REPAIR OF THE ACTIVE PART OF ELECTRICAL MACHINES

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ABSTRACT

Today, the most widely used type of machinery in industrial enterprises are electric machines. Therefore, their repair is urgent. This paper provides analytical information on the types of repair of active parts of asynchronous motors.

Keywords: core seat, ring, AC motors, stator, rotor, winding, deterioration

Introduction

During the operation of an electrical machine, wear, loosening of fastening and a change in the shape of its individual parts occur. Some parts, even while maintaining their shape and size, lose their performance as a result of loss of elasticity. All this leads to a deterioration in the energy and operational performance of the machine and requires its repair.

Characteristic damage to stator cores (rotors) are: weakening of the fit of the cores in the housing (on the shaft), their shift in the axial direction, fluffing of the outer sheets, weakening of the pressing, insulation failure between the sheets, burnout or melting of individual sections and wear of the inner (outer) surface .

Materials and methods

Repair when the core seat is loose. First , the stator core is inspected and the condition of the stops and the annular keyways in which they are installed is checked. Install the core in place according to the factory design and fix it with new stoppers or ring keys, and the holes for the stoppers are drilled in a new place. When the fit of the rotor core is loosened, it is pressed out from the shaft, the shaft is repaired or replaced with a new one, and the rotor core is reinstalled.

Repair when fluffing the outer sheets of the core. To eliminate this defect , *in low-power machines*, inclined grooves in the teeth are sawn with a hacksaw blade (their dimensions are shown in Fig. 1, *a)* and these grooves are welded by electric arc welding (0MM5 electrode with a diameter of 2 mm). During welding, fluffed teeth *4 are* compressed by a segment or ring *3* with the help of pins *2* passed through the grooves. Welds are sawn together with the core to the required size. Fluffy teeth can also be glued together by smearing with varnish and pulling with a ring and hairpins until the varnish is completely dry. *For higher power machines* with relatively high teeth, these repair methods are not used, since they do not provide strong and reliable fastening of the teeth and create closed circuits for the flow of eddy currents. In this case, we can recommend installing an additional washer 5 with teeth (pins) 6, as shown in Figure 1,b , or installing separate pressure fingers 6 between the core 4 and the pressure washer 7, as shown in Fig. 1, *c*. Such a repair is possible when the core is pressed out and its partial or complete reshuffling .

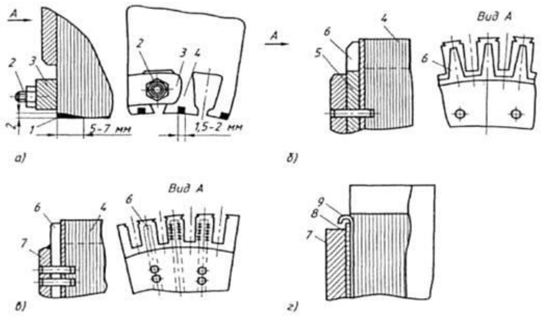


Figure 1 - Sketches of repaired cores using welding (*a)*, additional pressure washers with teeth *(b)*, separate pressure fingers *(c)* and wedges (d):

1 - welded seam; *2* - hairpin; *3* - ring; *4* - teeth; 5 - washer; *b* - pressure fingers; 7— pressure washer; *8* - textolite wedge; 9 - extreme sheet of the core

Repair when the core pressing is loosened. With a general weakening of the pressing of cores of small diameter between the pressure washer 7 and the outer sheets of the core, textolite wedges *8* (Fig. 1, d) are hammered every 2 ... 4 teeth , ensuring normal pressing of the core. To determine the required thickness of the wedge, the core can be preliminarily pressed at a pressure of 1 MPa. The width of the wedge must not exceed the width of the tooth. To protect the wedge from falling out, it is smeared with adhesive varnish before installation and the outermost sheet *9* of the core is bent. In case of local weakening of the pressing of the stator core (defect or loss of the ventilation strut), the damaged strut is straightened, and instead of the dropped one, a textolite wedge is hammered in, bending the extreme sheets of the core onto it from both sides.

When the pressing *of the cores of large electrical* *machines is weakened*, in which the pressing is carried out by tie rods, the studs are tightened. To do this, remove the welds, the locking nuts of the tie rods from self-unscrewing , tighten four nuts located at diametrically opposite points, and tighten the pressure flange, wrapping the remaining nuts in several bypasses. At the end of the tightening, the welds are restored.

If the nuts cannot be tightened or the tightening fails to restore the pressing of the core, the pressing is restored by driving wedges made of fiberglass STEF -1 brand into the tooth zone. The surfaces for driving the wedges are degreased with B-70 gasoline and dried, the contact surfaces of the segments and wedges are coated with BT-99 varnish or EL-4 epoxy adhesive varnish. After installing the wedges for complete polymerization, drying is carried out at a temperature of 2 O ... 25 ° C for 10 ... 12 hours.

Repair in case of violation of intersheet isolation. If there is a violation at a small depth of the lacquer coating of individual segments adjacent to the installation site of the wedges, then before driving the wedge between the segments, insert mica gaskets on BT-99 lacquer to a depth of 20 ... 35 mm. Local violations of intersheet insulation on the stator surface are eliminated by installing mica petals between the segments or by insulating the segments with BT-99 liquid varnish. To do this, the segments are bred with specially sharpened narrow and thin steel strips of the required length.

Large areas of damage are eliminated by etching in concentrated nitric acid. The magnetizing and control windings are wound on the stator and, by passing a current through the magnetizing winding, the place of increased heating is determined, which indicates damage to the insulation. They protect the surface surrounding the damage site with putty and chemically resistant enamel, heat the damaged area to 75 ... 105 ° C using a magnetizing winding and, turning off the current, pickle the damaged area with concentrated nitric acid. After the etching is completed, the acid residues are neutralized by 4-5-fold treatment with napkins moistened with a 10% solution of soda ash, and the repaired area is washed with hot distilled water (40-60°C). Then wipe it with napkins and rinse with alcohol.

Repair in case of burnout of the core tooth section. When the core tooth section burns out or melts, the defective part is removed and a “prosthesis” *1* made of fiberglass is installed in its place to prevent winding buckling, as shown in Fig. 2. Removal of the damaged area is carried **out** using a sharp chisel with its possible pre-drilling, after which the sheet closures are eliminated. The "prosthesis" is made locally and installed on EL-4 glue.

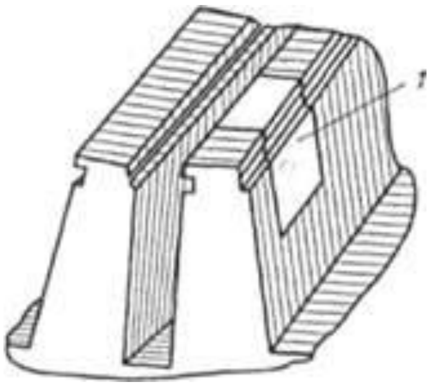


Figure 2 - Sketch of a core tooth with an insert

Most often, the cases of electrical machines have the following damage: breaking off of a paw at a cast-iron bed, wear or tear of threaded holes, wear of seats under shields, and cracks. Bearing shields are characterized by wear of the seating surfaces and cracks.

Repair of seating surfaces in cast iron housings and bearing shields . Seizures and dents are corrected by grinding if the total area of damage does not exceed 4% of the seating surface for the bearing and 15% of the seating surface of the locks. Grinding is done with a velvet file or sanding paper slightly moistened with machine oil. In case of severe damage, repairs are carried out by welding metal, pressing the bushing, applying sealant and other methods.

Before surfacing, the parts are heated in a furnace to 300...400°C. For melting, it is produced with a grade B cast-iron electrode and a gas burner, using borax or one of three mixtures as a flux, the percentage of which is indicated below.

Bura, %.. .... 56 23
Sodium carbonate, %................................. 22 27 50
Potassium carbonate, % .... 22 - -
Sodium nitrate, %............... - 50 -
Sodium bicarbonate, % .... - - 50

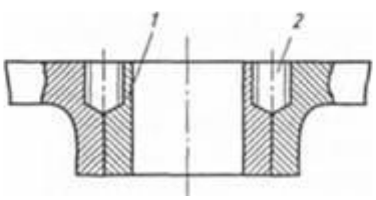
After surfacing, the parts are subjected to annealing in a furnace at a temperature of 300...400 "C for 4...6 hours and slow cooling in a switched off furnace for 12...16 hours.

In the shield, the seating surface for the bearing is restored by pressing the bushing. The socket is preliminarily machined up to the bearing and a bushing 6 ... 10 mm thick is used. In this case, the wall thickness on the shield must be at least 10 mm. The groove of the shield and the manufacture of the sleeve are made according to the dimensions and tolerances that ensure an interference fit. Pressing is carried out with heating. The sleeve 1 (Fig. 3) is fixed in the shield with two diametrically located stoppers *2.* The drilling depth for the stopper must be at least two stopper diameters.

If the wear of the seating surfaces is not more than 0.2 mm in the shields and on the shafts, it is eliminated by applying sealant 6F, which is available in the form of yellow sheets up to 5 mm thick. This material is resistant to water, alkalis and oils, but is soluble in acetone, toluene, benzene and ethyl butyl acetate. It has good adhesion to steel, cast iron, aluminum and copper alloys. To prepare the solution, the sealant is cut into small pieces and placed in a container with a solvent for 24 hours. The container is tightly closed and periodically shaken. The viscosity of the prepared solution should be within 33 ... 34 s according to the VZ-4 viscometer. The shelf life of the solution in a tightly closed container and in a shaded place is 2 ... 3 years.

Discussion

Crack welding may be used only in cases where it will not cause changes in the shape of the seating surfaces . Holes are pre- drilled at a distance of 8 ... 10 mm from the ends of the crack with a drill with a diameter of 6 ... 8 mm to the depth of the crack. Then the crack is cut for welding with an angle of at least 70 ° and the edges are blunted. The surfaces adjacent to the place of welding are cleaned to a metallic sheen with an abrasive wheel or a metal brush. Welding is carried out by electric welding with direct current of reverse polarity with a power of 45 ... 60 A per 1 mm of diameter, depending on the electrode.



As a filler material, copper rods with a diameter of 3 ... 6 mm are used with a shell of sheet metal 0.3 mm thick with a thin chalk coating. When welding, flux is used (borax - 50%, iron filings - 25%, iron scale - 25%). Welding is carried out in short sections of no more than 40 mm, avoiding overheating of the base material. Copper pads are used for heat dissipation. Each section immediately after welding is tapped with a hammer weighing 500 g. The seams are cleaned from slag with a metal brush

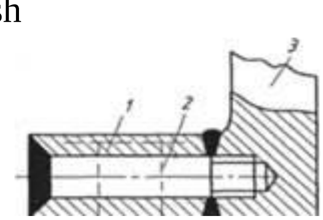


Figure 3-Sketch of the repaired seating surface of the bearing shield.

Restoration of broken paws of the body. The edges of the mating parts are cut at an angle of 30 ^{e} on both sides to a depth of at least 1/4 of the thickness. Make 2 - 3 screws *2* from a steel bar with a diameter of at least 1/2 of the thickness of the part. Mark and drill broken *1* and main *3* parts and cutting

thread in the main part. Wrap the screws *2* into the main Figure 2 - Sketch detail *3* and put the broken part on them. The broken-off part *1 is welded by gas welding of the restored paw of the body* by cutting, adhering to the technology considered at the beginning of this paragraph. The seams are cleaned with a steel brush. Mark and drill holes in the paw.

The developed keyway is restored by electric arc surfacing followed by machining. If the keyways are damaged in the shaft and in

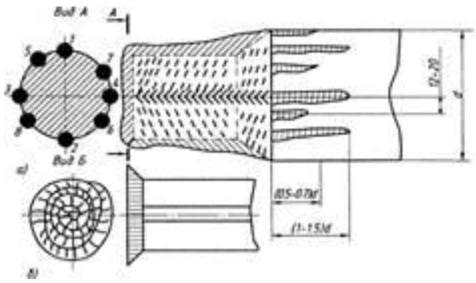


Figure 4 - Sketches of shafts, in which the seating surface (a) and the end *(b)* were restored by electric arc surfacing .

core, then you should make the keyways larger and install a new key. If one keyway is damaged, then it is milled to a larger size and a stepped key is installed or a new keyway is milled with its displacement relative to the old one by a quarter of a circle. The choice of repair method depends on the capabilities of the repair shop.

Correction of the curvature of the shaft is carried out as follows (Fig. 5). Slowly turning the rotor *3* in the centers or prisms on the arrow indicator *2* determine the curvature of the shaft. Editing is carried out with a curvature of more than 0.02 of its length without dismantling the core and slip rings.

Conclusion

To do this, rotor *3* is mounted on prismatic supports *1 and press 4 is* applied in the place of maximum bending . If this place is outside the core, then the support on the opposite side is placed as close as possible to the core, and on the side of the curved part, as close as possible to the end of the shaft. It is difficult to determine the pressing force of the press by calculation, therefore, the editing is carried out in several steps, each time measuring the amount of deflection with indicator *2* and selecting the force for the next step. Editing is stopped when the bending values are less than 0.04...0.05 mm.

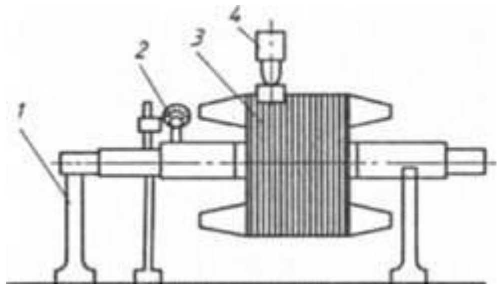


Figure 5 - Shaft curvature correction scheme. 1 - prismatic supports; 2-indicator; 3-rotor; 4-press.

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