ASPECTS OF CONDUCTIVE MATERIAL INFLUENCE ON THE CONTACT RESISTANCE OF THE SWITCHGEAR USED IN LOW-VOLTAGE ELECTRICAL INSTALLATIONS

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Abstract: *The paper aims to conduct a case study on the materials used in electrical contacts associated with the switchgear used in installations falling within the low-voltage electrical station configuration.The landmark of the paper was the major influence that has the contact resistance of the switchgear contacts on their reliability and lifetime.*

Key words*: electrical, installations, contacts, materials.*

1.INTRODUCTION

The purpose of this paper is to identify the role of the materials used by the building factories to manufacture electrical contacts for the switchgear and protection used in electrical installations form the electrical station and transformer stations.

Starting from the importance that it has the switching and protection device in assuring the quality parameters of electricity supply of the consumers that occur in various technological flow schemes, it is essential to identify the main causes that can reduce the life of electrical contacts related to those electrical switchgear.

This study can be extended from simple to complex, depending on the breaking capacity of the switchgear,on the consumer category that feeds them (vital, auxiliaries, etc.) and on the supply voltage (low voltage, medium voltage, high voltage). In light of these certain categories of preventive checks, which runs regularly from time to time and which are correlated with verification papers where are mainly recorded the value of contact resistance and the temperature at which measurement made.

The factories that are manufacturing switching and protection devices,are considering that the materials used in making contacts must ensure [1]:

- transient resistance low enough
- be stable against mechanical,
- be stable against corrosion action which is active especially at high temperatures

Because of these actions ,it also occurs low electrical erosion at coupling and uncoupling electrical switches. Depending on the construction of the contact system of switching devices, the materials are divided into three basic groups [1]:

issues,the current regulations provide for

- highly conductive materials which include: gold, silver, copper, etc .;
- materials with high mechanical stability which includes: tungsten, cadmium oxide, copper oxide, etc .;
- cermet materials which include: silver cadmium oxide, silver oxide, copper, silver, nickel, silver-tungsten-nickel, copper-tungsten-nickel.

The materials of the first group provides the lowest contact transient resistance. At long current movement ,the most suitable contacts are gold, platinum, iridium, osmium and other alloys [1-3]. Due to the high price, they are used in cases where technical and economic calculations design and dimensioning of electrical installations require it.

Among the materials specified in the second group, copper is the material used in making electrical contacts associated to the switchgear, mainly due to the relatively low cost price. Copper contacts disadvantage is the relatively rapid oxidation even at normal value sense of the environment temperature where are fitted. At this oxidation is typically that the copper oxides are spread at a temperature higher than that of pure copper. In order to fulfill their duties in this situation, copper contacts are covered with silver, gold and other components [1-3].

Silver is more stable to chemical action of a material which is widely used independently or as a coating layer applied to another base material. Silver oxides are converted at high temperatures and decomposes at temperatures around 200^0 C [1-3].

Their contact resistance is accepted practically unchanged. In the presence of the combination with sulfur from the surrounding area, on the surface of silver are deposited sulfides which must be removed through engineering and operating measures . The materials of the second group are used in the case of contacts loaded with high mechanical loads and intensive electrical arcing , characteristic to power switches [1-3].

Ceramic materials according to the supported components, have good quality with respect to the first two groups. In the presence of silver, ceramic materials have stability characteristics of contact transitional resistance and the oxides fill the required strength.The contacts with additions of silver-cadmium oxide and silver deposits in the form of ribbon are shown in Figure 1. b [1-3].

2. Electrical Contacts. Forms of contact systems

Electrical contacts are made by touching the conductive parts of current, by which it becomes possible passage of electric current.In mechanical drives,the circuit continuity and separation (interruption) becomes possible by varying the mutual position of the contacts.

According to the construction, contact connections can be [1-3] .:

- immovable. They have the same working condition - are assembled resistant by: screws, rivets, pins, studs - figure 1 a;
- sliding contacts where there is the possibility of moving from one contact to another by sliding or rolling (overturning). It is made of metal in solid and fluid (figure 1b);
- switch contacts, which performs the action "connect" and "disconnect" electrical circuits connected to them through movement contacts, figure 1 c, d.

The switching contacts systems (figure 1.c, d) consists of the following basic parts [1-3]:

- contact bodies (1);
- rod displacement contact (2);
- contact springs (3), current conductors details (4);

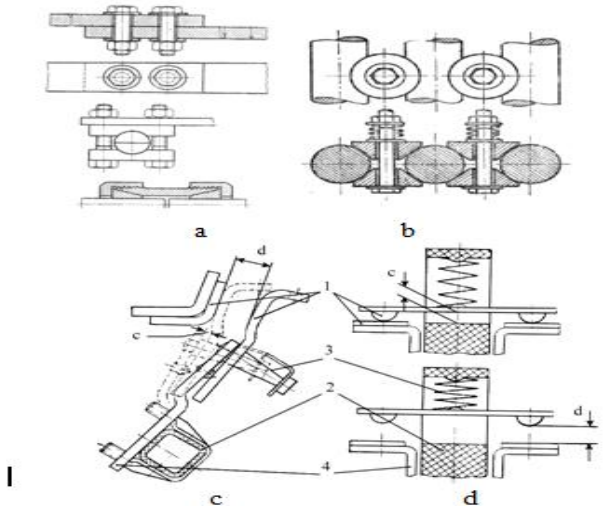


Figure1 Contact systems forms: a) with immovable contact ; b) with sliding contact; c) with a break contact; d)with two break contacts.

Contact systems can be with a interrupt contact of a current path (c) and with two interrupt contacts of two current paths (d). The distance between the contacts in open state is called opening (p) .The race (c) is the distance that the movable contact travels, unless exist building opposite contact (face to face).

Reaching the the two parts of the contact junction can be carried out by three processes (Figure 2) [1-3]:

- point contact;
- linear contact;

surface contact

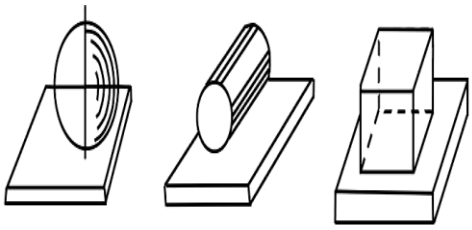


Figure 2. Methods of achieving the two sides that made contact

3.INFLUENCE OF CONDUCTIVE MATERIALS USED IN CONSTRUCTION OF ELECTRICAL CONTACTS RELATED WITH SWITCHGEAR ON CONTACT RESISTANCE

A vital parameter in prophylactic monitoring of switchgear reliability is the contact resistance, established on contact system. Framing this sizes within phase is a prerequisite for switchgear to ensure quality parameters of the electricity supply of the consumers which serves throughout its lifetime.

Contact resistance is actually, the transient resistance in the electrical contact, determined by the following [1-5]:

- materials from which the contact bodies are made of (mobile and fixed),
- contact system construction,
- contacts shape,
- size and surface condition

the factory building stablit from the design

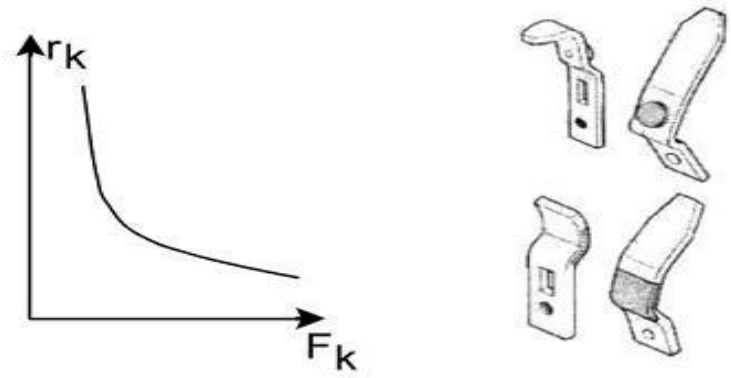
The basic factor that determines the size of transient contact resistance rK, is FK, the force that acts on the moving contact.

This force directly influence and determine the value of contact resistance, because it generates the necessary pressure for proper closing of the contacts.

of contacts.

Figure 3 illustrates the relationship between the pressure (force) of contact and contact resistance rK = f (FK) as [1-5]:

$$r_k = K / F_k^m \quad (1)$$



a b

Figure 3. a) the transitional contact resistance dependence of the pressure force FK which is acting on the moving contact: rK = f (FK); b) different contact clamps with additions of silver and cadmium oxide and silver deposits in the form of ribbon [1-5].

where:

K - feature material contacts.

m - coefficient whose value depends on the embodiment of the contact and from the data, it was established that it has values between 0.5-1 (for point contacts m = 0.5, for linear contacts m = 0.7; for contact surface m = 1).

4.CONCLUSIONS

Reducing the transitional resistance is obtained by the suitable choice of the contact bodies materials.The important condition for achieving this goal is the inclusion of systems contacts in constructions, which can surface self-cleaning of switching contacts.

This process removes the dirt from the dust, grease, moisture, or the sulfides or oxides of the coating to the contact surfaces.

Increasing the value of contact resistance over the allowable limit values seted by building factories or governed by technical standards of operation and protection switchgears has as directly effect [1-5]:

- heating contact bodies (mobile

Heating contact bodies influences the conductivity of the material contacts, increases contact resistance rK, creates melting conditions for parts of material bodies and increases the wear of material contact bodies.

In some cases, in particular to rare switching, decreases rK and the vibration of the contact system follows the welding of the contact bodies [1-5].

Wear bodies can be mechanical and electrical and it results after the process of switching and affects switchgears. The release is accompanied by the occurrence of arcing between the separated contacts.

The material of the contact bodies are oxidized, evaporated to intense discharge and

and fixed contacts),
- wearing contact bodies.

In relation to those mentioned is obvious that to ensure quality parameters of electric energy to terminal consumers, one of the conditions is to ensure reliability of switchgear by maintaining the contact resistance in the predetermined limits since the design stage of the equipment.

Checking contact resistance by maintenance personnel, is the desideratum makers from the hierarchical steps operative management of power stations of the National Energy System. These checks are implemented mainly in power plants that are made up of electric power groups of 330 MW unit [5-8].

These electroenergetic groups have in the configuration process of technological flow diagram for the production of electricity, all categories of consumers, which is why their operating instructions related to the general rules of operation of power stations and require an ongoing monitoring switchgear status contacts through reference parameter-contact resistance.

Contact resistance value shall be determined by V-A in continuous current, and the values obtained are reported in checking forms with deadline at certain predetermined time intervals, thereby evaluating evolution in time of this parameter [5-8].

disperse in the surrounding space. This reduces wear stability switching device.

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