The RF system for the linear electron accelerator LINAC-200

K. Yunenko

Laboratory of Nuclear Problems, Joint Institute for Nuclear Research, Dubna, Russia

Schematic diagram of the connection of RF power to the accelerating structures LINAC-200

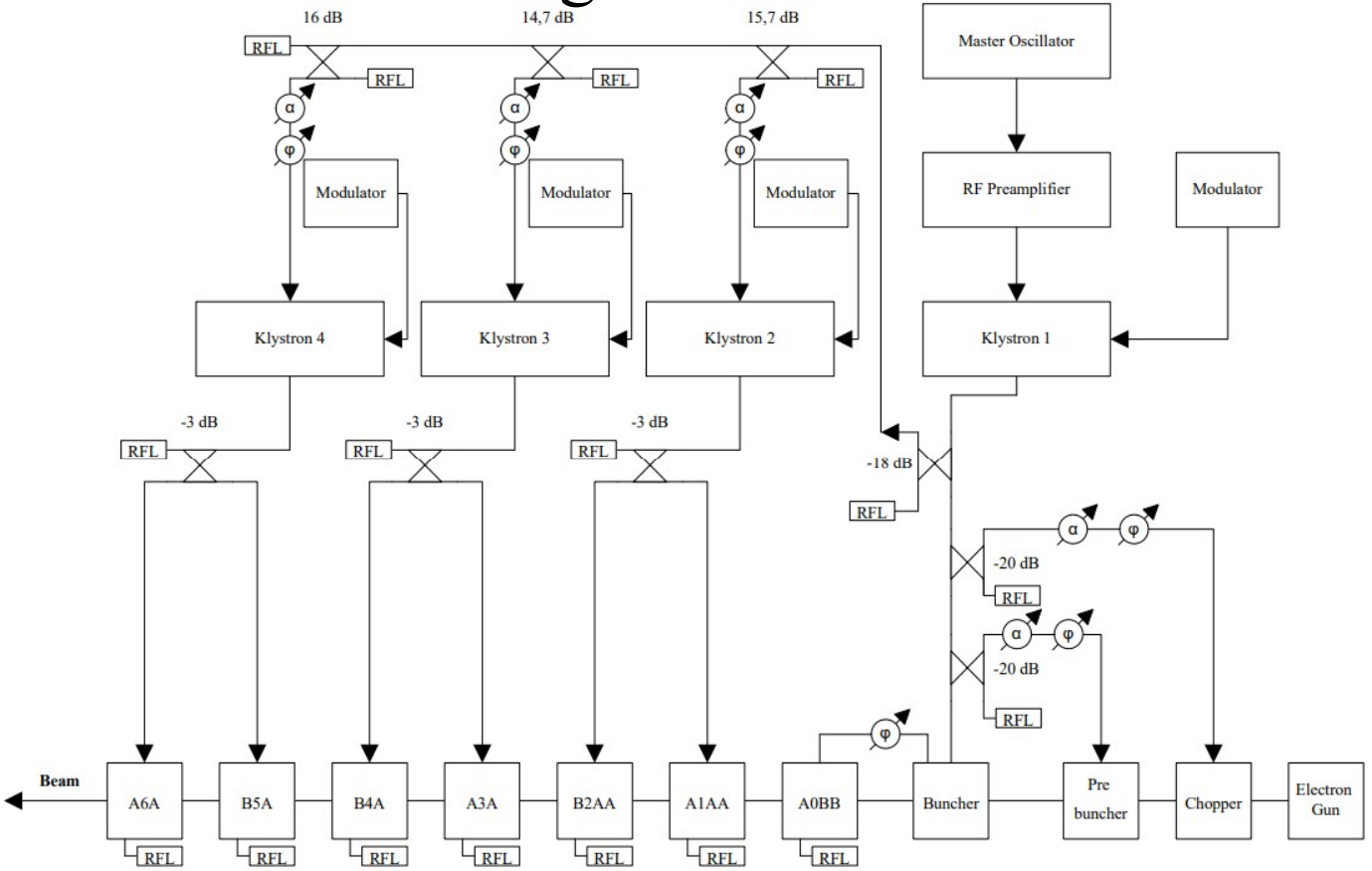

Fig.1. **A6A,..A0BB** – Accelerating sections; **Beam** ; **Buncher**; **Chopper** ; **Electron gun** ; **Klystron**; **Master Oscillator**; **Modulator**; **Pre-buncher**; **RFL** – RF load; **RF Preamplifier**; **α, φ –** Attenuator and phase shifter

Acceleration & RF

Table 1. Accelerator parameters

Parameter	Linac-200	Linac-800
Total linac length, m	55	200
Number of short (3.7 m) sections	3	3
Number of long (7.3 m) sections	4	22
Frequency, MHz	2856	
Wave type	TW	
Field mode	2π/3	
Filling time, μs	1.3	
v_g/c range	0.0093–0.0389	
Shunt impedance, MΩ/m	56.5–48	
Iris aperture: diameter, mm	32–17	
thickness, mm	5.84	
Number of klystrons	4	13
RF power: peak, MW	10	
mean, kW	20	

Klystron

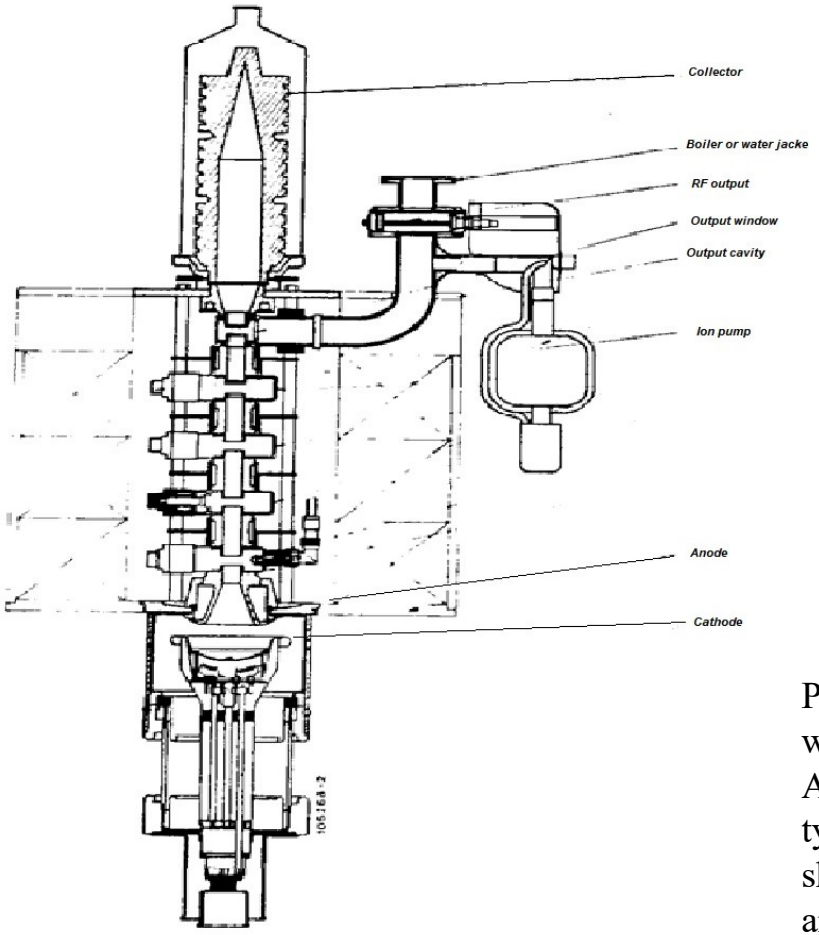

Fig.2. Klystron TH2129 (Thomson) of accelerator LINAC-200

Table 2. Klystron parameters.

Type	TH 2129
Company manufacturer	TTE (Thomson Tube Electronics)
Peak power: input, W output, MW	 100 20
Average power: input, W output (max), kW	 0.7 20
Pulse duration, μs	4
Frequency of repetition (max), Hz	100

Pulsed klystrons of the 10 cm range, the operating frequency of which corresponds to 2856 MHz, are used as RF power amplifiers. A modulator is used to provide power to the klystron. The linear type modulator consists of a pulse transformer and 40 pulse shaper blocks. Each of these blocks is made using printed wiring and is capable of generating a pulse with an amplitude of 2 kV and a duration of 25 μs. The amplitude and frequency of repetition of pulses change depending on the number of enabled blocks of shapers.

Modulators

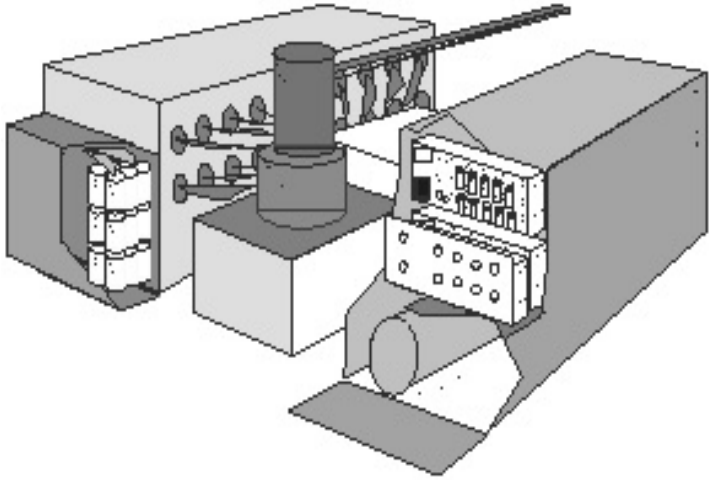

Fig.3. General view of the linear modulator

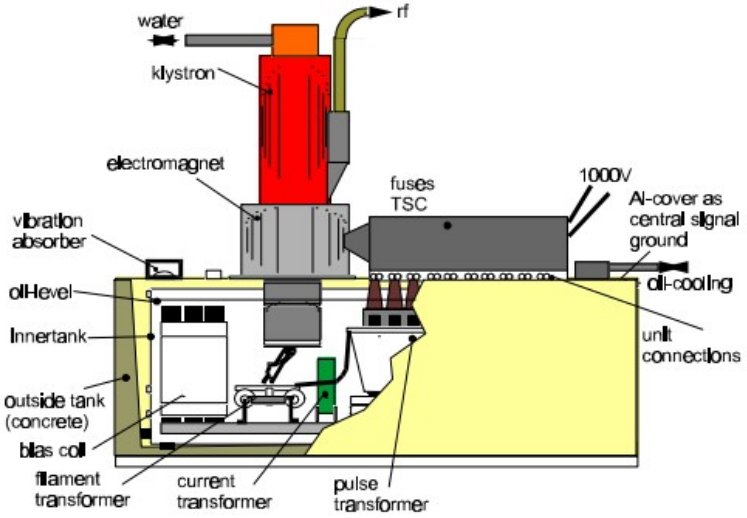

Fig.4. Oil tank layout

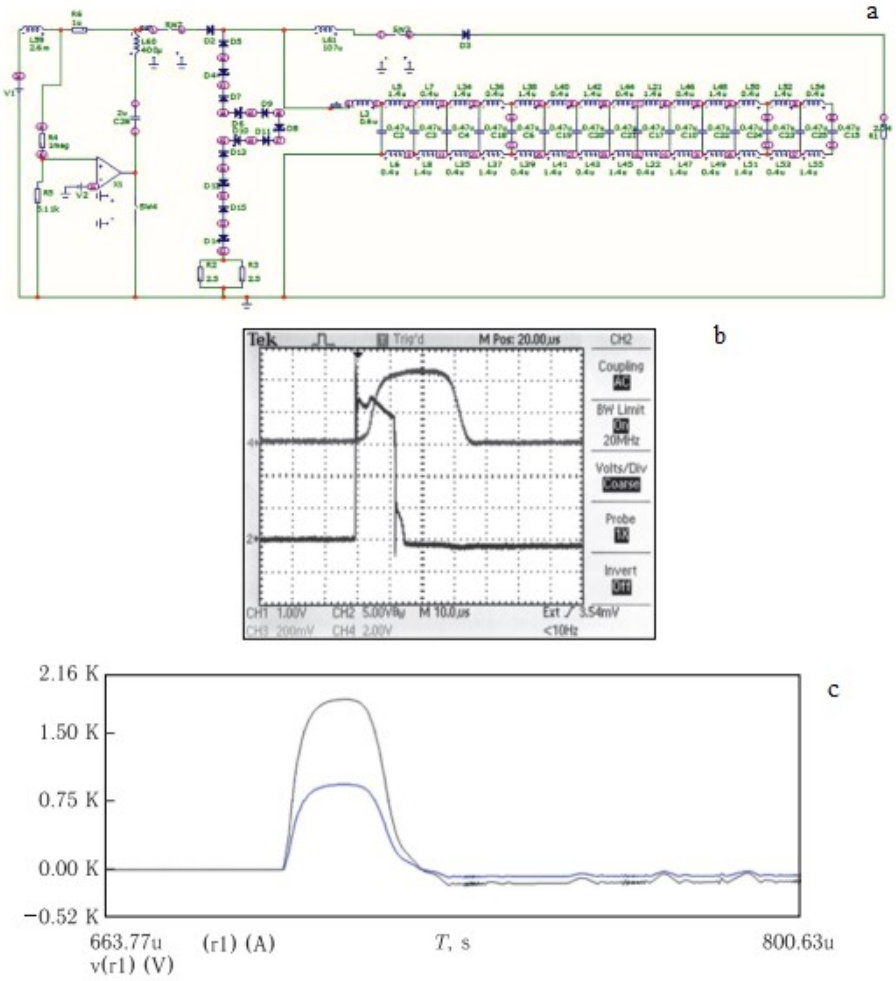

Fig.5. a) Modulator equivalent circuit adapted for calculations in the MicroCap program; b) oscillogram of the pulse on the load of the LINAK-200 klystron modulator (2 - input pulse, 4 - output pulse); c) graphs of voltage and current versus time on the load

Modulators and RF-path

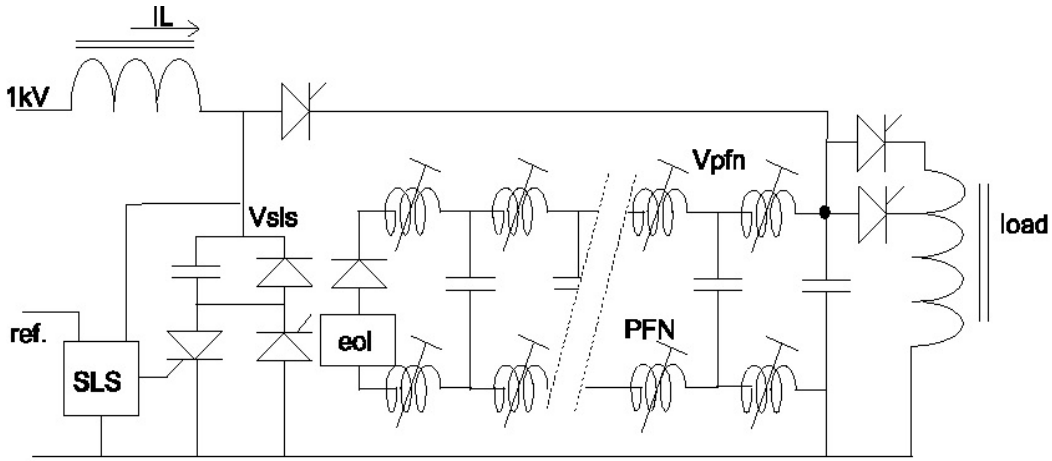

Fig.6. Schematic diagram of the pulse shaper block

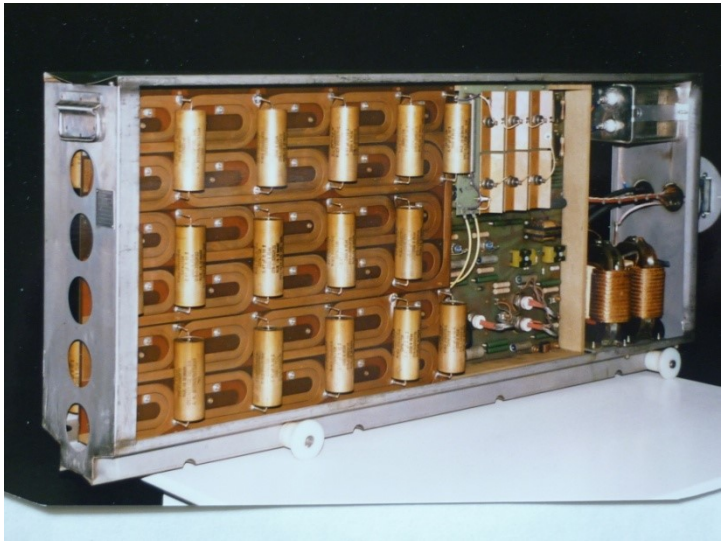

Fig.7. Pulse shaper block, dimensions: 1250×600 mm^2, weight 45 kg

Transfer of RF power from klystrons to the waveguides of the accelerating sections is carried out by standard copper waveguides of rectangular section 72x34mm^2 with a wall thickness of 4mm. The waveguides are evacuated to increase the electrical strength of the path. Vacuum posts were installed along the length of the tract, to which getter-ion vacuum pumps with a capacity of 75 l / s were connected.

The RF-path waveguides are thermally stabilized. To do this, copper tubes are soldered to the waveguides on both sides along the wide walls from the outside, through which distilled water of the cooling-thermostabilization system circulates.

Conclusion

- The RF system of the LINAC-200 accelerator was considered as a whole, as well as its individual elements (klystrons, modulators, RF path).
- The problems that are in the process of being solved are indicated.
- Plans have been outlined for the further development of the RF system for increasing the energy of the particle beam.