UDC 621. 3. 066. 5

Use environmentally safe and eroziyestiykyh composite contact materials to restore the contact details of switching devices

I. Rad'ko, PhD.

The results of studies using the contact details on the basis of silver, low toxic additives tin oxide instead of toxic cadmium oxide, which belongs to the first group of toxicity.

Contact details, switching devices, plasma arc, energy, electrical erosion.

Methods for restoring contact details electrical apparatus used previously did not account features of formation and structure of plasma coatings. Therefore, the actual problem of improving repair switching devices that operate in the agricultural industry, and the environmentally-safe exploitation.

The purpose of research - increasing eco-efficiency and operational reliability of switching devices, using them to repair environmentally safe and eroziyestiyki composite contact materials.

Materials and methods research. Electromechanical devices with contact switching elements make up 90% of the market switching devices due to a significant advantage over devices with semiconductor switching elements (depth switching, overload capacity, low energy loss, resistance to short circuits).

One of the common types of switching devices is contactors and starters, which is a feature of high frequency switching - switching to 1200 per hour.

In magnetic actuators such as PME, ACA, PML, PM-12 used cermet grade KVM contacts, A10m, which incorporates containing cadmium oxide (CdO), through which substantially increases wear contacts.

It should be borne in mind that cadmium oxide, which is toxic ingredient, under the influence of an electric arc that occurs between the contact gap electrical machine

is at a temperature of 900 °C decomposes to cadmium and oxygen, and at a temperature of 1559 °C sublimuye and into the environment [1].

According to the state sanitary rules and norms Ukraine Cadmium and its compounds belong to class 1 toksychnonebezpechnyh substances [2].

The same document states that cadmium oxide may adversely affect the broncho-pulmonary system, skin and subcutaneous tissue, nervous system, metabolism, and hematopoietic system.

According to international standards [3], which regulates the general hygiene requirements for air working area serednozminna maximum allowable concentration of cadmium and its compounds set at 0.01 mg/m3 only twice the maximum permissible concentration of substances such as lead and mercury toxicity are generally known.

United Nations Programme for the Environment, which regulates the use of chemicals, requires governments to take measures to reduce risks to human health and the environment.

In February 2009, the 25th session of the Board of Directors of the Programme and the Global Environment Forum at the ministerial level [4] adopted a strategic approach to international chemicals such as mercury, lead and cadmium.

Thus, the problem of replacing cadmium oxide in switching devices for materials that are not toxic, is certainly important for Ukraine.

Numerous studies [5] scholars in different countries have shown the applicability of electrical contacts instead of cadmium oxide oxides of other metals, among which attracted the attention of researchers tin oxide.

Tracks the number of silver tin oxide (SnO2) 8,10,12% weight in recent years are increasingly being used as contact materials for low-voltage switching devices.

Tin Oxide - non-toxic, increases the hardness of the composite material compared to the CCM-type contacts A10m by location fine particles (SnO_2) in the middle of silver grains.

Thermodynamic properties of tin oxide is much better than cadmium oxide. Thus, the melting temperature (SnO_2) 1900 º C, at which (SnO_2) does not decompose

on the tin and oxygen. Zone melting worktop arc is small, since the boiling point (SnO_2) is 2273 º C.

Metal processing plant INMET Institute of Non-ferrous Metals in Gliwice (Poland) makes contact material silver-tin oxide, which is toxic cadmium oxide is replaced by environmentally friendly tin oxide [6]. However, the working surface of the contact material undergoes significant oxidation during prolonged passage of current. Oxidation of the surface leads to overheating of the material and a significant increase in transition resistance, which reduces the reliability and lifetime of the devices.

The department of electrical machinery and operation of electrical equipment NUBiP Ukraine developed new types of environmentally friendly materials with high durability, which received patents Ukraine.

A safe and environmentally eroziyestiykyy pin composite material with ingredients: 82 wt% Ag + 11,5 wt% SnO_2 + 4 wt% In_2O_3 +2 masZn + 0.5 wt% WO_3 [7]

When switching current and long-term it passes through the closed contacts on the working surface a heat-resistant layer of SnO_2 with high resistivity (ρ = 4•104 ohm •m), leading to overheating and reduce their spark resistance. Preventing the formation of heat stable layer provides input tungsten oxide (WO_3) in an amount of 0.5 wt%. Molten particles WO_3 ($T_{plavl.}$ = 1470 º C) envelop particulate SnO_2 and form voloknystist molten silver where the fibers are particles SnO_2, coated particles WO_3.

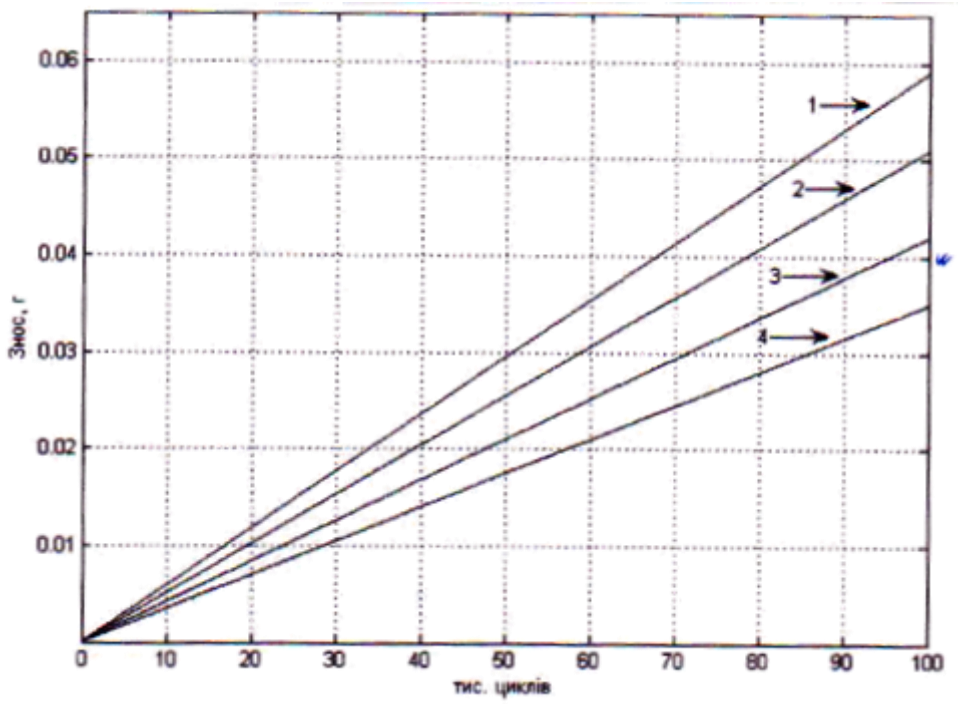
Particles of SnO_2, which are not covered tungsten oxide, pushed up molten silver, where the work surface is created by heat-tin oxide layer with high resistance to current flow.

Introduction Indium oxide (In_2O_3) can evenly distribute fine in a silver tin oxide matrix and accelerate the diffusion of tin in the silver matrix material in the manufacture of contact.

Introduction of zirconium (Zr) increases the stability of Electro contacts by absorbing oxygen from the molten silver under the influence of an electric arc, which reduces the time and arc spraying liquid silver.

The graph shows the dependence of electrical erosion and mass-produced prototypes contact details of the magnetic actuator PML-04b 3121 depending on the number of switching cycles and the number of ingredients.

Switching current was 40 A, voltage 380 V in the category zastosuvannyaAS-3.



Charts electrical erosion and mass-prototypes contact details of the magnetic actuator PML-04b 3121:

1) Serial contact details A10md CCM

2) prototype Ag-11, 5 wt% SnO_2;

3) prototype Ag-11, 5 wt% SnO_2-In_2O_3 4 wt%, 0.5 wt% WO_3;

4) prototype Ag -11,5% by weight SnO_2 - 4 wt% In_2O_3-masZn 2% - 0.5 wt% WO_3.

As can be seen from the graph electrical contact erosion increases linearly depending on the number of switching cycles.

Depreciation serial contact-type CCM A10m 1 • 105 switching cycles is 30 mg.

Depreciation prototype Ag +11,5% by weight of 25 mg, low resistance spark depends on a high resistance between the contact details and overheating.

Depreciation prototype Ag +11,5% by weight SnO_2 + 4 wt% In_2O_3 + 0.5 wt% WO_3 is 18 mg.

High spark resistance is achieved by the introduction of tungsten oxide covering the SnO2 particles and creates voloknystist molten silver. Also the introduction of indium oxide can evenly distribute fine in a silver tin oxide matrix.

Depreciation prototype Ag +11,5% SnO_2 + 4 wt% wt% In_2O_3 2 masZr + 0.5 wt% WO_3 - 35 mg.

Enhancement of electrical stability is achieved by the introduction of zirconium. Zirconium absorbs oxygen from the molten silver under the influence of an electric arc, which reduces the time and arc spraying liquid silver.

Restoration of worn surfaces of the contact details of the new composite materials that are represented by patents of Ukraine № 18931, 47346, 49215 and 93,778 Electro enhanced the resistance of 1.6 - 2.0 times compared with serial type KVM-A10m.

Studies. Use of the material contact parts from silver, low toxic additives tin oxide instead of toxic cadmium oxide belonging to the first group of toxicity increases the level of environmental purity material, and a joint introduction to composite materials such as low-toxic ingredients and indium tin oxide, tungsten and metal zirconium increases Electro stability, reliability and significantly reduces the contact force welding of contacts.

Conclusions

Structure fracture surface of composite materials is closely related to the nature of material components. The optimal structure of the material discontinuous contacts must match the type of matrix structure - electrically matrix based on isolated silver particles and oxides of refractory metals.

Lack of interaction between components of a silver matrix allows properties of each to increase stability of electrical contacts. Therefore, an electric arc is moved from one separately located refractory inclusion tin oxide to another, resulting in dissipation of energy of the arc and reduces the amount of heat energy absorbed by material contact.

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Представлены результаты исследований использования в контакт-деталях на основе серебра малотоксичной добавки оксида олова вместо токсичного оксида кадмия, который относится к первой группе токсичности.

Контакт-детали, коммутационные аппараты, плазма, электрическая дуга, энергия, электрическая эрозия.

The presented results of researches of the use are in pin details on the basis of silver, low-toxic addition of oxide of tin instead of toxic oxide of cadmium, that behaves to the first group of toxicness.

Pin –details, commutation apparatus, plasma , voltaic arc , energy ,electrical erosion.