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(54) **Insulation kit for electricity substations**

(57) An insulation kit 20 for an electricity substation 1 on a medium-tension line, said substation 1 comprising at least one electrical line input/output terminal 12,12',13,13',14,14' and at least one transformer TA1, TA2,TV1, TV2 provided with at least one contact element 40 that can be connected to said terminal by means of conductive means. The conductive means can be fixed to said contact element by means of a clamp 6,6',7,7'.

The insulation kit 20 is characterized in that it comprises at least one protective hood 21 that can be attached to the transformer to provide a watertight cover for said clamp and t insulate it from electric discharges, said hood 21 permitting the passage of said conductive means 8,8'9.

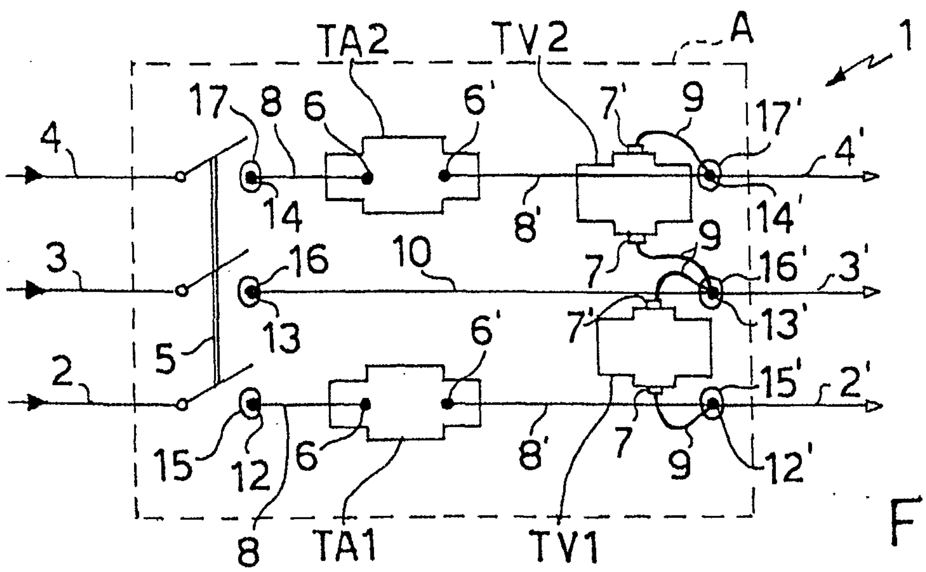

FIG.1

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Description

[0001] The present invention concerns installations for the distribution of electric energy and, more particularly, refers to an insulation kit for electricity substations installed on medium-tension transmission lines.

[0002] As is well known, the installations for the distribution of electric energy comprise medium-tension lines (1kV - 30 kV) that, starting from the terminal stations of high-tension lines, actually feed the substations (distribution boxes) situated in the various consumption centres. Such consumption centres may be constituted by individual industrial users or by a series of private or household users. In the case of household users, in particular, the substations are commonly used to transform the incoming electricity from medium voltages to low voltages. When the substations serve some industrial users, on the other hand, it may happen that the substation in question will not be required to transform the electric energy. In these cases the function of the substations is confined, for example, to measuring the supplied quantity of medium-voltage electricity for billing purposes.

[0003] Notwithstanding the continuous and gradual evolution of the installations and the equipment used for the distribution of electricity, breakdowns in the distribution system are still very frequent.

[0004] These breakdowns are the cause of considerable costs sustained by the electricity suppliers, who have to assure either the repair or the replacement of the defective equipment. Moreover, such breakdowns can be the cause of poor service and in some cases actually lead to interruption of the electricity supply for short or longish periods, often causing considerable problems for the users.

[0005] In particular, a high percentage of these breakdowns occurs in substations installed on medium-tension lines and is caused by undesired arcs or electrical discharges. Such discharges may be the consequence of various phenomena, including condensation, dust accumulation, water infiltration and contact with animals, especially rats, birds and reptiles.

[0006] Such discharges cause damage to the electrical equipment (transformers, for example) installed in the substations. In particular, frequent micro-discharges will lead to a rapid and continuous deterioration of the equipment, while high-intensity discharges will generally be the cause of irreparable damage.

[0007] Conventionally, the electrical equipment of the medium-voltage substations may either be installed in the open air or enclosed in special cubicles, these latter being intended to perform a protective function for the equipment they contain.

[0008] Numerous expedients are known for making it less likely that such undesired discharges will occur in substations. For example, extensive use is made of insulators that generally have the function of sustaining the substation conductors connected to the medium-tension line while yet keeping them insulated form the rest of the substation. When substations are enclosed in boxes or cubicles, for example, the insulators have the function of keeping the conductors away from the walls and maintaining a good dielectric insulation between the conductors and the walls. To this end, conducting metal stirrups are often attached to one end of these insulators and, in their turn, serve to fix the ends of one or more medium-voltage conductors.

[0009] In some cases these insulators also perform the function of supporting the conductors, in which case they are usually referred to as "stand-off insulators". The particular forms and materials used for making the insulators have to be such as to confer upon the insulators good characteristics of both mechanical strength and electrical resistance.

[0010] Another expedient employed for reducing the breakdowns at substations is to use insulating materials for the construction electrical equipment that will interface with high-voltage conductors. For example, it is a common practice to enclose transformers in outer shells made of high-insulation resins.

[0011] Though extensively used, these solutions known to the state of the art do not assure a sufficient immunity from undesired electrical discharges and the breakdowns they cause still constitute a frequently-occurring event.

[0012] The present invention therefore sets out to provide an insulation kit for electricity substations that will make it possible to reduce the causes of damage that are associated with conventional medium-voltage substations.

[0013] This aim is attained by means of an insulation kit as described in the first claim hereinbelow.

[0014] A further aim of the present invention is to provide an electricity substation as described in Claim 17.

[0015] Further characteristics of the invention and its advantages will be brought out more clearly by the detailed description about to be given of some preferred embodiments thereof, which are to be considered as examples and not limitative in any way, said description making reference to the attached drawings of which:

- Figure 1 shows the schematic layout of a conventional-type electricity substation on a medium-tension line;
- Figure 2 shows a particular example of an insulation kit in accordance with the present invention;
- Figure 2a shows some of the components of the insulation kit of Figure 2 in greater detail;
- Figure 3 shows the part of the electricity substation of Figure 1 in which there is installed an insulation kit in accordance with the present invention;
- Figures 4a and 4b show various views of a protective hood that can be employed in the insulation kit in accordance with the invention;
- Figure 5a shows a perspective view of a voltage transformer;

- Figure 5b shows a section through a clamp that can be used for making connections to current and voltage transformers;
- Figure 5c shows a section through the hood of Figure 4a when attached to the transformer of Figure 5a;
- Figure 6 shows a section through an insulating adapter that can be employed in the kit in accordance with the present invention, and
- Figures 7a, 7b and 7c show other components of the kit in accordance with the present invention and possible ways in which they can be mounted in the substation of Figure 1.

[0016] Referring to these drawings, there will now be described a preferred embodiment as an example of the insulation kit in accordance with the invention. In particular, this kit is intended for the insulation of an electricity substation 1 that - in this example - comprises a cubicle A, preferably with walls made of metal, capable of protecting the electrical equipment of substation 1.

[0017] The embodiment of the present invention about to be described refers in particular to an insulation kit for an electricity substation 1 with medium-voltage measuring equipment. Substations of this type are extensively used for the direct measurement in medium-voltage of the quantity of electricity supplied to an industrial-type user.

[0018] In this connection it should be noted that the teachings of the present invention can be extended also to applications other than those explicitly referred to in the description about to be given.

[0019] As can be seen from Figure 1, the substation 1 comprises two current transformers (TA), indicated respectively by TA1 and TA2, and two voltage transformers (TV), indicated respectively by TV1 and TV2. The substation 1 is connected to a medium-tension transmission line of the three-phase type, the conductors leading this line into and out of the substation being indicated, respectively, by 2,3,4 and 2',3',4'.

[0020] It is a common practice for an input disconnecting switch 5 to connect/disconnect the input terminals 12,13,14 of the substation to/from the input line 2,3,4. In the particular example of Figure 1, the electricity substation 1 is provided with output terminals 12',13',14', that are connected directly to the conductors 2',3',4' of the medium-tension line.

[0021] As already mentioned, in medium-tension substations it is a common practice for the conductors connected to the medium-tension line to be supported by insulating candles (or stand off insulating candles) that in the figure are indicated by 15,16,17 on the input side and by 15',16',17' on the output side.

[0022] In this connection it should be noted that in accordance with the particular embodiment of the present description, the input terminals 12,13,14 and the output terminals 12',13',14' of substation 1 are represented in the immediate proximity of the respective input and output insulators 15,16,17 and 15',16',17'. It should be borne in mind, however, that, as used in the present description, the term "input/output terminal" of the substation is not intended to indicate a precise physical point or component of the substation, but rather a generic point - situated within the substation and connected to the medium-tension line - that in a logic sense represents an input/output gate for the medium voltage.

[0023] Each current / voltage transformer is provided with a pair of contact elements (not shown in Figure 1) that represent the input gate of the primary transformer winding. By means of these contact elements the primary transformer winding can be connected to the medium-tension line. More precisely, each contact element can be connected to an input/output terminal of the substation by means of electrically conductive means, for example, by means of an electric conductor that can be fixed to the contact element with the help of a clamp.

[0024] In particular, in substation 1 the contact elements of the primary winding of current transformer TA1 are connected to, respectively, the output terminals 15' and 16' by means of electric connection means, for example, respective electrical conductors 9 that can be attached to said contact elements by means of respective clamps 6, 6'.

[0025] Similarly, the contact elements of the primary winding of the voltage transformer TV1 are connected to, respectively, to the output terminals 15' and 16' by means of electrical connection means, for example, respective electrical conductors 9 that can be attached to said contact elements by means of respective clamps 7,7'.

[0026] In substation 1 of Figure 1 the input and output terminals 16 and 16' are directly connected to each other by means of electrical connection means, for example, an electrical conductor 10.

[0027] The connections of the remaining transformers TA2, TV2 can be readily deduced from Figure 1.

[0028] Typically, in a substation of the type represented in Figure 1 the secondary windings of the transformers TA1, TA2, TV1 and TV2 will provide low-voltage or small-current outputs to permit measurement of the power supplied to the user connected to the three-phase output line 2',3',4'. In this example, in particular, substation 1 permits the supplied power to be measured by means of a measuring method known as "Aron measurement".

[0029] Figure 2 shows the various components of an example an insulation kit 20 in accordance with the invention that can be used in substation 1.

[0030] The insulation kit 20, hereinafter often referred to more simply as the "kit", comprises a protective hood 21 of a first type that can be used with the current/voltage transformers TA1, TA2, TV1 and TV2.

[0031] In a preferred embodiment the number of protective hoods 21 of the first type comprised in the kit 20 is equal to eight.

[0032] The kit 20 also includes an insulating adapter

22 of a first type that can be fixed to the current transformers TA1, TA2. Each adapter 22 makes it possible to attach a respective protective hood 21 of the first type to a respective current transformer TA1, TA2.

[0033] In a preferred embodiment of the invention the number of insulating adapters 22 of the first type comprised in the kit 20 is equal to four.

[0034] Also comprised in the kit 20 is at least one electrically insulating annular gasket suitable for being interposed between an insulating adapter 22 of the first type and a current transformer TA1, TA2 when the adapter is attached to the current transformer. In a preferred embodiment the kit will advantageously comprise annular gaskets 23 of three types, each of different dimensions, so as to make it possible for the adapter to be attached to transformers of different external shapes.

[0035] The insulation kit 20 also comprises at least one protective hood 24 of a second type that can be used with the output insulators 15',16',17'. In a preferred embodiment the number of protective hoods 24 of the second type comprised in the kit will be equal to three.

[0036] The kit 20 also includes an insulating adapter 25 of a second type that can be attached to the output insulators 15',16',17', each adapter 25 being such as to permit a protective hood 24 of the second type to be fixed to a respective insulator. In a preferred embodiment the number of insulating adapters 24 of the second type comprised in the kit 20 is equal to three.

[0037] The kit 20 further includes a stirrup 26' of a first type and a stirrup 26 of a second type.

[0038] The stirrup 26' of the first type is electrically conductive and can be attached to one end of an input insulator, for example, insulator 15. We may suppose that this stirrup physically represents, though without any limitation whatsoever, an input terminal, for example, the terminal 12.

[0039] The stirrup 26 of the second type is electrically conductive and can be attached to one end of an input insulator, for example, insulator 15'. We may suppose that this stirrup physically represents, though without any limitation whatsoever, an input terminal, for example, the terminal 12'.

[0040] Preferably the kit will comprise three stirrups 26' of the first type and three stirrups 26 of the second type.

[0041] Also comprised in the kit are the electrical connection means 8,8',9,10, which are shown in greater detail in Figure 2a. The connection means 8,8,9,10 are preferably in the form flexible electrical cables that comprise at least a metallic conductor 33 of the type, for example, comprising a plurality of plaited copper or aluminium wires, contained in a insulating and waterproof sheath 34. The insulating sheath preferably has a thickness of about two millimetres and is made of a silicon rubber mix such as to render it highly resistant to tearing, self-extinguishing, of low toxicity and with the optical density of smoke.

[0042] For the sake of simplicity said electrical connection means will henceforth be referred to by the terms "electrical cables" of "cables".

[0043] Preferably the cable ends will be provided with metallic lugs 27,27' jointed to the metallic conductor 33. A terminal lug 27,27', preferably made of copper or aluminium, consists of platelet 29 comprising a hole 29' and integral with a joint 28 that - in the example here described - consists of a substantially tubular element.

[0044] The cables 8,8'9 (of the type of cable 8 as shown in Figure 2a) are such as to permit the contact elements of the transformers TA1,TA2,TV1,TV2 to be electrically connected to their respective input/output terminals. The cables 8,8',9 may be of different lengths and, in a preferred embodiment, will measure, respectively, about 25 cm, about 65 cm and about 35 cm.

[0045] The cable 10, on the other hand, is used to provide an electrical connection between terminals, for example, between the input terminal 16 and the output terminal 16', and preferably has a length of about 100 cm.

[0046] Furthermore, still in a preferred embodiment, the end of these cables intended to be attached to the input/output terminals of the substation (in this case to the stirrups) also comprises a sleeve 69 that is superposed partly on the insulating sheath 34 and partly on the lug 27, such to adhere both to the sheath and the lug in an elastic and watertight manner.

[0047] In a preferred embodiment the sleeve 29 is made of waterproof and electrically insulating plastic material, for example, silicone rubber.

[0048] It should be noted from Figure 2a that cable 10 differs from cable 8 (and therefore also from cables 8' and 9) not only by its different length, but also and exclusively by virtue of the fact that, being intended to interconnect two terminals, it is provided with sleeves 69 at both ends. In a preferred embodiment the kit will include two cables 8 (length 25 cm), two cables 8' (length 65 cm), four cables 9 (length 35 cm) and one cable 10 (length 100 cm).

[0049] Lastly, the kit includes nuts, screws, bolts, washers of various types and sizes, all generically indicated in the figure by the letter V, for fixing the adapters to the transformers or the insulators and connecting the cables to the terminals or the contact elements.

[0050] The various components of the insulation kit will now be described in greater detail by reference to Figure 3. In particular, Figure 3 shows some of the components of the kit used for obtaining the insulation of the part of the substation comprised between the terminals 12 and 12'.

[0051] As can be seen from Figure 3, each of the transformers, i.e. current transformer TA1 and voltage transformer TV1, is provided with two protective hoods 21 of the first type.

[0052] A particular embodiment of the hood 21 of the first type is shown in greater detail in Figures 4a and 4b, which also show various views thereof. In particular, Figure 4b shows a section along the line A-A' through the hood 21 of Figure 4a. The protective hood 21 is preferably made of silicone rubber or natural rubber and can be produced by means of convention moulding techniques.

[0053] The hood 21 makes it possible to provide a waterproof cover for one terminal of the transformer and to insulate it from electric discharges and is designed in such a way as to permit the passage of the electric cable that connects a contact element of the transformer to a line terminal.

[0054] In a preferred embodiment the hood 21 comprises a principal body 21', substantially shaped in the manner of a cap, provided with a tubular appendix 31 that communicates with the principal body 21' through a connection hole 30. The hole 30 permits the passage of an electrical cable, for example, cable 9. One end of the tubular appendix 31 comprises an elastic annular border 32 of adhering elastically to the electrical cable 9. In particular, since the cable is preferably constituted by a conductor 33 enclosed in a sheath 34 made of insulating and waterproof material, the elastic adhesion of the border 32 of the end of tubular appendix 31 of the hood 21 to the sheath 34 makes it possible to avoid water infiltrating into the hood 21 and to interrupt the surface layers of dirt or humidity before they reach the transformer terminals.

[0055] As can be seen from Figure 3, the substation terminals (indicated in the figure by 12 and 12') are usually situated at a higher level than the transformer terminals. For this reason, trickles of water due to condensation, humidity or infiltration will tend to descend along the electrical cables and reach the transformer terminals.

[0056] In a preferred embodiment both the sheath 34 and the hood 21 are made of silicone rubber and the elastic adhesion is obtained by sizing the annular border 32 of the tubular appendix 31 in such a way as to make its internal diameter smaller than the outside diameter of the sheath 34. These choices make it possible to obtain not only an excellent impermeability, but also high electrical insulation, since silicone rubbers have a very high dielectric rigidity (generally better than 15kV/mm).

[0057] As can be seen from Figures 4a and 4b, the base of the principal body 21' of the hood 21 of the first type is provided not only with an opening or mouth 35, but also with an elastic edge 36, which together assure a waterproof joint between hood and transformer.

[0058] Figure 5a shows greater details of a voltage transformer similar to, say, transformer TV1 of Figure 3. This transformer comprises a contact element 40 that constitutes one end of the primary winding. This contact element 40 can be connected by means of an electrical cable, the cable 9 for example, to an output terminal of the medium-tension line like the terminal 12' of Figure 3. The electrical cable 9 can be fixed to the contact element by means of a clamp, for example, the clamp 7.

[0059] In a preferred embodiment the contact element 40 is constituted by a threaded cavity 41 provided with electrically conductive walls. Figure 5b shows a clamp 7 capable of attaching and electrical cable, the cable 9 say, to the contact element 40. This clamp comprises a substantially cylindrical metal element 42 that is threaded and can therefore be attached to the threaded cavity 41. A terminal lug of cable 9, indicated by 27', is such as to permit its being fitted onto the pin 42. The attachment of the terminal lug 27' - and therefore of cable 9 - to the pin 42 can be obtained by means of one or more washers and one or more nuts, as may be required in each particular case.

[0060] Figure 5c shows a section through the hood 21 when it is fitted to a voltage transformer TV1. More precisely, the hood 21 is attached to an upstand collar 46 of the transformer TV1 that surrounds the contact element 40. The collar is made of electrically insulating material, resin for example.

[0061] One end of the collar 46 of the transformer TV1 is provided with a rigid annular edge 46 that projects from the body 43 of the collar 46. The undercut 45 defined by the rigid edge 44 and the body 43 makes possible the formation of a watertight joint with the elastic edge 36 of the mouth 35 of the hood 21.

[0062] As can be seen in Figure 5c, the watertight joints between the hood 21 and, respectively, the cable 9 and the transformer TV1 define a chamber 47 that constitutes a waterproof environment that is electrically insulated from the outside and encloses the clamp 7 and the terminal lug 27'.

[0063] Similarly, in accordance with the electrical scheme of Figure 1, a protective hood 21 of the first type is used to protect the other clamp 7', similar to the clamp 7, of the primary winding of the voltage transformer TV1.

[0064] Turning back to Figure 3, it should be noted that the hood 21 of the first type is also suitable for being fitted to a current transformer, TA1 for example. In this case, however, since this type of transformer is not provided with the upstand collars that make it possible for the hoods 21 to be fitted to voltage transformers, use has to be made of the insulating adapters 22 of the first type forming part of the insulation kit 20.

[0065] The details of an insulating adapter 22 are shown in Figure 6 in the form of a section through the adapter and the other components of the connection. In this case the adapter comprises a base, which may be square for example, that can be made to bear against a wall 51 of the transformer TA1 in proximity of one of its contact elements 40. In a preferred embodiment the adapter 22 is rigid and made of insulating material, PVC for example.

[0066] An opening in the base 52 makes it possible for the adapter 22 to be attached to the transformer. In particular, the adapter 22 of the first type can be fixed to the transformer by means of a clamp 6 (which, for example, may be identical with the clamp previously describe in detail in connection with Figure 5b). In this case the clamp 6 performs the twofold function of assuring the electrical connection of cable 8 and the mechanical attachment of the insulating adapter 22 of the first type.

[0067] The base 50 of adapter 22 preferably comprises one or more grooves 52 to accommodate one or more insulating gaskets 23 made of elastic material.

[0068] The adapter also comprises a collar 53 integral with the base 50. The upper end of the collar 53 is provided with a rigid annular edge 54 that projects from the body of the collar 53. The undercut 55 constituted by the rigid edge 54 and the body 53 makes possible the formation of a watertight joint with the elastic edge 36 of the mouth 35 of the hood 21 of the first type.

[0069] In analogy with what has already been explained in connection with a voltage transformer, in this case, once again, the arrangement constitutes a chamber, not shown in the figure, that protects the clamp 6 against infiltrations and insulates it from electrical discharges.

[0070] In this case, moreover, the use of gaskets 23, preferably made from silicone-base materials, permits the insulating adapter 22 of the first type to be attached to the transformer TA1 in a watertight manner, thus avoiding the dangerous infiltrations of water deriving from a possible imperfect adhesion of the adapter 22 to the transformer TA1 when the adapter 22 is mounted on the transformer.

[0071] Similarly, in accordance with the electrical scheme of Figure 1, a protective hood 21 of the first type is used to protect the other clamp 6', similar to the clamp 6, of the primary winding of the current transformer TA1.

[0072] As shown by Figure 3, the protective hoods can also be used to protect the ends of the input/output insulators of the electricity substation in the vicinity of the input/output terminals. Conventionally these ends have a certain quantity of metallic parts that remain exposed and are therefore neither insulated nor protected.

[0073] Figures 7a and 7c show the details of a stand-off output insulator 15' in accordance with the present invention as used in an electricity substation. At one end of the insulator 15' there can be fixed an adapter 25 of the second type and a metal stirrup 26 of the second type. For example, the fixing can be obtained - as shown in Figure 7a - by means of nuts 63 and headless stud 63, the latter passing through holes 61, 62 appropriately arranged in the adapter 25 of the second type and the stirrup 26 of the second type. These studs can be screwed into respective threaded cavities 60 provided in the end of the insulator 15'.

[0074] As can be seen in Figure 7b, the insulating adapter 25 of the second type (shown in section in the figure) may be, for example, of a substantially cylindrical form and defines an opening 67 that permits the adapter 25 to be fitted onto the insulator 15', a side wall 66 and a bottom 68 integral with the side wall. In the region in which the wall merges into the bottom 68 the adapter a projecting edge that permits the formation of watertight joint with an insulating hood of the second type. The shape and the size of the adapter may be varied according to the type of stand-off insulator 15' used in the substation. The insulating adapter of the second type is preferably made of PVC.

[0075] Figure 7c illustrates a hood 24 of the second type attached to the insulator 15' of Figure 7b by means of an adapter 25 of the second type. To all intents and purposes, the hood 24 of the second type has a structure and functions similar to those of the hood 21 of the first type. Apart from the size, the only difference to be highlighted consists of the fact that the hood of the second type comprises a hole, not shown in the figure, and a tubular appendix 58 that projects towards the outside and is integral with the hole, appendix and hole being of such size as to permit the passage of a stirrup 26 of the second type rather than a connecting cable. An annular edge of at the free end of said tubular appendix 58 is such as to adhere elastically to the stirrup 26 and to sheath it at least partly in such a way as to reduce the exposed metal parts of the stirrup 26.

[0076] The stirrup 26 of the second type has a hole 59 that serves for the mechanical attachment and the electrical connection of the output cable of line 2' to the internal connection cables 9,8' of the substation connected to, respectively, the transformers TV1 and TA1 and shown in Figure 3. For the sake of simplicity, only cable 9 is shown in the figure.

[0077] The cables are attached/connected to the stirrup by means of, for example, a nut D that can be tightened on pin P passed through the hole 59 of the stirrup 26 and each terminal lug 27 of the cables.

[0078] The insulation kit of the present invention assures the partial protection (i.e. sheathing) of the stirrup 26 of the second type by the insulating hood 24. Furthermore, the stirrup 26 is smaller in size than conventional stirrups. In a preferred embodiment the stirrup 26 has a length of about 12 cm and only a small part of this (typically about 4-5 cm) will not be protected by the hood 24.

[0079] It should also be noted in Figure 7c that, as previously mentioned, the ends of the connection cables (cable 9 in the figure) of the kit in accordance with the invention intended for fixing to the input/output terminals (in this case the stirrup 26) comprise an elastic sleeve 69 that is superposed partly on the insulating sheath of the electric cables and partly on the terminal lug 27 and adheres in a watertight manner to both the insulating sheath and the terminal lug 27.

[0080] Apart from having the important function of reducing the exposed metal parts of the terminal lug, the sleeve 69 makes it difficult for particles of undesired substance (such a water and dust) to penetrate between the sheath and the conductor, where they would cause the deterioration of the cables and facilitate the formation of electric arcs.

[0081] Lastly, coming back to Figure 3, it should be noted that the kit also envisages the fitting of a stirrup 26' of the first type to the input insulators, the insulator 15' for example. Except for its size, stirrup 26' of the first type is wholly similar to the previously described stirrup 26 of the second type. As is well known to a person skilled in the art, an input insulator 15 in this particular example, being associated with an input disconnecting switch, has a form that differs slightly from the form of an output insulator 15'. This form makes it difficult to fit a protective hood to these insulators. For this reason, in a preferred embodiment the stirrup 26' of the first type, which lacks the partial protection/sheathing of an insulating hood, is of a smaller size (essentially of a shorter length) than a stirrup of the second type, this in accordance with the principle of the insulation kit of reducing the exposed metal parts in the electricity substation to a minimum.

[0082] In Figure 3 it should also be noted that the end of cable 8 fixed to the stirrup 26' is once again provided with a sleeve.

[0083] The advantages of the present invention can be made clear by referring once more to Figure 3, which shows that the components of the kit needed to insulate the parts of the substation comprised between the input terminal 12 and the output terminal 12'.

[0084] In the light of the detailed description given above, it should be noted that the conductive parts that in an electricity substation (distribution box) are conventionally naked/exposed, i.e. not covered by insulating material, are reduced to a minimal percentage with the insulation kit of the present invention.

[0085] In this connection it should further be noted that the combined use of hoods, adapters (possibly with gaskets), cables with sheaths and sleeves, all fitted in a watertight manner, protects the conductive electrical parts against water and renders them highly insulated. In particular, the kit as represented in Figure 2 makes possible the advantageous protection and insulation of about 95% of the exposed parts conventionally present in a substation. Thanks to its high surface resistivity, its excellent hygroscopic properties and its high thermal stability, the choice of silicone rubber for the hoods, the gaskets and the sleeves and sheaths of the cables makes it possible to obtain an excellent dielectric sealing of the substation and to maintain it in the course of time, thus assuring a long life for the equipment contained in it.

[0086] Obviously, when a person skilled in the art finds himself faced with contingent and specific problems, he will be able to introduce numerous modifications and variants into the insulation kit as described above, though without thereby going beyond the protection limits of the invention as defined in the claims attached hereto.

Claims

1. An insulation kit (20) for an electricity substation (1) on a medium-tension line (2,2',3,3',4,4'), said substation comprising at least one electrical line input / output terminal (12,12', 13,13',14,14'), at least one transformer (TA1,TA2,TV1, TV2) comprising at least one contact element (40) that can be electrically connected to the electrical terminal by means of conductive means (8,8',9), said conductive means being capable of being attached to said contact element by means of a clamp (6,6',7,7'), said kit (20) being **characterized in that** it comprises also:

    at least one first protective hood (21) that can be fitted to said transformer (TA1,TV1) to provide a watertight cover for the clamp (6,6',7,7') and insulate it from electric discharges, said first hood (21) permitting the passage of the conductive means (8,8',9) and comprising an opening (35) provided with an elastic edge (36) to form a watertight joint with said transformer (TA1,TV1,TA2,TV2).

2. An insulation kit in accordance with Claim 1, wherein said first hood (21) is made of elastic material and consists of a principal body (21') provided with a tubular appendix (31) that communicates with the principal body (21') by means of a connection hole that permits the passage of the conductive means (8,8',9), one of the tubular appendix (31) comprising an annular elastic border (32) such as to adhere to the conductive means in an elastic and watertight manner.

3. An insulation kit in accordance with Claim 1, that includes said conductive means, comprising at least one metallic conductor (33) and an insulating sheath (34) enclosing the conductor.

4. An insulation kit in accordance with Claim 1, wherein said transformer TV1,TV2) comprises an upstand collar (46) in proximity of said contact element (40), one end of said collar being provided with a rigid annular edge (46) that projects from the body of the collar and is suitable for forming a watertight joint with the elastic edge (36) of the opening of the first hood (21).

5. An insulation kit in accordance with Claim 1, comprising also a first insulating adapter (22) that can be attached to said transformer (TA1,TA2) in proximity of said contact element (40), said first protective hood (21) being capable of forming a watertight joint with said first insulating adapter (22).

6. An insulation kit in accordance with Claim 5, wherein the first insulating adapter (22) comprises a base (50) that can be made to bear against a wall (51) of said transformer and comprises a collar (53) integral with the base (50) and provided at one of its ends with a rigid annular edge (54) that projects from the body of the collar and is capable of forming a watertight joint with the elastic edge (36) of the

opening of the of the first hood (21).

7. An insulation kit in accordance with Claim 6, wherein said base (50) includes at least one groove (52) to accommodate an electrically insulating annular gasket (23) that can be interposed between the base (50) and the transformer.

8. An insulation kit in accordance with Claim 1, wherein said electricity substation (1) comprises an input/output insulator (13,13',14,14',15,15') in proximity of said input/output terminal and wherein the insulation kit also comprises a second protective hood (24) that can be attached to said insulator and is provided with an opening that has an elastic edge to form a watertight joint with said insulator.

9. An insulation kit in accordance with Claim 8, that also comprises at least one insulating adapter (25) that can be attached to one end of said insulator, said second protective hood (24) being capable of forming a watertight joint with said second insulating adapter (25).

10. An insulation kit in accordance with Claim 9, wherein said second insulating adapter (25) is of a substantially cylindrical form and defines a recess (67) that permits its being fitted onto the insulator, a lateral wall (66) and a bottom (68) of that recess and, in a region where the wall (66) merges with the bottom (68), a projecting edge that permits the formation of a watertight joint with said second protective hood (24).

11. An insulation kit in accordance with Claim 8, that also comprises at least one metallic stirrup (26) capable of being fixed to the end of said insulator and wherein said insulator (24) comprises a hole and a tubular appendix integral with the hole, the tubular appendix comprising an annular edge at its free end such as to permit the passage of the at least one stirrup (26) and to adhere elastically thereto, said tubular appendix and said second hood being such as to cover at least part of the said at least one stirrup (26) and to reduce the exposed metallic parts of said stirrup.

12. An insulation kit in accordance with Claim 11, that comprises at least one other stirrup (26') of smaller length than the at least one stirrup (26).

13. An insulation kit in accordance with Claim 3, wherein said conductive means also include a first and a second terminal lug (27,27') jointed to the respective opposite ends of said metallic conductor (33).

14. An insulation kit in accordance with Claim 13, wherein said conductive means also include an elastic and insulating sleeve (69) in proximity of at least on terminal lug (27), said sleeve being superposed partly on said terminal lug (27) and partly on said insulating sheath (34).

15. An insulation kit in accordance with Claim 3, wherein said conductive means are flexible and wherein said metallic conductor (33) is made of copper and includes a plurality of plaited conductors.

16. An insulation kit in accordance with any one of the preceding claims that comprises at least one of the following components made of silicone rubber: said first protective hood (21), said second protective hood (24), said insulating sheath (34), said annular gasket (23), said elastic sleeve (69).

17. An electricity substation (1) installed on medium-tension line (2,2',3,3',4,4'), said substation comprising at least one electric line input/output terminal (12,12',13'13',14,14'), at least one transformer (TA1,TV1,TA2,TV2) comprising at least one contact element (40) that can be electrically connected to the electrical terminal by means of conductive means (8,8',9), said conductive means being capable of being attached to said contact element by means of a clamp (6,6',7,7'), **characterized in that** it comprises also:

an insulation kit (20) in accordance with any one of the preceding claims.

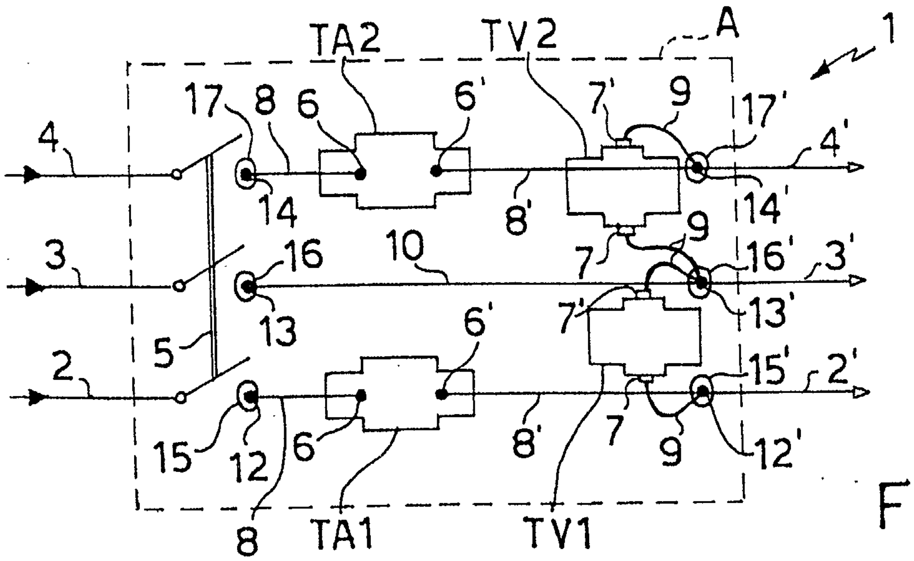

A
1
TA2
TV2
17
8
6
6'
7'
9
17'
4
4'
14
8'
14'
9
3
16
10
16'
3'
7
7'
13'
13
6'
5
2
15'
2'
15
12
6
8'
7
9
12'
8
TA1
TV1

FIG.1

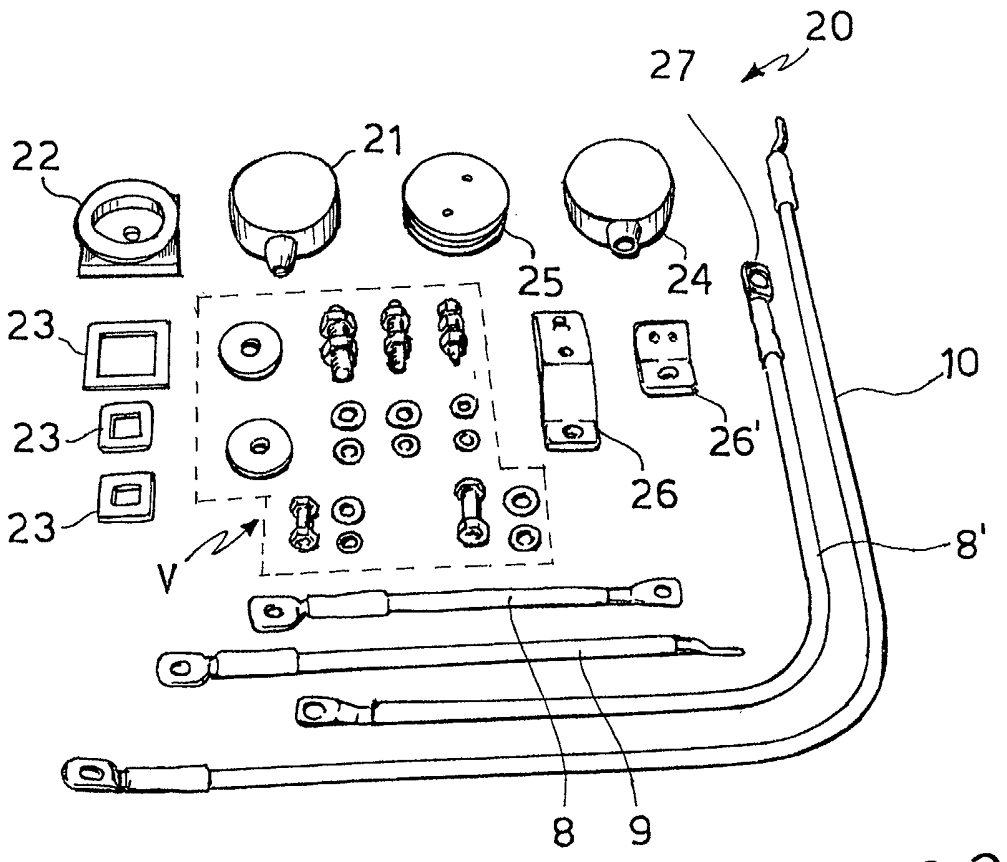

20
27
22
21
25
24
23
26'
10
23
23
26
V
8'
8
9

FIG.2

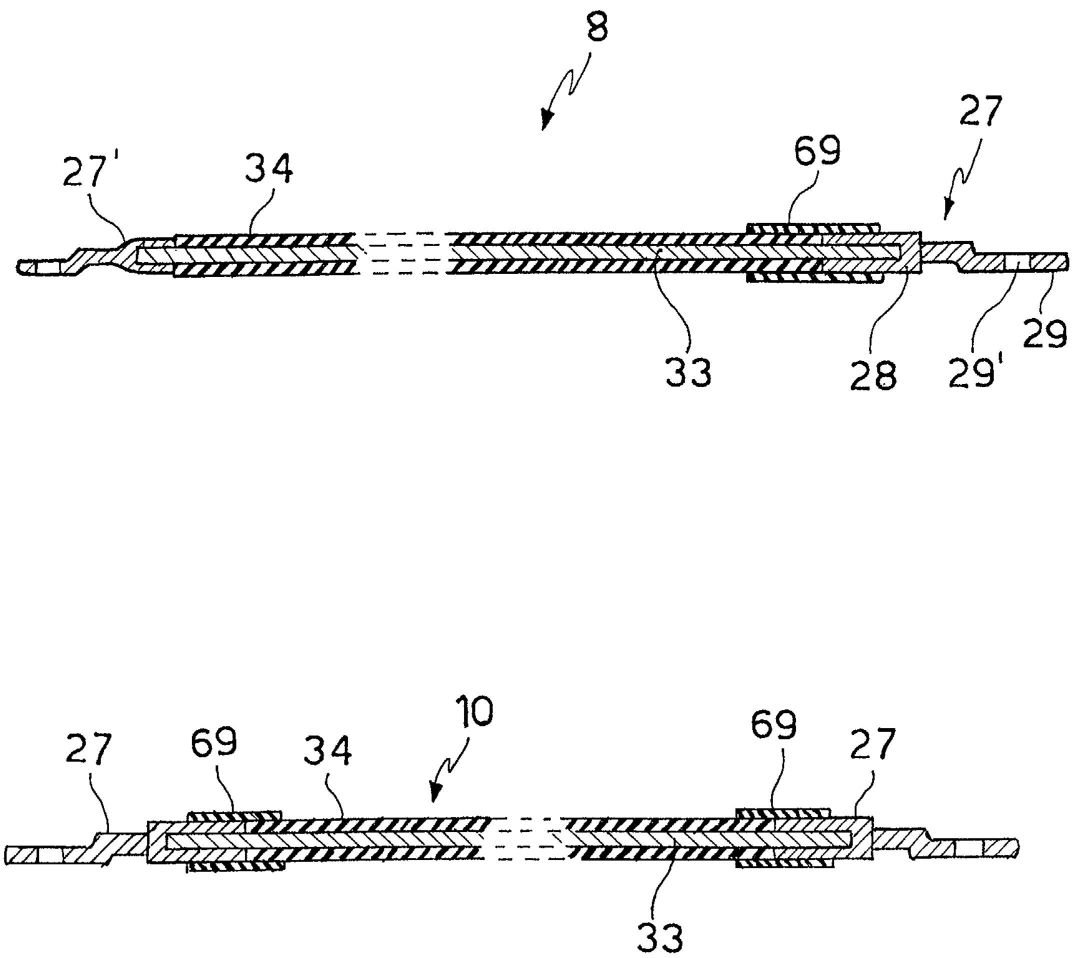


FIG. 2a

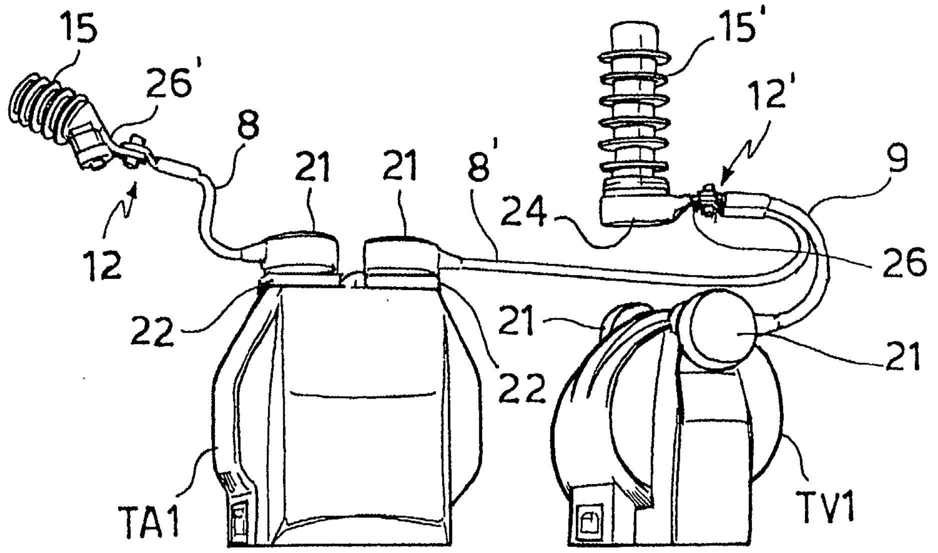
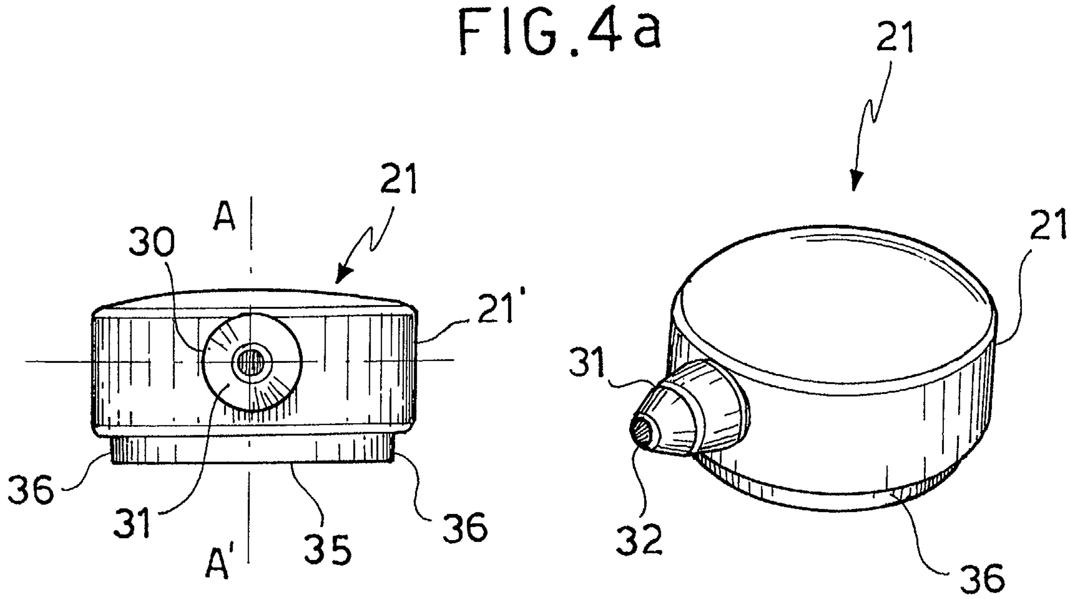


FIG. 3

FIG.4a



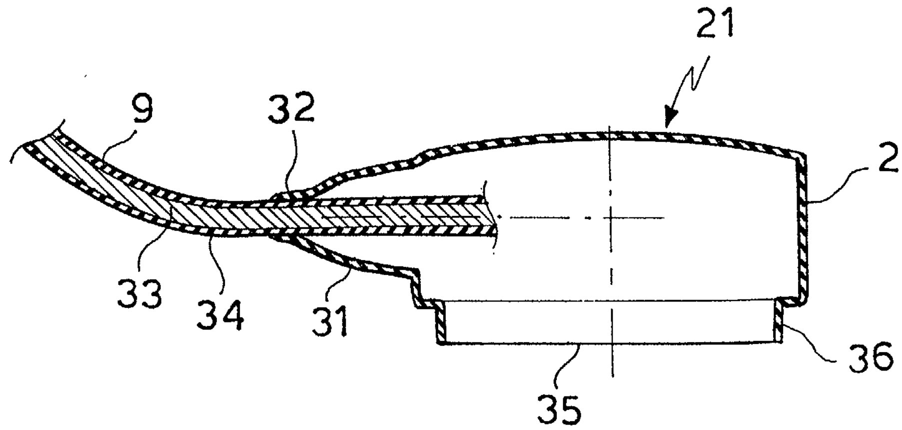


FIG. 4b

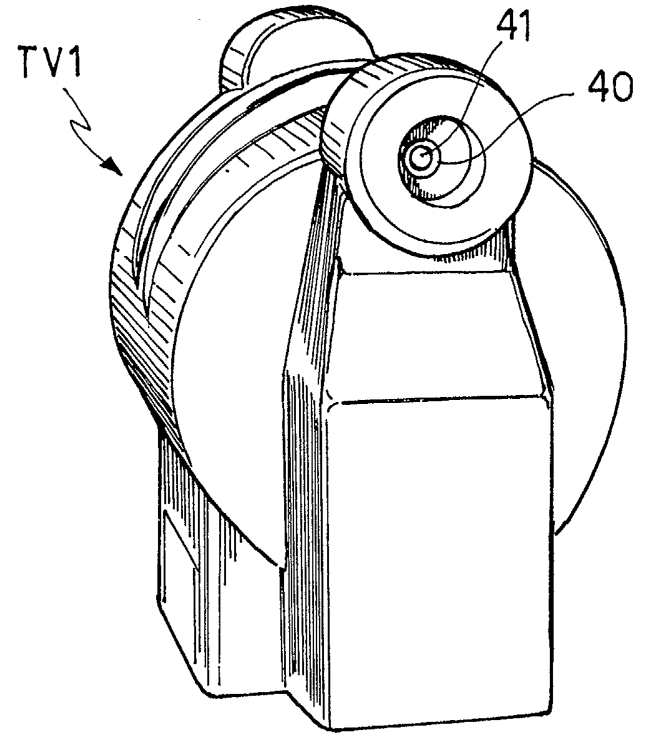


FIG.5a

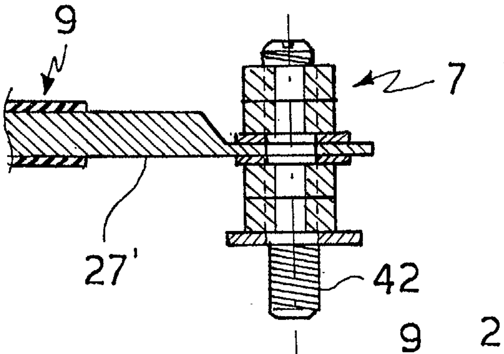


FIG.5b

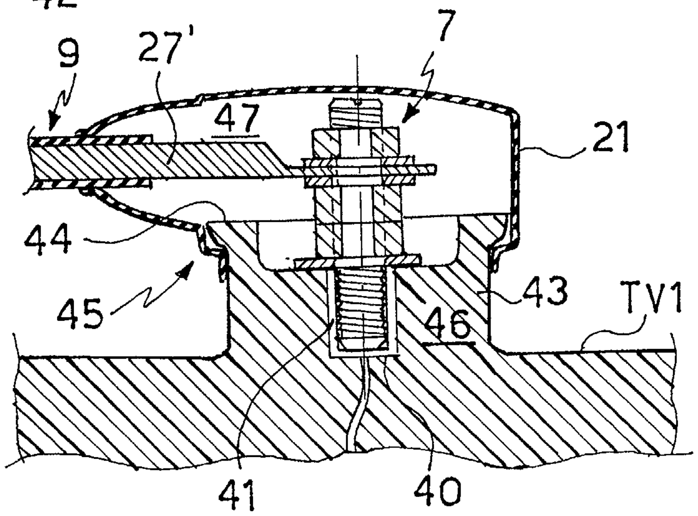


FIG.5c

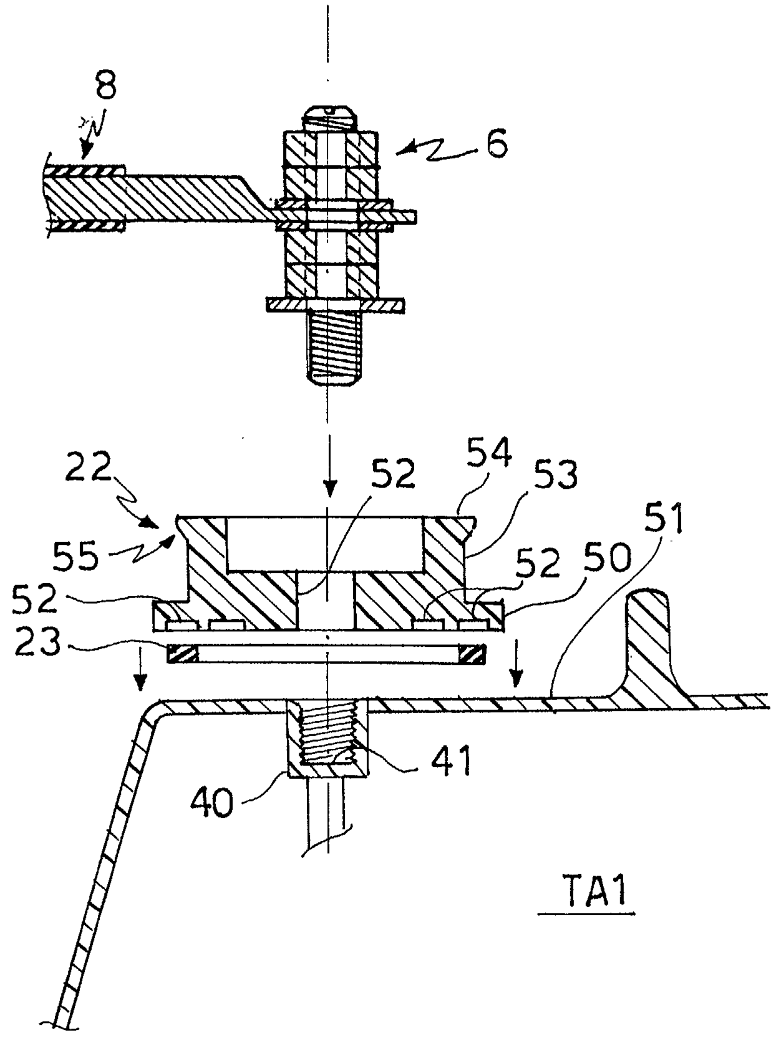


FIG. 6

FIG.7c

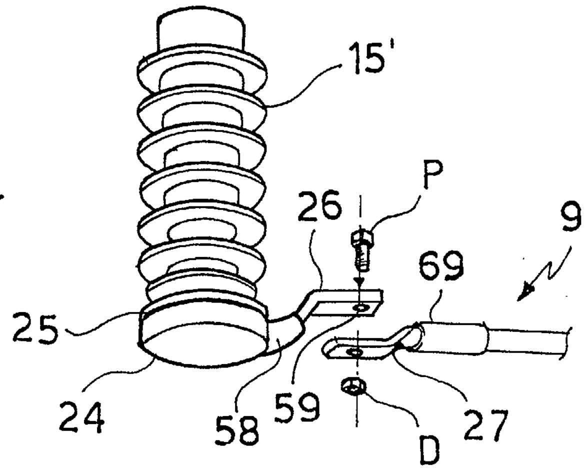


FIG.7a

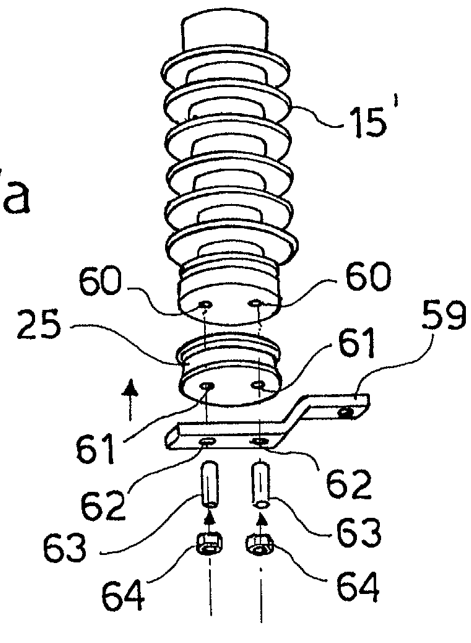
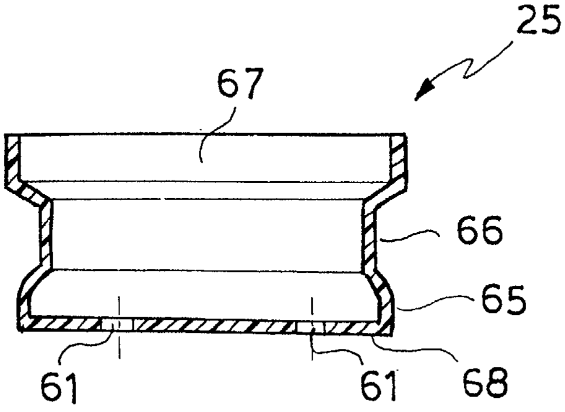


FIG.7b



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EUROPEAN SEARCH REPORT

Application Number
EP 02 42 5355

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 3 766 310 A (PASCHEN A) 16 October 1973 (1973-10-16) * column 2, line 30 - column 3, line 62; figures *	1-3	H01F27/04 H02B1/00
A	FR 2 615 339 A (ELECTR ET ENTREPRISES) 18 November 1988 (1988-11-18) * abstract; figures *	1-3	
A	US 3 059 283 A (CONNOLLY FRANKLIN J ET AL) 23 October 1962 (1962-10-23) * column 2, line 46 - column 3, line 15; figure 2 *	1-3	
A	GB 2 212 005 A (PIRELLI GENERAL PLC) 12 July 1989 (1989-07-12) * abstract; figures *	1-3	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01F
H02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16 October 2002	Marti Almeda, R

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