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(54) HEATING COILED COMPONENTS OF ROTATABLE ELECTRICAL MACHINERY

(71) We, AYORDEV PROCESSES LIMITED, a British Company, of Prestons Road, Poplar, London, E.14, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method of treating a coiled component of rotatable electrical machinery.

When the electrical insulation resistance of the windings of rotatable electrical machinery is impaired by adverse conditions, it is frequently necessary to rewind the defective parts. This is particularly demonstrated by, for instance, electrical machinery in sunken ships in which the penetration of salt water into the insulation structure has resulted in the complete loss of any significantly measurable electrical insulation resistance.

A primary object of this invention is the provision of a method of treating a coiled component of rotatable electrical machinery in a reliable and satisfactory manner and without the need to rewind any defective part.

According to the present invention, we provide a method of treating a coiled component of rotatable electrical machinery which includes impregnating the windings of the component with an electrically-insulating varnish by immersion of the windings in the varnish at such a rate that air does not become entrained in the windings, removing the component from the varnish and allowing it to drain to remove surplus varnish, and drying and curing the varnished component using the stoving oven disclosed and claimed in our co-pending Application No. 45284/63 (Serial No. 1,237,263). Preferably, the temperature of the air circulating in the said oven is controlled at 150 to 250°C. It is desirable that the component should be introduced into the oven at a controlled rate such that volatilisation of the varnish solvent(s) occurs

without ebullition to avoid any internal or external blistering. Generally the component will remain in the oven until substantially complete stabilisation has been achieved, as indicated by metering the following parameters:—

- (i) Temperature within the body of the component—measured by means of one or more thermocouples inserted in the coil windings.
- (ii) Electrical insulation resistance—measured by means of a megohmmeter, e.g. one capable of measuring tens to hundreds of megohms.
- (iii) Capacitance and loss factor (Tan δ)—measured by means of a capacity bridge connected between the coil windings and a supporting member, e.g. an outer shell or a coil former.

Preferably at least one and most desirably at least two of the said parameters (i), (ii) and (iii) are continuously or intermittently metered during the stoving process.

The resultant cured, varnished component may then be removed from the oven, allowed to cool and, where appropriate, restored to its operative position in the rotatable electrical machinery.

A coiled component of rotatable electrical machinery impregnated by the method of this invention may be a newly wound component. The benefits from such a treatment have been found to accrue from the following factors:—

- (a) On occasions in the manufacture of electrically insulated wire the electrically-insulating varnish thereon may not have been cured to a state of sufficient resistivity.
- (b) During the handling of such wire in the coil winding stage, the electrical insulation may have suffered damage.

A coiled component of rotating electrical machinery impregnated by the method of this invention may also be one which has been previously treated with a cleaning composition, for example an unmodified sol-

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vent or detergent-containing solvent media may be used. However, for this preliminary treatment we recommend the use of the cleaning composition disclosed and claimed in our co-pending Application No. 38797/68 (Serial No. 1,195,796. Also the method for applying the said cleaning composition as disclosed and claimed in our Application No. 38797/68 (Serial No. 1,195,796) may with advantage be that disclosed and claimed in our co-pending Application No. 47626/68 (Serial No. 1,237,264). The solvent(s) of the cleaning composition after application to the said component may be volatilised by heat or by blowing with live steam, the condensate from which contributes to the flushing out, for example, of salts, loose varnish film particles and flakes. Should steam have in fact been employed in this preliminary procedure any condensed moisture needs to be removed by a drying operation, preferably utilising the oven disclosed in our co-pending Application No. 45284/68 (Serial No. 1,237,263). The treatment with live steam is particularly advantageous in those circumstances where the electrical machinery has been intensively exposed to adverse conditions, for example, complete submersion in sea water. Steam treatment will not normally be necessary if the electrical machinery has not been severely damaged by sea water.

EXAMPLE

A 220 volt, 75 Kw. direct current armature weighing 5 cwt. was removed from a sunken dredger after immersion for five days. The windings thereon were found to have no measurable electrical insulation resistance and were heavily contaminated with sea water and with oil. After removing the bulk of the sea water by hosing with fresh water, the armature was treated as follows:

I. It was sprayed with the following cleaning composition:—

45	Dioleate salt of N-stearyl- n - propylene - 1,3-diam ine (marketed under the Trade Name "Duomeen TDO")	22 parts by weight.
50	Methyl salicylate ...	15 parts by weight.
	White Spirit	250 parts by weight.
	Dipentene	75 parts by weight.

The spraying was continued until the dirt, oil and carbon deposits had been substantially removed and its electrical insulation resistance had reached a value of 200 megohms at 500 volts.

II. The sprayed armature was hosed with live steam issuing from a boiler at a pressure of 80 lbs. per sq. in.

III. The hosed armature was raised by a winch and chain into the oven disclosed in our co-pending Application No. 45284/68 (Serial No. 1,237,263) through which air was circulating at a temperature of 200°C and was maintained in the oven under these conditions for two hours, during which time the electrical insulation resistance rose to a steady value of 5 megohms at 500 volts at an internal temperature.

IV. The armature was removed from the oven and allowed to cool to ambient temperature, when the electrical insulation resistance rose to 100 megohms at 500 volts.

V. The cooled armature was immersed at a rate of half an inch per minute in an electrically-insulating varnish based upon a blown linseed oil modified tung oil glycerylphthalate alkyd containing a cobalt naphthenate drier and allowed to remain completely immersed therein for 30 minutes, after which time it was withdrawn and allowed to drain for 30 minutes.

VI. The varnished armature was then raised, at a rate of half an inch per minute, into the oven used in stage II after having made the following electrical connections:

- (i) insertion of a thermocouple in the coil windings;
- (ii) insertion of a megometer probe;
- (iii) insertion of a capacity bridge between the coil windings and the armature core.

The leads from these metering devices passed through the open base of the oven to recording instruments located adjacent to the oven. With the air temperature of the oven at 200°C the internal sections of the coil windings attained a temperature of 135°C after 120 minutes. The electrical insulation resistance progressively increased to a value of 6 megohms at 500 volts at 135°C over a period of two hours, likewise the capacitance increased to 0.28 mFd and the Loss Factor (Tan δ) became constant at 0.02 during this period.

VII. The cured armature was removed from the oven and allowed to cool. The electrical insulation resistance then increased to 200 megohms at 500 volts and this value was maintained after re-installation of the armature in the dredger and when put into operation.

WHAT WE CLAIM IS:—

1. A method of treating a coiled component of rotatable electrical machinery which includes impregnating the windings of the component with an electrically-insulating varnish by immersion of the windings in the varnish at such a rate that air does not become entrained in the windings, removing the component from the varnish and allowing it to drain to remove the surplus varnish, and drying and curing the varnished component using the stoving oven disclosed and claimed in co-pending Application No. 45284/68 (Serial No. 1,237,263).
2. Method according to Claim 1, wherein the temperature of the air circulating in the oven is controlled at 150 to 250°C.
3. Method according to Claim 1 or Claim 2, wherein the component is introduced into the oven at a controlled rate such that volatilisation of the varnish solvent(s) occurs without ebullition to avoid any internal or external blistering.
4. Method according to any preceding Claim, wherein the coiled component has

previously been treated with a cleaning composition.

5. Method according to Claim 4, wherein the cleaning composition is that disclosed and claimed in co-pending Application No. 38797/68 (Serial No. 1,195,796).

6. Method according to Claim 4 or Claim 5, wherein the solvent(s) of the cleaning composition after application to the said component is/are volatilised by heat or by blowing with live steam.

7. Method according to Claim 6, wherein the said solvent(s) is/are volatilised by blowing with live steam and any condensed moisture is removed by drying in the said stoving oven.

8. A method according to Claim 1, substantially as hereinbefore described.

9. A coiled component of rotatable electrical machinery when treated by the method claimed in any preceding Claim.

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