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(71) We, CARL FREUDENBERG, a German Company (a Kommanditgesellschaft, the present personally responsible partners of which are Helmut Fabricius, Hans Erich Freudenberg, Otto Schildhauer, Hermann Freudenberg, Dieter Freudenberg, and Reinhart Freudenberg) of 6940 Weinheim Bergstrasse, Hohnerweg 2, West Germany, 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 multi-layer insulating materials comprising a mica paper layer.

Mica papers are used in the electrical insulation of high-tension power units. However, known mica papers have very low mechanical strength, and various solutions have been proposed for dealing with this problem.

One solution provides mica paper on, or backed with, paper or a non-woven or woven fabric as a support material. These materials are usually also used to cover the mica paper web or sheet, so that a three-layer product is made, with two layers of the same or different support materials. The layers are generally bonded together with a suitable liquid resin e.g. an epoxy resin. The resin can be applied by using a doctor blade or by impregnation, spraying or sprinkling, but the whole process is complicated, involving intermediate drying stages and more than one application of the resin. A further disadvantage of this procedure is that it allows only a low production rate. In addition, there is no defined distribution of the resin, so that areas with a large amount of adhesive are often produced, making it difficult, subsequently, to achieve thorough impregnation of the wound mica paper strip.

According to the present invention, an insulator is manufactured by a process comprising applying a discontinuous coating of a thermally activatable coating composition to a support layer, drying the composition onto the support layer without curing the composition, and laminating one such layer onto each side of a mica paper layer. The composition can be cured later, e.g. when the insulator is in position for use.

An insulator of the invention comprises a mica paper layer sandwiched between two support layers which are each bonded to the mica paper layer with a discontinuous layer of a thermally curable composition.

Suitable materials for the support layer comprise non-woven fabrics which will usually have a weight per unit area of from 5 to 100, preferably from 10 to 50, e.g. 20 to 30, g/m^3. The thermosetting coating composition, e.g. an epoxy resin-based coating, is discontinuously applied to the material. The discontinuous layer may be applied by spraying or scattering to give a wholly random arrangement of the composition although the application is preferably by printing to give a regular geometrical pattern of the composition. The geometrical pattern may be the same or different for each support layer, i.e. on each side of the mica paper layer in the product. The pattern may be, for example, of strips or dots or any desired shape such as squares, triangles, rhombi or circles. The printing may be regular to give a recognisable pattern or the resulting arrangement of dots may comprise repeating areas in each of which the dots are randomly arranged, for example as is described and claimed in British Patent Specification No. 1,420,261, where suitable substrates and adhesives are also described.

After application, the coated fabric is passed through a drier to evaporate the water or other solvent from the composition and thus to pre-cross-link the resin. One such coated and dried fabric is then laid on

each side of a mica paper and the resultant trilayer is laminated, preferably using pressure as well as heat. A heated calender is particularly suitable, the temperature for lamination being 60° to 170°C. and preferably from 110° to 140°C.

We find that the preferred insulator of the invention is strong and has good winding or wrapping characteristics, owing to the geometrical distribution of the bonding agent.

It is often desirable to mix a hardening agent with the coating composition before application, but in any case care should of course be taken that the drying or sintering temperature is so chosen that the coating does indeed dry or sinter, but is present before lamination only in a pre-cross-linked state and can consequently be thermally reactivated in the laminating process. However, it is a particular advantage of the present invention that a hardening agent can be added to the coating composition after the manufacture of the multilayer insulator and its incorporation in, for example, electrical apparatus, with the aid of a penetrating impregnating operation. The hardening then takes place by heating the completely fitted insulating body together with the insulated object, for example a high-tension winding.

WHAT WE CLAIM IS:

1. A process for manufacturing an insulator comprising applying a discontinuous coating of a thermally curable coating composition to a support layer, drying the composition on the support layer without curing the composition, and laminating one such layer onto each side of a mica paper layer.

2. A process according to claim 1 in which each discontinuous coating is in the same or a different geometrical pattern.

3. A process according to claim 1 or claim 2 in which each support layer comprises a non-woven fabric.

4. A process according to any preceding claim in which the coating composition comprises a hardening agent.

5. A process according to any preceding claim which comprises the additional step of curing the composition.

6. A process according to claim 1 substantially as herein described.

7. An insulator when manufactured by a process according to any preceding claim.

8. An insulator comprising a mica paper layer sandwiched between two support layers which are each bonded to the mica paper layer with a discontinuous layer of a thermally curable composition.

9. An insulator according to claim 8 in which each discontinuous coating is in the same or a different geometrical pattern.

10. An insulator according to claim 8 or claim 9 in which each support layer comprises a non-woven fabric.

11. An insulator according to any of claims 8 to 10 in which the composition contains a hardening agent.

12. An insulator according to any of claims 8 to 10 which has been impregnated with a hardening agent.

13. An insulator according to any of claims 8 to 12 in which the composition has been cured.

14. An insulator according to claim 8 substantially as herein described.

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