



(86) Date de dépôt PCT/PCT Filing Date: 2005/11/01
(87) Date publication PCT/PCT Publication Date: 2006/05/11
(45) Date de délivrance/Issue Date: 2012/10/23
(85) Entrée phase nationale/National Entry: 2007/04/11
(86) N° demande PCT/PCT Application No.: SE 2005/001645
(87) N° publication PCT/PCT Publication No.: 2006/049567
(30) Priorité/Priority: 2004/11/01 (SE0402641-5)

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

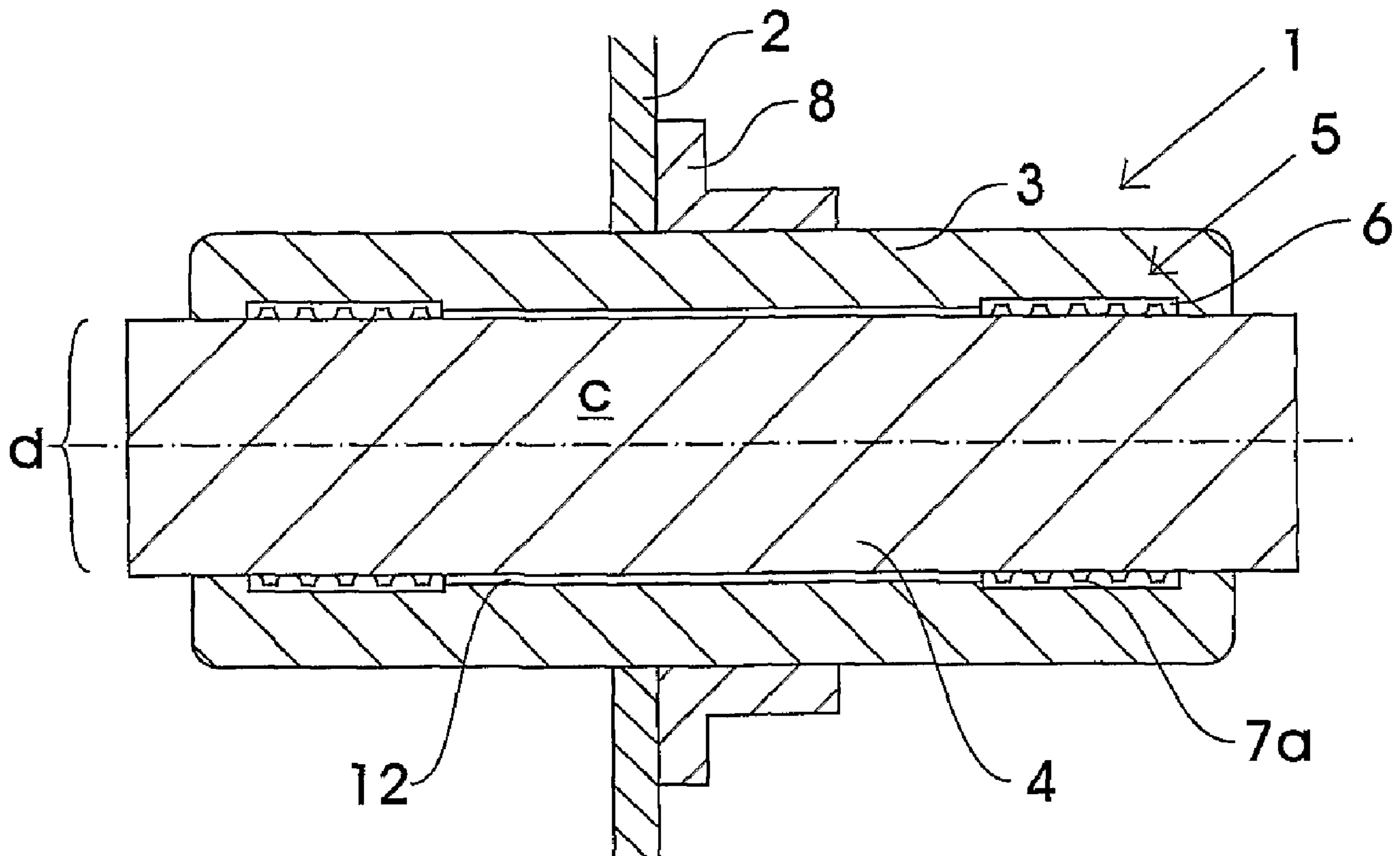
(72) Inventeurs/Inventors:
SJOEBERG, PETER, SE;
STAEHL, ROBERT, SE

(73) Propriétaire/Owner:
ABB TECHNOLOGY LTD., CH

(74) Agent: MARKS & CLERK

(54) Titre : ISOLATEUR DE TRAVERSEE ET SON PROCEDE DE FABRICATION

(54) Title: ELECTRIC BUSHING AND A METHOD OF MANUFACTURING AN ELECTRIC BUSHING



(57) Abrégé/Abstract:

A bushing (1) for electrical current and/or voltage through a grounded plane (2) comprising a substantially rotationally symmetrical insulating body (3) surrounding a central electrical conductor (4). The bushing exhibits a sealing member (5) for gas /liquid sealing



(57) Abrégé(suite)/Abstract(continued):

between the conductor and the insulator body, which is in the form of a so-called RIP (Resin Impregnated Paper) body. According to the invention, the bushing is provided with a compressible sealing element (6), which forms a gas /liquid seal, integrated with the insulating body, between the conductor and the insulating body. The invention also relates to a method of manufacturing a bushing. The bushing is preferably intended for higher voltages, from 36 kV up to 800 kv and above. The bushing may preferably be used with a transformer but also with a cable termination.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
11 May 2006 (11.05.2006)

PCT

(10) International Publication Number
WO 2006/049567 A1

(51) International Patent Classification:
H01B 17/30 (2006.01)

(21) International Application Number:
PCT/SE2005/001645

(22) International Filing Date:
1 November 2005 (01.11.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0402641-5 1 November 2004 (01.11.2004) SE

(71) Applicant (for all designated States except US): **ABB TECHNOLOGY LTD.** [CH/CH]; Affolternstrasse 44, CH-8050 Zürich (CH).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **SJÖBERG, Peter** [SE/SE]; Anisstigen 9, S-771 43 Ludvika (SE). **STÅHL, Robert** [SE/SE]; Röbacksvägen 34, S-771 60 Ludvika (SE).

(74) Agent: **ABB AB**; Legal Affairs and Compliance/Intellectual Property, Forskargränd 7, S-721 78 Västerås (SE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

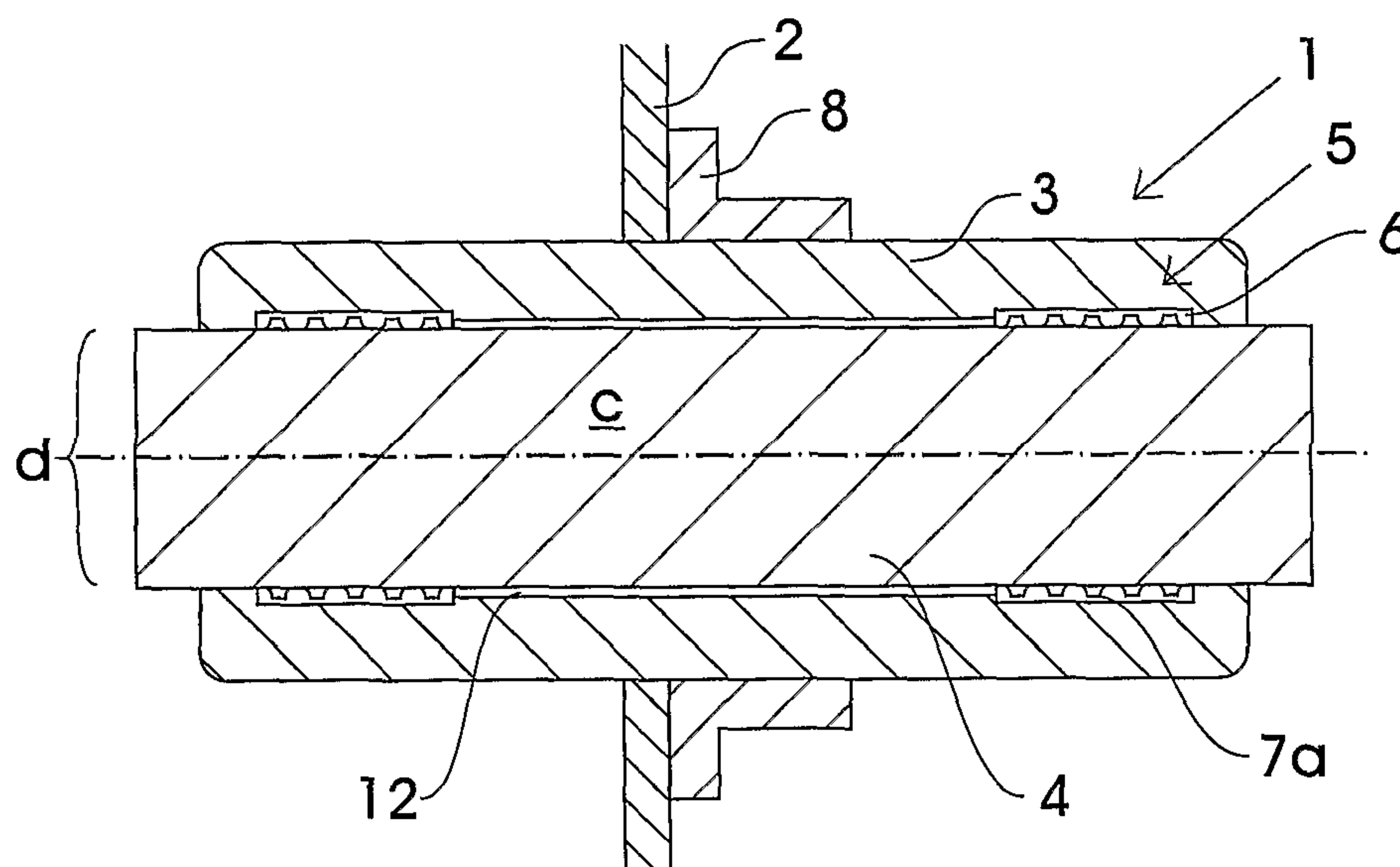
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ELECTRIC BUSHING AND A METHOD OF MANUFACTURING AN ELECTRIC BUSHING



(57) Abstract: A bushing (1) for electrical current and/or voltage through a grounded plane (2) comprising a substantially rotationally symmetrical insulating body (3) surrounding a central electrical conductor (4). The bushing exhibits a sealing member (5) for gas /liquid sealing between the conductor and the insulator body, which is in the form of a so-called RIP (Resin Impregnated Paper) body. According to the invention, the bushing is provided with a compressible sealing element (6), which forms a gas /liquid seal, integrated with the insulating body, between the conductor and the insulating body. The invention also relates to a method of manufacturing a bushing. The bushing is preferably intended for higher voltages, from 36 kV up to 800 kv and above. The bushing may preferably be used with a transformer but also with a cable termination.

WO 2006/049567 A1

Electric bushing and a method of manufacturing an electric bushing

TECHNICAL FIELD

5

The present invention relates to a bushing for electric current and/or voltage through a grounded plane, where a conductor is surrounded by an insulator body that is formed by impregnation and hardening of an insulating material that is wound around the conductor. The invention also relates to a method of manufacturing a bushing. The bushing according to the invention is used, for example in transformers, for connection of a transformer winding through the wall of a transformer tank to a distribution network. Other applications of the bushing are in cable terminations and gas-insulated equipment.

The invention also relates to a method of manufacturing a bushing.

20

BACKGROUND ART

In bushings, high demands are placed on the sealing between the conductor and the surrounding insulator body, so that no gas or liquid, for example transformer oil, may leak in the boundary layer between these.

WO 00/55872 discloses a bushing intended for connection to the wall of a transformer tank. The bushing according to the patent exhibits an insulator body 17 that is applied to a conductor 15. The patent relates to means to sealingly connect the bushing to the transformer housing. The problem with sealing between the insulator body and the conductor is not dealt with in the patent.

35

US 3,775,547 discloses another example of a bushing exhibiting means integrated into the insulator body for

connection of the bushing to a transformer housing. To solve the problem with sealing between the insulator and the conductor, it is proposed to attempt to adapt the coefficient of thermal expansion of the insulator material to the
5 coefficient of thermal expansion of the conductor by supplying additives to the insulating material (column 3, lines 22 et seq.). The insulator body is here preferably made by casting and subsequent hardening of an epoxy material and is intended for lower voltages; a voltage level of 7 kV is,
10 for example, mentioned in the patent. This solution of the leakage problem is not sufficient at the higher voltages to which the present invention relates.

In bushings for higher voltages, that is, above 36 kV and up
15 to the highest system voltages occurring, 800 kV and above, difficulties of achieving satisfactory sealing arise since the size of the insulator body increases, which, among other things, in case of temperature variations, results in problems with sliding between the insulator body and the conductor due to the difference in the coefficient of temperature
20 expansion of the material in the conductor, which usually consists of metal such as aluminum or copper or alloys thereof, and the material in the insulator. The contact between the insulator and the conductor may become released,
25 which may then result in the occurrence of undesired leakage of gas/liquid.

It is common to apply a pressure-relieving layer, for example in the form of cork rubber, between the conductor and the
30 insulator body. However, this layer does not ensure the sealing between the conductor and the insulator body, so the problems with leakage remain.

To ensure sealing, it is known to apply slots for seals, for
35 example in the form of O-rings, at the end portions of the insulator. Such sealing measures are both complicated and costly in manufacture.

SUMMARY OF THE INVENTION

One aspect of the present invention is to provide a bushing that exhibits an effective seal between the insulating body
5 of a bushing and the conductor.

This is achieved by a bushing for electric current and/or voltage through a grounded plane comprising a substantially rotationally symmetrical insulating body surrounding a
10 central electrical conductor, said bushing comprising a sealing member for gas/liquid sealing between the conductor and the insulating body, said insulating body being formed by winding insulating material onto the conductor and then being impregnated with a hardening material, and being
15 transferred into solid shape by a hardening process, wherein said sealing member comprises at least one sealing element with compressible means arranged on a part of an axial direction of the conductor between the insulating body and the conductor, a compressed state being imparted
20 to the at least one sealing element during said hardening process by the externally arranged insulating body, said at least one sealing element then forming a gas/liquid seal, integrated with the insulating body, between the conductor and the insulating body.

25 Preferred embodiments are described below. By the invention, a bushing with an integrated seal is achieved that is suitable for voltages up to the highest system voltages occurring (800 kV) and above while ensuring the
30 sealing function for gas or liquid between the insulating body and the conductor, this seal being ensured also in case of major temperature variations.

Another aspect of the invention is to suggest a method of
35 manufacturing a bushing. In particular, there is provided a

3a

method for manufacturing a bushing for electric current and/or voltage through a grounded plane comprising a substantially rotationally symmetrical insulating body surrounding a central electrical conductor, said bushing
5 comprising a sealing member for gas/liquid sealing between the conductor and the insulating body, the method comprising:

forming said insulating body by winding insulating material onto the conductor,

10 impregnating said insulating body with a hardening material,

transferring the insulating body into solid shape by a hardening process, said sealing member comprising at least one sealing element with compressible means applied
15 to a part of an axial direction of the conductor between the insulating body and the conductor prior to the winding of the insulating material, said material being applied so as to cover the at least one sealing element, and

imparting a permanent and substantially radial
20 compressive force to the at least one sealing element with the compressible means during a subsequent manufacturing process by the insulating body, whereby the at least one sealing element in its compressed state serves as the gas/liquid seal between the conductor and the insulating
25 body.

Preferred embodiments are described below.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

30 According to one preferred embodiment, the at least one sealing element at the bushing is designed as an annular band where the compressible means comprise grooves formed on the annular band. The grooves are arranged perpendicular to an axial direction of the conductor and facing the
35 conductor. One advantage with the grooves is that they will also under compressed condition slide against the surface of

3b

the conductor, during temperature change at the conductor and the insulating body, and still keep its sealing ability.

According to one preferred embodiment, the
5 compressible means of the at least one sealing element comprise gas-filled cavities. Such cavities improve the elasticity of the sealing member.

According to one preferred embodiment, the compressible
10 means of the at least one sealing element comprise grooves as well as gas-filled cavities.

According to one embodiment, the at least one sealing element is designed for geometric locking of the at least
15 one sealing element, for example in the form of locking grooves. The at least one sealing element may alternatively be formed with a cross section with a thickness increasing in a direction towards the centre of the bushing for forming such locking.

20 According to another preferred embodiment, the at least one sealing element is arranged at the outer end of the insulating body and is provided with a lip facing this end, which during the manufacturing process serves as a flexible
25 spacer that attends to removal or relief of force between the conductor and the outer end of the insulator body.

The at least one sealing element comprises rubber or a rubber-like material that exhibits chemical resistance to
30 gas or liquid. In a non-compressed state, the at least one sealing element preferably exhibits a largest thickness of between 0.5 and 10 mm and a width of between 10 and 100 mm as well as an inner diameter of between 20 and 300 mm, which diameter is somewhat smaller than the outer diameter
35 of the electrical conductor.

According to one preferred embodiment, the bushing according to the invention is designed for a lowest system voltage of 36 kV, alternatively from 170 kV up to the highest system voltages occurring, that is, 800 kV and
5 above, which means that the insulating body is dimensioned for this.

According to one embodiment, the insulator body comprises, in addition to insulating material, also means for field control,
10 for example in the form of field-controlling linings.

According to one preferred embodiment, the bushing according to the invention is arranged in a transformer and there constitutes part of its electrical connection to a
15 force line, whereby the grounded plane consists of the wall of a transformer tank. The bushing may also be arranged in gas-insulated equipment, whereby the grounded plane consists of the enclosure around the insulating gas. Alternatively, the bushing constitutes part of a cable
20 termination, whereby the grounded plane consists of a ground casing in a cable segment.

In some embodiments the insulating material comprises insulating paper.
25

In some embodiments, the hardening material comprises epoxy.

According to a second aspect of the invention, a method for
30 manufacturing a bushing for electric current and/or voltage through a grounded plane is suggested.

This is achieved by the method discussed above, namely, a method for manufacturing a bushing for electric current
35 and/or voltage through a grounded plane comprising a substantially rotationally symmetrical insulating body

4a

surrounding a central electrical conductor, said bushing comprising a sealing member for gas/liquid sealing between the conductor and the insulating body, the method comprising:

- 5 forming said insulating body by winding insulating material onto the conductor,
- impregnating said insulating body with a hardening material,
- transferring the insulating body into solid shape by
- 10 a hardening process, said sealing member comprising at least one sealing element with compressible means applied to a part of an axial direction of the conductor between the insulating body and the conductor prior to the winding of the insulating material, said material being applied so
- 15 as to cover the at least one sealing element, and imparting a permanent and substantially radial compressive force to the at least one sealing element with the compressible means during a subsequent manufacturing process by the insulating body, whereby the at least one
- 20 sealing element in its compressed state serves as the gas/liquid seal between the conductor and the insulating body.

According to a preferred method, the at least one sealing

25 element comprises rubber or a rubber-like material and is compressed by deformation of its compressible means comprising grooves making contact with the conductor.

According to a preferred method, the at least one sealing

30 element comprises rubber or a rubber-like material and is compressed by deformation of its compressible means comprising cavities which are compressed.

According to a preferred method, the at least one sealing

35 element is compressed by deformation of grooves as well as gas-filled cavities.

According to a preferred method, after the hardening process, a final shape is imparted to the bushing by machining, for example by turning in a lathe.

- 5 According to a preferred method, the end of the at least one sealing element facing the outer end of the insulating body is formed

with a lip which is exposed or removed during the machining of the insulating body.

5 According to a preferred method, means for field control for example in the form of field-controlling linings are wound into the insulating body between the insulating materials.

10 According to a preferred method, a pressure-equalizing layer is applied between part of the conductor and the insulating body.

15 According to a preferred method, the manufacturing process is adapted to the manufacture of a bushing for a lowest system voltage of 36 kV, alternatively from 170 kV, and up to the highest currently occurring system voltages, that is, 800 kV and above.

20 In some embodiments the insulating material comprises insulating paper.

In some embodiments the hardening material comprises epoxy.

25 In some embodiments the hardening process comprises hardening shrinkage.

BRIEF DESCRIPTION OF THE DRAWINGS

30 The invention will now be described with reference to the accompanying drawings, wherein

Figure 1 shows a section of a bushing according to the invention,

35 Figure 2 shows in detail a section of the sealing element at the outer end of the bushing,

Figure 2a shows in detail a section of the sealing element with locking grooves,

40 Figure 2b shows in detail a segment of the sealing element with compressible gas cavities,

Figure 3 shows in detail a segment of the sealing element,

Figure 4 schematically shows the bushing arranged in the transformer tank of a transformer.

5 Figure designations

- 1 bushing
- 2 grounded plane
- 3 insulator body
- 10 4 electrical conductor
- 5 sealing member
- 6 sealing element
- 7a grooves
- 7b gas-filled cavities
- 15 8 fixing element
- 9 outer end of insulator body
- 10 lip
- 11 field-controlling lining
- 12 pressure-reliving layer
- 20 13 locking grooves
- 14 transformer
- 15 transformer winding
- 16 force line
- 17 transformer tank
- 25 18 insulator

DETAILED DESCRIPTION OF THE DRAWINGS

Figure 1 shows a bushing 1 for electric current and/or voltage through a grounded plane 2. The grounded plane may, for example, constitute part of a transformer tank, to which the bushing, which is provided with fixing element 8, is sealingly attached (by suitable means not shown).

35 The bushing 1 comprises a substantially rotationally symmetrical insulating body 3 surrounding a central electrical conductor 4. The conductor is usually made of a metallic

material, such as aluminum or copper or alloys thereof, but may also consist of other conductive material.

The bushing is provided with a sealing member 5 to achieve
5 gas/liquid sealing between the conductor and the insulator
body 3. The insulator body is formed by winding insulating
material (e.g. insulating paper) on the conductor in a known
way and then impregnating it with a hardening material, for
example epoxy. By a hardening process, the insulator body
10 assumes a solid shape in the form of a so-called RIP (Resin
Impregnated Paper) body. A pressure-relieving layer 12, for
example in the form of cork rubber, may be applied to the
conductor between parts of the boundary layer between the
conductor and the insulating body. However, this layer does
15 not ensure the sealing function but has a pressure-relieving
function.

According to the invention, the sealing member 5 comprises
at least one sealing element 6 with compressible means, which
20 sealing element is arranged on the conductor between the
insulating body 3 and the conductor 4, to which sealing
element, during said hardening process, a compressed state
has been imparted by the externally arranged insulator body
3, the sealing element then forming a gas/liquid seal,
25 integrated with the insulating body, between the conductor 4
and the insulating body 3. The sealing element, which con-
sists of a rubber material or a rubber-like material of a
quality suited for the purpose, is shaped as an annular band.
To impart a permanently compressed state to the sealing
30 element, the sealing element is provided with compressible
means. According to one embodiment of the invention, the
compressible means comprise grooves 7a facing the conductor,
said grooves being deformed during the compression process.
According to another embodiment of the invention, the
35 compressible means of the sealing element 6 comprise gas-
filled cavities 7a that are compressed and deformed during
the compression. A combination of these methods of imparting

a permanent compression to the sealing element by deforming grooves 7a and gas-filled cavities 7b is possible within the scope of the invention.

5 According to the invention, sealing member 5 comprises at least one sealing element 6 with compressible means arranged on a part of the axial lengths of the conductor 4. Preferably, sealing elements can be arranged at both ends of the insulating body. Alternatively, sealing element 6 can be
10 arranged between the ends of the insulating body or at the ends as well as in-between the ends.

Figure 2 shows in detail a section of the sealing element 6 at the outer end of the bushing 1. Here, the sealing element
15 6 is formed with a cross section with an increasing thickness in a direction towards the centre c of the bushing 1 and a corresponding void formed in the insulator body. This implies that geometrical locking of the sealing element is achieved when an overpressure of gas or liquid from the centre of the
20 bushing towards the ends brings about an axial force on the seal against the outer end thereof.

Further, Figure 2 shows that the sealing element 6 is provided with a lip 10 facing the outer end of the insulator. This
25 lip serves as a flexible spacer that attends to the relief of force between the conductor 3 and the outer end 9 of the insulator body. 12 designates a pressure-relieving layer.

Figure 2a shows a section of the sealing element 6, where the
30 geometrical locking against the insulator is achieved by means of locking grooves 13. The locking grooves 13 are waved in the figure. The compressible means here comprise grooves 7a.

35 Figure 2b shows a section of the sealing element 6 similar to Figure 2a, where the compressible means comprise gas-filled cavities 7b as well as grooves 7a.

Figure 3 shows a section of a segment of the sealing element 6, which in non-compressed state exhibits a largest thickness t of between 0.5 and 10 mm and a width b of between 10 and 100 mm, as well as an inner diameter d of between 20 and 300 mm, said diameter being somewhat smaller than the outer diameter D of the electrical conductor (Figure 1).

The sealing element 6 in Figure 2 and 3 can also be provided with gas-filled cavities 7b as shown in Figure 2b.

The bushing is preferably designed for a lowest system voltage of from 36 kV, alternatively from 170 kV and up to the highest system voltages occurring, that is, 800 kV and above. In these applications, it is suitable for the insulator body 3 to comprise, in addition to insulating material, also means for field control, for example in the form of field-controlling linings 11, which is schematically shown in Figure 2.

In Figure 4, the bushing 1 according to the invention is shown arranged in a transformer 14 and constitutes part of its electrical connection between the transformer winding 15 and a force line 16. Here, the grounded plane 2 consists of the wall of a transformer tank 17. 18 designates an insulator connected to the bushing.

Alternatively, the bushing may be arranged with gas-insulated equipment (not shown), where the grounded plane 2 consists of the enclosure around the insulating gas.

Where the bushing constitutes part of a cable termination (not shown), the grounded plane 2 is in the form of a ground casing in the cable segment that is connected to the cable termination.

When the sealing element 6 is placed at the outer end of the insulator body as described above, a sealing element is preferably attached at each outer end of the insulator body.

Alternatively, the sealing element may be centrally located.

5 In this case, the sealing element is preferably formed without a lip 6.

The invention also relates to a method of manufacturing a bushing 1 for electric current and/or voltage through a
10 grounded plane 2 according to the above.

The bushing thus comprises a substantially rotationally symmetrical insulating body 3 surrounding a central electrical conductor 4 that exhibits sealing members 5 for gas/liquid
15 sealing between the conductor 4 and the insulator body 3. Such an insulator body 3 is formed using known technique such that an insulating material, for example in the form of insulating paper, is wound onto the conductor (or onto a pressure-relieving layer possibly applied thereon). There-
20 after, the insulator body is impregnated with a hardening material, for example epoxy, whereupon it is changed into solid shape by a hardening process. During this process, shrinkage of the insulating material, so-called hardening shrinkage, occurs, which causes the insulating body to become
25 attached to the envelope surface of the conductor and sealing thereagainst.

In bushings for higher voltages and currents, they have to be dimensioned accordingly, which means that such bushings
30 assume larger dimensions. From this follows, in turn, that the contact surface along the insulator body and the axial extent of the conductor may become considerable, for example 1-2 meters.

35 Since the coefficient of temperature expansion is not identical for the conductor material and the insulator material, respectively, shear forces will arise at the boundary layer

as a result of temperature variations, which implies that the seal cannot be maintained between the conductor and the insulator material, which results in gas/liquid leakage therebetween.

5

According to the method of manufacturing the bushing according to the invention, a sealing member 5 in the form of a compressible elastic sealing element 6 is applied to the conductor 4 prior to winding on the insulating material. The insulating material is applied so as to at least substantially cover the sealing element 6, whereupon a permanent and substantially radial compressive force is imparted to the sealing element during the subsequent manufacturing process from the surrounding insulator body 3, whereby the sealing element 6 in its compressed state serves as a gas/liquid seal between the conductor 4 and the insulator body 3.

10

15

20

25

30

35

40

45

50

55

60

65

70

75

80

85

90

95

100

105

110

115

120

125

130

135

140

145

150

155

160

165

170

175

180

185

190

195

The sealing element 6 is made of rubber or a rubber-like material, and for the compression to become permanent it is important that the material be given space for deformation. Since the sealing element is provided with compressible means such as grooves 7a, which compressible means are elastically deformed during compression, space for expansion is provided between these grooves.

Alternatively, the compressible means of sealing element 6 contain air or gas-filled cavities that are compressed.

Alternatively, the compressible means of sealing element 6 comprise grooves 7a as well as air or gas-filled cavities 7b.

After the hardening process, the bushing is given its final shape by machining the insulator, for example by turning the insulator to the desired shape in a lathe.

When the sealing element is arranged at the outer end 9 of the insulator body, it is preferably formed with a lip 10 which, when the insulating material is being wound on, is

allowed completely or partly to cover this end. During the machining of the insulator body 3, the lip is exposed, or alternatively removed. By this method, mechanical stress concentrations at the outer end 9 of the insulator body are
5 avoided.

At the high electric voltages to which the bushing is designed, means for field control are normally required, for example in the form of field-controlling linings 11, which in
10 a known manner are wound into the insulator body 3 between the insulating material.

The manufacturing process is preferably suited for manufacture of bushings for a lowest system voltage of 36 kV, alternatively from 170 kV up to the highest system voltages
15 currently occurring, 800 kV and above, but according to the invention is it also suitable for manufacture of bushings for lower electric voltages.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A bushing for electric current and/or voltage through a grounded plane comprising a substantially rotationally symmetrical insulating body surrounding a central electrical conductor, said bushing comprising a sealing member for gas/liquid sealing between the conductor and the insulating body, said insulating body being formed by winding insulating material onto the conductor and then being impregnated with a hardening material, and being transferred into solid shape by a hardening process, wherein said sealing member comprises at least one sealing element with compressible means arranged on a part of an axial direction of the conductor between the insulating body and the conductor, a compressed state being imparted to the at least one sealing element during said hardening process by the externally arranged insulating body, said at least one sealing element then forming a gas/liquid seal, integrated with the insulating body, between the conductor and the insulating body.
2. A bushing according to claim 1, wherein the compressible means of the at least one sealing element comprise grooves formed on an annular band, which grooves are arranged perpendicular to the axial direction of the conductor facing the same.
3. A bushing according to claim 1, wherein the compressible means of the at least one sealing element comprise gas filled cavities.
4. A bushing according to claim 2 or 3, wherein the compressible means of the at least one sealing element comprise grooves as well as gas-filled cavities.
5. A bushing according to any one of claims 1 to 4, wherein the at least one sealing element is formed with a cross section with an increasing thickness in a direction towards a centre of

the bushing for achieving geometrical locking of the at least one sealing element.

6. A bushing according to any one of claims 1 to 5, wherein the at least one sealing element is arranged at an outer end of the insulating body and provided towards this end with a lip, which during a manufacturing process serves as a flexible spacer that attends to relief of force between the conductor and the outer end of the insulating body.

7. A bushing according to any one of claims 1 to 6, wherein the at least one sealing element comprises rubber or a rubber-like material.

8. A bushing according to any one of claims 1 to 7, wherein the at least one sealing element in non-compressed state exhibits a largest thickness of between 0.5 and 10 mm, a width of between 10 and 100 mm, and an inner diameter of between 20 and 300 mm, said diameter being somewhat smaller than an outer diameter of the conductor.

9. A bushing according to any one of claims 1 to 8, wherein the bushing is designed for a lowest system voltage of 36 kV and up to a highest system voltage of at least 800 kV.

10. A bushing according to any one of claims 1 to 8, wherein the bushing is designed for a lowest system voltage of 170kV and up to a highest system voltage of at least 800 kV.

11. A bushing according to any one of claims 1 to 10, wherein the insulating body, in addition to the insulating material, also comprises means for field control.

12. A bushing according to claim 11, wherein said means for field control are in the form of field-controlling linings.

13. A bushing according to any one of claims 1 to 12, wherein the bushing is arranged in a transformer and constitutes part of its electrical connection to a force line.

14. A bushing according to any one of claims 1 to 12, wherein the bushing is arranged in a transformer and constitutes part of its electrical connection to a force line, whereby the grounded plane consists of a wall of a transformer tank.

15. A bushing according to any one of claims 1 to 12, wherein the bushing is arranged with gas-insulated equipment, whereby the grounded plane consists of an enclosure around an insulating gas.

16. A bushing according to any one of claims 1 to 12, wherein the bushing constitutes part of a cable termination, whereby the grounded plane consists of a ground casing in a cable segment.

17. A bushing according to any one of claims 1 to 16, wherein said insulating material comprises insulating paper.

18. A bushing according to any one of claims 1 to 17, wherein said hardening material comprises epoxy.

19. A method for manufacturing a bushing for electric current and/or voltage through a grounded plane comprising a substantially rotationally symmetrical insulating body surrounding a central electrical conductor, said bushing comprising a sealing member for gas/liquid sealing between the conductor and the insulating body, the method comprising:

forming said insulating body by winding insulating material onto the conductor,

impregnating said insulating body with a hardening material,

transferring the insulating body into solid shape by a hardening process, said sealing member comprising at least one sealing element with compressible means applied to a part of an

axial direction of the conductor between the insulating body and the conductor prior to the winding of the insulating material, said material being applied so as to cover the at least one sealing element, and

imparting a permanent and substantially radial compressive force to the at least one sealing element with the compressible means during a subsequent manufacturing process by the insulating body, whereby the at least one sealing element in its compressed state serves as the gas/liquid seal between the conductor and the insulating body.

20. A method according to claim 19, wherein the at least one sealing element comprises rubber or a rubber-like material and is compressed by deformation of its compressible means comprising grooves making contact with the conductor.

21. A method according to claim 19, wherein the at least one sealing element comprises rubber or a rubber-like material and is compressed by deformation of its compressible means comprising cavities which are compressed.

22. A method according to claim 19, wherein the at least one sealing element is compressed by deformation of grooves as well as gas-filled cavities.

23. A method according to any one of claims 19 to 22, wherein, after the hardening process, a final shape is imparted to the bushing by machining.

24. A method according to claim 23, wherein imparting the final shape to the bushing comprises imparting the final shape to the bushing by turning in a lathe.

25. A method according to claim 23 or 24, wherein an end of the at least one sealing element facing an outer end of the insulating body is formed with a lip, and wherein said lip,

during the machining of the insulating body, is exposed or removed.

26. A method according to any one of claims 19 to 25, wherein means for field control are wound into the insulating body between the insulating material.

27. A method according to claim 26, wherein said means for field control are in the form of field-controlling linings.

28. A method according to any one of claims 19 to 27, wherein a pressure-equalizing layer is applied between part of the conductor and the insulating body.

29. A method according to any one of claims 19 to 28, wherein the method is adapted to manufacture of a bushing for a lowest system voltage of 36 kV and up to a highest system voltage of at least 800 kV.

30. A method according to any one of claims 19 to 28, wherein the method is adapted to manufacture of a bushing for a lowest system voltage of 170kV and up to a highest system voltage of at least 800 kV.

31. A method according to any one of claims 19 to 30, wherein said insulting material comprises insulating paper.

32. A method according to any one of claims 19 to 31, wherein said hardening material comprises epoxy.

33. A method according to any one of claims 19 to 32, wherein said hardening process comprises hardening shrinkage.

1/2

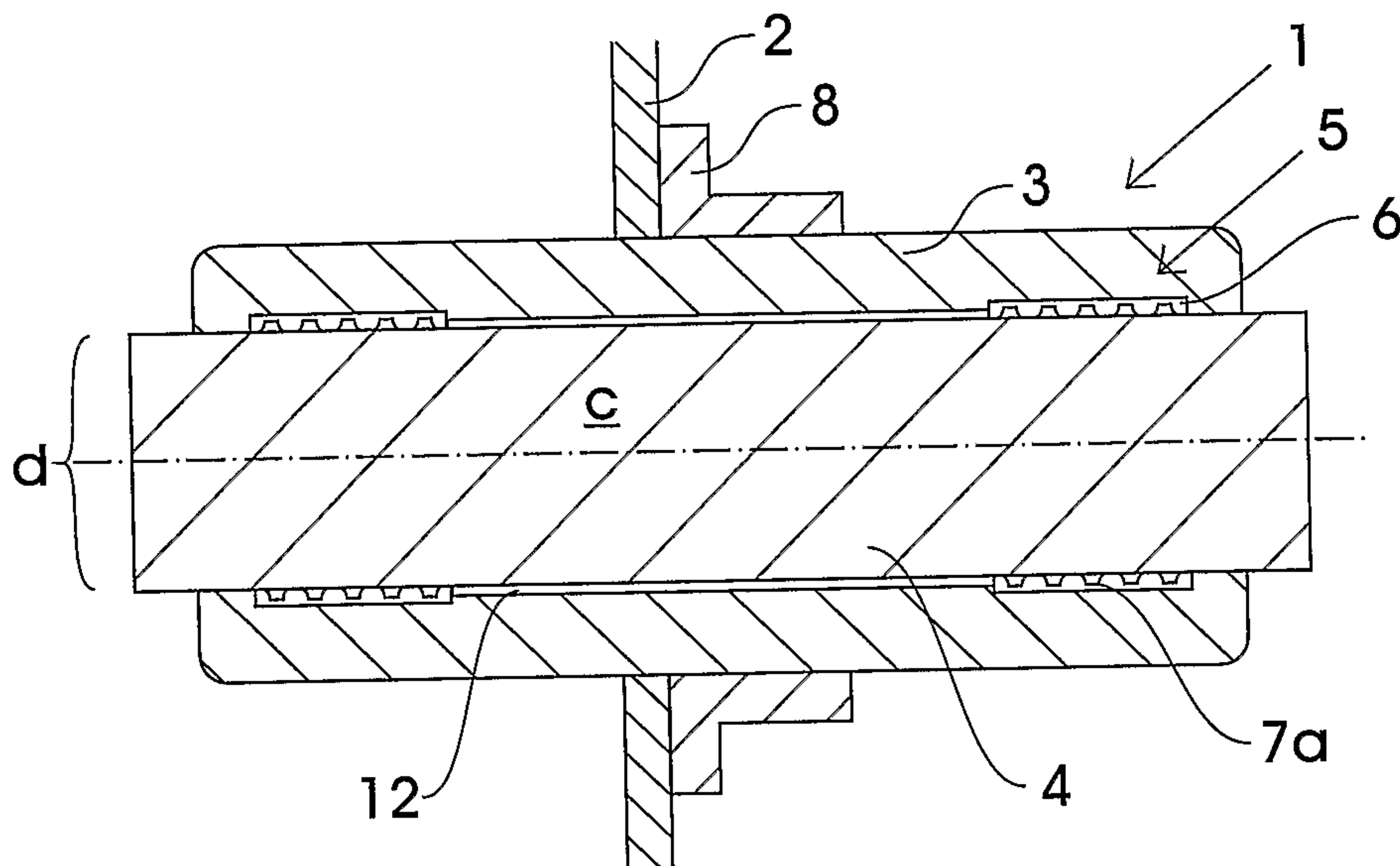


Fig 1

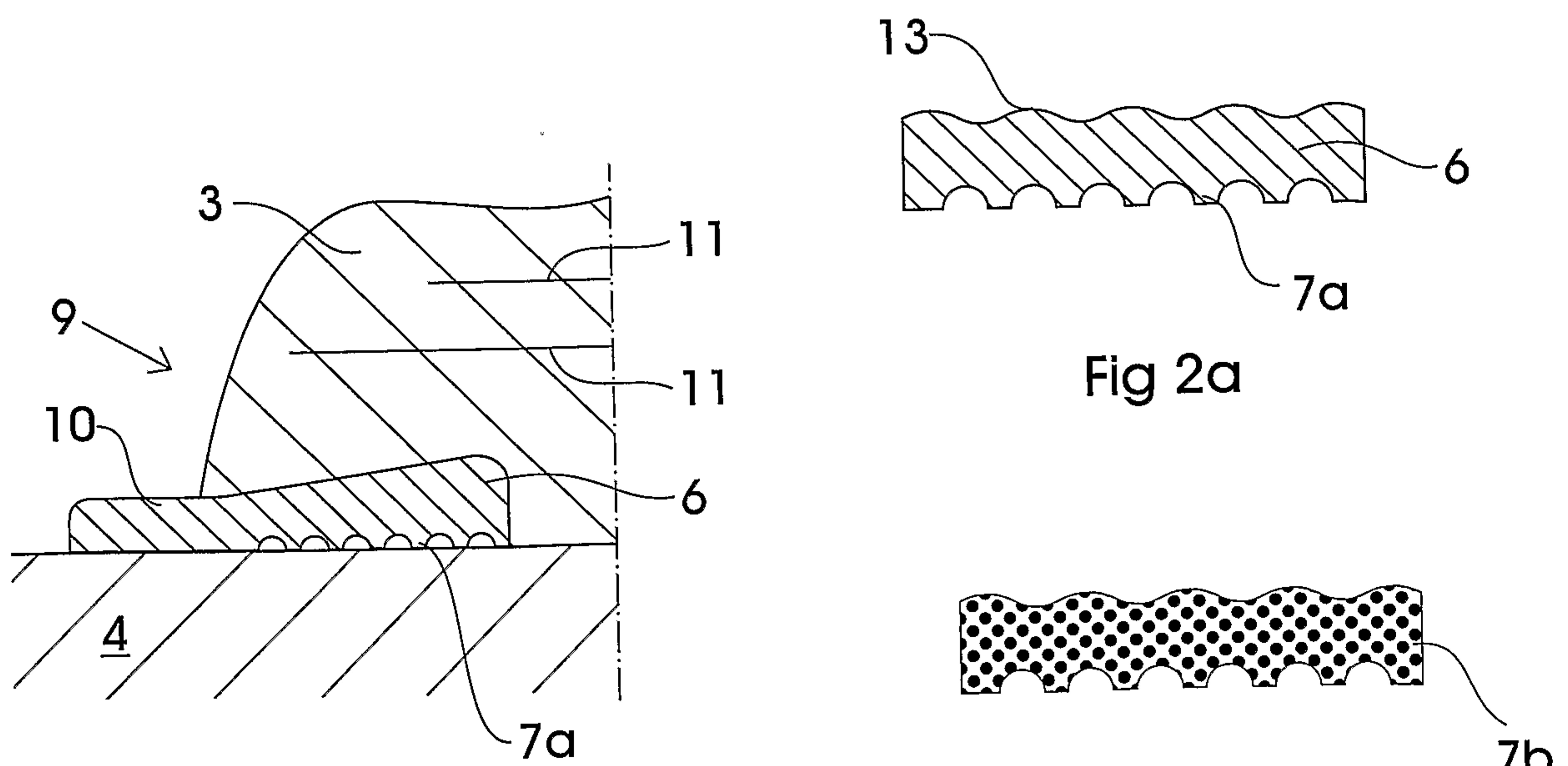


Fig 2

Fig 2a

Fig 2b

2/2

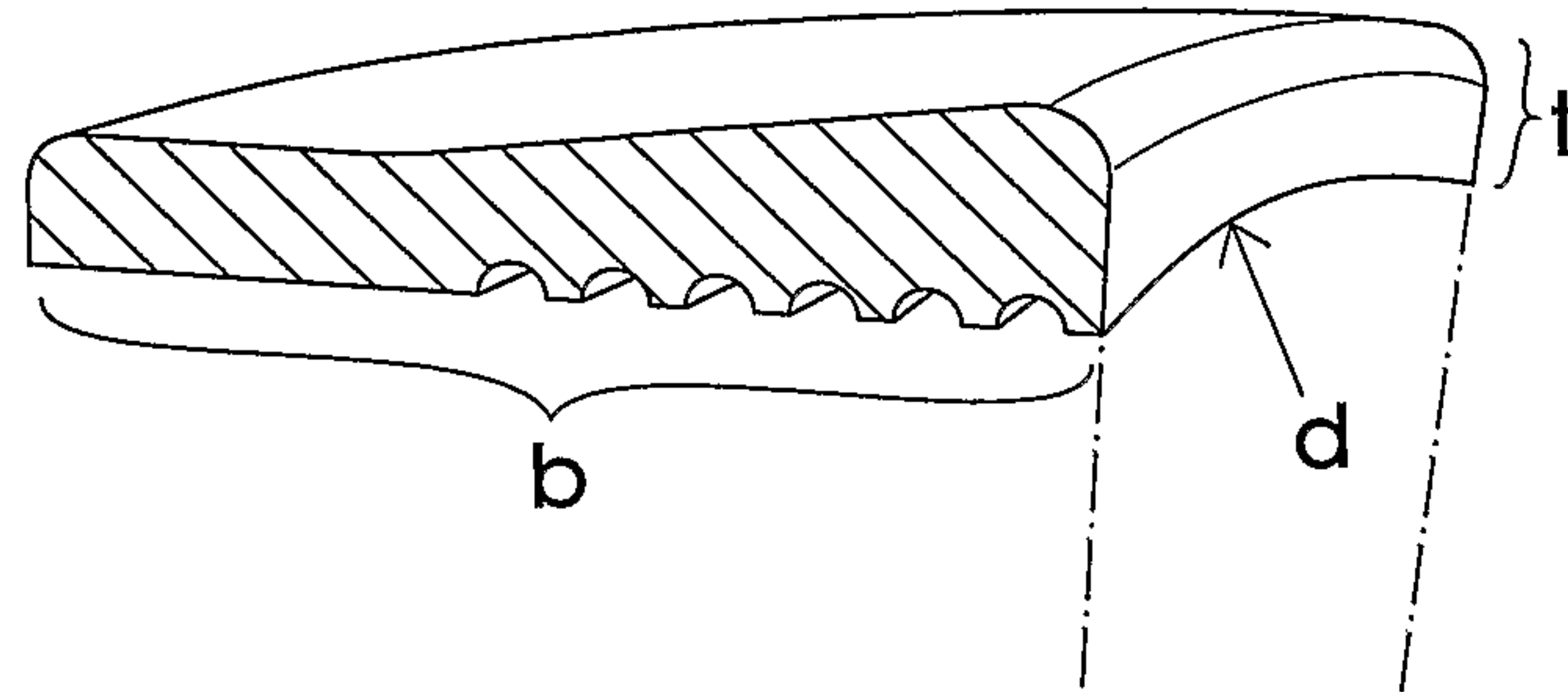


Fig 3

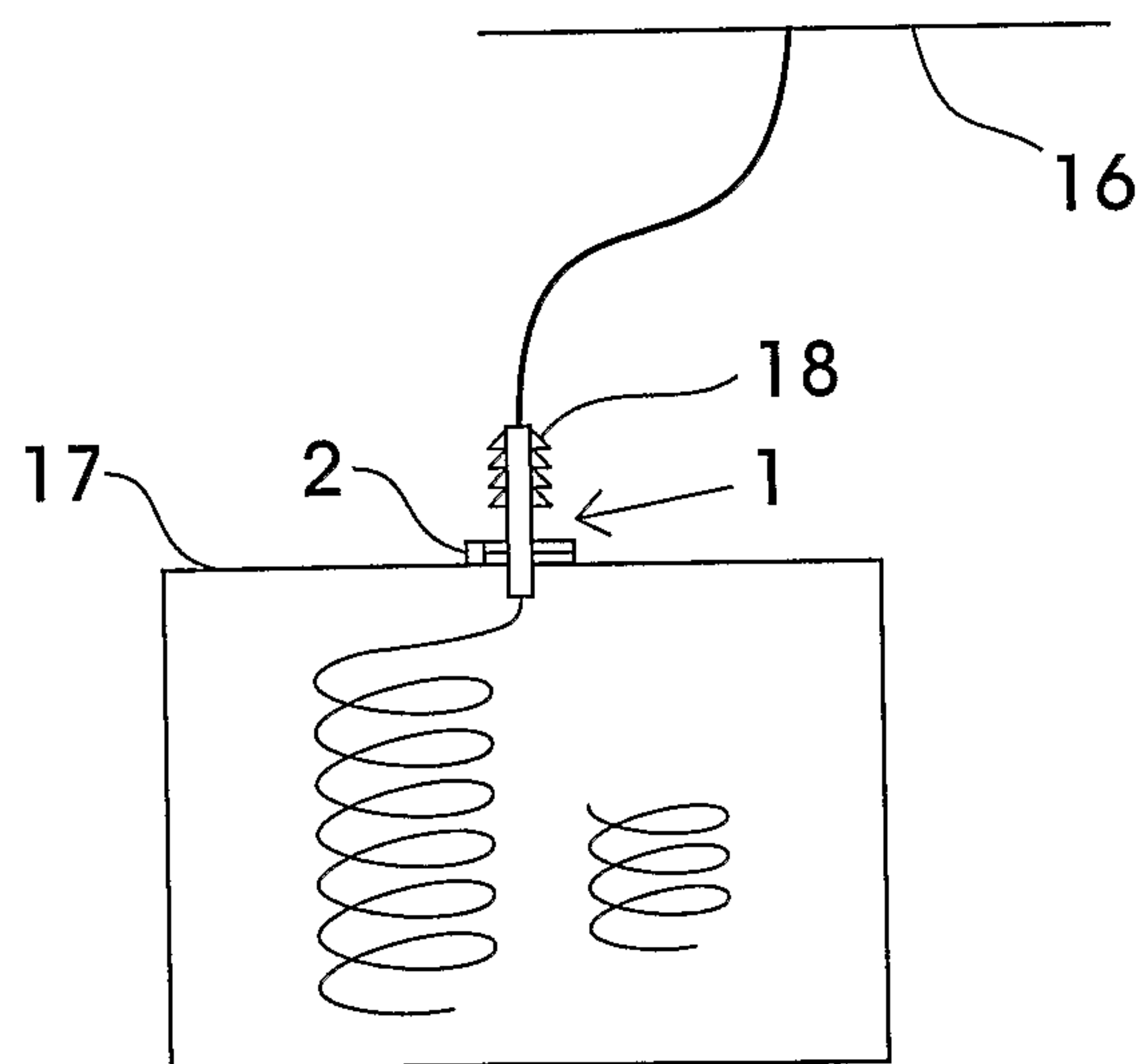


Fig 4

