(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 479 792 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
24.11.2004 Bulletin 2004/48

(51) Int Cl.[7]: **C23F 13/18**

(21) Application number: **04007030.2**

(22) Date of filing: **24.03.2004**

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

(30) Priority: **26.03.2003 IT AN20030018**

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(54) Dielectric means of fastening for an anode in a metal tank

(57) The object of the present invention is the realisation of insulating means of fastening for an armoured electric resistance (1) that extends inside the tank, and whose external metallic armour (1.1) acts as an anode.

Said insulating means of fastening are composed of dielectric bushes (4; 4.1) directly moulded onto the armour (1.1) at the end of the tubular element that forms said electric resistance (1).

An electrical connector (8; 8.1) guarantees the electrical connection between the positive pole of an impressed current generator and the armour (1.1) that acts as an anti-corrosion anode.

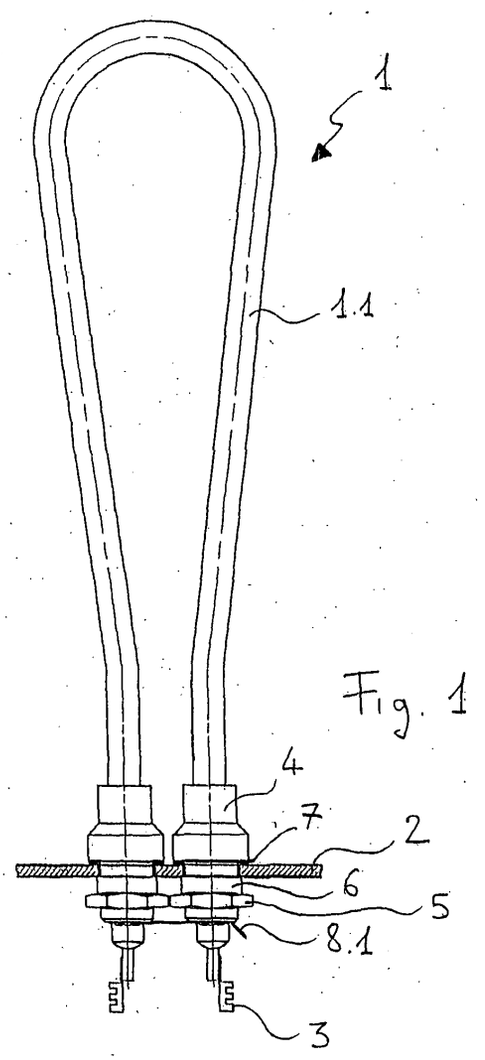

Fig. 1

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Description

[0001] The aim of the present invention is the realisation of an insulating means of fastening for devices adapted to provide anticorrosion protection for metal tanks containing liquids to be heated.

[0002] In the field of water heaters in particular, an important problem concerns the corrosion that attacks the internal surface of the metal accumulation tank. This corrosive process, caused by the contact between the water and the metal alloy and by the resulting ionic exchange, increases with the rise in water temperature.

[0003] Various anti-corrosion methods for water heater metal structure protection are already well-known and widely used in the sector in question: known methods are based on so-called anodic protection and so-called cathodic protection, the latter being the only method widely used in the sector in question; cathodic protection can be obtained by means of a passive sacrificial anode, or using a method that is becoming more popular, called "impressed current".

[0004] Cathodic protection using passive anodes is applied by inserting, inside the structure to be protected, a metal anode (generally magnesium) or one of its alloys, with an electrochemical potential considerably higher than that of the metal tank walls that, in this way, act as a cathode.

[0005] On the other hand, "impressed current" cathodic protection foresees a direct current generator whose negative pole is connected to the metallic mass to be protected while the positive pole is connected to the electrode that acts as an anode which is also electrically insulated from the metallic mass to be protected.

[0006] The application for the Italian patent No. AN2001A005 explains this method clearly and explains how to use an armoured electric resistance, generally used exclusively for heating the accumulator water, to act also as an electrode to distribute impressed current for cathodic protection.

[0007] The invention described in the aforesaid document provides a means of avoiding the use of an anode adapted for insertion inside the tank, because the heating element also includes the additional function of acting as an anode.

[0008] The resistance armour must be made from a metal or metal alloy that is not subject to electrochemical corrosion, at least for the values of potential difference that are required for cathodic protection: a particularly suitable material for this purpose is titanium, or one of its alloys, for this reason widely used in the construction of electrodes for impressed current devices. However, it should be stated that because of this property, said titanium and its appropriate alloys have a drawback in that their electrical resistance is rather high; and consequently along the armour there is a considerable voltage drop between the point adjacent to the current generator connection and the furthest point; thus making it difficult to distribute in a uniform manner the current from the anode to the metal surface requiring protection.

[0009] Naturally, for the system to function correctly, the resistance must be mounted so that it is electrically insulated from the tank and connected electrically to the negative pole of the impressed current generator.

[0010] The aim of the present invention is to indicate a simple, economical and prompt means for realising on the metal mass to be protected, and in particular, on the metal flange of the tank, an insulated fastening device for the resistance, whose armour acts as an anode.

[0011] A further aim of the present invention is to indicate a means for electrical connection that improves the uniformity of the electrical potential on the surface of the armour that acts as an anode.

[0012] Another further aim of the present invention is to facilitate the electrical connection of the resistance armour to the impressed current generator.

[0013] These and other aims, that will be explained further on, are attained according to the present invention by a means that fastens and connects the resistance armour realised according to the method described in the claims and appended illustrations, which are understood as being an integrated part of the present description.

[0014] Further aims, characteristics, and advantages of the present invention will be made clear from the following description, that includes references to the appended drawings, and that are provided simply as examples that are not to be considered limitative in any way, wherein:

- figure 1 shows an armoured electrical resistance and the means for fastening it to the tank flange, according to a first possible version of the invention;
- figure 2 shows a blow-up side view of an enlarged detail of figure 1, to demonstrate the means of fastening of the resistance according to a first possible version of the invention;
- figure 3 shows an armoured electric resistance and its fastening means to the tank flange according to a second possible version of the invention;
- figure 4 shows a blow-up side view of an enlarged detail of figure 3, to demonstrate the fastening means of the resistance according to a second possible version of the invention;
- figure 5 shows an enlarged detail of an armoured electric resistance and its means of fastening to the flange, under which is positioned a heat control and impressed current generating device.

[0015] The following components refer indifferently to both figures 1 and 2 to show a metallic mass to be protected against corrosion comprising a metal tank, a portion 2 on which is fastened an armoured electric resistance 1 that extends into the tank and whose external metal armour 1.1 acts as an anode. Said portion 2, in fact, generally consists of a metal flange 2, electrically connected to said tank and acting as a closure system

on said tank.

[0016] The external metallic armour 1.1 of said electrical resistance 1 is realised in a material particularly resistant to electrochemical corrosion, such as titanium or one of its alloys. The tubular element that forms the electrical resistance 1 has an inverted U shape, in a manner so that the ends can be fixed to, and supported by flange 2.

[0017] Numeral 3 refers to the electrical contacts of the electrical resistance 1, to which the connectors of a common electromechanical or electronic thermostat are electrically connected, although these are not illustrated in the figures.

[0018] Numeral 4 refers to the dielectric bushes realised through co-moulding, adapted to act as an insulating means of fastening of resistance 1 to flange 2. Co-moulding technology, that will be illustrated in more detail further on, consists in moulding a thermoplastic or thermosetting material over another material that remains encased as an insert.

[0019] The lower part of the bushes 4, hereafter referred to as "stem" and identified by the numeral 6, is threaded so that the nuts 5 can be screwed to the stem thus blocking the resistance 1 on flange 2.

[0020] Numeral 7 refers to the seals that prevent any water leaking from the accumulator tank towards the exterior of flange 2, while numerals 8 and 8.1 identify two possible variants of an electrical connector that provides the electrical connection between the positive pole of an impressed current generator, not shown in the figures, and the armour 1.1, that acts as an anticorrosion anode. Said electrical connector 8 can be realised in many modes; a preferred form, because of its simplicity, consists of a part in the form of a notched washer that can be forced onto one end of the armour 1.1, and another part in the form of a faston for rapid connection to the current generator. On the other hand, the electric connector 8.1 is conceived so that it can be electrically connected to both ends of armour 1.1.

[0021] Figures 3 and 4 represent a second possible version of a dielectric means for fastening the resistance 1 to the flange 2: instead of realising two separate bushes 4, co-moulded onto the two tubular ends that form resistance 1, a single bush, 4.1, is realised using the same co-moulding process and technology that will be described further on, that contains both ends of resistance 1. There is also only a fastening single nut 5.1. screwed onto stem 6.1.

[0022] As described previously, the dielectric fastening device represented by bushes 4 or 4.1, is co-moulded directly onto the end of the tubular element that forms the electrical resistance. The co-moulding process is preceded by appropriate treatment on the tubular element surfaces in order to improve adhesion between the metal, ideally titanium or one of its alloys, and the material of the bushes 4 or 4.1.

[0023] Certain examples of these physical and chemical treatments, that may be used separately or together for even better effect, consist of:

- physical preparation adapted to increasing the surface roughness of the ends of the tubular element using mechanical methods such as sanding or peening;
- chemical preparation adapted to improve adhesion by the plastic material compound, by oxidising the surface with flame, corona, or plasma treatment to increase wettability and the chemical polarity of the armour 1.1;
- chemical preparation by localised surface attack using chromic acid and/or nitric acid, adapted to increase the microscopic roughness of the area on the armour 1.1. most subject to co-moulding;
- chemical preparation using adhesion primer to guarantee gripping adherence by the plastic materials.

[0024] Following one or more of the aforesaid processes, resistance 1 is inserted into the dielectric mould for bushes 4 or 4.1, ready for co-moulding. Both the single version bush 4, and the double version bush 4.1, are realised using well-known hot moulding techniques with a pure or charged thermosetting resin such as a dual component epoxy resin, or a compound thermoplastic resin for example, such as polypropylene charged with glass and/or other appropriate charges. In fact, a wide range of mouldable dielectric materials is available and those skilled in the art are able to choose the type with the necessary resistance to mechanical and thermal stress to which said dielectric bushes 4 or 4.1 are subject.

[0025] As well as insulating resistance 1 from flange 2, the bushes 4 or 4.1 realised in this manner, will also cover this zone of the armour 1.1, preventing it from emitting impressed protection current that, furthermore, would not be distributed evenly on the walls of tank 1 to be protected, because of its close proximity to flange 2, and therefore attracted by the flange. Therefore, bushes 4 or 4.1 can extend along the armour 1.1 for a distance much longer than the length strictly necessary to provide the required mechanical resistance only.

[0026] A further advantage of the present invention is represented by the prevision of the electrical connector 8 or 8.1, positioned at the end of the armour 1.1. of the electrical resistance 1, below nut 5 or 5.1. Said alternative electrical connectors 8 or 8.1 both possess the advantage of permitting rapid electrical connection to the impressed current generator. Moreover, the variant identified with the numeral 8.1 supplies both ends of armour 1.1 so that the current is distributed in a sufficiently homogeneous manner along the whole armour 1.1. This device is advantageous because, as stated previously, both titanium and its alloys are materials that possess a certain resistivity to current that looses some of its potential travelling along from one end of the armour 1.1 to the other, with the risk that the anti-corrosion protec-

tion may result less balanced and efficient.

[0027] Figure 5 shows a possible application of the aspects of this invention, by facilitating the connection between the electrical resistance 1, and the impressed current generator. Numeral 9 shows an electro-mechanical or electronic device, placed in an adjacent position to the encasing means of fastening for the electrical resistance 1, represented in this case by the insulating bush 4.1. (although, naturally an identical configuration can be foreseen in the case where the insulating bush is realised in the version shown by numeral 4).

[0028] Said device 9 can incorporate both an immersion rod thermostat 10, whose fastons are connected to the electrical contacts of resistance 1, as well as an impressed current generator, whose positive pole is connected to electrical connector 8 or 8.1. Although it is not illustrated in the figure, it is obvious that the electrical connector 8 or 8.1 may not even be necessary, or better still, the appropriate electrical connection means could be realised directly inside device 9, that would therefore be fitted directly onto one or both the ends of armour 1.1.

[0029] A first advantage of the present invention can be obtained from the simple and economical possibility of fastening an electric resistance 1 to the flange 2 of a tank to be protected against corrosion using co-moulded dielectric means, said resistance 1 acting as an impressed current anode as well as a heating element.

[0030] A further advantage is demonstrated by the fact that the electrical connection between resistance 1 and the impressed current generator is facilitated by the presence of electrical connector 8.1 that guarantees a sufficiently homogeneous electric potential along the whole armour 1.1 of the resistance 1.

[0031] Finally, another advantage is demonstrated by the fact that the means described permit the rapid direct insertion of an incorporated current generator inside a device 9 onto armour 1.1 acting as an anode.

[0032] It is clear that numerous variants can be applied by those skilled in the art to the fastening and insulating means for the electric resistance, described as an example, but without deviating from the innovative nature of the invention, just as it is also clear that in the practical application of this invention, the various components and materials described above can be replaced with technically equivalent elements.

Claims

1. Dielectric means (4, 5, 6; 7; 4.1, 5.1, 6.1, 7) for fastening an electric resistance (1) to a portion (2) of a metallic mass to be protected against corrosion through impressed current, said metallic mass comprising a metallic tank, and said portion (2) generally consisting of the flange (2) of said metallic tank containing a liquid to be heated, said resistance (1) being adapted to act as a heating element, while its armour (1.1) is adapted to act as an electrode for anti-corrosion protection,
characterised by the fact that
said means of fastening (4, 5, 6; 7; 4.1, 5.1, 6.1, 7) comprises elements in mouldable dielectric material (4; 4.1) moulded directly onto the armour (1.1) at the ends of the tubular element forming the said electric resistance (1).

2. Dielectric means of fastening for an electrical resistance (1) according to the previous claim,
characterised by the fact that
said elements in mouldable dielectric material (4; 4.1) comprise two bushes (4) each one being moulded separately onto each of said ends using a co-moulding technique.

3. Dielectric means of fastening for an electrical resistance (1) according to claim 1,
characterised by the fact that
said elements in mouldable dielectric material (4; 4.1) comprise a single bush (4.1) being moulded onto each of said ends using a co-moulding technique.

4. Dielectric means of fastening for an electrical resistance (1) according to any of the previous claims,
characterised by the fact that
the mouldable dielectric material of said bushes (4; 4.1) can consist of any type of resin possessing the necessary resistance to mechanical and thermal stress.

5. Dielectric means of fastening for an electrical resistance (1) according to the previous claim,
characterised by the fact that
said mouldable dielectric material consists of a thermosetting resin, either pure or charged, in particular a dual component epoxy resin.

6. Dielectric means of fastening for an electrical resistance (1) according to claim 4,
characterised by the fact that
said mouldable dielectric material consists of a thermoplastic resin, in particular a component resin, such as polypropylene charged with glass and/or other suitable charges.

7. Dielectric means of fastening for an electrical resistance (1) according to any one of the previous claims,
characterised by the fact that
said bushes (4; 4.1) comprise a threaded stem (6; 6.1) through which they can be fastened to the flange (2) by means of nuts (5; 5.1), while seals (7) guarantee water tightness.

8. Dielectric means of fastening for an electrical resistance (1) according to any one of the previous claims,

characterised by the fact that
the co-moulding of said elements (4; 4.1) in mouldable dielectric material is preceded by one or more of the following physical and/or chemical treatments on the surface of the ends of said electrical resistance (1), said treatments being able to consist of sanding or peening, for example, or oxidising using flame, corona or plasma processing, or localised surface attack using chromic and/or nitric acid, or through preparation using an adhesion primer.

9. Dielectric means of fastening for an electrical resistance (1) according to any one of the previous claims,
characterised by the fact that
an electrical connector (8; 8.1) is foreseen for rapid connection between the armour (1.1) and the positive pole of the impressed current generator.

10. Dielectric means of fastening for an electric resistance (1) according to the previous claim,
characterised by the fact that
said electrical connector (8) comprises a part in the form of a notched washer adapted to be forced onto one end of the armour (1.1) and another part in the form of a faston for rapid connection to the current generator.

11. Dielectric means of fastening for an electric resistance (1) according to the previous claim ,
characterised by the fact that
said electrical connector (8.1) comprises a further second part in the form of a notched washer adapted to be forced onto the second end of the armour (1.1).

12. Dielectric means of fastening for an electric resistance (1) according to any one of the previous claims,
characterised by the fact that
said electrical connectors (8; 8.1) permit direct insertion of a device (9) comprising the current generator, through suitable electrical connection means in said device (9).

13. Dielectric means of fastening for an electric resistance (1) according to any one of the previous claims from 1 to 11,
characterised by the fact that
the direct insertion of the device (9) comprising the current generator is foreseen through a suitable electrical connection means realised directly in said device (9) and adapted to connect said generator directly to one or both the ends of the armour (1.1).

14. Dielectric means of fastening for an electric resistance (1) according to any one of the previous claims from 1 to 11,
characterised by the fact that
said device (9) also comprises the heat control thermostat of said resistance (1), said thermostat being in particular, of the type that is inserted directly onto said electric resistance (1) by means of appropriate fastons.

Fig. 2

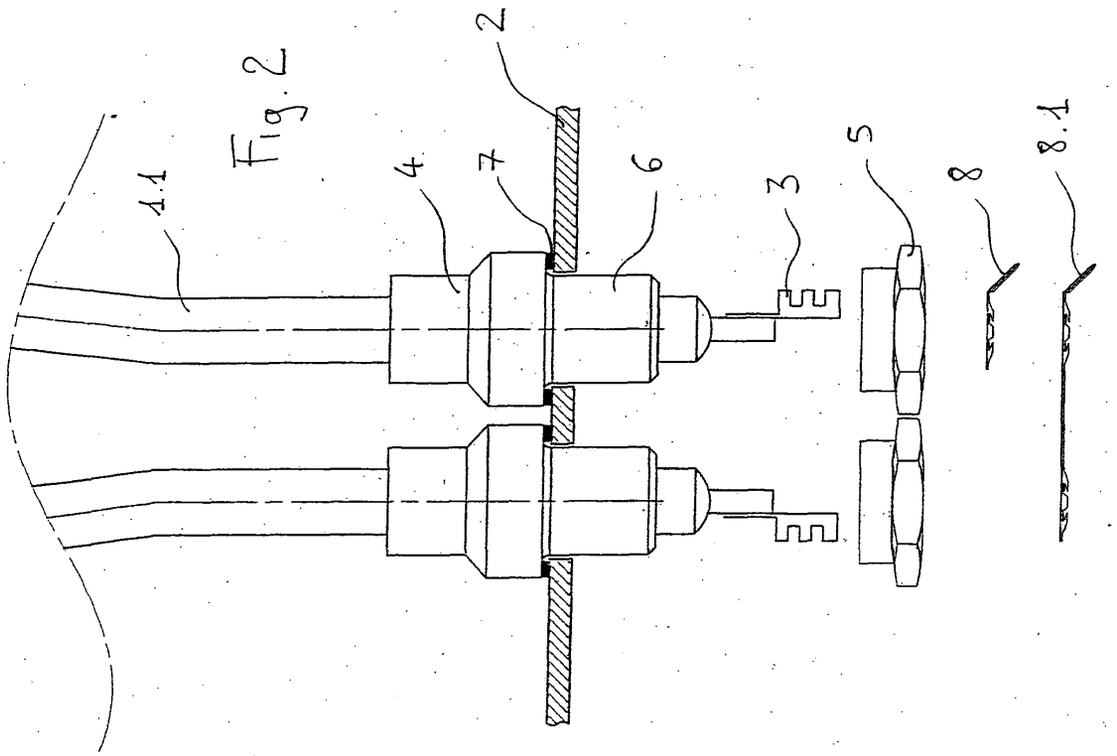
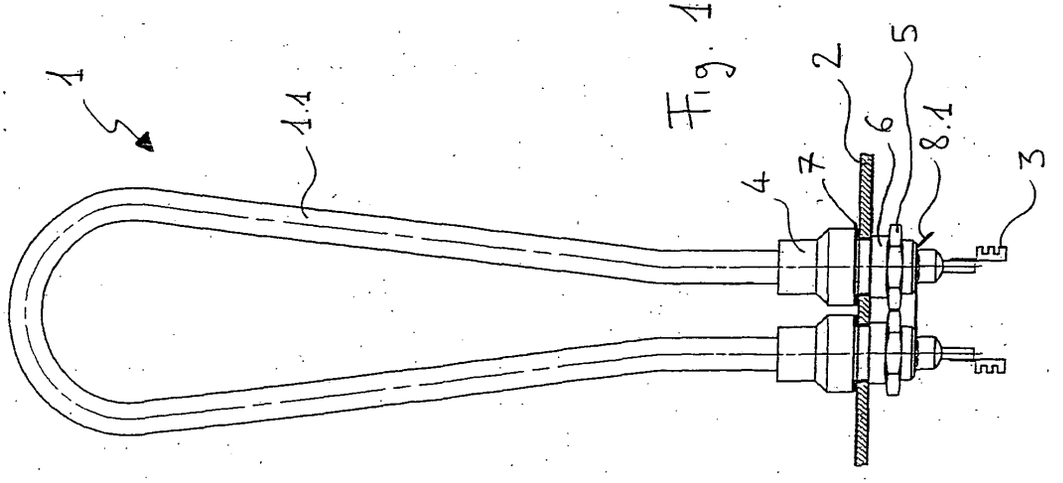


Fig. 1



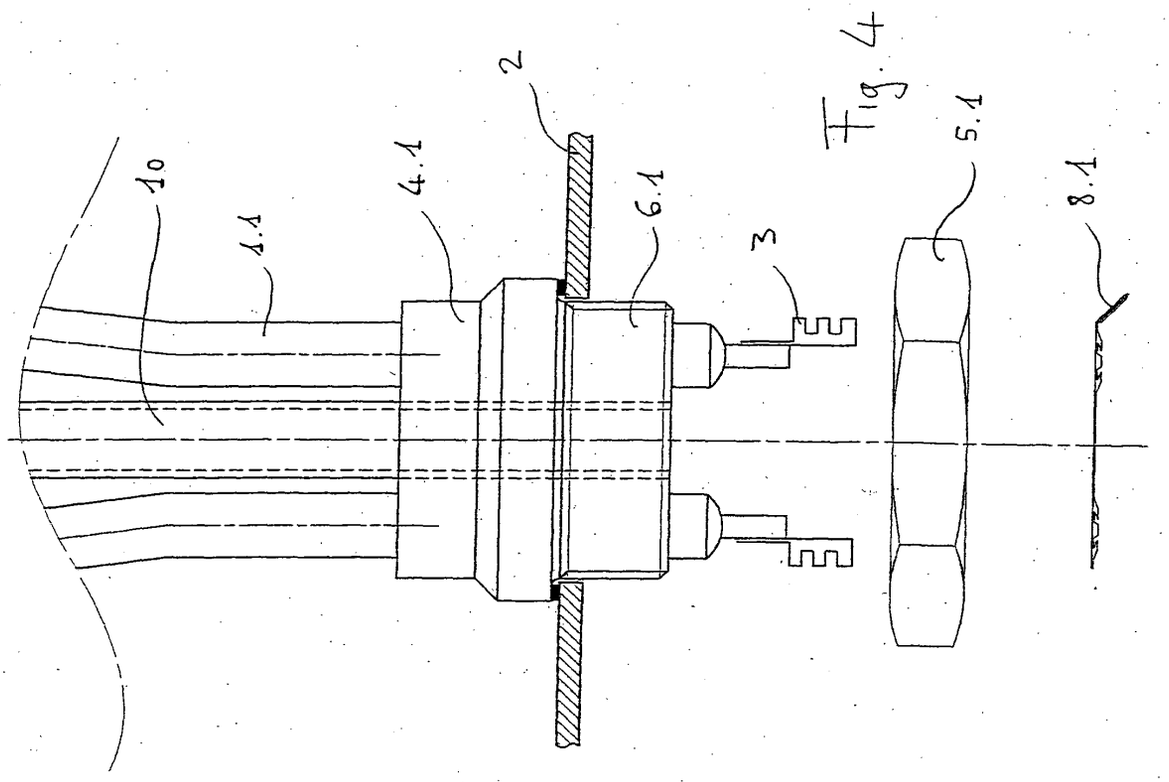


Fig. 4

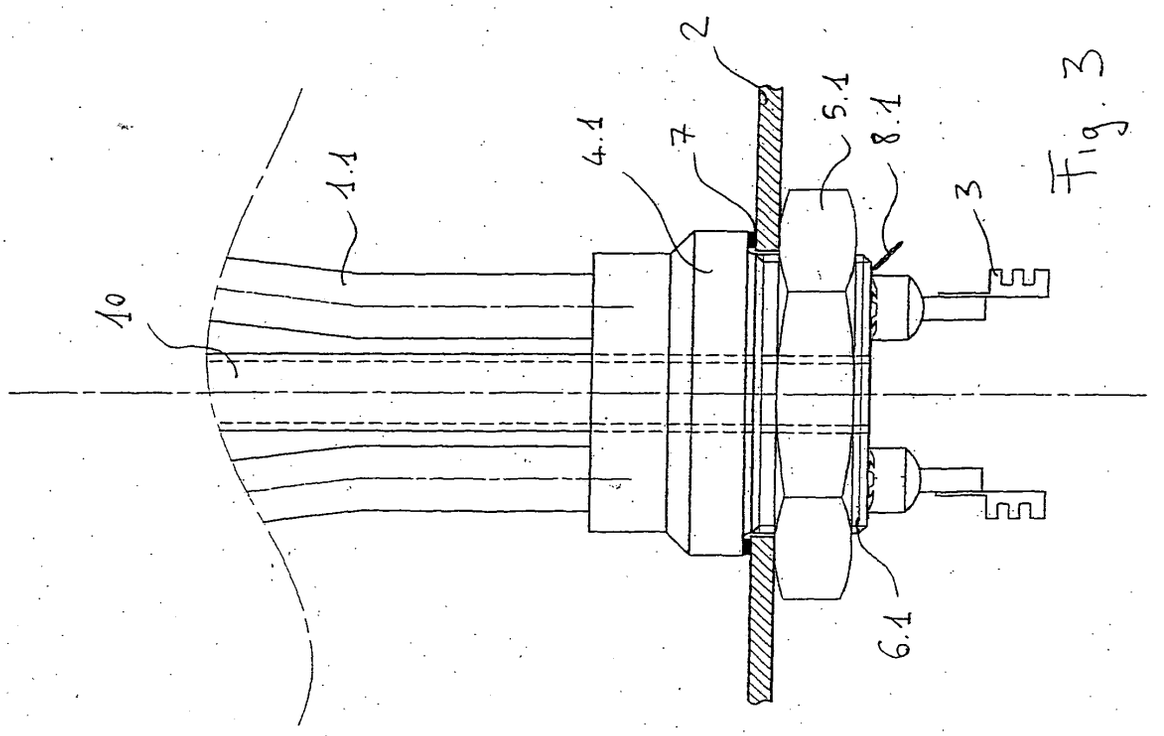


Fig. 3

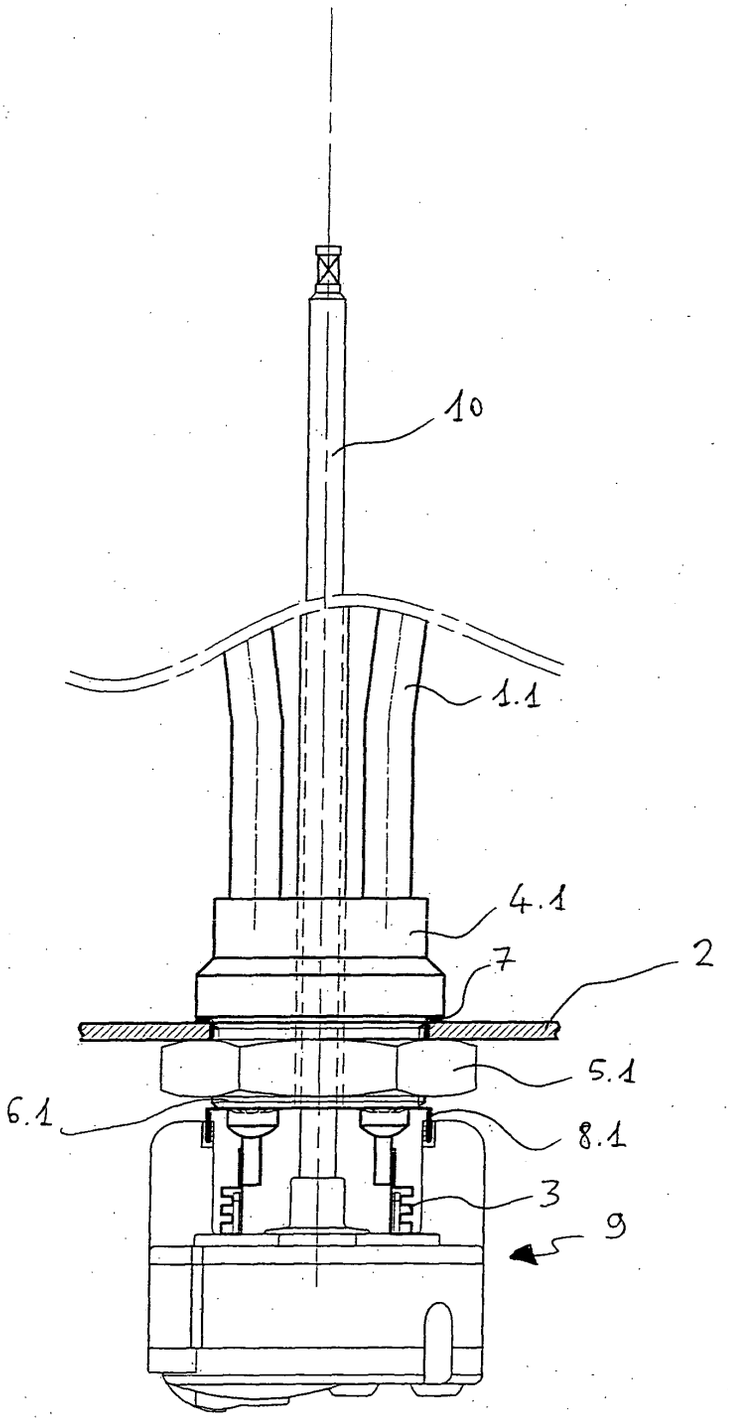


Fig. 5