# RESEARCH OF TRANSITIONAL RESISTANCE AND ELECTRICAL EROSION OF SERIAL CONTACT DETAILS OF RELAY-RPL – 2204

**Mrachkovskyy AM, Ph.D., assistant professor of electrical machinery and electrical operation of the National University of Life and Environmental Sciences of Ukraine,**

**M.V.Marhon assistant of electrical machinery and electrical operation of the National University of Life and Environmental Sciences of Ukraine**

*The processes of electric arc and duration of burning on contact details relay series HRC-2204 and changing patterns of erosion as a function of electrical current strength and number of switching.*

***Electromagnetic relays, electrical erosion, contact material, voltage, current, power, power switching devices.***

**The purpose of research.** The purpose of research is to improving the reliability and reduce a wear resistance of contact - details of electromagnetic relays in electrical agriculture at the expense of material properties contact and parameters of arc (voltage, current and length of operation).

Electro erosion resistance of contact details relay basically determined by the properties of the contact material and parameters of electric arc, voltage, amperage, power and energy. Setting dependencies modes of commutation apparatus at different loads of the electrical circuit is a determining factor of contact details durability.

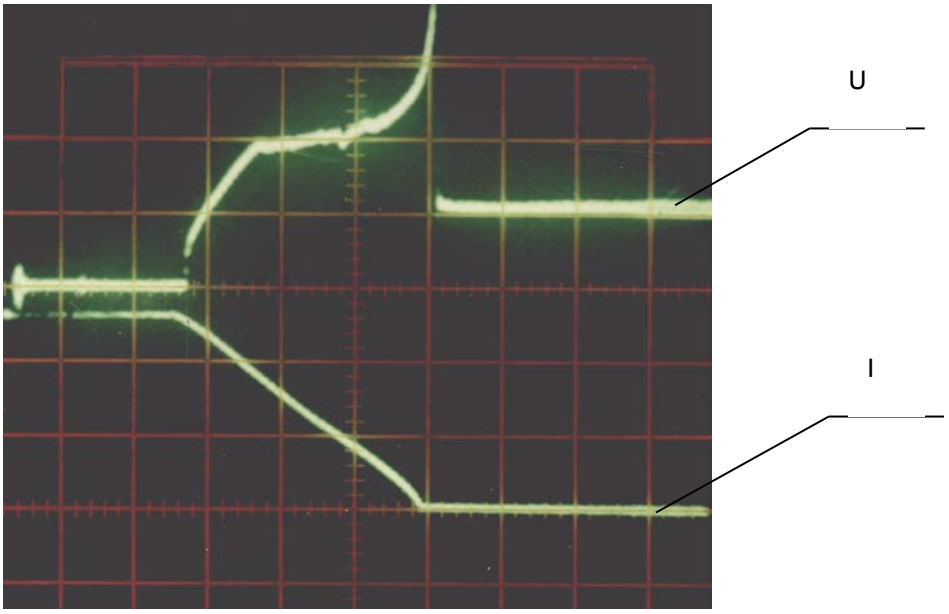
**Materials and research methods.** Known and developed deterministic and probabilistic mathematical and physical models of the contact details of switching devices were used to an establishment of laws changes the electrical resistance of erosion and the transition from electric arc parameters and properties of contact materials.

Experimental investigations were conducted in the laboratory on a special stand with climatic chamber. Analysis of thermal processes on the contact details was conducted by a nonlinear heat conduction problem solving semi-infinite body considering energy expenditure.

**Research processes of occurrence electric arc and duration of her burning on contact details relay series HRC-2204**

Electro erosion stability of contact details relay mainly determined by the properties of the material contacts and arc parameters: voltage, current strength and duration of combustion. As the length of arc burning is the determining factor in the durability of contact details it was held oscillography of arc parameters on the contact details relay type HRC-2204 when an electrical circuit DC disconnecting.

Oscillogram of the arc process appearance and the duration of combustion when closing the circuit with a current value $I$ = 10 A, voltage $U$ = 64V and a time constant $\tau$ = 40ms shown in Pic. 1. To the moment of breaking contact system $t$ = 0 in terms of leaking current $I$ = 10A and the voltage drop at the terminals was $\Delta U_к$= 45V. Since time $t$ = 0, arc resistance Rd increases, the voltage across it $U_д$ - increases and current $I_д$ - decreases straightforward.




Pic.1. Oscillogram of voltage and current in the arc between the relay contact details HRC-2204 electrical circuit DC parameters disconnected: U = 65 B; I = 10 A; L = 240 mH. Arc burning time t = 35 ms.

**Correlation connection of electrical erosion with physicomechanical properties of the contact material**

Tests of metals which are components of composite contact materials used in relays and in switching devices with voltage up to 1000V were carried out for determination the electric erosion due to the physical and mechanical properties of it.

The electric erosion value is determined by testing at a value of current I=10A in dissimilar pairs of silver and copper, and in homogeneous pairs with the same name metals.

Dependencies of the intensity the anode erosion have the same character during testing in a pair with cathodes considered (Ag, Cu). The intensity of the electric erosion anodes $\Delta m_{ai}$ in metals with different physical and mechanical properties varies. Yttrium has the highest intensity of electric erosion. The weight of the silver anode is not reduced, it is increased, and that is a directed transfer of metal from the cathode to the anode. The cathode mass is growing in heterogeneous pairs, where the silver cathode is, which indicates directed transport of material from the anode to the cathode.

The analysis of results investigations showed that among the tested metals are those which have high erosion stability on the anode - nickel, copper, niobium, molybdenum, silver and metals that have erosion resistance at the cathode - titanium, zirconium, niobium, molybdenum, silver. This trend, that there are metals show high erosion stability under any polarity, that is resistant to erosion as on anode as on cathode, is also traced. Silver, molybdenum, niobium belong to them.

So, we can make the following conclusions, through the resulting from research electro erosion resistance, transition resistance contact details, exploring the microstructure of the contact material after testing:

- established that electro erosion stability of contact details from NRF-10 material depends on current strength, arc burning length, the number of switching and physico-mechanical properties of the contact material;

- the electro-microscopic studies of the microstructure detected areas of thermal, mechanical and tedious material destruction.
- melting and intensive evaporation of fusible component with the working surface of the cathode occurs In the process of switching current thus forming a dispersed bumpy surface. The working surface of the anode is covered with finely dispersed particles of silver transferred from the cathode through the gaseous or liquid phase. Spectral analysis of surface layers developments showed that the amount of nickel on the working surface of the cathode is greatly increased, and this is an indication of priorities silver evaporation from the surface of contact details in the process of switching current.
- results of research on the impact of chemically active reagents on the value of environmental transition resistance showed that the maximum allowable concentration of ammonia, hydrogen sulfide, sulfur dioxide, carbon dioxide in the air stock buildings at humidity 95-100% increases the transition resistance of contact details in 5-7 times.

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