



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 0 971 378 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.01.2000 Bulletin 2000/02

(51) Int. Cl.⁷: **H01F 27/04, H01B 17/26**

(21) Application number: **99112778.8**

(22) Date of filing: **02.07.1999**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **09.07.1998 IT PD980076**

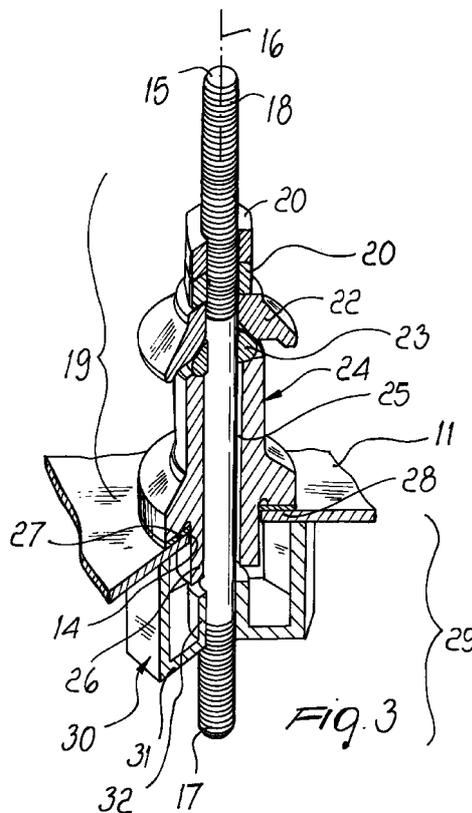
(71) Applicant: **COMEM S.p.A.**
36054 Montebello Vicentino (Vicenza) (IT)

(72) Inventor: **Dal Lago, Silvio**
36100 Vicenza (IT)

(74) Representative:
Modiano, Guido, Dr.-Ing. et al
Modiano & Associati SpA
Via Meravigli, 16
20123 Milano (IT)

(54) **Bushing insulator**

(57) A bushing insulator to be applied between an electrical conductor and a tank of a transformer or another equivalent body, of the type for low voltages (1 to 3 kV and currents from 100 to 6500 A), comprising a part (19) to be exposed to the air which is coupled to a part (29) to be arranged inside the tank; the parts are crossed axially by a tie (15) which acts as an electrical conductor, the part to be exposed to the air comprising, packed on the tie, a hood (22), an annular gasket (23), an external insulating body (24) and a gasket (28) to be arranged between the insulating body and the tank of the transformer at an opening (14) provided therein; the part (29) to be arranged inside the tank comprising an internal insulating body (30) which engages between the external insulating body (24) and a part which is rigidly coupled to the tie; the hood and each one of the external and internal insulating bodies being made of plastics.



EP 0 971 378 A1

Description

[0001] The present invention relates to an improved bushing insulator of the type used for low voltages (1 to 3 kV) and for currents from 100 to 6500 A, to be applied, for example, to the tank of a transformer.

[0002] It is well-known that the bushing insulators allow a live electrical conductor to pass through an obstacle, constituted for example by the tank of a transformer, ensuring a seal in terms of electrical voltage between the free end of the conductor and the point where the bushing insulator is anchored on the tank, with values which are sufficiently high with respect to the operating values.

[0003] The bushing insulators are currently constituted by a tie which acts as an electrical conductor, passes axially through an insulating part exposed to the air and located outside the tank and then engages and passes through an opening formed in the surface of the tank with an insulating part arranged inside the tank.

[0004] It is known that the insulating parts are conveniently coupled to each other.

[0005] Conventionally, the insulating parts of the bushing insulator, both the one that remains inside the tank and the one to be arranged externally, are made of ceramic material, preferably porcelain.

[0006] Porcelain in fact has characteristics adapted for insulation, because it ensures high rigidity, good mechanical strength and also good resistance to temperature variations.

[0007] It is in fact very important that electrical insulation never fail regardless of the environmental conditions (dust, carbon residues, polluted atmospheres) and of the weather (fog, rain, damp, etcetera).

[0008] In this regard, it is important to stress that the ceramic material is used in a mixture which is designed appropriately from the point of view of the composition and of the heat treatment to which it must be subjected.

[0009] The higher the temperatures reached during the firing treatment, the better the rigidity of the material, but the lower the resistance to temperature variations, and viceversa.

[0010] It is also very important to cover the finished product with a layer of glaze so that its surface is conveniently smooth, accordingly facilitating self-washing of the bushing insulator when it rains.

[0011] Unfortunately, however, the layer must have the same expansion coefficient as the porcelain, otherwise in the course of time surface cracks tend to form which may lead to the breakage of the insulator as they deepen.

[0012] This preliminary explanation is necessary to point out the fact that ceramic materials to be used for electrical insulation are currently rather expensive and are often not easily available.

[0013] Unfortunately, however, the mechanical and electrical characteristics of the materials used are of very low quality and this can seriously compromise the

insulation and duration of the bushing insulator during use.

[0014] In addition to this, in conventional bushing insulators all the sealing gaskets must be checked periodically and replaced, since said gaskets, which are in practice compressed between the mutually packed components of the bushing insulator, are directly exposed to the action of the weather.

[0015] Another drawback affecting conventional bushing insulators is linked to the large number of components required for their standard configuration; this in fact entails for the user a certain complexity in the assembly and disassembly operations.

[0016] After all, the fragility of insulating parts made of ceramic material also cannot be ignored.

[0017] Said parts in fact require particular care on the part of the user every time they have to be handled.

[0018] The aim of the present invention is to provide a bushing insulator which solves the above-mentioned drawbacks of conventional types.

[0019] A consequent primary object of the present invention is to provide a bushing insulator of the type for low voltages, with values between 1 and 3 kV and for currents between 100 and 6500 A, which can be handled without requiring any particular care and which at the same time ensures improved insulation characteristics with respect to those ensured by conventional bushing insulators.

[0020] A further important object of the present invention is to provide a bushing insulator which can be obtained by assembling a smaller number of components than conventional types.

[0021] A further object is to provide a bushing insulator which allows to considerably simplify all the operations for its assembly and disassembly.

[0022] A further object is to provide a bushing insulator which requires no particular maintenance.

[0023] A further object is to provide a bushing insulator for low voltages which can be obtained at a significantly lower cost than conventional models.

[0024] A further object is to provide a bushing insulator whose constructive configuration can be obtained in practice by resorting to per se known processes.

[0025] A further object of the present invention is to provide a bushing insulator which ensures greater impact resistance than conventional types and can thus be handled without requiring any special care or attention.

[0026] This aim, these objects and others which will become apparent hereinafter are achieved by a bushing insulator to be applied between an electrical conductor and a tank of a transformer or another equivalent body, of the type for low voltages (1 to 3 kV and currents from 100 to 6500 A) comprising a part to be exposed to the air which is coupled to a part to be arranged inside said body, said parts being crossed axially by a tie which acts as an electrical conductor, said bushing insulator being characterized in that said part to be exposed to

the air comprises, packed on said tie, a hood, an annular gasket, an external insulating body and a gasket to be arranged between said insulating body and said tank of the transformer at a corresponding opening, said part to be arranged inside the tank comprising an internal insulating body which engages between said external insulating body and a part which is rigidly coupled to said tie, said hood and each one of said external and internal insulating bodies being made of plastics.

[0027] Further characteristics and advantages of the present invention will become apparent from the following detailed description of a preferred embodiment, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a front view of an electric transformer on which improved bushing insulators according to the invention are fitted;

Figure 2 is a perspective view of an improved bushing insulator according to the invention;

Figure 3 is a partially sectional perspective view of the bushing insulator of Figure 2.

[0028] With reference to the above figures, an electric transformer is generally designated by the reference numeral 10 and has a tank with radiators 11 to which high-voltage insulators 12 and low-voltage bushing insulators, generally designated by the reference numeral 13, are fixed at the upper part.

[0029] Each one of the low-voltage insulators 13 is of the type for low voltages (1 to 3 kV and currents from 100 to 6500 A) and is fixed to the upper part of the tank 11 at an opening 14 formed thereon.

[0030] Each bushing insulator 13 is predominantly elongated longitudinally and comprises a metallic tie 15 which is arranged along the main elongation axis 16, acts as an electrical conductor and has a threaded lower end 17 and a threaded upper end 18.

[0031] The tie 15, in the working configuration, has an upper end 18 which remains outside the tank and a lower end 17 which, after passing through the opening 14, remains inside the tank 11.

[0032] Each bushing insulator 13 is provided with a part to be exposed to the air, which is generally designated by the reference numeral 19 and is crossed axially by the tie 15.

[0033] The part 19 to be exposed to the air comprises nuts 20 which are packed together and stacked starting from the upper end 18 of the tie 15, are internally threaded and lie above a hood 22.

[0034] The hood is substantially umbrella-shaped and is perforated in its central part, so that it is crossed by the tie 15.

[0035] The hood 22 is made of plastics, preferably a mix constituted by 70% of a material known as PBT and 30% glass fiber, and has excellent mechanical characteristics in terms of impact resistance and resistance to the direct action of weather.

[0036] Clearly, in other equivalent embodiments the hood 22 can be made of a different material having equivalent physical and chemical characteristics.

[0037] In a position that lies below the hood 22, the insulating part 19 to be exposed to the air is provided with an annular gasket 23 of a per se known type (see Figure 3) which in this case has a semicircular transverse cross-section, with the flat part arranged internally at the tie 15.

[0038] In this manner, the annular gasket 23 ensures the seal in the axial direction and simultaneously in the radial direction as well.

[0039] In particular, the hood 22 is conveniently chamfered at the region in contact with the annular gasket 23.

[0040] Below the annular gasket 23 there is an external insulating body 24 which is substantially bell-shaped and has a central through hole 25 through which the tie 15 passes.

[0041] A tubular extension 26 protrudes monolithically from the lower part of the external insulating body 24 and is coaxial to the through hole 25; its radial dimensions are smaller than the remaining part of the external insulating body 24 and are substantially complementary to the opening 14, so that it can be inserted in the tank 11.

[0042] The external insulating body 24 is made of plastics, and in this configuration it is obtained with a mixture constituted by 70% polyamide and 30% glass fiber.

[0043] In this manner, the external insulating body 24 has excellent characteristics in terms of resistance to impacts and to the effects of weather.

[0044] Clearly, in other equivalent constructive embodiments the external insulating body 24 can be made of materials other than the above-mentioned one, provided that they have adequate mechanical and chemical characteristics.

[0045] In particular, the external insulating body 24 is to be packed against the upper part of the tank 11 at an annular portion 27 which is delimited externally by the bell-like shape and internally by the tubular extension 26.

[0046] A flat annular gasket 28 is interposed between the annular portion 27 and the tank 11, outside the opening 14, and has a rectangular cross-section; its outside diameter is conveniently smaller than the annular portion 27, so that the annular portion becomes a containment seat which protects it from the direct action of the weather when, in the operating configuration, it is packed together with the other components of the part 19 to be exposed to the air of the bushing insulator 13.

[0047] The bushing insulator 13 further comprises a part to be arranged inside the tank, which is designated by the reference numeral 29 and is constituted by an internal insulating body 30 which has, in this case, a structure which internally has a substantially hollow hexagonal transverse cross-section so as to allow the insertion of the tubular extension 26.

[0048] In an upward region, the internal insulating body 30 is to be placed in abutment against the inner face of the tank 11, while the lower end is provided with a bottom 31 which is monolithic therewith and forms a plane which is perpendicular to the longitudinal main axis 16.

[0049] A tubular tang 32 protrudes monolithically from the bottom 31 toward the inside of the insulating body 30 and wraps around the threaded lower end 17 of the tie 15.

[0050] The anchoring of the internal insulating body 30 to the tie 15 is particularly stable thanks to the presence of the thread in the lower end 17 surrounded by the tang 32.

[0051] As an alternative, the grip of the internal insulating body 30 on the tie 15 can be ensured by providing an adequate punching on the tie 15.

[0052] The internal insulating body 30, in this particular embodiment, is made of plastics by overmolding on the tie 15, so that the body and the tie form in practice a single part.

[0053] In other cases, the internal insulating body 30 can be provided as a separate part by molding.

[0054] In particular, the internal insulating body 30 is made, in this case, of a plastic material which is resistant to the oils used inside the tanks 11 of transformers.

[0055] If the internal insulating body 30 is formed by overmolding on the tie 15, the bushing insulator 13 no longer needs to resort to a washer, to be fixed to the tie by brazing, tinning or punching, in order to lock the internal insulating part 29 at the lower end 17.

[0056] Another extremely significant advantage is ensured to the bushing insulator 13 by virtue of the annular portion 27, which protects the flat annular gasket 28 when, being packed between the external insulating body 14 and the tank 11, it is compressed and tends to widen.

[0057] In this manner, the annular gasket 28, appropriately protected by the annular portion 27, is not affected by the action of the weather and therefore does not have to be replaced periodically.

[0058] Likewise, the hood 22 protects the annular gasket 23, whose operating life can therefore be much longer than in conventional bushing insulator models.

[0059] It is very important to stress that the configuration of the bushing insulator 13 described with the present invention is provided with a reduced number of components with respect to the conventional ones.

[0060] The plastics used to provide the hood 22, the external insulating body 24 and internal insulating body 30 ensures optimum characteristics in terms of rigidity and mechanical impact resistance.

[0061] It is also important to stress that said plastics ensures a more than satisfactory resistance to thermal variations and to transformer oils.

[0062] Further to many practical tests, bushing insulators executed according to the present invention in fact ensure better electrical insulation than conventional

types.

[0063] Another feature to be noted is certainly that all the insulating parts are made of plastics, with much smaller size tolerances than equivalent parts that can be made of ceramic material.

[0064] In this manner, therefore, the assembly and disassembly operations are much more practical and faster to complete, since the components can be packed more easily.

[0065] In practice it has been observed that the present invention fully achieves the intended aim and all of the intended objects.

[0066] An important advantage has in fact been achieved in that a bushing insulator has been provided which can be handled without requiring particular care and at the same time ensures better insulating characteristics than conventional bushing insulators.

[0067] A further important advantage consists in that a bushing insulator has been provided which is obtained by assembling a reduced number of components with respect to conventional types.

[0068] A further advantage consists in that a bushing insulator has been provided which allows to considerably simplify all assembly and disassembly operations.

[0069] A further advantage of the present invention consists in that a bushing insulator has been provided which requires no particular maintenance thanks to sealing gaskets which are practically shielded from the direct action of the weather.

[0070] The present invention has provided a bushing insulator for low voltages (1 to 3 kV) which benefits from the fact that it can be obtained at a significantly lower cost than conventional models.

[0071] A further advantage consists in that a bushing insulator has been provided whose constructive configuration is obtained in practice by resorting to per se known processes.

[0072] It is also important to stress that the devised and described bushing insulator ensures higher impact resistance than conventional types and can therefore be handled without requiring any particular care or attention.

[0073] The present invention is susceptible of numerous modifications and variations, all of which are within the scope of the same inventive concept.

[0074] In particular, a further embodiment can be obtained by providing, between the annular portion 27 and said tank 11, outside the opening 14 and as an alternative to the flat annular gasket 28, a flat rubber-cork gasket of the incompressible type.

[0075] A still further embodiment is possible if a flat gasket, for example of the kind made of a material known as NBR, combined with a rubber-cork gasket, is interposed between the annular portion 27 and the tank 11.

[0076] All the details may be replaced with other technically equivalent elements.

[0077] The materials employed, so long as they are

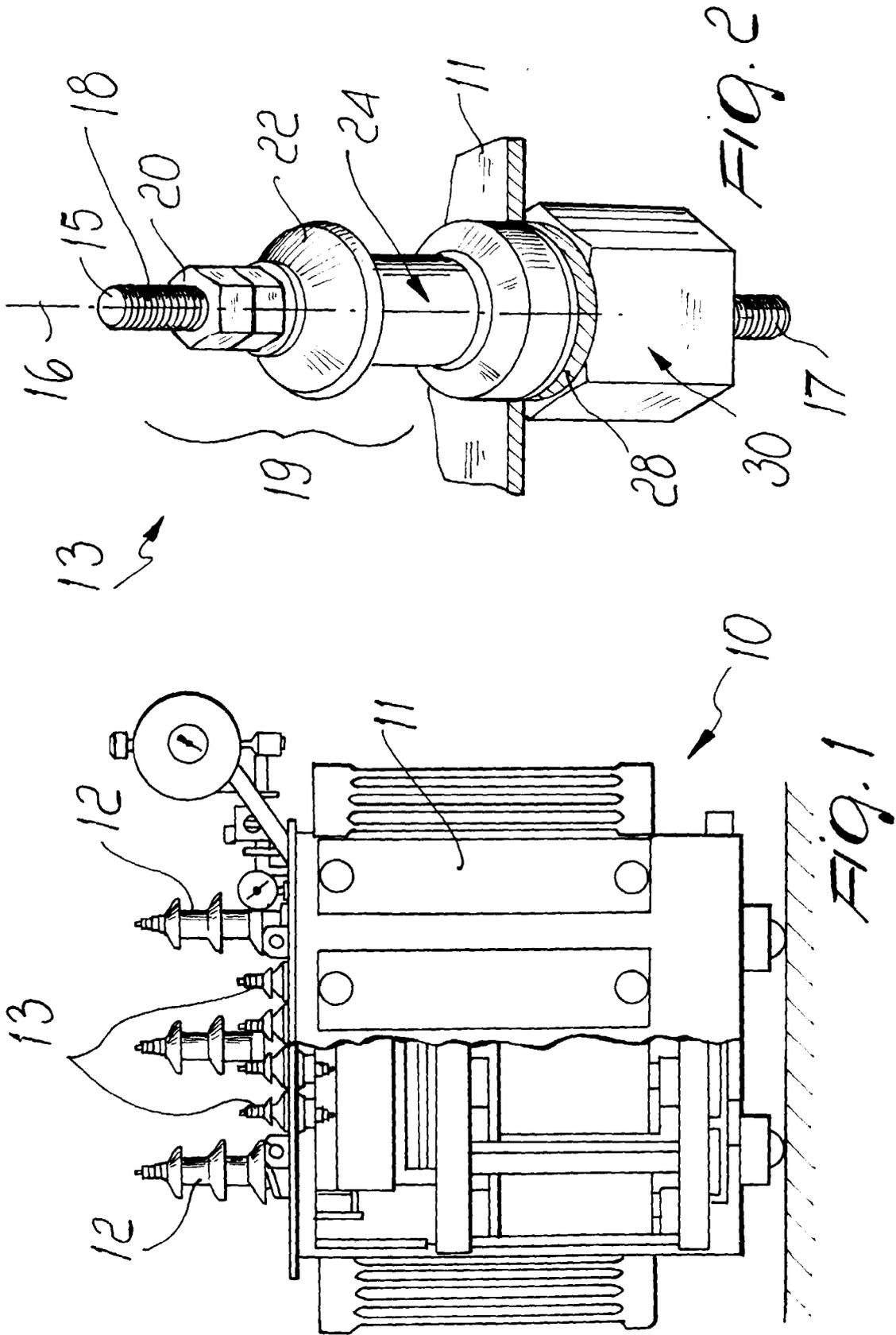
compatible with the contingent use, as well as the dimensions, may be any according to requirements.

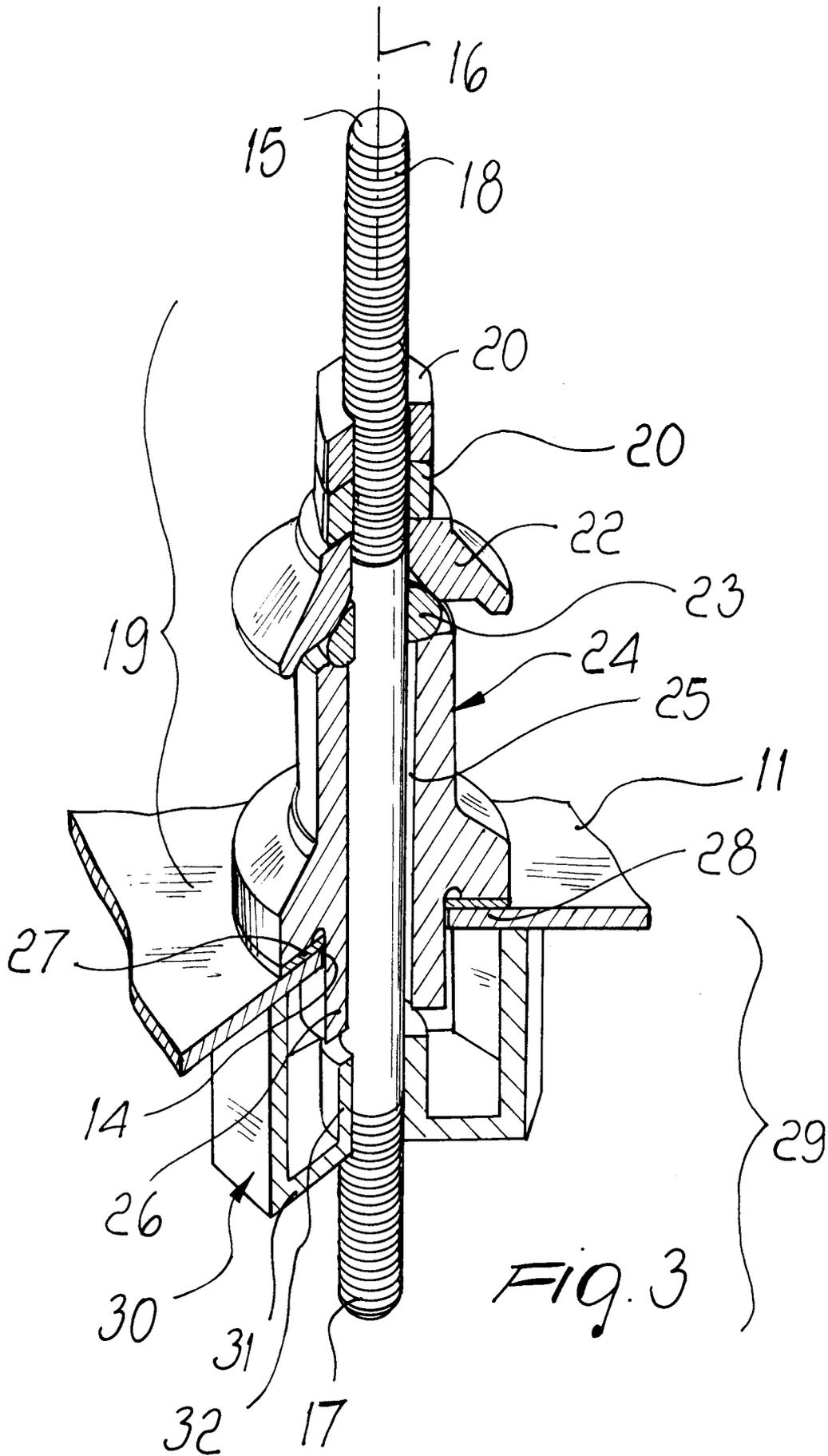
[0078] The disclosures in Italian Utility Model Application No. PD98U000076 from which this application claims priority are incorporated herein by reference. 5

[0079] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs. 10

Claims

1. A bushing insulator to be applied between an electrical conductor and a tank of a transformer or another equivalent body, of the type for low voltages (1 to 3 kV and currents from 100 to 6500 A) which comprises a part to be exposed to the air which is coupled to a part to be arranged inside said tank, said parts being crossed axially by a tie which acts as an electrical conductor, characterized in that said part to be exposed to the air comprises, packed on said tie, a hood, an annular gasket, an external insulating body and a gasket to be arranged between said insulating body and said tank of the transformer at a corresponding opening, said part to be arranged inside the tank comprising an internal insulating body which engages between said external insulating body and a part which is rigidly coupled to said tie, said hood and each one of said external and internal insulating bodies being made of plastics. 15
2. The bushing insulator according to claim 1, characterized in that said internal insulating body is provided by overmolding on the tie or as a separate part by molding. 20
3. The bushing insulator according to claim 2, characterized in that said internal insulating body has a tubular structure to be placed in abutment, in an upward region, against the inner face of the tank and has a lower end which is provided with a bottom from which a tubular tang protrudes monolithically inward and surrounds the lower end of the tie. 25
4. The bushing insulator according to claim 1, characterized in that said internal insulating body has a hexagonal transverse cross-section. 30
5. The bushing insulator according to claim 3, characterized in that said lower end of the tie, partially surrounded by said tang, is threaded. 35
6. The bushing insulator according to claim 3, characterized in that said external insulating body is bell-shaped and is axially provided with a through hole, a tubular extension protruding from the lower end of said external insulating body and having an external diameter which is shaped complementarily to said opening and to the inside diameter of said internal insulating body. 40
7. The bushing insulator according to claim 6, characterized in that said external insulating body is to be packed against said tank with an annular portion which is externally delimited by the bell-shaped region and internally delimited by the tubular extension, said flat gasket being interposed between said annular portion and said tank. 45
8. The bushing insulator according to claim 7, characterized in that it comprises a cork-rubber gasket which is interposed between said annular portion and said tank. 50
9. The bushing insulator according to claim 7, characterized in that said annular portion of said external insulating body completely covers said flat gasket. 55
10. The bushing insulator according to claim 1, characterized in that said internal insulating body is made of a plastic that is resistant to the oils of transformers.
11. The bushing insulator according to claim 1, characterized in that said external insulating body and said internal insulating body are constituted by approximately 70% polyamide and approximately 30% glass fiber.
12. The bushing insulator according to claim 1, characterized in that said hood is constituted by approximately 70% of a material known as PBT and approximately 30% glass fiber.







European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 11 2778

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 678 879 A (PIOCH SA) 25 October 1995 (1995-10-25) * figure 1 *	1	H01F27/04 H01B17/26
A	PATENT ABSTRACTS OF JAPAN vol. 007, no. 284 (E-217), 17 December 1983 (1983-12-17) & JP 58 162012 A (HITACHI SEISAKUSHO KK), 26 September 1983 (1983-09-26) * abstract *		
A	FR 1 373 721 A (LE MATÉRIEL ÉLECTRIQUE) 8 January 1965 (1965-01-08)		
A	DE 36 13 569 A (POL SA) 23 October 1986 (1986-10-23)		
A	US 3 936 592 A (GAMBLE JAMES R) 3 February 1976 (1976-02-03)		
A	DE 87 07 789 U (SPEICHER, KURT PETER) 16 July 1987 (1987-07-16)		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H01F H01B
Place of search	Date of completion of the search	Examiner	
THE HAGUE	7 October 1999	Vanhulle, R	
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	

EPO FORM 1503 03/82 (P04/C01)

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

EP 99 11 2778

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.

07-10-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0678879 A	25-10-1995	FR 2719150 A DE 69500432 D DE 69500432 T JP 8055734 A US 5623125 A	27-10-1995 21-08-1997 22-01-1998 27-02-1996 22-04-1997
JP 58162012 A	26-09-1983	JP 1450417 C JP 62059881 B	11-07-1988 14-12-1987
FR 1373721 A	08-01-1965	NONE	
DE 3613569 A	23-10-1986	BE 904577 A FR 2582143 A IT 1204866 B	31-07-1986 21-11-1986 10-03-1989
US 3936592 A	03-02-1976	CA 1034223 A	04-07-1978
DE 8707789 U	16-07-1987	NONE	