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UNITED STATES PATENT OFFICE

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INSULATING MATERIAL

No Drawing. Application filed August 30, 1928. Serial No. 303,119.

My invention relates to an improved insulating material and more particularly to the outer layer of insulating material that is applied to the coils of high-voltage alternating-current generators and turbo-alternators.

An object of my invention is to provide an outer insulation for electrical conductors that is slightly conductive so that corona will not develop between the insulation and other conductors adjacent thereto.

Another object of my invention is to provide an outer layer of insulating material for turbo coils that is slightly conductive so that the potential gradient between the coils and the iron parts of the machine will be below the critical value at which corona is developed.

Another object of my invention is to provide an outer layer for the insulating material of turbo-coils that has a slight conductivity which is permanent and is not affected within the temperature range at which the electrical machinery is operated.

A still further object of my invention is to provide an outer layer of insulating tape for the coils of turbo-generators which consists essentially of a fibrous insulating material, such as asbestos tape, impregnated with an organic phosphate.

It has heretofore been the practice to insulate the conductors of high-power turbo-alternators with mica-folium, bound together with shellac, or, preferably, with the improved bonding material described in the co-pending application of George F. Hadley, Serial No. 212,363, filed August 11, 1927, and assigned to the Westinghouse Electric & Manufacturing Company.

In accordance with previous practice, the mica-folium was wrapped around the conductor and reinforced by asbestos tape. When turbo coils are insulated in this manner, however, considerable difficulty is experienced because corona develops and causes deterioration of the insulation.

Although asbestos tape is slightly conductive at room temperature, the resistance increases rapidly with increase of temperature until, at a temperature of from 90° to 100° C., it becomes practically non-conducting and is unsatisfactory as the reinforcing layer for the insulated coils of turbo alternators because there is too high a potential gradient between the asbestos-coated insulation and the iron parts of the machine to prevent the development of corona.

I have made the discovery that, when asbestos tape is impregnated with an organic phosphate, such as tricresyl phosphate, a slightly conductive reinforcing material for the insulated coils of the turbo-alternators will be produced that is not affected by the ordinary temperature changes to which such tape is subjected during the operation of the alternator. Although I prefer to employ tricresyl phosphate, other organic phosphates have been found suitable, such as methyl, ethyl, phenyl or naphthyl phosphates. In general, organic phosphates having a boiling point above 150° C. have been found satisfactory for my purpose.

It has sometimes been found desirable to first subject the asbestos tape to a baking operation to remove any organic material that may have been added during the manufacture of the tape to improve its mechanical properties. The organic material is objectionable because, at the operating temperature of the machine, obnoxious vapors are liberated, the organic material carbonizes and electrical break-downs are sometimes caused on account of the deterioration of the insulation, while, at lower temperatures, such material absorbs moisture from the air which increases the conductivity.

The baking operation may be performed in an oven that is capable of being heated to from 300° to 400° C., the layers of tape being so arranged that the air can circulate about them. The temperature is raised, during the first half hour, to approximately 300° C. and is maintained at this temperature for from 3 to 4 hours.

While the baking temperature may vary considerably, it is essential that it should not exceed 400° C. because such high temperatures have the tendency to impair the strength of the tape.

After the organic material has been re-

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moved by the baking operation, the tape is immersed in the impregnating substance until it has become saturated, and, after being drained, is wrapped around the insulated coils or other conductors of turbo-alternators in the usual manner. If desired, however, the asbestos tape may be first wrapped around the insulated coils and impregnated with a solution of the tricresyl phosphate in a volatile thinner, such as benzene. When the impregnating substance employed is in the solid state; for instance, when triphenyl phosphate is utilized, it may either be dissolved in a volatile thinner or heated until it becomes liquid and the tape immersed in the liquefied material.

Asbestos tape ¾ of an inch in width, treated in the manner specified, was impregnated with tricresyl phosphate, and baked in air for about 12 days. At a temperature of 90° C., it had a resistance of 1300 megohms per inch of length, while, after standing 24 hours in air at room temperature, the resistance was 1000 megohms per inch. Untreated asbestos tape increases in resistance hundreds to thousands of times upon being heated from room temperature to 90° to 125° C., becoming practically non-conducting at the higher temperatures. When cooled, untreated asbestos tape has the tendency to absorb moisture from the air which causes it to again become conducting. The tricresyl phosphate renders the fibrous material non-hygroscopic and may even cause a slight decrease in resistivity at elevated temperature. The organic phosphates also act as plasticizers, rendering the asbestos tape soft and pliable after heating, say at temperatures ranging from 100° to 300° C., so that it may be readily applied to the coils.

While I have described a preferred form of my invention, it will be understood that various modifications thereof may be made without departing from the spirit of my invention. For example, if the asbestos is high in iron and low in organic matter, it may be possible to eliminate the baking operation and impregnate the tape directly with the organic phosphate. In order to obtain the best result, however, the organic material should be removed.

It will also be understood that, while I have described the use of the organic phosphates as being especially suitable for increasing the conductivity of asbestos tape, they may also be employed for increasing the conductivity of other insulating material, such as linen or cotton tape or insulating papers, when such material is utilized in electrical apparatus where the formation of corona is objectionable.

Other modifications of my invention will become apparent to those skilled in the art. I desire, therefore, that only such limitations shall be placed upon my invention as are imposed by the prior art and the appended claims.

I claim as my invention:

1. An insulating material comprising asbestos impregnated with an organic ester of phosphoric acid.

2. An insulating material comprising asbestos tape impregnated with an aryl ester of phosphoric acid.

3. An insulating material comprising asbestos tape impregnated with an organic phosphate that is non-volatile at ordinary temperatures, the insulating material having a slight conductivity when the insulation is subjected to the ordinary operating temperatures of alternating-current generators.

4. An insulating material comprising asbestos tape impregnated with an organic phosphate having a boiling point above 150°, the insulation being slightly conductive at temperatures ranging from room temperature to 125° C.

5. An insulating material comprising asbestos impregnated with an organic phosphate.

6. An insulating material comprising asbestos tape impregnated with tricresyl phosphate.

7. An insulating material comprising asbestos tape impregnated with tricresyl phosphate, the insulating material being slightly conductive at temperatures ranging from room temperature to 125° C.

8. The method of making an insulating material which comprises subjecting asbestos tape to a baking operation to remove any carbonaceous material and then impregnating the asbestos tape with an organic phosphate.

9. The method of making an insulating material which comprises subjecting asbestos to a baking operation to remove any organic material and then impregnating the asbestos with tricresyl phosphate.

10. The method of making an insulating material which comprises subjecting asbestos tape to a baking operation at a sufficient high temperature and for a sufficient length of time to remove any carbonaceous material, and then impregnating the tape with tricresyl phosphate.

In testimony whereof, I have hereunto subscribed my name this 22nd day of August 1928.

CHARLES A. STYER.