

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
06.08.2008 Bulletin 2008/32

(51) Int Cl.:
H01B 17/30 (2006.01)

(21) Application number: **07446002.3**

(22) Date of filing: **31.01.2007**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
 HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
 SK TR**
 Designated Extension States:
AL BA HR MK RS

(71) Applicant: **ABB Research Ltd.**
8050 Zürich (CH)

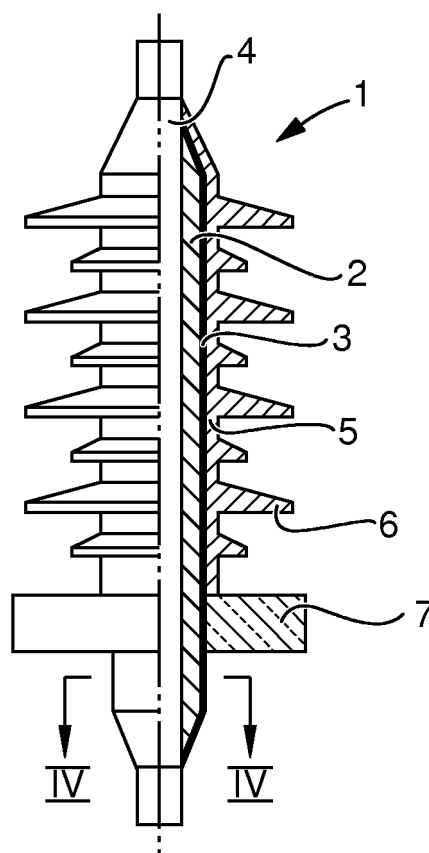
(72) Inventors:

- **Gäfvert, Uno**
723 49, VÄSTERÅS (SE)
- **Johansson, Erik**
722 45, VÄSTERÅS (SE)

(74) Representative: **Fröderberg, Anders Oskar**
BRANN AB
Västgötagatan 2
P.O. Box 17192
104 62 Stockholm (SE)

(54) **An electric insulation element, a bushing provided therewith, and a method of producing such an element**

(57) An electric insulation element (1) comprising; a body (2) that comprises a water absorbing, electrically insulating material; and a water barrier (3) attached to said body (2). The water barrier (3) is formed by a web attached to said body (2).



Description

TECHNICAL FIELD

[0001] The present invention comprises an electric insulation element comprising; a body that comprises a water absorbing, electrically insulating material; and a water barrier attached to said body.

[0002] The invention also comprises a bushing for an electric device, provided with such an electric insulation element, and a method of producing such an electric insulation element, said method comprising the step of providing said body with a water barrier.

[0003] The invention is primarily focused on electric insulation elements used in bushings, but may, in a broader scope, also include other applications in which a reliable electrical insulation is required and in which the humidity of the environment is such that the water absorbing, electrically insulating material of the element might absorb water in the absence of any water barrier.

[0004] A bushing is referred to as a component the task of which is to guide an electric conductor through or past an object or barrier of different voltage than said conductor, primarily a grounded object, such as a wall, and ensuring that there is no flash-over or short circuit between said conductor and said object. In this context, the conductor is, primarily, a conductor that, under operational conditions, presents a medium or high voltage, i.e. a voltage from approximately 40 kV and above. AC as well as DC applications are included.

BACKGROUND OF THE INVENTION

[0005] The primary function of a bushing is to carry current through a grounded barrier, such as a wall or an enclosure of an electrical apparatus. The bushing keeps current from passing into the grounded barrier by virtue of its insulating properties. For this purpose, the bushing comprises an electrical insulation element. A bushing is built with or without a condenser.

[0006] A non-condenser bushing comprises a current carrying center conductor surrounded by a solid, liquid or gas dielectric medium and a ceramic- or elastomeric insulator.

[0007] A condenser bushing for medium- and high-voltage has an additional component called an insulating core that aids electrical field distribution along the length of the bushing. The insulating core is built up around a central tube that is in the current carrying path of the bushing. For some types of bushings the central tube is not in the current carrying path of the bushings. The medium- and high-voltage bushing insulating cores are, for example, constructed of either oil impregnated paper (OIP) or resin impregnated paper (RIP). Wound with the paper is a plurality of equalization plates arranged concentrically within the core. These layers are constructed of metallic foil, preferably aluminum foil, or conductive ink, which serve to control the electrical field internal and

external to the bushing assembly.

[0008] The insulating core made of paper impregnated with resin may be produced by winding paper and equalization plates on the center tube and then impregnating with a resin in a mould. The resin used in a resin impregnated paper insulating core is, for example, epoxy.

[0009] The mould may also be the actual elastomeric sheath that becomes part of the final product assembly. The mould could also be made of paper or metal that is removed after the curing process. When using a removable mould, an elastomeric sheath is extruded directly on to the resin impregnated paper insulating core. The resin impregnated paper insulating core could also be placed inside a hollow glass fiber reinforced epoxy cylinder with an elastomeric sheath extruded directly on its outer surface or placed inside a hollow ceramic cylinder. There are certain constructions that do not require either the elastomeric sheath or the hollow ceramic cylinder after removal from the mould. Outfitting with a mounting flange along with several other components, such as mechanical fittings, possibly an expansion tank, completes the bushing assembly.

[0010] The elastomeric sheath made of silicon or EP-rubber, along with the ceramic insulator act to prevent creepage current along the outer surface of the bushing assembly. Both the elastomeric and ceramic insulator have bell shaped protrusions called sheds that increase the creepage distance along its length and further reduce the incidence of creepage current.

[0011] When using a hollow glass fiber reinforced epoxy cylinder or a hollow ceramic cylinder as insulator, the space between the insulating core and the outer hollow insulator is filled with a solid, semi-solid, liquid or gaseous dielectric medium. An example of a liquid dielectric medium is oil and an example of a gaseous dielectric medium is SF₆.

[0012] The paper of the paper bushing is, needless to say, water-absorbing. However, also Epoxy and elastomers absorb moisture when exposed to the atmospheric conditions. Resin impregnated paper bushings, with or without elastomeric sheathing extruded directly on its insulating core, are susceptible to moisture absorption during long term exposure to atmospheric conditions. Moisture absorption into the insulating core may cause degradation of the dielectric integrity of the bushing and diminish its ability to serve its intended purpose.

[0013] To prevent water from reaching the epoxy the applicant has, as for example disclosed in Swedish patent SE 526 713, suggested the use of a water barrier applied to the body of wound paper impregnated with resin. According to one embodiment the water barrier, also named the diffusion barrier, comprises an organic matrix such as a polymer, for example polyvinylchloride (PVC). In a preferred embodiment the organic matrix comprises incorporated small inorganic particles or particles of hybrid material, in the range from nanometer to several micrometers. The water barrier is, for example, applied by one of the following coating methods; painting,

dipping, spraying, plasma arc, sol-gel technique, Physical Vapor Deposition (PVD) or Chemical Vapor Deposition (CVD). However, a facilitated applying technique would be of economical interest for any manufacturer of such insulating elements, as well as for those involved in the maintenance and retro-fitting of already installed insulating elements.

THE OBJECT OF THE INVENTION

[0014] The object of the invention is to provide an electric insulation element as initially defined, wherein the water barrier is of a kind that is easily applied to the body that comprises a water absorbing, electrically insulating material, thereby contributing to an economically feasible production of said insulation element.

[0015] It is also an object of the invention to provide a method that promotes a cost efficient production of an electric insulation element provided with a water barrier. The suggested method should be easily put into practice in an industrial scale and should be applicable either to the production of new insulation elements or to the upgrading or maintenance of existing insulation elements in order to provide the latter with an efficient water barrier.

SUMMARY OF THE INVENTION

[0016] The object of the invention is achieved by means of the initially defined electrical insulation element, characterised in that said water barrier is formed by a web attached to said body. A web is referred to as a sheet-like or tape-like, or foil-like element, preferably with a flexibility that permits to be applied onto or around objects of different shapes. The use of a web, which is at least partly in a such a solidified state that it can be wound onto said body, enables a rapid and precise manufacture of the insulation element.

[0017] Preferably, said water barrier is attached onto an outer surface of said body. Said surface may be any surface of said body that is exposed to a humid environment and therefore susceptible to the adsorption of water in the absence of a water barrier. The water barrier may cover only parts of the body that are more susceptible to water absorption than other parts, or that are more susceptible to dielectric losses, for example parts that, upon operation of an electrical device to which the insulation element is fitted, present a higher electric stray field than other parts.

[0018] According to one embodiment, said water absorbing, electrically insulating material is arranged as a plurality of layers of said material overlapping each other, wherein said water barrier is arranged between at least two of said layers. The arrangement of said web between individual layers may facilitate the adhesion of the water barrier to said body. It may also protect said water barrier from physical or chemical attacks that it might be sensitive to. If there are a plurality of interlacing, parallel layers of the water barrier web, a certain redundancy may also

be achieved, since, if an outer layer is damaged, an inner layer may still be fully in force.

[0019] According to one embodiment, said water absorbing, electrically insulating material comprises a web wound to the shape of a tube, wherein said water barrier web is located between individual windings of said tube in the region of a surface thereof. This design particularly promotes a production step by which, during winding of the insulating material, the water barrier web is wound together with the web of insulating material, thereby becoming naturally, and continuously interlaced between individual layers of the insulating material.

[0020] According to one embodiment, said surface is the outer peripheral surface of said tube. According to a further embodiment, said surface is the inner peripheral surface of said tube. Off course, these embodiments may be combined.

[0021] Preferably, said web comprises a plurality of particles of a water impermeable material carried by a carrier substrate. The use of particles is advantageous in the sense that it promotes a certain flexibility of the web, and a length or width expansion thereof. The carrier substrate should be of a flexible kind, able to follow the shape of said body, and to expand upon alteration of the volume of said body, such as during curing of an impregnation means with which said body is impregnated. According to one embodiment, the carrier substrate presents the shape of a weft. The carrier substrate should be of an electrically insulating material. According to one embodiment, it comprises glass. Other suitable materials are, however, also conceived.

[0022] Preferably, said particles are flake-shaped. Flake-shaped particles, if located correctly, will promote the barrier function of the water barrier, and still not be adding very much to the thickness of the water barrier web. Accordingly, it is preferred that said flake-shaped particles present a main extension plane that is parallel with the main extension plane of the web. It is also preferred that at least some of said flake-shaped particles are arranged in an overlapping relation to each other. Thereby, the water barrier function will be even further improved, since water has to diffuse along a tortoise path through the structure in order to pass the barrier.

[0023] Preferably, said particles comprise an inorganic material. Preferably, said material, apart from being impermeable to water, is also electrically insulating or non-conducting. Such materials are easily found among inorganic materials. In particular, mineral materials might be conceived. According to one embodiment, said particles comprise mica. Other, conceivable materials may include Al_2O_3 or SiO_2 .

[0024] Preferably, said body comprises an impregnating material in which said water absorbing, electrically insulating material is embedded. Typically, said impregnating material may comprise a polymer, typically a thermosetting polymer, such as epoxy. It is preferred, but not necessary, that said carrier substrate is made of a material apt to adhere to said impregnating material or com-

patible with said impregnating material.

[0025] According to one embodiment, said particles are carried by and dispersed in a polymer matrix. Thereby, plural layers of overlapping, flake-shaped particles may be held together, thereby defining said web. The polymer matrix may form the carrier substrate itself, or act as a complement to a separate carrier substrate, for example of a kind as previously described herein, and may contribute the adhesion of said particles to said carrier substrate.

[0026] Preferably, said body comprises an impregnating material in which said water absorbing, electrically insulating material is embedded, and that said matrix comprises the same material as said impregnating material. Thereby, adhesion and compatibility between said matrix and said impregnating material is promoted.

[0027] Typically, said water absorbing, electrically insulating material comprises paper. According to one typical embodiment said water absorbing, electrically insulating material is impregnated with a polymer. However, in its broadest sense, the invention also includes embodiments in which the water absorbing material is of much less absorbing character than paper, such as any water absorbing polymer, for example epoxy.

[0028] The invention also relates to a bushing for an electrical device, characterised in that it comprises an electric insulation according to the invention. The bushing is arranged for the purpose of guiding a medium or high voltage conductor through or passed an object, such as a transformer station wall, of different voltage, typically grounded, than the conductor upon operation of the electric device, and to prevent a flash over or a short circuit between said conductor and said object.

[0029] The object of the invention is also achieved by means of the initially defined method, characterised in that the water barrier is provided as a web that is attached to said body. The use of a continuous, at least partly solid web contributes to a cost efficient and exact application of the water barrier.

[0030] According to one embodiment, said web is attached onto an outer surface of said body. Said surface may be any surface of said body that is exposed to a humid environment and therefore susceptible to the absorption of water in the absence of a water barrier.

[0031] According to a further embodiment, said water absorbing, electrically insulating material is arranged as a plurality of layers of said material overlapping each other, wherein said water barrier is arranged between at least two of said layers.

[0032] Preferably, said water barrier is arranged between at least two of said layers in the region of an outer surface of said body. Thereby, a protection of the bulk part of said body is provided for.

[0033] According to one embodiment, said body is formed by wounding a web of said water absorbing, electrically insulating material to the shape of a tube, wherein said water barrier web is arranged between individual windings of said tube. Preferably, said barrier web is in-

terlaced between individual windings of said tube in the region of a surface of the latter.

[0034] According to one embodiment said water barrier web is wound together with said web of said water absorbing, electrically insulating material. Preferably, the barrier web is further wound one or more turns on the innermost or outermost turn of the web of the water absorbing, electrically insulating material in order to generate a barrier on an outer surface of said body. Said surface is may be the outer peripheral surface of said tube or the inner peripheral surface of said tube.

[0035] Preferably, said web is formed by applying a plurality of flake-shaped particles of a water impermeable material to a carrier substrate.

[0036] According to one embodiment, during the formation of said web, said particles are embedded in a polymer matrix. The latter has the function of holding the particles together. It might form the carrying substrate itself or may complement such a carrying substrate by contributing to the adhesion of said particles to said substrate.

[0037] According to one embodiment, said polymer matrix is partially solidified when present in said web, and then fully solidified after attachment of said web to said body. Partial solidification of the matrix will improve the ability of the latter of holding the particles together, while still preserving a certain flexibility of the matrix. Upon subsequent solidification, preferably achieved by means of the addition of a chemical catalyser or heat or radiation, an improved adhesion of the web to said body may be achieved.

[0038] According to one embodiment, said polymer matrix comprises a thermosetting resin, partly hardened during web preparation and finally hardened when said web has been attached to said web.

[0039] Further features and advantages of the present invention will be disclosed in the following detailed description of preferred embodiments and in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] The invention will now be described more in detail with reference to the annexed drawing, on which

Fig. 1 shows schematically in a side view and partly in a longitudinal cross section, a bushing according to one embodiment of the invention,

Fig. 2 shows schematically in a side view and partly in a longitudinal cross section, a bushing according to another embodiment of the invention,

Fig. 3 shows schematically in a longitudinal cross section, a bushing with an outer hollow insulator according to a further embodiment of the invention,

Fig. 4 is a cross section according to IV-IV in fig. 1,

Fig. 5 is a cross section according to fig. V-V in fig. 2,

Fig. 6 is a cross section in an enlarged scale of a water barrier web used in accordance with the invention, and

Fig. 7 is a cross section in an enlarged scale of a part of the insulating element shown in fig. 4.

DETAILED DESCRIPTION OF THE INVENTION

[0041] Fig. 1 shows a bushing according to the invention provided with an electric insulation element 1 provided with a body 2 mainly comprised by electrically insulating material, and a water barrier 3. An electric conductor 4, which might be regarded as a part of the bushing, extends through said body 2 in a longitudinal direction of the latter. Said conductor 4 may be of tubular design or of rod-like design. The body 2 may be moulded directly on the conductor 4, which then functions as a mould core during moulding. Alternatively, the conductor is fit into the body 2 subsequently to the production, preferably moulding, of the latter. The task of the bushing is to provide for a safe transmission of electric current through a grounded barrier such as a transformer station wall without the upcoming of any flash-over or short circuit between the conductor 4 and said barrier. Thereby, the bushing is supposed to penetrate and be attached to said barrier.

[0042] In the embodiment of fig. 1, the insulation element also comprises an outer tubular member 5 provided with sheds 6 and enclosing the body 2 along at least a part of the length of the latter.

[0043] To avoid creepage current, an outer tubular member 5 of an elastomer, such as silicon or EP-rubber, or a ceramic material, is arranged on the outside of said body 2. The outer tubular member 5 is provided with bell shaped protrusions called sheds 6. A flange 7 extends in a radial direction from said body 2 for the purpose of fastening the bushing to a barrier such as a transformer station wall.

[0044] According to the invention, said body 2 comprises a electrically insulating material which is, however, also of a water absorbing character, said material preferably being paper, preferably wound to a tubular shape as shown in fig. 1 and subsequently impregnated with an electrically insulating material, preferably a polymer, preferably a thermosetting resin such as Epoxy, which is let to solidify in order to form a solid, electrically insulating body. However, other materials, such as thermoplastic polymers are also conceivable as the impregnation material, as well as suitable copolymers. Preferably, however, the impregnation material is impermeable to water to a certain degree in order to prevent moisture from being absorbed by the paper, something that would have a negative impact on the insulation capability of said body 2.

[0045] Inside said body 2, in a way known per se, there

might also be provided a plurality of elements such as plates (not shown in the figures) for the equalization of an electric field generated around the conductor 4. Preferably, said elements are arranged as one or more layers that are concentric with said body 2. Said elements may, preferably, comprise a metallic foil, preferably an aluminum foil, or conductive ink, and serve to control the electrical field internal and external to the bushing assembly. Said elements may be wound together with and thereby intercalated between separate windings of paper in the case of a body 2 comprising wounded paper.

[0046] In the embodiment of fig. 1 there is also provided a water barrier 3, or moisture barrier, for the purpose of preventing water from being absorbed by the water absorbing material of said body 2, i.e. the paper. The water barrier 3 has a higher impermeability with regard to water than has the impregnation material of the body 2. In fig. 1 the water barrier 3 is provided on the outer periphery of the tubular body 2 along the whole length of the latter. It might, however, be provided only along parts of the tubular body in which the risk of having a flash over or the like is enhanced, for example where there is a locally higher stray field from the conductor 4, or where said body is more subjected to moisture than at other parts thereof.

[0047] The water barrier 3 comprises a web 8, preferably wound to a plurality of layers thereof on the outer periphery of the body 2, as shown in fig. 4, and preferably to a thickness in the millimeter range or more. A cross section of said web, in an enlarged scale, is shown in fig. 6. Preferably, the web 8 comprises a plurality of particles 9 of a material that is more impermeable to water than said impregnation material. Preferably, the material of said particles 9 is also electrically non-conducting or of electrically insulating character. According to preferred embodiment, said particles are mainly comprised by mica. Said particles 9 should be flake-shaped with their main extension planes in parallel with each other and also in parallel with the main extension plane of the web 8. Preferably the thickness of the flake-shaped particles is only a fraction, preferably less than 1/10, of the dimension thereof in any direction thereof in said main extension plane. The flake-shaped particles overlap each other to a certain degree, thereby being positioned in parallel adjacent planes.

[0048] The particles 9 of the web 8 are dispersed in a polymer matrix 10. This matrix 10 may be provided during production of the web 8 itself, i.e. before the web 8 is attached to the body 2. It may then form part of or be a complement to a carrier substrate 11 that is used for carrying the particles 9 and which forms part of the web 8. The matrix 10 may, preferably, comprise a material compatible with the impregnation material of the body 2, i.e. a material with a high ability of adhesion to the impregnation material. Preferably, it comprises the same polymer as that of the impregnation material. In the case of the material being a thermosetting resin, it is preferred that it be only in a partially cured condition until the web

8 is attached to the body 2, and then fully cured in order to provide an improved adhesion to said body 2.

[0049] As an alternative to being attached to the body 2 after impregnation of the paper windings of the latter, the web 8 may be applied to the body 2 before impregnation thereof. Thereby, the matrix 10 may comprise the impregnation material used for the impregnation of the paper material of said body 2, and an even more reliable adhesion of the web to the underlying body 2 will be the result.

[0050] As mentioned earlier, there is provided a carrier substrate 11 that carries the particles 9 of the web 8 and which provides for a certain mechanical strength of the web 8. The carrier substrate 10 may be formed by only a matrix such as a polymer matrix in which the particles are dispersed or distributed, but is, preferably, a separate substrate onto which the particles, possibly dispersed in a polymer matrix, are deposited and attached. It is preferred that the web has a certain flexibility in order to adopt dimensional changes occasioned by dimensional changes of the body 2 due to, for example, curing of the impregnation material thereof. Therefore, it is preferred that the carrier substrate has a corresponding flexibility. In the preferred embodiment shown in fig. 6, this is achieved by means of providing the carrier substrate as a weft. Preferably, the material of the weft is glass, provided as glass fibres, or any suitable polymer, provided as threads or fibres connected into a weft-like design. Furthermore, the web 8 may be provided with an adhesive, such as a glue, on either or both of its opposite large sides, in order to provide for easy and ready attachment and adhesion to the underlying body 2.

[0051] With reference now also to fig. 7, the invention includes the idea of providing the web 8 in an intercalating manner between individual layers 25 or windings of paper of the body 2. This is achieved during the winding of the paper when forming said body 2. During the last, or first depending on the direction of winding, turns of the winding operation, the web 8 is wound together with the paper. Where the winding of the paper ceases a few extra turns of the web are provided on the periphery of the body in order to provide for a good outer protection. However, also the intercalated turns of the web 8 will add to the water barrier effect and will provide for extra safety in case of physical damage on the outer layers of the water barrier 3.

[0052] The provision of the water barrier 3 as a web or a tape is, above all, advantageous from a manufacturing and maintenance point of view, since it makes it easy to apply the barrier 3 onto the body 2 both during operation and during retro-fit thereof on already existing insulation elements 1. It also facilitates the provision of the water barrier 3 on specific, separate locations on the body 2, as well as an incorporation of the barrier 3 inside the body 2, as exemplified by the winding procedure described above. A water barrier 3 applied as a tape attached to the outer surface of said body 2 by means of an adhesive such as a glue, may, though partly depending on the

character of the adhesive, also be removed at a later stage by a unwinding procedure, if for some reason desired.

[0053] Fig. 2 shows a second embodiment of a bushing with an insulating element 12 according to the invention. In this case, also the inner periphery of the body 2 is provided with a water barrier 13 apart from the water barrier 3 provided on the outer periphery thereof. This might be a preferred solution in those cases when the conductor 4 is fitted into the body 2 at a later stage than during the production of the latter, and where there might be a risk of absorption of water through the inner periphery during storing and transportation of the insulation element 1 prior to the insertion of the conductor 4. A cross section of the body 2 provided with the outer water barrier 3 and the inner water barrier 13 is shown in fig. 5. Preferably, the barrier 13 is of similar design and applied in a similar way as the outer water barrier 3 disclosed earlier with regard to the embodiment of fig. 1 and further shown in figs. 6 and 7.

[0054] Fig. 3 shows a further alternative embodiment of a bushing with an electric insulation element 14 according to the invention. In this embodiment, the electric insulation element comprises an outer tubular insulator 15 provided around and with a certain distance to the conductor 4. The insulation element 14 further comprises an electrically insulating body 2 through which the conductor 4 penetrates and in contact with said conductor 4. Said body 2 is provided with a water barrier 3 on the outer periphery thereof, said water barrier 3 preferably being of similar design and applied in a similar way as the outer water barrier 3 disclosed earlier with regard to the embodiment of fig. 1 and further shown in figs. 6 and 7. There is also provided a space 16 between the outer periphery of said body 2-barrier 3 and the outer tubular insulator 15, said space preferably being filled with an insulating medium such as an insulating gas, preferably SF₆. The space is further delimited, in opposite ends thereof, by a first end cover 17 formed by a flange corresponding to the flange 7 described earlier, and a second end cover 18. Attached to the outside of the outer tubular insulator 15 there is provided an outer tubular element 19 with shreds 20 corresponding to the outer tubular element 5 and shreds 6 disclosed with regard to the embodiment of fig. 1.

[0055] The outer tubular insulator 15 comprises a body of an electrically insulating material, preferably a polymer, such as epoxy, preferably reinforced by fibres, for example glass fibres. A water barrier 21 is provided on the outer peripheral surface of said insulator 15, said water barrier 21 preferably being of similar design as the outer water barrier 3 disclosed earlier with regard to the embodiment of fig. 1 and further shown in figs. 6 and 7. There is also provided a water barrier 22 on the inner peripheral surface of said insulator 15. Preferably, also the inner water barrier 22 is of similar design as the outer water barrier 3 disclosed earlier with regard to the embodiment of fig. 1 and further shown in figs. 6 and 7, but

of course with duly regard taken to the fact that it is attached to the inner peripheral surface of said insulator 15. The main purpose of the water barriers 21 and 22 on the outer tubular insulator 15 is to further prevent water from reaching the body 2 of wounded paper. However, if the outer tubular insulator 15 itself is of water-absorbing character, said barriers 21, 22 may as well have as their purpose to prevent water from being absorbed by said outer tubular insulator 15 itself.

[0056] It should be understood that the above description of preferred embodiments has been made in order to exemplify the invention, and that alternative solutions will be obvious for a person skilled in the art, however without departing from the scope of the invention as defined in the appended claims supported by the description and the drawings.

[0057] For example, the web 8 may be applied to an outer surface of the body 2 with the carrier substrate 11 turned away, in an outward direction, from said body 2. However, it should be obvious that also the reversed position is conceivable.

[0058] It should also be noted that, during solidification, or curing of the water barrier web, more precisely the solidification of the matrix in which said particles are distributed, a pressure should be applied to the body covered by the web in order to prevent inclusions of air or gas from remaining in the material. Such pressure may be of a mechanical nature.

Claims

1. An electric insulation element (1, 14) comprising; a body (2, 15) that comprises a water absorbing, electrically insulating material; and a water barrier (3, 13, 21, 22) attached to said body (2, 15), **characterised in that** said water barrier (3, 13, 21, 22) is formed by a web (8) attached to said body (2, 15).

2. An electric insulation element according to claim 1, **characterised in that** said water barrier (3, 13, 21, 22) is attached onto an outer surface of said body (2, 15).

3. An electric insulation element according to claim 1 or 2, **characterised in that** said water absorbing, electrically insulating material is arranged as a plurality of layers (25) of said material overlapping each other, and that said water barrier (3, 13, 21, 22) is arranged between at least two of said layers (25).

4. An electric insulation element according to claim 3, **characterised in that** said water absorbing, electrically insulating material comprises a web wound to the shape of a tube, and that said water barrier web (8) is located between individual windings (25) of said tube in the region of a surface thereof.

5. An electric insulation element according to claim 4, **characterised in that** said surface is the outer peripheral surface of said tube.

6. An electric insulation element according to claim 4, **characterised in that** said surface is the inner peripheral surface of said tube.

7. An electric insulation element according to any one of claims 1-6, **characterised in that** said web (8) comprises a plurality of particles (9) of a water impermeable material carried by a carrier substrate (11).

8. An electric insulation element according to claim 7, **characterised in that** said particles (9) are flake-shaped.

9. An electric insulation element according to claim 8, **characterised in that** said flake-shaped particles (9) present a main extension plane that is parallel with the main extension plane of the web (8).

10. An electric insulation element according to claim 8 or 9, **characterised in that** at least some of said flake-shaped particles (9) are arranged in an overlapping relation to each other.

11. An electric insulation element according to any one of claims 7-10, **characterised in that** said particles (9) comprise an inorganic material.

12. An electric insulation element according to any one of claims 7-11, **characterised in that** said particles (9) comprise mica.

13. An electric insulation element according to any one of claims 7-12, **characterised in that** said body (2, 15) comprises an impregnating material in which said water absorbing, electrically insulating material is embedded, and that said carrier substrate (11) is made of a material apt to adhere to said impregnating material.

14. An electric insulation element according to any one of claims 7-15, **characterised in that** said carrier substrate (11) comprises a weft onto which said particles (9) are attached.

15. An electric insulation element according to claim any one of claims 7-14, **characterised in that** said particles (9) are carried by and dispersed in a polymer matrix (10).

16. An electric insulation element according to claim 15, **characterised in that** said body (2, 15) comprises an impregnating material in which said water absorbing, electrically insulating material is embed-

ded, and that said matrix (10) comprises the same material as said impregnating material.

17. An electric insulation according to any one of claims 1-16, **characterised in that** said water absorbing, electrically insulating material comprises paper. 5

18. An electric insulation according to any one of claims 1-17, **characterised in that** said water absorbing, electrically insulating material is impregnated with a polymer. 10

19. A bushing for an electrical device, **characterised in that** it comprises an electric insulation element (1) according to any one of claims 1-18. 15

20. A method of producing an electric insulation element comprising a body (2, 15) that comprises a water absorbing, electrically insulating material, comprising the step of 20

- providing said body (2, 15) with a water barrier (3, 13, 21, 22), **characterised in that** the water barrier (3, 13, 21, 22) is provided as a web (8) that is attached to said body (2, 15). 25

21. A method according to claim 19, **characterised in that** said web (8) is attached onto an outer surface of said body (2, 15). 30

21. A method according to claim 19 or 20, **characterised in that** said water absorbing, electrically insulating material is arranged as a plurality of layers (25) of said material overlapping each other, and that said water barrier (3, 13, 21, 22) is arranged between at least two of said layers (25). 35

22. A method according to claim 21, **characterised in that** said water barrier (3, 13, 21, 22) is arranged between at least two of said layers (25) in the region of an outer surface of said body (2, 15). 40

23. A method according to any one of claims 20-22, **characterised in that** said body (2, 15) is formed by wounding a web (8) of said water absorbing, electrically insulating material to the shape of a tube, and that said water barrier (3, 13, 21, 22) web (8) is arranged between individual windings of said tube in the region of a surface thereof. 45 50

24. A method according to claim 23, **characterised in that** said water barrier (3, 13, 21, 22) web (8) is wound together with said web (8) of said water absorbing, electrically insulating material. 55

25. A method according to claim 23 or 24, **characterised in that** said surface is the outer peripheral

surface of said tube.

26. A method according to claim 23 or 24, **characterised in that** said surface is the inner peripheral surface of said tube.

27. A method according to any one of claims 20-26, **characterised in that** said web (8) is formed by applying a plurality of flake-shaped particles (9) of a water impermeable material to a carrier substrate (11).

28. A method according to claim 27, **characterised in that**, during the formation of said web (8), said particles (9) are embedded in a polymer matrix (10).

29. A method according to claim 28, **characterised in that** said polymer matrix (10) is partially solidified when present in said web (8), and fully solidified after attachment of said web (8) to said body (2, 15).

30. A method according to claim 29, **characterised in that** said polymer matrix comprises a thermosetting resin, partly hardened during web (8) preparation and finally hardened when said web (8) has been attached to said web (8).

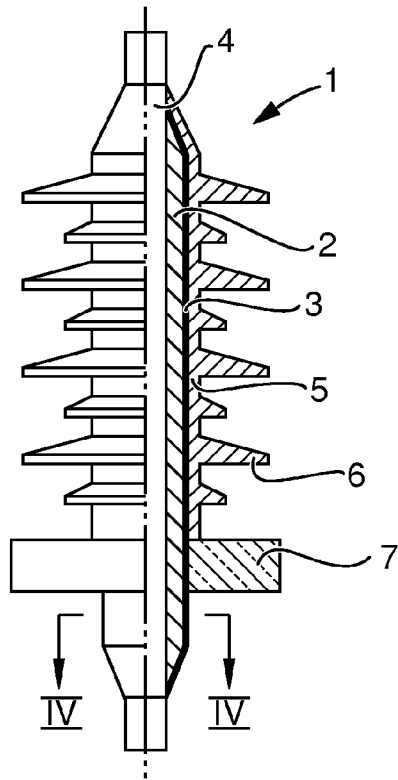


Fig 1

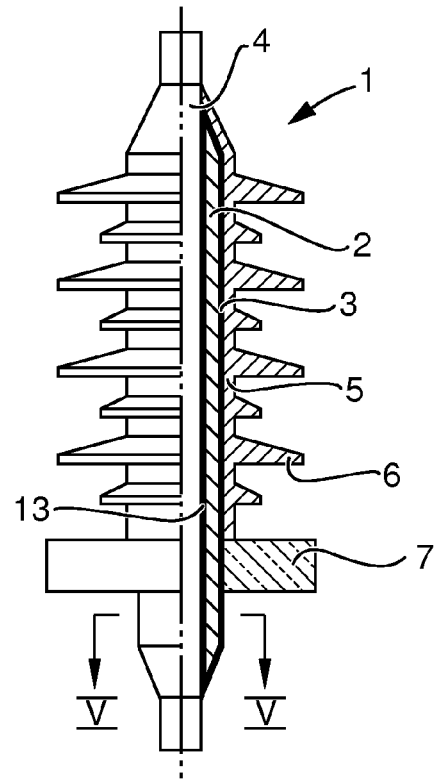


Fig 2

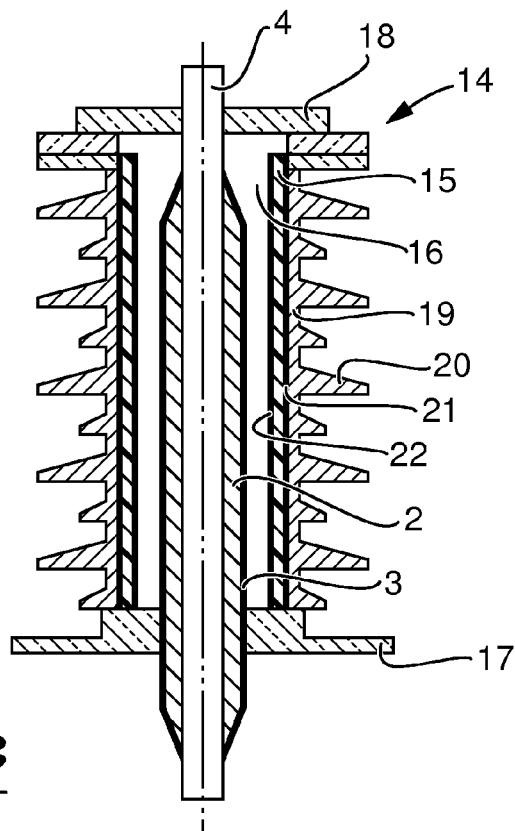


Fig 3

VII - VII

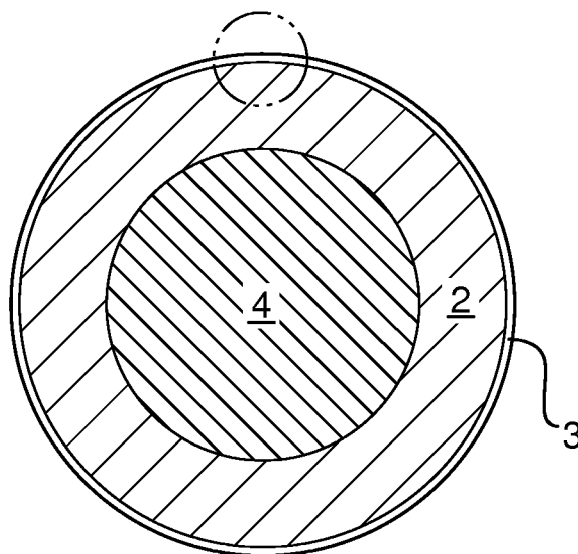


Fig 4

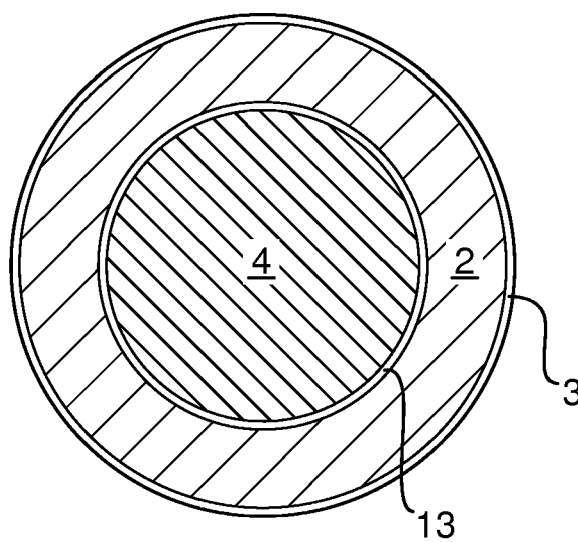


Fig 5

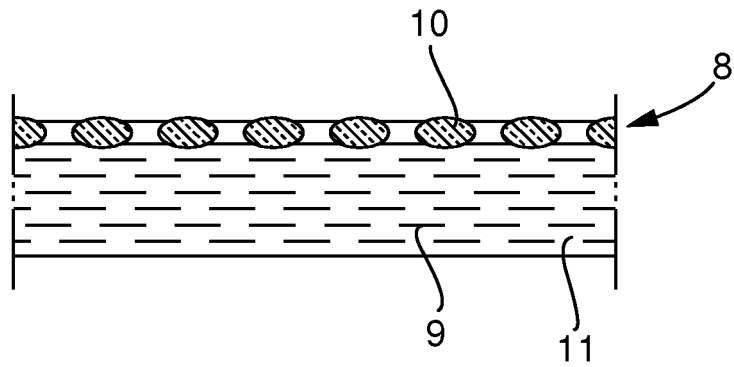


Fig 6

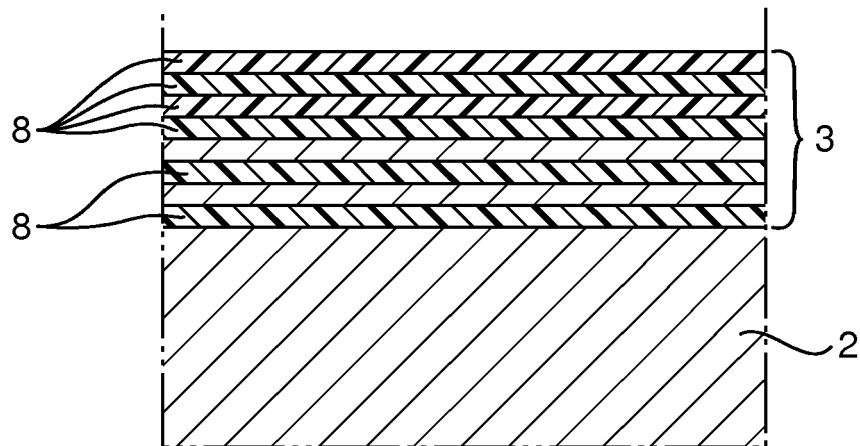


Fig 7



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 44 6002

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A D,A	WO 2005/006355 A (ABB RESEARCH LTD [CH]; ISBERG PETER [SE]; OENNEBY CARINA [SE]; JOHANSS) 20 January 2005 (2005-01-20) * page 6, line 10 - line 15; figure 1 * & SE 526 713 C2 (ABB RESEARCH LTD [CH]) 25 October 2005 (2005-10-25) -----	1,20	INV. H01B17/30
			TECHNICAL FIELDS SEARCHED (IPC)
			H01B H01F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 21 June 2007	Examiner Salm, Robert
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 P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

2
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 44 6002

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-06-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2005006355 A	20-01-2005	BR PI0412467 A	19-09-2006
		CN 1894754 A	10-01-2007
		EP 1644940 A1	12-04-2006
		SE 526713 C2	25-10-2005
		SE 0302091 A	08-03-2005

SE 526713 C2	25-10-2005	BR PI0412467 A	19-09-2006
		CN 1894754 A	10-01-2007
		EP 1644940 A1	12-04-2006
		SE 0302091 A	08-03-2005
		WO 2005006355 A1	20-01-2005

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- SE 526713 [0013]