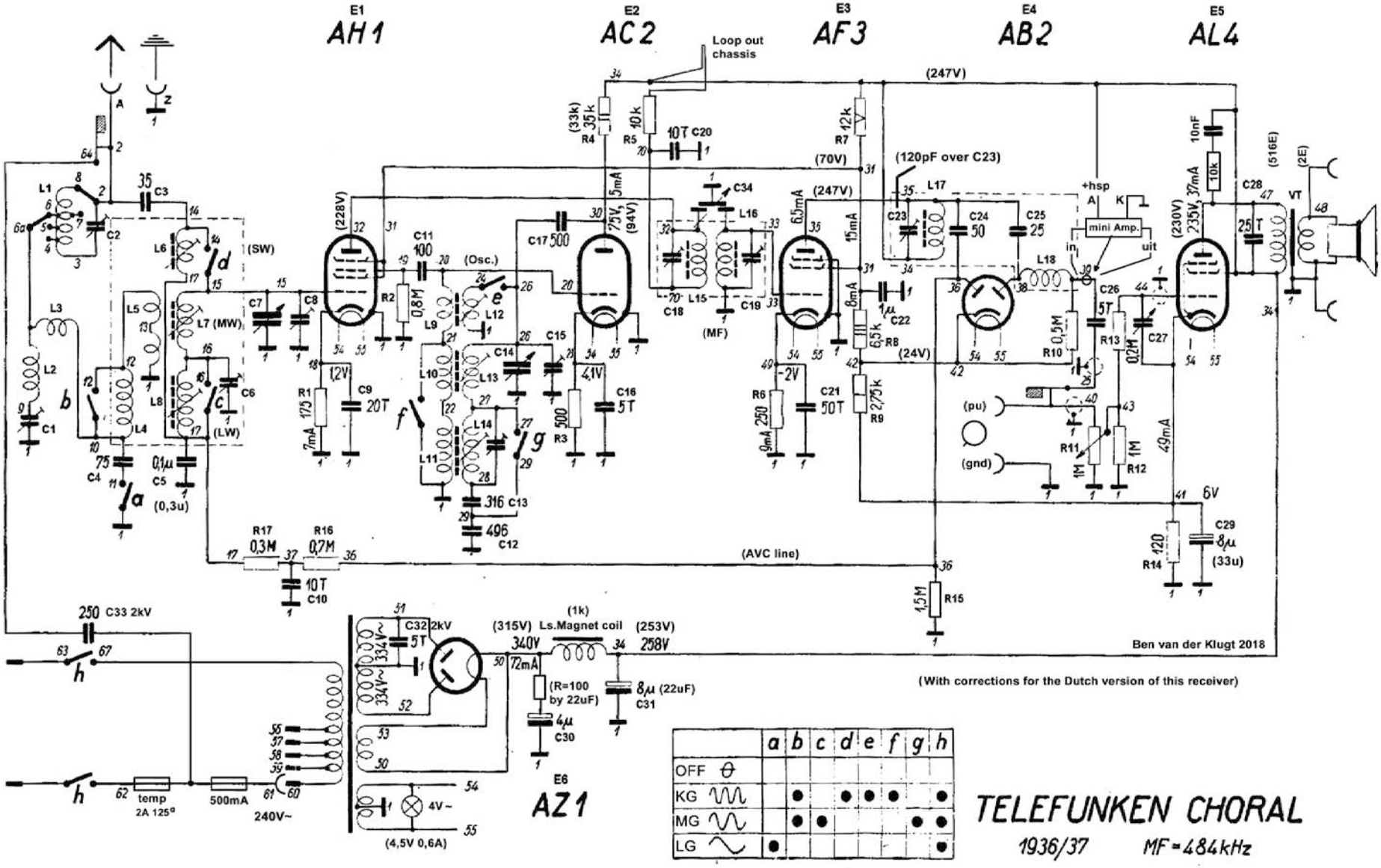
The wire work for the pointer was a chapter apart, there was a indication in the Slovakia document but the metal wire has no spring to make the pointer hold tight. This give the need for an additional spring and is processed in a drawing.



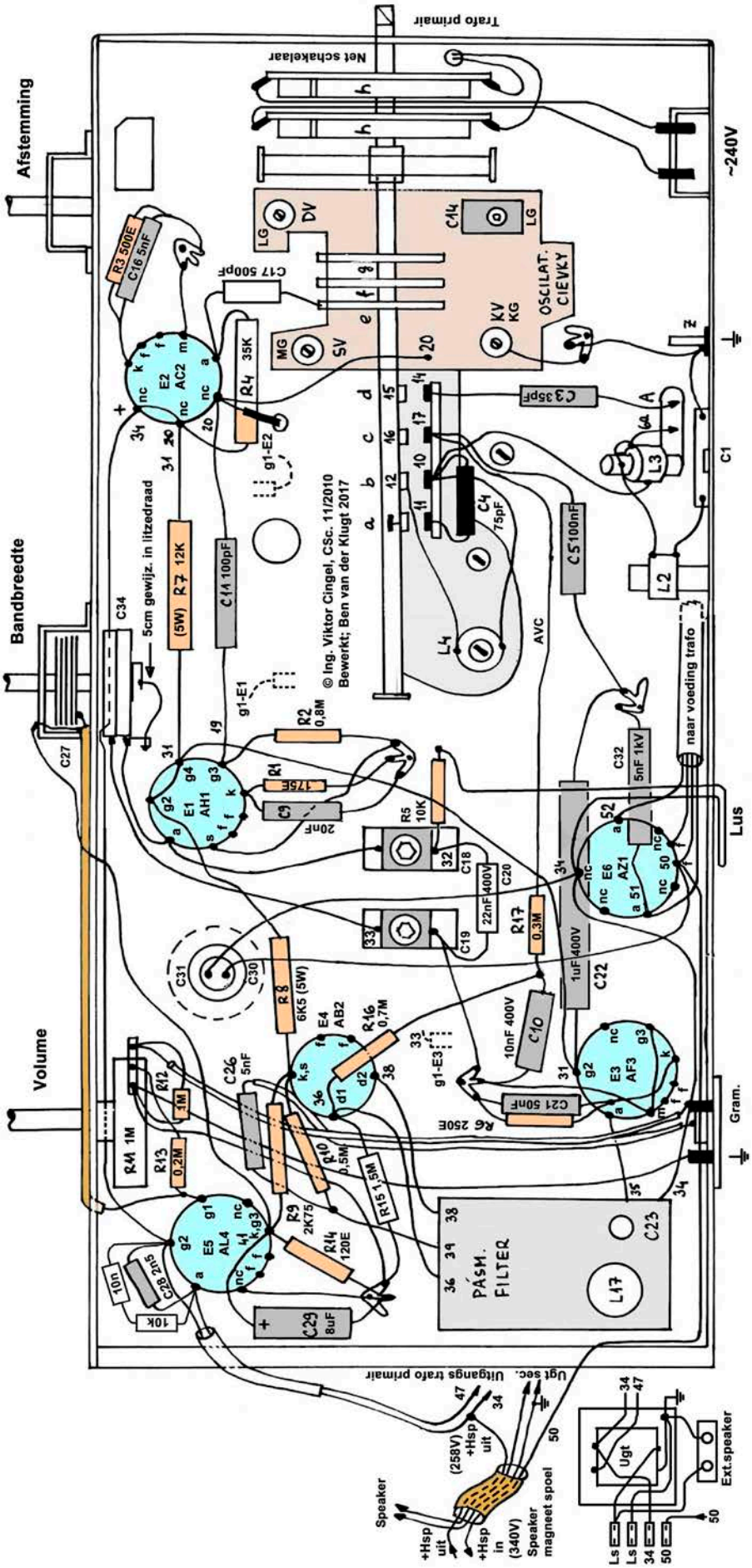


14. Schematic

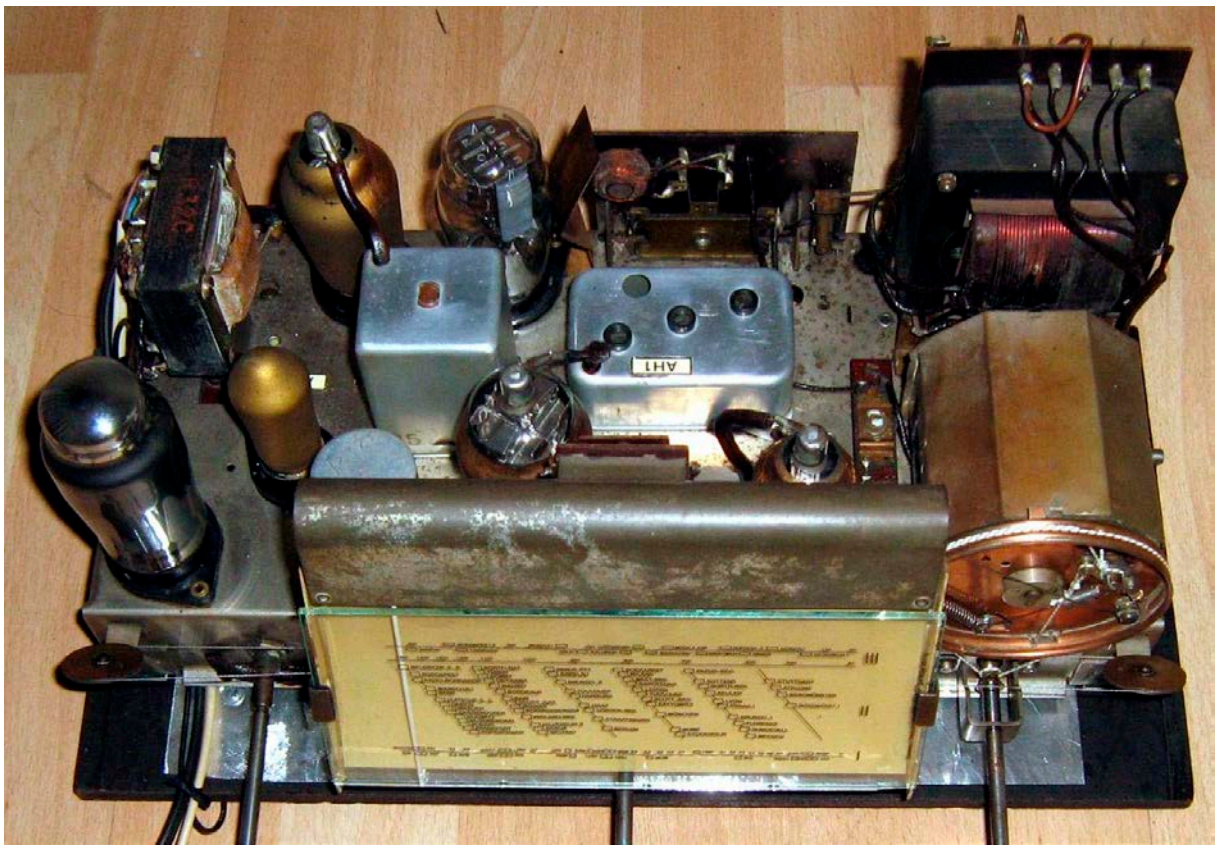
- The schematic give the measured and chanced values in (xx).
- Because the LF signal was weak, I placed a mini amplifier after L18-R10 for better sound.
- On the output transformer (prim.) is placed a serial C-10nF and R-10k between point 34-47.


E1
AH1
E2
AC2
E3
AF3
E4
AB2
E5
AL4
Loop out chassis
(247V)
(70V)
(120pF over C23)
(247V)
(24V)
(SW)
(MW)
(LW)
(Osc.)
(MF)
(AVC line)
mini Amp.
+hsp
in
uit
(pu)
(gnd)
(0,3u)
(R=100 by 22uF)
Ls.Magnet coil
(1k)
(315V)
(253V)
340V
258V
72mA
temp 2A 125°
500mA
240V~
4V~
(4,5V 0,6A)
E6
AZ1
6V
(33u)
Ben van der Klugt 2018
(With corrections for the Dutch version of this receiver)
OFF
KG
MG
LG
TELEFUNKEN CHORAL
1936/37
MF = 484kHz

15. Component indication



Final views




AZ1
AF3
AL4