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(54) **An electric insulator surface protection element, and an electric insulator provided therewith**

(57) An electric insulator comprising an electrically insulating body (4). The insulator is provided with a surface protection element (7) that comprises a second body (7) comprising a hydrophobic material, said hydrophobic material being arranged so as to be successively deposited onto a surface of said electrically insulating body (4).

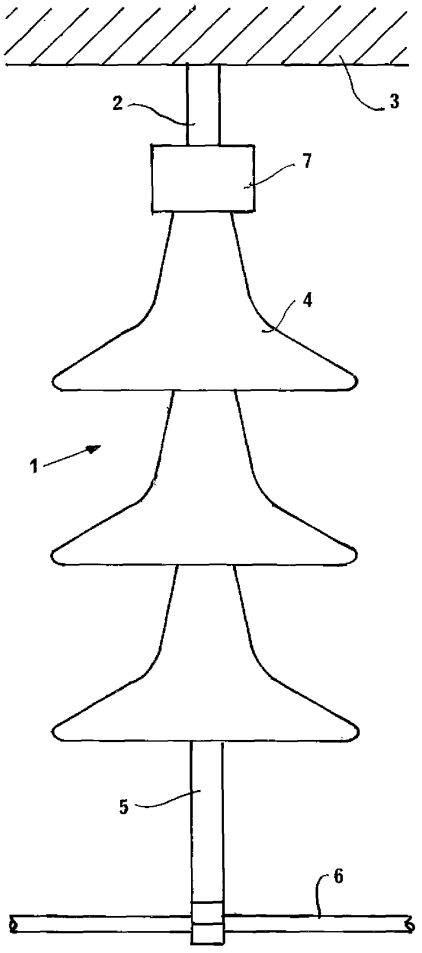

Fig 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to an electric insulator surface protection, as well as in electric insulator provided therewith, said electric insulator also comprising an electrically insulating body.

[0002] The insulator may be a line insulator, an apparatus insulator, such as a cable termination, or a support insulator, such as station post. Accordingly, a wide range of insulators are within the scope of protection applied for.

[0003] Typically, the insulator is a medium voltage or high voltage insulator, wherein medium voltage is referred to as voltages in the range of 1-36 kV, and high voltage is referred to as voltages above 36 kV. Thus, also ultra high voltages, e.g. 800 kV are included.

[0004] The invention is particularly relevant to insulators arranged in such environments in which the insulating body thereof is subjected to a deposition of any kind of particles on the outer surface thereof, and in which there is such humidity conditions that moisture will also be likely to deposit on said outer surface. Typically, but not necessarily, such an environment is an outdoor environment.

BACKGROUND OF THE INVENTION

[0005] It is well known that insulators arranged in outdoor environments are prone to be subjected to deposition of electrically conducting dust particles and the like on the outer surfaces thereof, and that humid air and rain will have a tendency of being deposited as a water film on said outer surfaces. The presence of the dust particles may promote the deposition and forming of the water film. The particles and the water film may form a layer that promotes the up-coming of partial discharges that will degrade the insulator surface, which can lead to mechanical or electrical failure of the insulator.

[0006] It is also a fact that outer surfaces of insulators, though they might be provided with a hydrophobic surface layer, with time will become less hydrophobic and eventually will present hydrophilic properties if not regularly treated or exchanged. Such hydrophilic properties will, off course, further promote the formation of a water film on said surfaces, thereby increasing the risk of having partial discharges or electric arcs.

THE OBJECT OF THE INVENTION

[0007] It is an object of the present invention to present a surface protection element by means of which a sustained, long term protection of a surface of an electrically insulating body of an insulator will be permitted. The surface protection element shall contribute to decreasing the formation of a water film on the surface of the insulator by providing and maintaining hydrophobic properties to said surface.

[0008] It is also an object of the invention to present an insulator provided with such a surface protection element.

SUMMARY OF THE INVENTION

[0009] The object of the invention is achieved by means of the initially defined surface protection element, characterised in that it comprises a body that comprises a hydrophobic material, said hydrophobic material being arranged so as to be successively drained off from said body. Preferably the hydrophobic material is drained off in a liquid state. Liquid is referred to as being able to flow, though only slowly, or diffuse, or creep, preferably within a given temperature range corresponding to the temperature range to which the element is assumed to be subjected during use thereof in its operative position. The liquid property of the hydrophobic material may be inherent or generated as a result of exterior affection, for example due to subjection to a liquid such as water, possibly rain water. Preferably, the viscosity of said material is low enough for permitting a well distributed covering of a surface of an electrically insulating body, and high enough for resulting in a slow deposition and retention of the material on said insulating body. Successive draining is referred to as continuous, continual or repeated draining over a long term period, preferably more than a year. Accordingly, the draining should be a slow process, by which the hydrophobic material slowly bleeds off from said body of the protection element. The draining may be a continuous process generated as a result of inherent properties of the material of said body or as a result of the design thereof. It should be understood that the hydrophobic material may comprise the same material as the one that constitutes the body from which it is drained, but be in a liquid state while the remaining part of said body is in a solid state. Thereby, a kind of self-depositing protection element is provided for. When emptied on its liquid parts, such a body may be replaced by a new one. As an alternative, the body from which the liquid hydrophobic material is drained off may comprise any kind of container, possibly made of a different material than that of the hydrophobic material, and provided with any kind of outlet means that permits continuous or repeated draining or leakage of the hydrophobic material from said body. Such a container may either replaced by a new one or be refilled with hydrophobic material when the hydrophobic material initially contained therein has been consumed or is close to being consumed. The surface protection element should be positioned where the hydrophobic material drained off from it will be able of spreading on a target surface of an electrically insulating body of an electric insulator, thereby contributing to the provision or maintenance of a hydrophobic property of said surface.

[0010] According to a preferred embodiment, said hydrophobic material is a silicone-based, or at least silicone-containing, material. Silicone has the advantage of

conferring hydrophobic properties to those compositions that it forms part of. Therefore, the provision of a certain amount of silicone in the material that is to form the hydrophobic material is preferred.

[0011] Preferably, said hydrophobic material comprises a silicone oil. The silicone oil will have the advantage of being in a liquid state, thereby permitting the draining thereof from the body of the surface protection element as well as a good spreading of thereof onto a target surface of an electrically insulating body.

[0012] According to a preferred embodiment, said body comprises a solid material that is UV-degradable, whereby at least a part of said hydrophobic material will drain off from said body when the latter is subjected to UV radiation. By the aid of this feature, a repeated self-draining of the surface protection element upon subjection of the body in question to UV-radiation will be achieved. The problem of achieving self-deposition in environments in which UV radiation exists, is thereby solved. A silicone-based elastomer will exhibit such properties and is therefore preferred.

[0013] According to an alternative embodiment, said body of the surface protection element comprises a solid material in which at least a part of the hydrophobic material that is to be drained off from said body is housed in a liquid state. In the case of a body comprised by a solid silicone-based elastomer, from which a silicone oil is drained, the silicone oil may be there as a result of a production process or as a result of a chemical reaction like the one described above with reference to UV-radiation. As explained earlier, the solid body containing said hydrophobic material may, as an alternative, be of other composition than the hydrophobic material and may be provided with one or more outlets for the draining of the hydrophobic material from the latter.

[0014] The object of the invention is also achieved by means of an electric insulator comprising an electrically insulating body, said insulator being characterised in that it is provided with surface protection element that comprises a second body comprising a hydrophobic material, said hydrophobic material being arranged so as to be successively deposited onto a surface of said electrically insulating body. Preferred embodiments of the invented insulator comprises the preferred embodiments of the surface protection element previously described. The electrically insulating body may comprise a ceramic or any polymer material suitable for the application. It may be form a line insulator, carrying an electric power transmission or distribution line, or an apparatus insulator, such as an insulator of an electric breaker, a bushing or a cable termination, or a support insulator, such as a station post. The surface of the electrically insulating body may be provided with a glaze or any surface layer for the improvement of its durability and functionality.

[0015] Preferably, said second body forms a solid body. The solid body should be located close to or even in contact with the electrically insulating body in order to promote the transfer of the hydrophobic material to the latter.

[0016] Preferably, said second body comprises a solid material that is UV-degradable, whereby at least a part of said hydrophobic material, which is to be deposited onto the electrically insulating body, is formed during UV-degradation of said second body in its operative position.

[0017] According to an alternative embodiment, said second body comprises a solid material in which at least a part of the hydrophobic material that is to be deposited onto the electrically insulating body, is housed in a liquid state.

[0018] As already mentioned, it is preferred that said second body be located close to the electrically insulating body when the insulator is in an operative position.

[0019] Preferably, said second body is located above the electrically insulating body, or at least a part thereof, when the insulator is in an operative position. Thereby, the gravitational force will contribute to a distribution of the hydrophobic material onto the surface of the electrically insulating body.

[0020] It is preferred that said second body is provided with attachment means in order to be attached to said electrically insulating body or to an element adjacent to said electrically insulating body. Preferably, the second body has a rotational symmetry such that it will permit a symmetric deposition of material onto the electrically insulating body, in particular in those cases when the latter is located below the surface protection element in the operative position. It is presently preferred that the second body be flexible, ring-shaped, preferably with discontinuity in the circumferential direction, permitting it to clipped onto a rod shaped element or the like. Alternatively a helix-shaped, flexible body is used, which is wrapped around the element to which it is attached.

[0021] Further features and advantages of the invention will be shown in the following detailed description of a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The invention will now be described more in detail with reference to the accompanying drawing on which:

Fig. 1 is a schematic side view of a line insulator according to the invention, and

Fig. 2 is a perspective view of a ring-shaped surface protection element according to one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0023] Fig. 1 shows an embodiment of an insulator 1 according to the invention. The insulator 1 shown in fig. 1 is a line insulator. The insulator 1 is suspended in a steel rod 2 which, in its turn, is connected to a beam 3, which might be connected to earth.

[0024] The insulator 1 comprises a plurality of insulating bodies 4 interconnected by interconnection pins or the like (not shown). An overhead transmission or distribution line 6 for electric power is suspended at an end part or line holder 5 of the insulator 1. Thereby, the line 6 is electrically insulated from the beam 3 by means of the insulator 1.

[0025] Each of the insulating bodies 4 of the insulator 1 is mainly constituted by an electrically insulating material such as porcelain or a polymer. Both thermosetting and thermoplastic polymers are conceived as a suitable polymer of said bodies 4.

[0026] Above the insulating bodies 4 there is provided a surface protection element 7. The surface protection element 7 is attached to the rod 2 in which the insulator 1 is suspended. The surface protection element 7 comprises a solid body made of a silicone-based material, preferably silicone rubber. The body of silicone rubber of the protection element 7 contains a predetermined amount of silicone oil that will slowly be drained off from the said body and be deposited onto the neighbouring underlying insulating body 4. The draining will at least partly be an effect of the gravitational force that the protection element 7 is subjected to. The length of the silicone-based molecules of said oil, determining the viscosity thereof, is such that a prolonged, long-term draining is provided for. A plurality of different molecule lengths might be conceived in order to provide for a continuous long term draining. As an alternative or supplement, different oils, i.e. oils of different compositions, might be used in one and the same body, whereby the different oils will drain with different rate, thereby also providing for continuous long term draining.

[0027] The solid silicone rubber body of the protection element 7 is designed so as to be susceptible to a slow degradation when subjected to UV radiation, whereby silicone-based molecules of shorter length than the molecules of the solid material are formed and whereby such shorter molecules will define a liquid phase able of being drained off from the body and deposited on the neighbouring insulating body 4.

[0028] The surface protection element 7 is formed so as to be easily and readily attached to the rod 2. Therefore, with reference to fig. 2, the protection element 7 has a shape that promotes such attachment. In the embodiment shown in fig. 2, the element 7 is of annular shape, or ring-shaped, with an attachment means formed by a discontinuity 8 in its circumferential direction, which makes it possible to bend open the ring to a horse-shoe shape and snap it onto the rod 2 or any similar element onto which it may be attached. The protection element may have other suitable designs for the purpose of permitting rapid and easy attachment and removal thereof to/from a carrying element like the rod 2. For example the protection element may be formed by a sheet or slip that is to be wound onto the carrying element.

[0029] The liquid hydrophobic phase, in this case the silicone oil, shall have such a viscosity and such an affinity to the material of the insulating bodies that it tends to spread on the surface of the latter. The viscosity and composition of the liquid phase may preferably be such that the liquid phase also continues to spread to insulating bodies further down the line of those bodies 4. There might be provided further surface protection elements between individual insulating bodies 4 further down the line of the insulating bodies 4, depending on the ability of the liquid phase to spread to further insulating bodies and on the number of insulating bodies in a specific application. Preferably, the number and positioning of such further surface protection elements is adapted to guarantee that each insulating body in a chain of insulating bodies is sufficiently covered and protected by the liquid hydrophobic phase drained from those protection elements. For outdoor applications, like the electric power overhead line insulator of the present embodiment, it is assumed that the spreading of the liquid hydrophobic phase is promoted by weather phenomena such as rain or snow that is deposited on the drained phase.

[0030] It should be understood that the invention only have been described by way of example and that further embodiments will be obvious for a person skilled in the art, however without departing from the scope of protection as defined by the annexed patent claims, supported by the description and the drawing. For example, the surface protection element may be formed by one of a plurality of electric insulation bodies of an insulator, said protection element then being arranged so as to deposit a liquid phase of hydrophobic material onto one or more of the other insulating bodies of the insulator.

Claims

1. An electric insulator surface protection element (7), **characterised in that** it comprises a body (7) that comprises a hydrophobic material, said hydrophobic material being arranged so as to be successively drained off from said body (7).

2. An electric insulator surface protection element according to claim 1, **characterised in that** said hydrophobic material is a silicone-based material.

3. An electric insulator surface protection element according to claim 1 or 2, **characterised in that** said hydrophobic material comprises a silicone oil.

4. An electric insulator surface protection element according to any one of claims 1-3, **characterised in that** said body (7) comprises a solid material that is UV-degradable, whereby at least a part of said hydrophobic material will drain off from said body (7) when the latter is subjected to UV radiation.

5. An electric insulator surface protection element according to any one of claims 1-4, **characterised in**

that said body (7) comprises a solid material in which at least a part of the hydrophobic material that is to be drained off from said body (7) is housed in a liquid state.

6. An electric insulator comprising an electrically insulating body (4), said insulator being **characterised in that** it is provided with a surface protection element (7) that comprises a second body (7) comprising a hydrophobic material, said hydrophobic material being arranged so as to be successively deposited onto a surface of said electrically insulating body (4).

7. An electric insulator according to claim 6, **characterised in that** said second body (7) forms a solid body.

8. An electric insulator according to claim 6 or 7, **characterised in that** said hydrophobic material is provided so as to be drained off from said second body (7).

9. An electric insulator according to any one of claims 6-8, **characterised in that** said hydrophobic material is a silicone-based material.

10. An electric insulator according to any one of claims 6-9, **characterised in that** said hydrophobic material comprises a silicone oil.

11. An electric insulator according to any one of claims 6-10, **characterised in that** said second body (7) comprises a solid material that is UV-degradable, whereby at least a part of said hydrophobic material, which is to be deposited onto the electrically insulating body (4), is formed during UV-degradation of said second body (7) in its operative position.

12. An electric insulator according to any one of claims 6-11, **characterised in that** said second body (7) comprises a solid material in which at least a part of the hydrophobic material that is to be deposited onto the electrically insulating body (4), is housed in a liquid state.

13. An electric insulator according to any one of claims 6-12, **characterised in that** said second body (7) is located close to the electrically insulating body (4) when the insulator is in an operative position.

14. An electric insulator according to any one of claims 6-13, **characterised in that** said second body (7) is located above the electrically insulating body (4) when the insulator is in an operative position.

15. An electric insulator according to any one of claims 6-14, **characterised in that** said second body (7) is provided with attachment means (8) in order to be attached to said electrically insulating body (4) or to an element adjacent to said electrically insulating body (4).

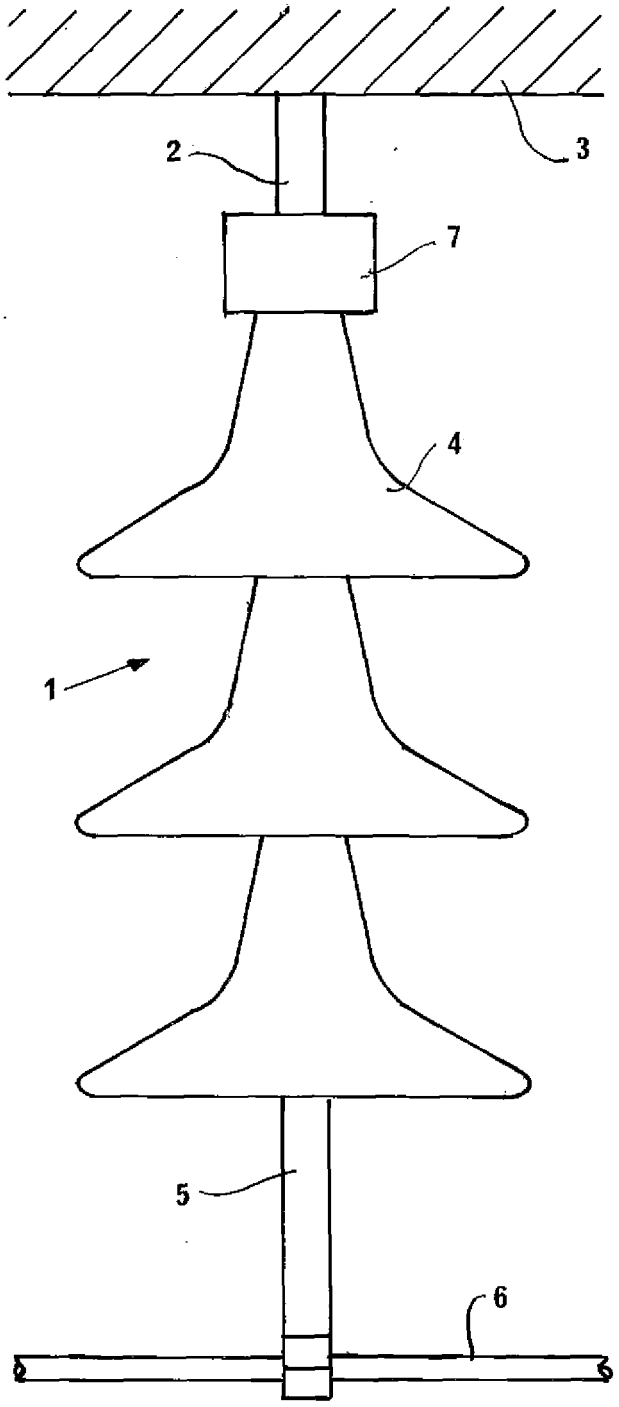

Fig 1

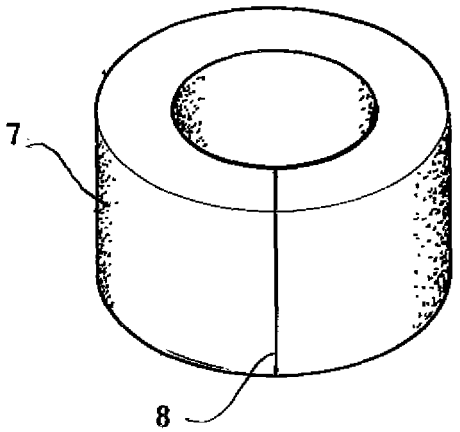

Fig 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 10 1252

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 077 516 A (TOKYO SHIBAURA ELECTRIC CO [JP]) 27 April 1983 (1983-04-27)	1-3, 5-10,12, 13,15	INV. H01B17/50
Y	* page 3, line 31 - page 4, line 3; figure 2 * * page 4, line 25 - line 31 * * page 6, line 16 - line 21; figures 4-6 *	14	
X	GB 740 938 A (STEATITE AND PORCELAIN PRODUCT) 23 November 1955 (1955-11-23)	1,2,5-9, 12,13	
Y	* page 1, line 24 - line 56 * * page 2, line 3 - line 13 *	14	
A	US 1 493 262 A (HAMMOND JR JOHN HAYS) 6 May 1924 (1924-05-06) * page 2, line 20 - line 41; figures 1,2 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

H01B
H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	24 June 2008	Hillmayr, Heinrich

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 10 1252

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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24-06-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0077516 A	27-04-1983	AU 534103 B2	05-01-1984
		AU 8889382 A	19-05-1983
		DE 3263015 D1	15-05-1985
		JP 58066213 A	20-04-1983
		MX 151934 A	03-05-1985
		US 4433203 A	21-02-1984
GB 740938 A	23-11-1955	NONE	
US 1493262 A	06-05-1924	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82