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(54) A LEAD EXIT ARRANGEMENT

(57) A lead exit arrangement (1) for a high voltage transformer/reactor (20) comprising an elongate bushing (2) having a bushing axis (B), a stress shield (5) located at a base (6) of the bushing (2) for receiving a winding lead (7) from a transformer (20) and housing a connection between the winding lead (7) and the base (6) of the bushing (2), the stress shield (5) configured to receive said winding lead (7) in a direction off-axis with respect to the bushing axis (B).

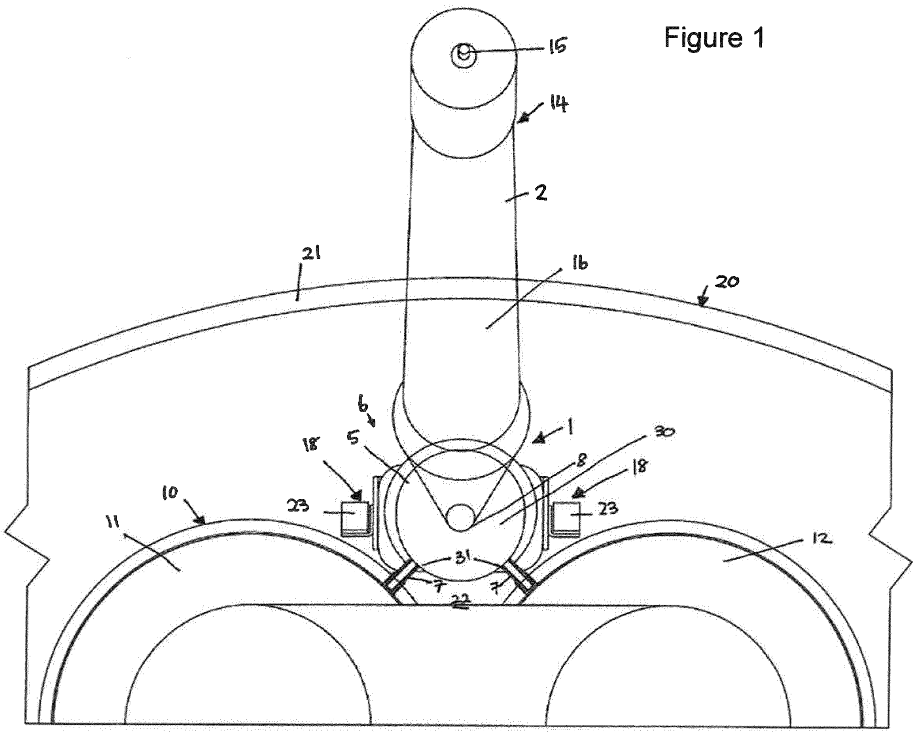

Figure 1

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Description

[0001] This invention relates to a lead exit arrangement for a high voltage (HV) transformer or reactor. The invention also relates to a transformer or reactor having said lead exit arrangement. The invention also relates to a power distribution network including said transformer or reactor.

[0002] A transformer or reactor typically comprises an inductive element, such as windings, mounted within a tank or housing. A lead exit arrangement provides an external connection to the internal inductive element of the transformer or reactor. The lead exit arrangement typically includes a bushing and associated electrostatic shielding and insulation. The bushing carries a conductor that at one end connects to the inductive element by way of a winding lead and at the other end provides a terminal of the transformer. The terminal allows, for example, external equipment or a power distribution network to be connected to the transformer.

[0003] At high voltages, the bushing is typically mounted in a turret, which extends from the external surface of the transformer housing. The turret supports the bushing and houses the connection between the bushing and the winding lead that extends from the windings, through an aperture in the housing and into the turret. Shielding and insulation, referred to as a stress shield, surrounds the connection between the bushing and the winding lead in the turret.

[0004] The turrets and bushings are usually detached for transportation of the transformer after manufacture and testing. Therefore, the transformer must be carefully reassembled on site. Care must be taken to ensure that the apparatus is returned to the same condition in which it was tested in the factory. While replacing the turret and bushing the stress shield must be carefully positioned to ensure its insulating integrity. The turret is also typically filled with an insulating fluid, such as an oil, and the insulation is conditioned accordingly. The need to detach the turret for transportation may prolong exposure of the lead exit arrangement's hygroscopic insulation to the environment, which can increase the risk of contamination.

[0005] According to a first aspect of the invention, there is provided a lead exit arrangement for a high voltage transformer/reactor comprising an elongate bushing having a bushing axis, a stress shield located at a base of the bushing for receiving a winding lead from a transformer/reactor and housing a connection between the winding lead and the base of the bushing, the stress shield configured to receive said winding lead in a direction off-axis with respect to the bushing axis.

[0006] Thus the stress shield is configured such that the bushing extends out of the stress shield along the bushing axis and the winding lead extends into the stress shield along a second axis or direction, the angle between the bushing axis and the second axis being less than 180°. It has been found that constructing the stress shield in this way, such that it does not have to receive the winding lead along the bushing axis, allows for a more compact design and can obviate the need for a turret and therefore any disassembly of the turret during transportation.

[0007] The stress shield may be configured such that the angle between the winding lead and the bushing axis at the point of connection between the winding lead and the base of the bushing is less than 180°. The angle may be less than 170° or less than 150° or less than 120°. The angle at which the stress shield accepts the winding lead with respect to the bushing axis and the angle at which the connection between the two parts is formed is important as it allows the lead exit arrangement to be compact.

[0008] The lead exit arrangement may form part of a transformer or reactor. The transformer/reactor may comprise an ultra high voltage (UHVAC) transformer/reactor. The transformer/reactor may include an inductive element mounted within a tank. The stress shield may be mounted within the tank. This is advantageous as a turret is no longer required because the stress shield, which houses the connection between the bushing and the winding lead, is mounted within the tank rather than external to the tank within the turret structure. A transformer/reactor having an inductive element mounted within a tank wherein a stress shield forming an insulating structure around the connection between a lead of the transformer/reactor and a bushing may form an aspect of the invention.

[0009] The bushing may be arranged such that it extends through an aperture in the tank.

[0010] The tank may be configured to support the bushing at the point it projects through the tank.

[0011] The bushing may include a first end, which is received within the stress shield and a second end, opposite the first end, which forms a terminal of the transformer/reactor, the first end and second end separated by a central section, wherein the tank is configured to engage and support the bushing by its central section.

[0012] The inductive element may comprise one or two (or more) coils or windings mounted side by side and said stress shield of the lead exit arrangement may be mounted at least partly between said coils. This can lead to a particularly compact design as the stress shield can occupy the space between the sides of the two substantially cylindrical coils and may fit within a linear perimeter extending between the outside edges of the coils.

[0013] The stress shield may be mounted to and supported by an insulating support structure that extends within the tank.

[0014] The tank may contain an insulating fluid and said fluid may immerse said stress shield and said inductive element.

[0015] The stress shield may be configured to receive more than one winding lead. The further winding lead may also be received into the stress shield in a direction other than along the bushing axis.

[0016] According to a second aspect of the invention, we provide a method of assembling a lead exit arrangement for a HV transformer/reactor, said transformer/reactor including a tank configured to house an inductive element of the transformer/reactor, the method comprising;

a) mounting a stress shield within said tank;

b) mounting a base of an elongate bushing in said stress shield, said bushing extending along a bushing axis;

c) mounting a winding lead from the inductive element to said base of the bushing, said winding lead received into said stress shield in a direction off axis with respect to the bushing axis.

[0017] According to a third aspect of the invention, we provide a power distribution network including a transformer/reactor having the lead exit arrangement of the first aspect of the invention.

[0018] There now follows a brief description of a preferred embodiment of the invention, by way of a non-limiting example, with reference to the following figures in which:

Figure 1 shows a plan view of a transformer including the lead exit arrangement in which the bushing is shown with transparency;

Figure 2 shows a front view of a transformer shown in Figure 2;

Figure 3 shows a side view of the transformer shown in Figures 2 and 3; and

Figure 4 shows a flow chart illustrating a method of assembling a lead exit arrangement in a transformer.

[0019] Figures 1 to 3 show a lead exit arrangement 1 for an ultra high voltage transformer 20. It will be appreciated that the lead exit arrangement is equally applicable to a reactor, although the examples below will refer only to a transformer for brevity. The lead exit arrangement comprises an elongate bushing 2 having a bushing axis B (shown in figure 3). The bushing 2 comprises an insulated conductor 4 (shown schematically in Figure 2) that provides an electrical connection to the transformer 20. The arrangement 1 further comprises a stress shield 5 located at a base 6 of the bushing 2 for receiving a winding lead 7 from the transformer 20 and housing an electrical connection 8 between the winding lead 7 and the base 6 of the bushing 2. The stress shield 5 is configured to receive said winding lead 7 in a direction off-axis with respect to the bushing axis B. The stress shield 5 provides an insulating function around the junction between the winding lead and the bushing.

[0020] The winding lead 7 comprises an electrical conductor that extends from an inductive element of the transformer 20, comprising windings 10. The windings 10, in this example, are arranged as two coils 11 and 12. The winding lead 7 thus provides an electrical connection between the coils 11, 12 and the bushing 2. In the embodiment shown herein, two winding leads 7*a* and 7b are received by the stress shield 5, one from each of the coils 11, 12. It will be appreciated that the stress shield 5 may be configured to receive only one lead, two leads, or more.

[0021] The coils 11 and 12 are substantially cylindrical structures having insulation there around and are mounted side by side, as is conventional, with their axes parallel to one another. The stress shield 5 and the connection 8 is mounted in a gap 22 between the two coils 11, 12. This is possible due to the stress shield 5 accepting the winding lead 7 at an angle to the bushing axis.

[0022] The inductive element 11, 12 of the transformer 20 is mounted with a tank 21, which forms a housing for the coils 11, 12. The stress shield 5 and connection 8 is also mounted within the tank 21.

[0023] The tank 21 also includes a support structure 23 to which the stress shield 5 is mounted. The stress shield 5 sits within the space defined by the gap 22 and tank 21. The tank 21 also includes an aperture 24 in an upper surface which allows the bushing 2 to extend out of the tank.

[0024] The bushing 2 comprises a first end 13 at which the connection 8 is made and which is received within the stress shield 5. The bushing also has a second end 14, opposite the first end 13, which includes a terminal 15 which provides the electrical connection to the transformer 20. The terminal 15 comprises the terminal end of the conductor 4 that extends through the bushing 2. The first end 13 comprises the base 6 of the bushing 2. The first end 13 and second end 14 are separated by a central section 16. The arrangement 1 is configured such that the central section 16 of the bushing 2 extends through the aperture 24. The central section 16 may include a flange 17 arranged to be connected to the tank 21. The tank 21 may include an annular ring 25 adapted to engage the flange 17. Thus, the tank supports the bushing 2 by its central section as it projects through a wall of the tank 21.

[0025] The stress shield 5 comprises a substantially spherical or ovoidal conducting body with insulating walls that houses the connection 8. The stress shield 5 is supported by an insulating support structure 18 mounted within the tank 21.

[0026] Figure 3 shows the angular relationship between the winding lead 7 and the bushing 2. Bushing 2 is received into the stress shield 5 along a bushing axis B. Accordingly, the stress shield 5 includes an aperture 30 for receiving the bushing 2. The stress shield 5 also includes a lead aperture 31 (in this embodiment two lead apertures) which receives the winding leads. One of the winding leads is received along an axis L. The lead axis L does not lie along the axis B and is therefore off-axis with respect to the bushing axis B. Further, the axes L and B are not parallel to one another. An angle C formed between the axis B and the axis L is therefore less than 180°. The angle between the bushing axis and the lead 7 at the connection 8 is also less than 180°. Thus, the connection 8 between the lead 7 and the base of the bushing is formed at an obtuse angle rather than end to end. The other winding lead is also received along an axis arranged at a similar angle to the bushing axis B, as viewed in Figure 3. Thus, the other winding lead has a similar angular relationship to the bushing axis B. The axes L substantially perpendicular to the axis of the coils 11, 12. The bushing 2 thus extends at an acute angle away from directly upward and the lead(s) 7 extend at an angle substantially perpendicular to the upward direction (as the coils, in this example, are mounted with their axes parallel to the upward direction).

[0027] Figure 4 shows a flow chart illustrating the method of mounting a stress shield within said tank shown as step 50. Step 51 shows mounting a base of an elongate bushing in said stress shield, said bushing extending along a bushing axis. Step 52 shows mounting a winding lead from the inductive element to said base of the bushing, said winding lead received into said stress shield in a direction off axis with respect to the bushing axis. Step 53 shows securing a central section of the bushing to the tank, at a point where it extends through an aperture in the tank. Step 54 shows filling the tank with an insulating fluid and thereby immersing the stress shield and inductive element in said fluid.

Claims

1. A lead exit arrangement (1) for a high voltage transformer/reactor (20) comprising an elongate bushing (2) having a bushing axis (B), a stress shield (15) located at a base (6) of the bushing (2) for receiving a winding lead (7) from a transformer/reactor (20) and housing a connection (8) between the winding lead (7) and the base (6) of the bushing (2), the stress shield (5) configured to receive said winding lead (7) in a direction off-axis with respect to the bushing axis (B).

2. A lead exit arrangement according to claim 1, in which the stress shield (5) is configured such that the angle between the winding lead (7) and the bushing axis (B) at the point of electrical connection between the winding lead (7) and the base (6) of the bushing (2) is less than 180°.

3. A transformer/reactor including the lead exit arrangement (1) of claim 1 or claim 2.

4. A transformer/reactor according to claim 3, in which the transformer/reactor (20) includes an inductive element (11,12) mounted within a tank (21) and the stress shield (5) is mounted within the tank (21) adjacent the inductive element (11,12).

5. A transformer/reactor according to claim 4, in which the arrangement is configured such that the bushing (2) extends through an aperture (30) in the tank (21).

6. A transformer/reactor according to claim 5, in which the tank (21) is configured to support the bushing (2) at the point it projects through the tank (21).

7. A transformer/reactor according to claim 6 in which the bushing (2) includes a first end (13), which is received within the stress shield (5) and a second end (14), opposite the first end (13), which forms a terminal of the transformer/reactor (20), the first end (13) and second end (14) separated by a central section (16), wherein the tank (21) is configured to engage and support the bushing (2) by its central section (16).

8. A transformer/reactor according to any one of claims 4 to 7, in which the inductive element comprises at least two coils (11,12) mounted side by side and said stress shield (5) of the lead exit arrangement (1) is mounted at least partly between said coils (11,12).

9. A transformer/reactor according to any one of claims 4 to 8, in which the stress shield (5) is mounted to and supported by an insulating support structure (18) that extends within the tank (21).

10. A transformer/reactor according to any one of claims 4 to 9, in which the tank (21) contains an insulating fluid and said fluid in said tank (21) immerses said stress shield (5) and said inductive element (11,12).

11. A method of assembling a lead exit arrangement (1) of a transformer/reactor (20), said transformer/reactor (20) including a tank (21) configured to house an inductive element (11,12) of the transformer/reactor (20), the method comprising;

    a) mounting a stress shield (5) within said tank (21);
    b) mounting a base (6) of an elongate bushing (2) in said stress shield (5), said bushing (2) extending along a bushing axis (B);
    c) mounting a winding lead (7) from the inductive element (11,12) to said base (6) of the bushing (2), said winding lead (7) received into said stress shield (5) in a direction off axis with respect to the bushing axis (B).

12. A power distribution network including a transformer/reactor (20) as defined in any one of claims 3 to 10.

Figure 1

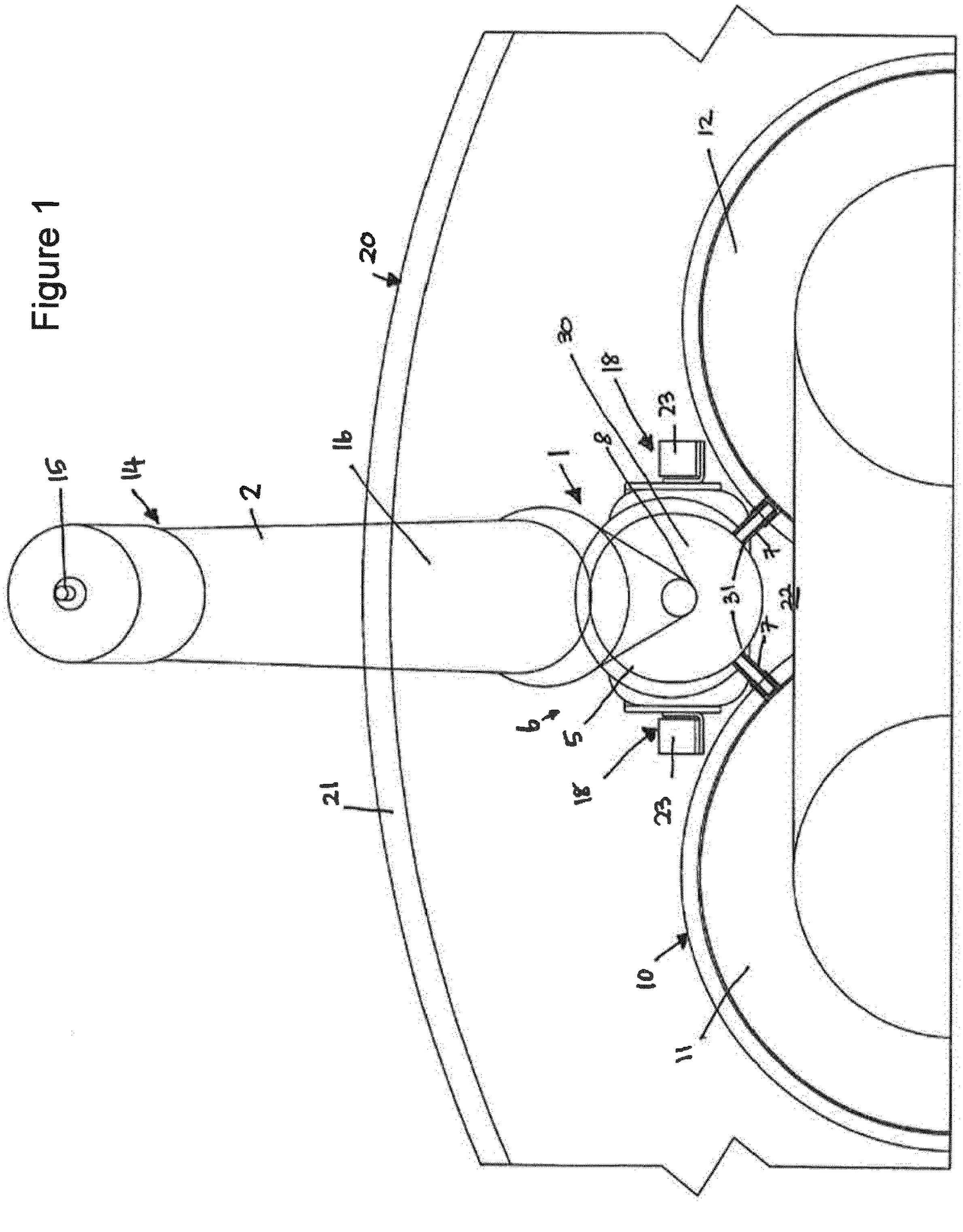
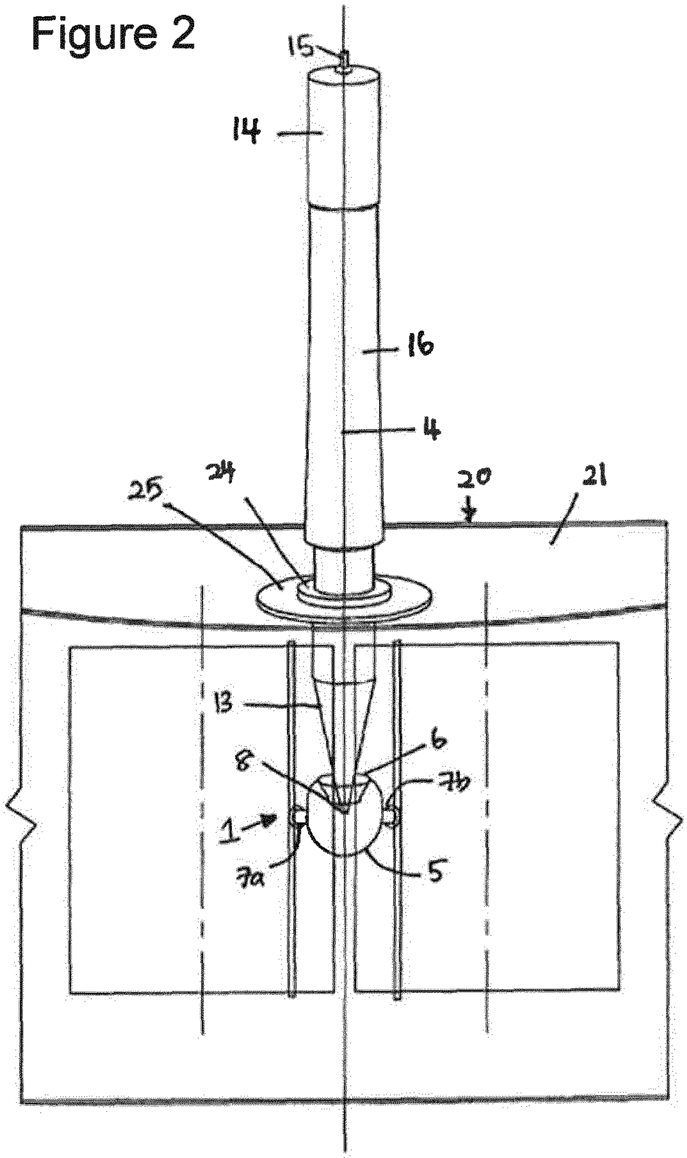


Figure 2



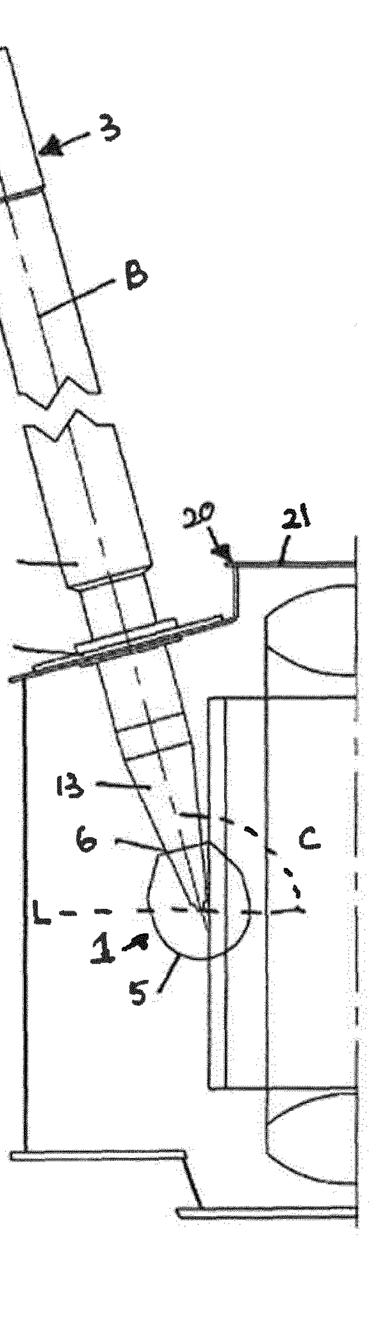
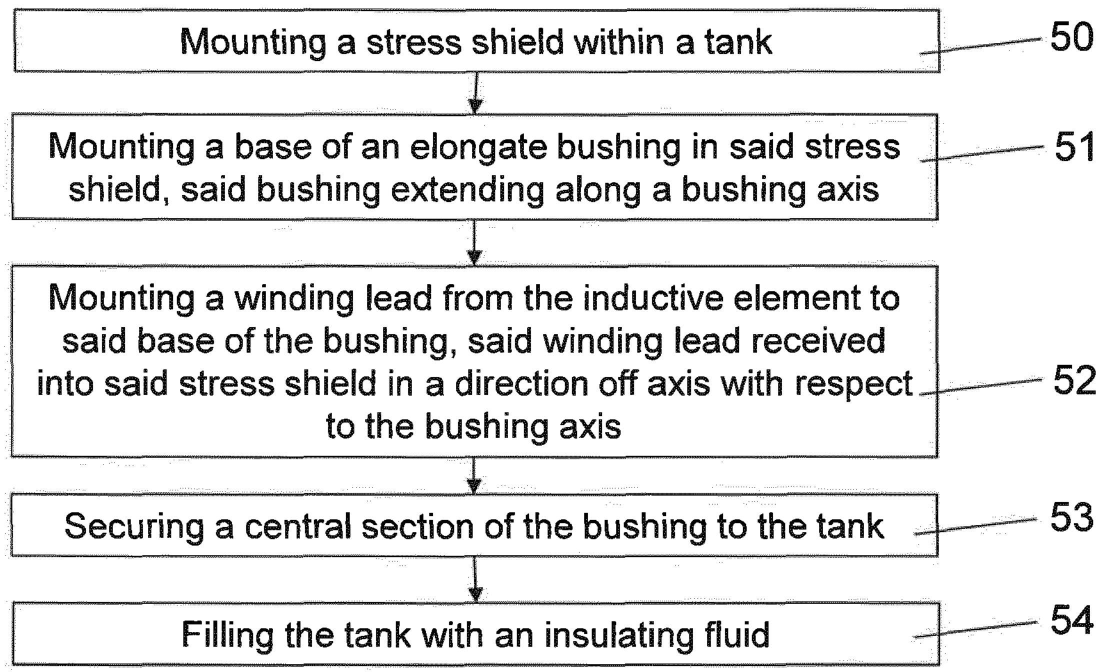


Figure 3

Figure 4


Mounting a stress shield within a tank
50
Mounting a base of an elongate bushing in said stress shield, said bushing extending along a bushing axis
51
Mounting a winding lead from the inductive element to said base of the bushing, said winding lead received into said stress shield in a direction off axis with respect to the bushing axis
52
Securing a central section of the bushing to the tank
53
Filling the tank with an insulating fluid
54

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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 0730

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

3

Place of search	Date of completion of the search	Examiner
Munich	3 January 2017	Gols, Jan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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