

ФІЗИКО-МАТЕМАТИЧНІ НАУКИ

THE SYSTEM OF PROTECTION AGAINST BURNING OF THE FOIL IN THE  
OUTLET WINDOW OF ELECTRON ACCELERATOR

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In technological processes of modern industry, transformer accelerators of electrons of direct action – ELV became popular [1]. Among the electron accelerators of this type, the ELV-1 series is widely operated [2]. In this series of accelerators, an electron beam with a diameter about 8 mm passes through the accelerator tube and the magnetic field formed by the coils of the deflection system. The coils of the deflection system are powered by an external generator with a voltage in the shape of a saw. As a result of the magnetic field formed by the deflection coils, the electron beam scans a titanium foil 75×980 mm in size and 50 μm thick, scattering electrons along the foil, causing its warm-up. For a beam with a current of 30 mA, scattering losses reach a power of 1500 watts. To remove released thermal energy, compressed air is used, which is pushed out of the slot of the cooler.

Experience of operation of the ELV-1 series electron accelerator showed that today there is a need for its improvement and bringing to the technical level and requirements of modern production. For this reason, we have been working on improving the protection system for the currents of the line and the vertical sweeps coil of the deviation system from the burning of the titanium foil of the transformer type ELV-1 industrial accelerator of direct action.

In the case of a violation of the line and vertical sweeps, such as the break or short circuit in the deflecting coils of their electric power wires, it is necessary to have a reliable foil protection system from burning by an electron beam. Special attention should be paid to the case when the current that passes through the line deviation coil disappears. Under these conditions, the energy of the electron stream is concentrated on a small surface of the foil. The airflow, in this case, will be not enough for cooling of the titanium foil of the exhaust window. That will cause an emergency situation and burning of the foil.

The system developed by us allows to prevent the burning of the accelerator's foil of the exhaust window through two channels: the 1st channel is on the scan of the 50 Hz line scan; the 2nd channel is on the 1075 Hz scan. In the case of an emergency in one of the channels, the system brings the signal to the PC and to the fast protection system at high voltage breakdown. The system will turn off the power from the primary winding of the high-voltage rectifier of the accelerator, for a time not exceeding  $1,25 \cdot 10^{-3}$  s, which will make it impossible for the emission and subsequent passage of an electron beam to the titanium foil of the exhaust window.

The proposed protection system has been tested for one year on the accelerator series ELV-1 in LLC "Azov cable company". During the operation of the system deficiencies in its operation were not revealed. It gives the reason to say about the

possibility of its use as a part of industrial electron accelerators of the proposed series to protect the foil from its burning by an electron beam in current as a frame and line scans.

**References**

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