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(54) A POLE PART

(57) The present invention relates to a pole part, comprising:
- a vacuum interrupter (100);
- a primer layer (10); and
- a hotmelt material (20);
wherein the vacuum interrupter (100) comprises a ceramic insulator (110);
wherein an inner surface of the primer layer (10) is in contact with an outer surface of the ceramic insulator (110);
wherein the primer layer (10) comprises a solvent;
wherein an inner surface of the hotmelt material (20) is in contact with an outer surface of the primer layer (10); and
wherein the hotmelt material (20) comprises polyamide.

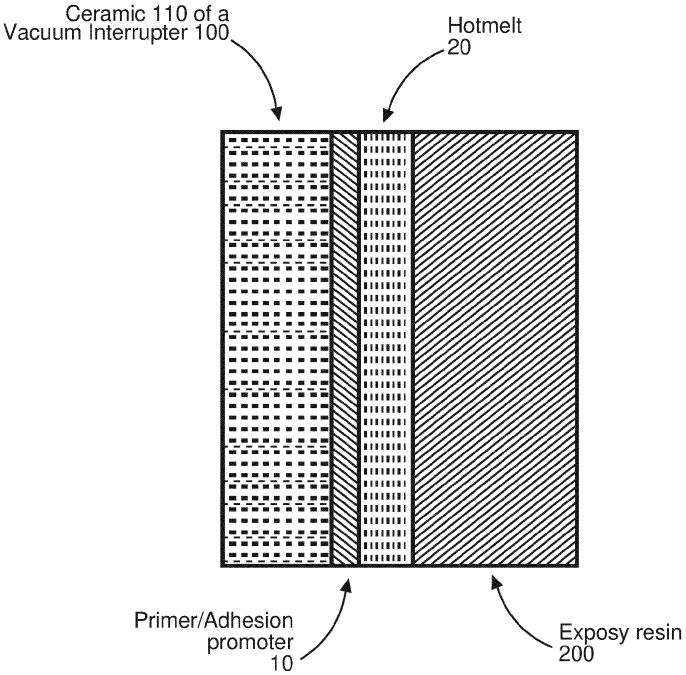

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a pole part and method of potting a vacuum interrupter for a pole part.

BACKGROUND OF THE INVENTION

[0002] One of the most important tasks in low-, medium- or high-voltage applications is the insulation of parts, which are under voltage. Interfaces between different insulating materials are the most likely areas where partial discharges could start, and/or a breakdown can occur. To avoid failures caused by bubbles, air gaps, cavities or defects between these joined insulating interfaces, a good adhesion or mechanical link of the materials used is necessary.

[0003] The state of the art for embedded pole parts are two different techniques:
The first one is a direct molding of a thermoplastic material on a prior, with a primer, coated vacuum interrupter (VI) surface.

[0004] The second one is a soft material layer between a VI and a surrounding epoxy material.

[0005] The soft material layer should avoid cracks in the epoxy resin or damage of the VI caused by different thermal expansion coefficients. State of the art for this soft compensation layer is the use of a warm or hot shrinkage tube or a molding with a soft material like silicone rubber, polyurethane, elastomeric material, or a soft epoxy resin.

[0006] The adhesion of a warm or hot shrinkage tube, as this soft layer on the VI surface, may not extend reliable over the complete contact surface of the warm or hot shrinkage tube to the VI. The shrinkage process is also a time consuming process, which takes several hours. When using silicone rubber, the adhesion needs to be enhanced through the use of a glue material or primer. This glue or primer needs time and elevated temperature for curing. Furthermore, the whole process for using silicone rubber, polyurethanes or soft epoxy resins, applying and curing of primer and embedding VI into soft material layer, needs more than 10 to 15 minutes. In addition, the cured and excess material can't be reused or recycled which leads to waste material.

[0007] There is a need to address these issues.

SUMMARY OF THE INVENTION

[0008] Therefore, it would be advantageous to have an improved embedded Vacuum interrupter for usage in a pole part.

[0009] The object of the present invention is solved with the subject matter of the independent claims, wherein further embodiments are incorporated in the dependent claims.

[0010] In an aspect, there is provided a pole part, comprising:

- a vacuum interrupter;
- a primer layer; and
- a hotmelt material;

The vacuum interrupter comprises a ceramic insulator. An inner surface of the primer layer is in contact with an outer surface of the ceramic insulator. The primer layer comprises a solvent. An inner surface of the hotmelt material is in contact with an outer surface of the primer layer. The hotmelt material comprises polyamide.

[0011] In an example, the pole part further comprises an epoxy resin. An inner surface of the epoxy resin is in contact with an outer surface of the hotmelt material.

[0012] Thus a molded vacuum interrupter can then be used in an epoxy pole part for example, but can also stand alone.

[0013] In an example, the primer layer comprises silane.

[0014] In an example, a thickness of the primer layer is greater than or equal to 10μm.

[0015] In an example, the thickness of the primer layer is less than or equal to 500μm.

[0016] In an example, the primer layer and the hotmelt material form a compensation layer. A thickness of the compensation layer is greater than or equal to 1 mm.

[0017] In an example, the thickness of the compensation layer is less than or equal to 8mm.

[0018] In an example, the primer layer and the hotmelt material form a compensation layer. A hardness of the compensation layer is greater than or equal to Shore A 20.

[0019] In an example, the hardness of the compensation layer is less than or equal to Shore A 95.

[0020] In a second aspect, there is provided a method of potting a pole part, comprising:

- coating an outer surface of a ceramic insulator of a vacuum insulator with a primer layer, and wherein the primer layer comprises a solvent; and

- applying a hotmelt material to an outer surface of the primer layer, and wherein the hotmelt material comprises polyamide.

[0021] In an example, the method comprises:

- molding the vacuum interrupter having the ceramic insulator coated in the primer layer and the hotmelt material in an epoxy resin.

[0022] In an example, molding the vacuum interrupter having the ceramic insulator coated in the primer layer and the hotmelt material in epoxy resin is carried out above 100C.

[0023] In an example, molding the vacuum interrupter having the ceramic insulator coated in the primer layer

and the hotmelt material in epoxy resin is carried out at approximately 140C.

[0024] In an example, molding the vacuum interrupter having the ceramic insulator coated in the primer layer and the hotmelt material in epoxy resin is carried for several minutes.

[0025] In an example, molding the vacuum interrupter having the ceramic insulator coated in the primer layer and the hotmelt material in epoxy resin is carried for several hours.

[0026] In an example, after coating the outer surface of the ceramic insulator with the primer layer and before applying the hotmelt material, the method comprises:

- curing the primer layer at room temperature.

[0027] In an example, the hotmelt material is applied to the outer surface of the primer layer by low pressure molding.

[0028] In an example, the primer layer comprises silane.

[0029] In an example, the method comprises coating the outer surface of the ceramic insulator of the vacuum insulator with the primer layer to a thickness of the primer layer that is greater than or equal to 10μm.

[0030] In an example, the method comprises coating the outer surface of the ceramic insulator of the vacuum insulator with the primer layer to the thickness of the primer layer that is less than or equal to 500μm.

[0031] In an example, the method comprises applying the hotmelt material to the outer surface of the primer layer to a thickness of the hotmelt material that is greater than or equal to 1.5mm.

[0032] In an example, the method comprises applying the hotmelt material to the outer surface of the primer layer to the thickness of the hotmelt material that is less than or equal to 3.5mm.

[0033] In an example, the primer layer and the hotmelt material form a compensation layer, and wherein a hardness of the compensation layer is greater than or equal to Shore A 20.

[0034] In an example, the hardness of the compensation layer is less than or equal to Shore A 95.

[0035] The above aspect and examples will become apparent from and be elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] Exemplary embodiments will be described in the following with reference to the following drawings:
Fig. 1 shows a compensation layer, formed from a primer 10, also called an adhesion promoter 10, and a hotmelt 20, that has been applied to a ceramic 110 of a vacuum insulator, and this has been embedded in an epoxy layer 200.

DETAILED DESCRIPTION OF EMBODIMENTS

[0037] Fig. 1 relates to a new pole part and a new method of potting a pole part

[0038] In an example a pole part comprises:

- a vacuum interrupter 100;
- a primer layer 10; and
- a hotmelt material 20;

The vacuum interrupter 100 comprises a ceramic insulator 110. An inner surface of the primer layer 10 is in contact with an outer surface of the ceramic insulator 110. The primer layer 10 comprises a solvent. An inner surface of the hotmelt material 20 is in contact with an outer surface of the primer layer 10. The hotmelt material 20 comprises polyamide.

[0039] In an example, the pole part further comprises an epoxy resin 200. An inner surface of the epoxy resin 200 is in contact with an outer surface of the hotmelt material 20.

[0040] In an example, the primer layer 10 comprises silane.

[0041] In an example, a thickness of the primer layer 10 is greater than or equal to 10μm.

[0042] In an example, the thickness of the primer layer 10 is less than or equal to 500μm.

[0043] In an example, the primer layer 10 and the hotmelt material 20 form a compensation layer. A thickness of the compensation layer is greater than or equal to 1mm.

[0044] In an example, the thickness of the compensation layer is less than or equal to 8mm.

[0045] In an example, the primer layer 10 and the hotmelt material 20 form a compensation layer. A hardness of the compensation layer is greater than or equal to Shore A 20.

[0046] In an example, the hardness of the compensation layer is less than or equal to Shore A 95.

[0047] In example, a method of potting a pole part comprises:

- coating an outer surface of a ceramic insulator 110 of a vacuum insulator 100 with a primer layer 10, and wherein the primer layer 10 comprises a solvent; and
- applying a hotmelt material 20 to an outer surface of the primer layer 10, and wherein the hotmelt material 20 comprises polyamide.

[0048] In an example, the method comprises:

- molding the vacuum interrupter 100 having the ceramic insulator 110 coated in the primer layer 100 and the hotmelt material 20 in an epoxy resin 200.

[0049] In an example, the molding the vacuum interrupter 100 having the ceramic insulator 110 coated in the primer layer 100 and the hotmelt material 20 in the epoxy

resin 200 is carried out above 100C.

[0050] In an example, the molding the vacuum interrupter 100 having the ceramic insulator 110 coated in the primer layer 100 and the hotmelt material 20 in the epoxy resin 200 is carried out at approximately 140C.

[0051] In an example, the molding the vacuum interrupter 100 having the ceramic insulator 110 coated in the primer layer 100 and the hotmelt material 20 in the epoxy resin 200 is carried out for several minutes.

[0052] In an example, the molding the vacuum interrupter 100 having the ceramic insulator 110 coated in the primer layer 100 and the hotmelt material 20 in the epoxy resin 200 is carried out for several hours.

[0053] In an example, after coating the outer surface of the ceramic insulator 110 with the primer layer 10 and before applying the hotmelt material 20, the method comprises:

- curing the primer layer 10 at room temperature.

[0054] In an example, the hotmelt material 20 is applied to the outer surface of the primer layer 10 by low pressure molding.

[0055] In an example, the primer layer 10 comprises silane.

[0056] In an example, the method comprises coating the outer surface of the ceramic insulator 110 of the vacuum insulator 100 with the primer layer 10 to a thickness of the primer layer 10 that is greater than or equal to 10μm.

[0057] In an example, the method comprises coating the outer surface of the ceramic insulator 110 of the vacuum insulator 100 with the primer layer 10)to the thickness of the primer layer 10 that is less than or equal to 500μm.

[0058] In an example, the method comprises applying the hotmelt material 20 to the outer surface of the primer layer 10 to a thickness of the hotmelt material that is greater than or equal to 1.5mm.

[0059] In an example, the method comprises applying the hotmelt material 20 to the outer surface of the primer layer 10 to the thickness of the hotmelt material that is less than or equal to 3.5mm.

[0060] In an example, the primer layer 10 and the hotmelt material 20 form a compensation layer, and wherein a hardness of the compensation layer is greater than or equal to Shore A 20.

[0061] In an example, the hardness of the compensation layer is less than or equal to Shore A 95.

[0062] Thus, a compensation layer (formed from a primer 10 also called an adhesion promoter 10 and a hotmelt material 20) between epoxy resin 200 and a vacuum interrupter 100 is utilized. Problem associated with hot shrinkage tube that can't guarantee a good adhesion to the vacuum interrupter over the whole life time of a pole part are addressed, where with the use of a primer 10 and a hotmelt material 20, which can be applied by low pressure molding, the adhesion of the compensation layer is improved, and production time is shortened and waste is reduced.

[0063] Continuing with Fig. 1, several detailed embodiments are now described.

[0064] Thus, a new technique has been developed that involves coating a vacuum interrupter (VI) 100 with a primer 10 and embedding this VI in a hotmelt material 20. Afterwards this embedded VI can be molded into an epoxy resin 200.

[0065] The primer 10, also called an adhesion promotor 10, is solvent-based, which allows the primer to flash off in a few moments at room temperature. The primer 10 activates the VI surface to get a good adhesion. The primer layer 10 is in a range between 10 to 500 μm and is applied on the ceramic surface 110 of the VI before potting in a hotmelt material layer 20.

[0066] This hotmelt material is based on polyamide, because for the following molding process with epoxy resin, the compensation layer has to withstand elevated temperatures.

[0067] This compensation layer has a thickness of 1 to 8 mm, a Shore hardness in a range of Shore A 20 to A 95 and is applied by low pressure molding. The process of low pressure molding enables a process time of less than 5 minutes, which allows the application process to be faster than what can be currently achieved. By this application method (low pressure molding) imperfections like air gaps, bubbles, cavities or defects can be avoided.

[0068] The combination of these two layers (primer 10 and hotmelt material 20) guaranties a good adhesion or mechanical link on VI surface and therefore an interface which is resistant against partial discharges or electrical breakdowns. Furthermore, the use of a hotmelt material 20 based on a polyamide reduces waste, because excess material can be recycled.

[0069] Also, the hotmelt material 20 being polyamide based, provides for processing at an elevated the temperature range. Thus, after producing the hotmelt layer 20 with the low pressure molding, the "covered" VI 100 is molded in epoxy resin 200. This molding is done above 100°C, for example at 140°C. Other hotmelt materials would melt at this temperature and they would not remain in position with respect to the VI. However, the new hotmelt material 20 that is Polyamide based has a higher melting temperature than existing hotmelts, and can therefore be used for the processing at the elevated temperature above 100°C, for example at 140C, for several minutes or hours

Claims

1. A pole part, comprising:

- a vacuum interrupter (100);
- a primer layer (10); and
- a hotmelt material (20);

wherein the vacuum interrupter (100) comprises

a ceramic insulator (110);
wherein an inner surface of the primer layer (10) is in contact with an outer surface of the ceramic insulator (110);
wherein the primer layer (10) comprises a solvent;
wherein an inner surface of the hotmelt material (20) is in contact with an outer surface of the primer layer (10); and
wherein the hotmelt material (20) comprises polyamide.

2. Pole part according to claim 1, further comprising an epoxy resin (200), and wherein an inner surface of the epoxy resin (200) is in contact with an outer surface of the hotmelt material (20).

3. Pole part according to any of claims 1-2, wherein the primer layer (10) comprises silane.

4. Pole part according to any of claims 1-3, wherein a thickness of the primer layer (10) is greater than or equal to 10μm.

5. Pole part according to claim 4, wherein the thickness of the primer layer (10) is less than or equal to 500μm.

6. Pole part according to any of claims 1-5, wherein the primer layer (10) and the hotmelt material (20) form a compensation layer, and wherein a thickness of the compensation layer is greater than or equal to 1mm.

7. Pole part according to claim 6, wherein the thickness of the compensation layer is less than or equal to 8mm.

8. Pole part according to any of claims 1-7, wherein the primer layer (10) and the hotmelt material (20) form a compensation layer, and wherein a hardness of the compensation layer is greater than or equal to Shore A 20.

9. Pole part according to claim 8, wherein the hardness of the compensation layer is less than or equal to Shore A 95.

10. A method of potting a pole part, comprising:

- coating an outer surface of a ceramic insulator (110) of a vacuum insulator (100) with a primer layer (10), and wherein the primer layer (10) comprises a solvent; and
- applying a hotmelt material (20) to an outer surface of the primer layer (10), and wherein the hotmelt material (20) comprises polyamide.

11. Method according to claim 10, comprising:

- molding the vacuum interrupter (100) having the ceramic insulator (110) coated in the primer layer (100) and the hotmelt material (20) in an epoxy resin (200).

12. Method according to claim 11, wherein the molding the vacuum interrupter (100) having the ceramic insulator (110) coated in the primer layer (100) and the hotmelt material (20) in the epoxy resin (200) is carried out above 100C.

13. Method according to any of claims 10-12, wherein after coating the outer surface of the ceramic insulator (110) with the primer layer (10) and before applying the hotmelt material (20), the method comprises:

- curing the primer layer (10) at room temperature.

14. Method according to any of claims 10-13, wherein the hotmelt material (20) is applied to the outer surface of the primer layer (10) by low pressure molding.

15. Method according to any of claims 10-14, wherein the primer layer (10) comprises silane.

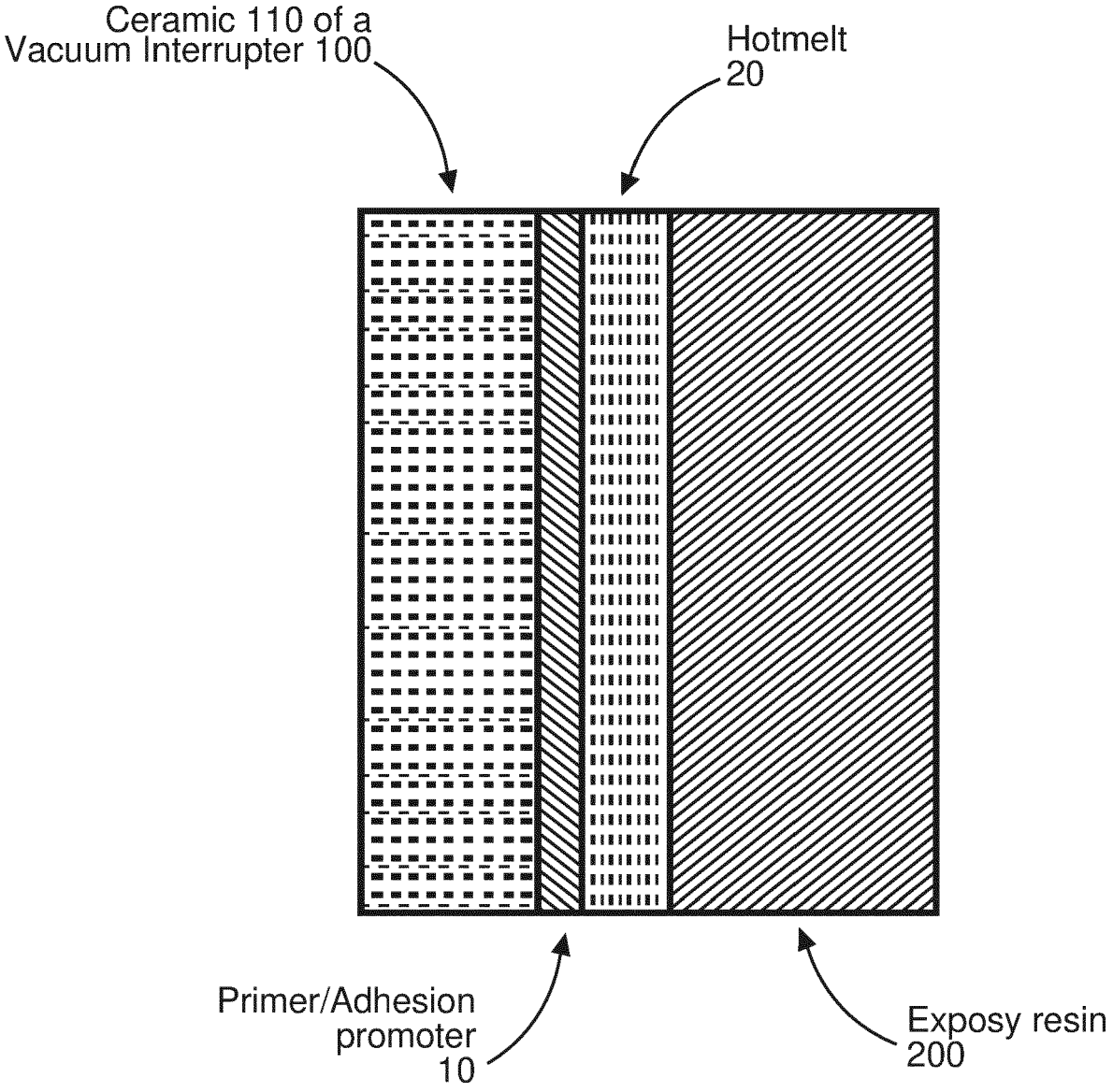
Ceramic 110 of a
Vacuum Interrupter 100
Hotmelt
20
Primer/Adhesion
promoter
10
Exposy resin
200

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 23 16 6245

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 October 2023	Nieto, José Miguel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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