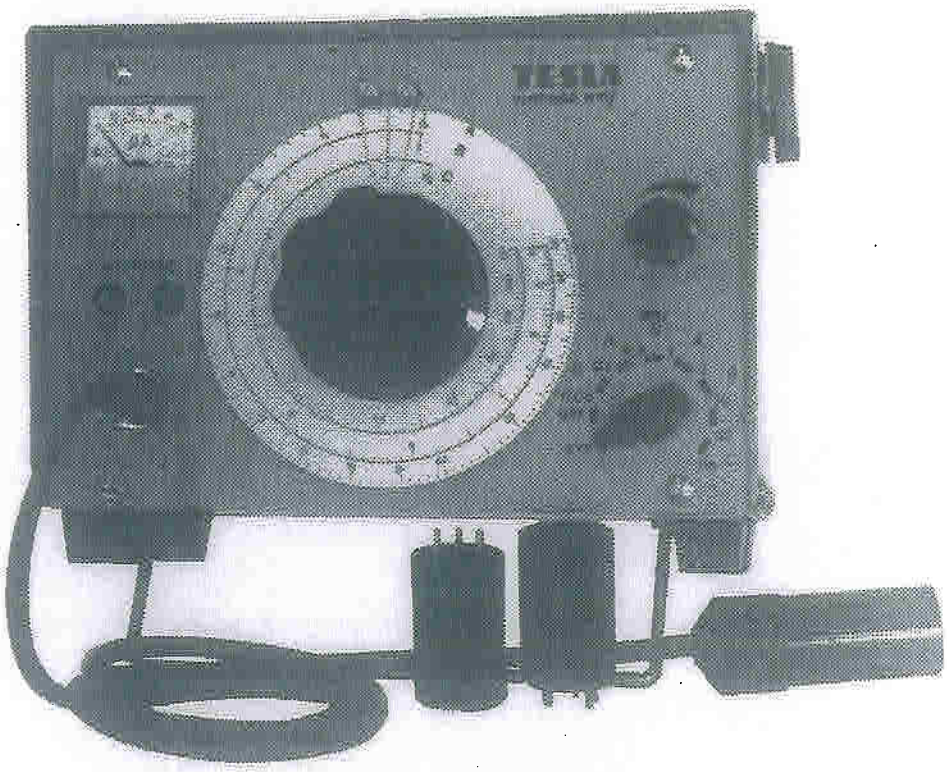
M 117



Wavemeter M 117 with adjustable stand and coupling loops.
Vlnoměr kalibrační M 117 s regulovatelnou podstavcem a spojovacími (či připojovacími?) smyčkami (?)

I. DESCRIPTION OF THE INSTRUMENT AND ITS ACCESSORIES

The wavemeter M 117 serves for the speedy measurement of the frequencies of oscillators and other frequency sources.

Makers:	TESLA BRNO, 612 00 Brno, Purkyňova 99 ČSSR
Name:	Wavemeter
Type:	M 117
Characteristics:	30 kHz to 110 MHz
Application:	For frequency measurements - especially suitable for use in transistor technique.
Production No.:	505878

Application

The wavemeter is built into a standard instrument case provided with retractable handles for carrying and with an adjustable stand enabling convenient tilting of the instrument. All the controls are on the front panel. On the back panel is the battery compartment which has a removable cover.

The friction drive of the dial enables speedy as well as very fine tuning. The scales are marked A, B, and C respectively, thus corresponding to the appropriate positions of the range switch, as follows:

Scale A - For the ranges 0.1 to 0.3 MHz; 1 to 3 MHz; 10 to 30 MHz

Scale B - For the ranges 30 to 100 kHz; 0.3 to 1 MHz; 3 to 10 MHz

Scale C - For the range 30 to 110 MHz

The wavemeter is provided with three loops intended for various frequency bands, and a contact probe switchable to 3 sensitivity steps. When the probe is set to step 3, the wavemeter has minimum sensitivity and maximum input impedance, making it suitable for the measurement of the frequencies of electron tube oscillators or transistorized oscillators of higher output power. When set to step 2, the sensitivity is higher and is suitable for transistorized oscillators of smaller output. With the probe set to step 1, the sensitivity is maximum and the input impedance is minimum.

The sensitivity can be controlled also continuously by altering the distance between the employed loop and the oscillator, or when the probe is employed, by continuously adjusting the sensitivity control of the wavemeter.

Correct tuning of the wavemeter is indicated by maximum deflection of the meter. In order to prevent destruction of the transistor in the RF amplifier of the wavemeter by an excessively high input voltage, a circuit is built into the wavemeter which signalizes the presence of such a high input voltage by causing the pointer of the meter to deflect even when the wavemeter is not tuned to resonance.

The wavemeter is powered by two battery cells, the service life of which in interrupted operation is limited only by the duration of their storage. Old battery cells must not be left inside the wavemeter, as the battery compartment could get soiled by the seeping out of the contents of the worn-out cells.

List of accessories

Contact probe:

With rotatable head for switching the sensitivity in three steps.

Coupling loops:

Three loops for different frequency bands:

0.03 to 1 MHz
1 to 10 MHz
10 to 110 MHz

Cable:

For the interconnection of the employed coupling loop and the wavemeter.

Instructions for Use

Packing Note

Guaranteed Certificate

II. TECHNICAL DATA

Frequency range: 30 kHz to 110 MHz

Frequency error: ± 2 %

Sensitivity of contact probe: 40 divisions on the meter scale

Range 1:

Within the band 30 kHz to 10 MHz Better than 5 mV
10 MHz to 30 MHz Better than 15 mV
30 MHz to 110MHz Better than 25 mV

Range 2:	
Within the band 30 kHz to 30 MHz	**Better than 10 V**
30 MHz to 110 MHz	**Better than 5 V**
Range 3:	
Within the band 30 kHz to 20 MHz	**Better than 35 V**
20 MHz to 110 MHz	**Better than 15 V**

Input impedance of contact probe:

Range 1:	**200 pF, 200 Ω, in parallel**
Range 2:	**4 pF, 30 kΩ, in parallel**
Range 3:	**4 pF, 300 kΩ, in parallel**

AF modulation output:	**50 mV at f.s.d. of the meter and 30 % modulation by 400Hz**
Max. DC voltage on probe tip:	**± 250 V**
Operating temperature range:	**0 to+45 °C**

The design of the instrument responds to safety class III. according to IEC.

Complement:	**1 x GF506, 2 x GC517, 2 x GA205**
Powering:	**By 2 battery cells, type 140**
Power consumption:	**4 mA**
Dimensions and weight:	**170 x 250 x 190 mm; 3.6 kg**

III. PRINCIPLE OF OPERATION

The voltage picked up by the coupling loop or contact probe is fed to the wavemeter by means of a coaxial cable. The contact probe is provided with a three-position input voltage switch.

The input voltage of the wavemeter is applied over the potentiometer R1 to the transistor T1 which operates in earthed base connection. Into the collector circuit of this transistor is inserted a tuned measuring circuit formed by coil L1 and capacitor C8 for the range 30 to 110 MHz, and by tuning capacitor C9 and coils L2 to L7 for the other ranges. The voltage, which at resonance of the circuit is maximum, is rectified by the diode D2 and connected between the bases of a DC amplifier in bridge connection. This amplifier is fitted with transistors T2 and T3. During frequency measurement a meter is connected between the collectors; it indicates maximum deflection when resonance is achieved. The potentiometers R2 and R3 serve for adjusting the working points of the transistors T2 and T3 and thus also for zero adjustment of the meter.

If the voltage applied to the wavemeter is amplitude-modulated, then transistor T2 operates as an amplifier of the AF modulating voltage. The amplified AF voltage is available from the sockets NF (2 - Fig. 1) e.g., for checking with an oscilloscope, etc.

The transistor of the RF amplifier is protected against damage caused by an excessively high input voltage by rectification of such a voltage by the diode D1 and then by its application to the meter via a DC amplifier. Thus, an excessive input voltage is indicated by a deflection on the meter even when the wavemeter is not tuned to resonance. Consequently, the transistor of the RF amplifier is protected against possible damage.

When the range switch (5 - Fig. 1) is set to the position BAT., the meter (3 - Fig. 1) operates as a voltmeter for checking the state of the powering battery. At the same time, the powering battery is loaded by increased power consumption. The battery can be still used if the meter indicates a deflection of at least 60 divisions on the scale.

IV. INSTRUCTIONS FOR USE

Front panel of the wavemeter:

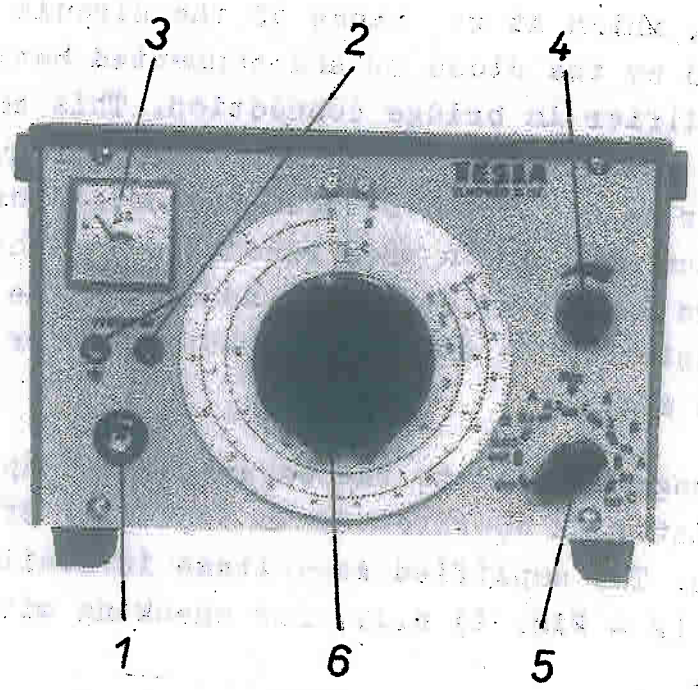


Fig. 1

1. Coaxial input socket
2. AF modulation output
3. Meter
4. Sensitivity control
5. Main switch, range selector and battery checking
6. Dial

Back panel of the wavemeter:

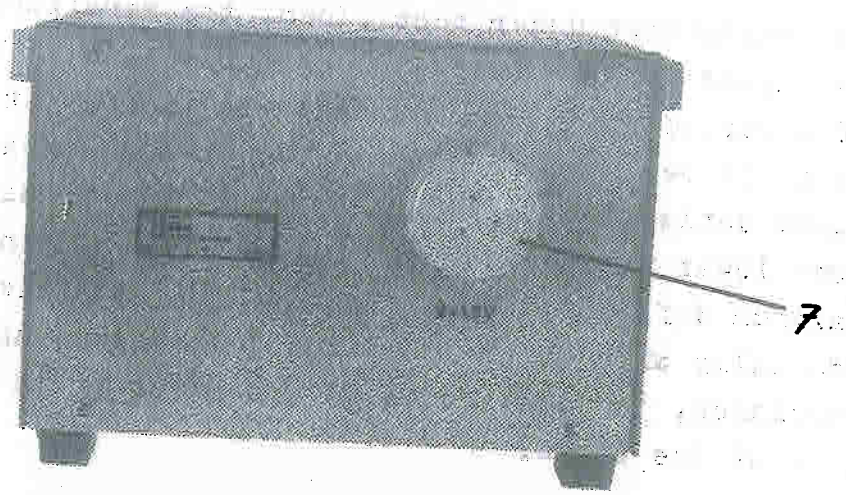


Fig. 2

7. Battery compartment

Before setting the wavemeter in operation, it must be ensured that switch 5 (Fig. 1) is in the position OFF. The cover of the battery compartment (7 - Fig. 2) on the back panel is unscrewed and two battery cells (type 140) are inserted with their positive poles forwards. When the cover is screwed back, its spring presses on the negative pole of the second cell.

The selected sensor (probe or loop) is connected to the input socket 1 (Fig. 1) by means of the supplied coaxial connection cable and the range selector 5 is changed over from the position OFF to position BAT. In the latter position, of the selector, the meter indicates the state of the battery at increased load. If the pointer of the meter indicates a deflection less than 60 divisions, then the battery cells must be exchanged.

The dial 6 (Fig. 1) is set to the lowest frequency (by turn-

ing it counterclockwise), the range selector is set to the next position and the contact probe is set to sensitivity step 3, or the coupling loop is approached to the coil of the oscillator under test. Then, the sensitivity of the wavemeter is increased with potentiometer R1 (4 - Fig. 1). If a deflection is indicated on the meter, it is not necessary to set maximum sensitivity of the contact probe. Maximum deflection is sought by gradually turning the dial from lower frequencies to higher ones. During tuning to maximum deflection of the meter, the sensitivity is reduced gradually with the rise of the deflection, until finally at resonance, the deflection of the meter is in the second half of the scale.

If the meter does not show a deflection when the dial of the wavemeter is turned through its whole scale, then the range selector has to be switched to a further position and by turning the dial anew, a deflection increase of the meter is sought. This procedure is repeated until the wavemeter can be tuned to resonance at the measured frequency.

The measured value is read on that scale of the dial, the marking of which (A, B, C) corresponds to the range set with the range selector.

During tuning it is important always to proceed from the lowest frequencies to the highest ones, as owing to its high sensitivity, the wavemeter could be tuned easily to a harmonic frequency.

If the deflection on the meter is small during tuning with the contact probe employed, then the probe sensitivity has to be set to step 2, thus increasing the deflection approximately 10 x.

Sensor selection

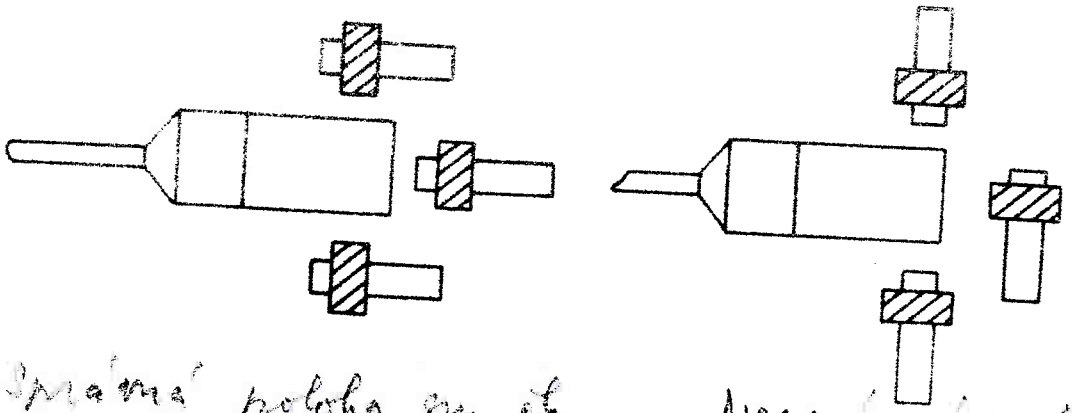
For measurements, either coupling loops or the contact probe can be employed. The coupling loops are designed for three different frequency ranges marked on their covers. They are employed for measuring the frequencies of such oscillators, the tuning coil of which is not inside a screening. Frequency measurements carried out by means of a coupling loop are the most precise, as during such a measurement the mutual influence of the testing and tested circuits is minimum.

When the meter indicates a large derlection, the sensitivity need not be altered by means of the potentiometer, as it can be reduced more conveniently by moving the coupling loop further away from the tuning coil of the oscillator. During final tuning to maximum deflection, the position of the coupling loop must not be altered any more as this could cause erroneous tuning of the wavemeter.

When the frequency of a low-power oscillator or of an oscillator which employs enclosed core cup-type coils has to be ascertained, the correct positioning of the coupling loop is very important in order to ensure that the voltage induced in the loop is sufficiently high. Maximum voltage is obtained when the axis of the oscillator coil and that of the coupling loop are identical or parallel. If the coil axes are at right angles to each other, then the voltage induced in the loop is low and may not be sufficient for the measurement.

For checking the erasing frequency and the premagnetizing frequency of a tape recorder, the most suitable method is to place the coupling loop close to the erasing head where the magnetic field is very strong.

In Fig. 3 are shown the correct and incorrect mutual positions of the coupling loop and the tested coil.



Správná poloha smyčky
Correct positioning of ccupling loop.

Nesprávná poloha smyčky
Incorrect positioning of coupling loop.

Fig. 3

The contact probe has three switchable sensitivity steps. With step 1 selected, the wavemeter has maximum sensitivity and low input impedance, therefore the probe set to step 1 can be connected only to points of low impedance (tap of tuning coil, emitter of oscillator transistor during the testing of RF generators, etc.).

When the voltage of a live point of a tuning circuit is being measured, the probe has to be set to sensitivity step 2 or 3. In step 3 the sensitivity is the lowest, therefore each measurement has to be commenced with the probe set to this step. Only if this sensitivity is insufficient, then the probe has to be switched over to step 2.

Application of the contact probe affects the circuit to which it is connected. If the probe is connected directly to the operating oscillator, a change in the frequency of the latter occurs and thus also an error is introduced into the measurement. This error is inversely proportional to the capacitance of the measured circuit and directly proportional to the probe capacitance.

Error:

$$\varepsilon = 100 \left(1 - \sqrt{\frac{C}{C + C_1}}\right) \quad \%, \text{ pF}$$

where C is the tuning capacitance of the circuit, and
C_p is the additional capacitance of the probe and connections.

The error occuring with low tuning capacitances can even considerably exceed the error of the wavemeter.

Warning!

When voltages of circuits having voltage against earth are being measured, this voltage can appear on the cover of the instrument. Attention!

V. INSTRUCTIONS FOR MAINTENANCE AND REPAIRS

Before commencing a measurement, the state of the battery must be ascertained. A faulty cell must be exchanged. Should the battery compartment have become soiled by the contents of a cell, the walls of the compartment, including the contact in it and the spring of the cover, must be cleaned. If the wavemeter measures incorrectly within any range, or if the dial has worked loose, then it is essential to readjust the wavemeter by the application of precise frequencies with inherent errors less than 0.5 %.

Displacement of the meter pointer by ± 5 divisions has no influence on the operation of the wavemeter. After exchanging the transistor T1, it is essential to check the frequencies in all ranges.

The transistors T2 and T3 are matched. With a powering voltage of 3 V employed, these two transistors must have identical properties. If this is not the case, the correct operation of the whole wavemeter is impaired.

Seznam elektrických součástí

LIST OF ELECTRICAL COMPONENTS

Resistors: Odpory

No. Číslo	Type Typ	Value Hodnota	Max. load W	Tolerance ± % Přesnost	Standard ČSSR
R1	Potentiometer	250 Ω	0.5	-	TP 280a 32A 250/N
R2	Potentiometer	1 kΩ	0.2	-	TP 041 1k/N
R3	Potentiometer	470 Ω	0.2	-	TP 041 470/N
R4	Film	6.8 kΩ	0.125	10	TR 112a 6k8/A
R5	Film	1.8 kΩ	0.125	10	TR 112a 1k8/A
R6	Film	3.3 kΩ	0.125	10	TR 112a 3k3/A
R7	Film	120 Ω	0.125	10	TR 112a 120/A
R8	Film	22 kΩ	0.125	10	TR 112a 22k/A
R9	Film	47 kΩ	0.125	10	TR 112a 47k/A
R10	Film	220 kΩ	0.125	10	TR 112a M22/A
R11	Film	470 Ω	0.125	10	TR 112a 470/A
R12	Film	470 Ω	0.125	10	TR 112a 470/A
R13	Film	680 Ω	0.125	10	TR 112a 680/A
R14	Film	680 Ω	0.125	10	TR 112a 680/A
R15	Film	47 kΩ	0.125	10	TR 112a 47k/A
R16	Film	220 kΩ	0.125	10	TR 112a M22/A
R17	Film	68 Ω	0.5	10	TR 144 68/A
R18	Film	30 kΩ	0.25	1	TR 106 30k/D
R19	Film	330 kΩ	0.125	10	TR 112a M33/A
R20	Film	33 kΩ	0.125	10	TR 112a 33k/A

Kondenzátory
Capacitors: Max. napětí

No.	Type	Value Hodnota	Max.DC voltage V	Tolerance ± % Přesnost	Standard ČSSR
C1	Trimmer	4.5 pF	400	-	WK 701 22
C2	Trimmer	30 pF	-	-	1AK 703 04
C3	Trimmer	30 pF	-	-	1AK 703 04
C4	Trimmer	30 pF	-	-	1AK 703 04

C5	Trimmer	30 pF	-	-	1AK 703 04
C6	Trimmer	30 pF	-	-	1AK 703 04
C7	Trimmer	30 pF	-	-	1AK 703 04
C8 C9	Double capacitor	-	-	-	1AN 705 06
C10	Ceramic	33 000 pF	250	-	TK 357 33k
C11	Ceramic	10 000 pF	160	-	TK 440 10k
C12	Ceramic	0.1 µF	32	-	TK 783 100n
C13	Ceramic	0.1 µF	32	-	TK 783 100n
C14	Electrolytic	2 µF	35	-	TC 943 2M
C15	Ceramic	0.1 µF	32	-	TK 783 100n
C16	Ceramic	6 800 pF	160	-	TK 440 6k8
C17	Electrolytic	10 µF	10	-	TE 003 10M
C18	Electrolytic	2 µF	35	-	TC 943 2M
C19	Ceramic	0.1 µF	32	-	TK 783 100n

Transformátory a cívky

Transformers and coils:

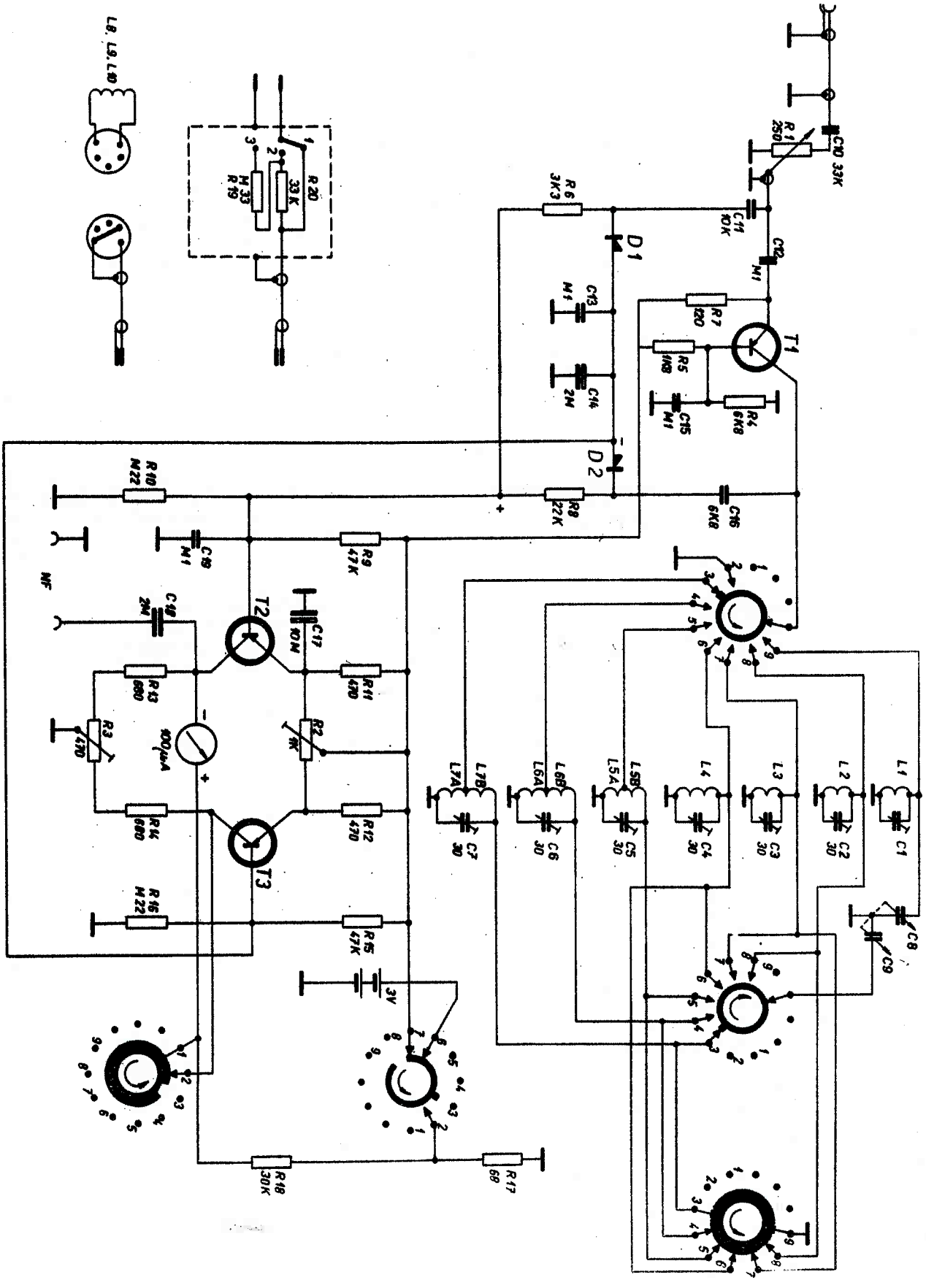
Component Součástka		Winding vinutí	No. of turns Počet závitů	Wire ø in mm ø drátu v mm
Coil	L1		3	4 x 0.5
Coil	L2		10	1.00
Coil	L3		27	20x0.05
Coil	L4		82	20x0.05
Coil	L5	A	170	0.10
		B	140	0.10
Coil	L6	A	320	0.10
		B	570	0.10
Coil	L7	A	375	0.10
		B	1125	0.10

Coil L8	2	0.20
Coil L9	20	0.10
Coil L10	150	0.10

Různé elektrické součástky

Sundry el. components:

Component	Type
Transistor T1	GF506
Transistor T2, T3	GC517
Diode D1, D2	GA205



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