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(54) **Magnetic proximity sensor**

(57) The sensor comprises a case (1) housing a reed phial (4) with terminal leads (7, 8) connected to an electric cable (11) that comes out of said case through a sealing cap (16). The phial (4) is mounted inside the case (1) by means of a support board (14) which is adapted to keep the same phial suspended therein, without any direct mechanical contact with said case.

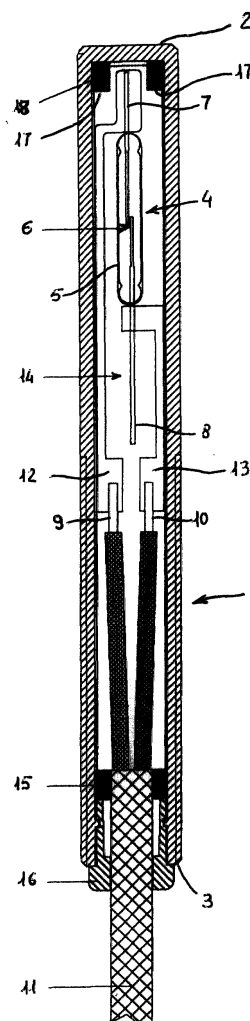


Fig. 1

EP 1 172 835 A2

Description

[0001] The present invention refers to an improved magnetic proximity sensor.

[0002] Magnetic proximity sensors are generally known in the art to usually comprise a reed phial, the terminal leads of which are connected to a sheathed electric cable coming out, through a sealing cap, of a substantially cylindrical insulating case in which the phial itself is housed. The interior of this case is furthermore filled with a resin that is adapted to both ensure full insulation of the component parts and to effectively hold them firmly in place.

[0003] Such a reed phial normally comprises a glass tube which, according to the requirements, may contain at least an electric switch, a break-before-make switch, or the like, which is normally in a resting position (open switch, for instance) and is adapted to change over to an operating condition (closed switch, for instance) when the sensor is approached by a magnetic body.

[0004] Reed phials are largely known to be inherently brittle devices that are quite easily subject to a breakage of the glass tube. Especially in some applications, such as for instance those involving the use of magnetic proximity sensors to control such lifting or hoisting installations as lifts or elevators, in which the reliability of the whole system is of paramount importance, malfunction problems quite often occur to arise due to these sensors being tampered with or used incorrectly by the people in charge of the installation of such apparatuses. In almost the totality of the cases that have been investigated in this connection, this incorrect handling of the sensors by the installers has led to a breakage of the glass tube, with substantially unacceptable consequences.

[0005] It therefore is a main purpose of the present invention to provide a magnetic proximity sensor which is particularly robust and reliable, and is capable of preserving its integrity also in the case of its being used or handled incorrectly.

[0006] A further purpose of the present invention is to provide a magnetic proximity sensor of the above cited kind, which has a structure that is substantially simple and capable of being easily assembled.

[0007] According to the present invention, these and further aims are reached in a magnetic proximity sensor embodying the characteristics as recited in the appended claims.

[0008] Anyway, features and advantages of the present invention will be more readily understood from the description that is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a schematical, longitudinal-section view of a preferred embodiment of the present invention;
- Figures 2 and 3 are views of respective enlarged details of the magnetic proximity sensor illustrated

in Figure 1;

- Figure 4 is a schematical view of the magnetic proximity sensor as sectioned along a plane that is orthogonal to the section plane of Figure 1; and
- Figure 5 is a view according to the section V-V of the magnetic proximity sensor of Figure 4.

[0009] With reference to the above listed Figures, the magnetic proximity sensor mainly comprises a substantially cylindrical case 1 made of an insulating material such as a plastic material containing a glass filler. An outer head end portion 2 of such a case 1 is preferably sealed, whereas at the opposite end portion there is provided with an aperture 3 for the insertion of the component parts therein, as this shall be explained in greater detail further on.

[0010] In a per se known manner, the active part of the sensor is constituted by at least a reed phial 4, which in turn comprises a glass tube 5 housing at least an electric device 6, such as a switch, a break-before-make contact, or the like, which is adapted to switch between a resting condition and an operating condition in a traditional manner. According to the particular case, said electric device 6 comprises two or more terminal leads 7, 8 which must be connected to respective electric leads 9, 10 that are part of a connection cable 11, which is of a bipolar type in the described example.

[0011] According to an important feature of the present invention, said terminal leads 7, 8 of the reed phial 4 are welded or soldered to respective electric conductors 12, 13 that are provided on a support member 14. In a preferred manner, such a support member 14 is formed by a printed-circuit board provided with at least two conductive paths that form the above cited conductors 12, 13. Said welding or soldering of the terminal leads 7, 8 to said paths 12, 13 brings about also the mechanical support of the reed phial 4.

[0012] The board 14 has dimensions that are correlated to the ones of the case 1, into which it is mounted through the aperture 3, so as to be capable of supporting said reed phial 4 in a suspended manner, i.e. without any direct contact of said phial with the case 1.

[0013] In a preferred manner, also the board 14 is mounted in the case 1 without any direct mechanical contact therewith, as this will be described in greater detail further on.

[0014] The end portions of the electric leads 9, 10 are welded or soldered to the respective paths 12, 13 of the board 14, and the cable 11 is supported and centered with respect to the case 1 through the interposition of an elastic ring or grommet 15 of rubber or similar material. The latter also ensures an effective insulating action to protect the interior of the case 1 against the penetration of dust, liquids or the like therein.

[0015] Furthermore, the cable 11 comes out of the case 1 by passing in an air-tight manner through a seal-

ing cap 16 that is press-fitted mechanically on to the aperture 3.

[0016] With particular reference to Figure 3, it can be noticed that said cap 16 is preferably shaped so as to include check means (such as for instance one or more side recesses 19) adapted to snap into engagement with complementary check means (such as for instance one or more protrusions 20) provided on the inner surface of the case 1. In an advantageous manner, such a positive coupling of said check means 19, 20 can be effective in view of preventing the cap 16 not only from slipping or coming off accidentally from the case 1, but also from being able to rotate with respect to the same case.

[0017] On its side lying near to the sealed end portion 2 of the case 1, the board 4 is shaped so as to feature two opposite undercuts 17, in correspondence of which it is supported and centered with respect to the case 1 through the interposition of a further elastic spacer ring 18, made of rubber or similar material, which protrudes transversally and axially from the board 14.

[0018] Conclusively, the board 14, which in turn supports the reed phial 4, is mounted in the case 1 without any direct contact therewith, neither in correspondence of the sides nor in correspondence of the head or outer end portions thereof. Furthermore, said elastic grommets or rings 15 and 18 advantageously act so to say as respective shock and vibration damping means ensuring an additional degree of mechanical strength to the entire magnetic proximity sensor, which is so able to more effectively withstand possible rough or even incorrect handling.

[0019] In any case, the reed phial 4 and the respective terminal leads 7, 8 are actually suspended inside the casing 1 and are therefore advantageously protected against those mechanical stresses which are most likely to cause them to break down in traditional solutions.

[0020] It should furthermore be duly noticed that the use of such a press-fitted sealing cap 16 (and said grommet 15) is effective in ensuring a perfect insulation of the inner space of the case 1, which therefore, as against traditional solutions, does not require to be filled with insulating resin. This brings about a further advantage in that possible mechanical strains that may be imposed on to the cable 11 (for instance in those cases in which the same cable is pulled with a certain force) are not passed on to the reed phial 4, since said two component parts are connected to each other in an indirect and substantially non-rigid manner,

[0021] It will be appreciated that the above described magnetic proximity sensor may be the subject of a number of modifications without departing from the scope of the present invention.

[0022] So, for example, the cable 11 may be a three-core cable, in the case that the reed phial 4 is provided with more than two terminal leads, or the end portion 2 of the case 1 may also be of the type sealed with the use of a mechanically press-fitted cap similar to the cap

16.

Claims

1. Magnetic proximity sensor comprising a case that has at least an insertion aperture and houses at least a reed phial having terminal leads connected to an electric cable coming out of the same case through a cap used to seal said aperture, **characterized in that** said reed phial (4) is mounted inside said case (1) through the use of support means (14) adapted to keep said phial suspended in said case (1) without any direct mechanical contact therewith.
2. Magnetic proximity sensor according to claim 1, **characterized in that** said support means comprise a printed-circuit board (14) provided with conductive paths (12, 13) to which there are attached respective terminal leads (7, 8) of the reed phial (4), in which said terminal leads are furthermore connected via said conductive paths (12, 13) to respective conductors (9, 10) of the electric cable (11).
3. Magnetic proximity sensor according to claim 1, **characterized in that** said cable (11) comes out of the case (1) through said sealing cap (16) which is mounted by mechanically press-fitting it on to said insertion aperture (3), in which the interior of the case (1) is free of any insulating resin or similar filling material.
4. Magnetic proximity sensor according to claim 1, **characterized in that** said support means (14) are mounted in the case (1) through the use of at least a spacer member (18), so that also these support means (14) are suspended inside the case (1) without any direct mechanical contact therewith.
5. Magnetic proximity sensor according to claim 1, **characterized in that** said cable (11) is supported and centered with respect to the case (1) through the interposition of a spacer member (15).
6. Magnetic proximity sensor according to claim 3, **characterized in that** said sealing cap (16) is shaped so as to include check means (19) adapted to snap into engagement with complementary check means (20) provided on the inner surface of the case (1) in such a manner as to prevent the cap (16) from slipping or coming off accidentally from the same case and/or being able to rotate with respect thereto.
7. Magnetic proximity sensor according to claim 4, **characterized in that** said spacer member (18) is elastic and acts also as a shock and vibration damping member.

8. Magnetic proximity sensor according to claim 4, **characterized in that** said spacer member (18) is provided in correspondence of a shaped end portion (17) of the support means (14), from which it protrudes transversally and axially so as to abut against the case (1). 5
9. Magnetic proximity sensor according to claim 5, **characterized in that** said spacer member (15) is elastic and also acts not only as a shock and vibration damping member, but also as an insulating member protecting the interior of the case (1) against the infiltration of dust or liquids. 10

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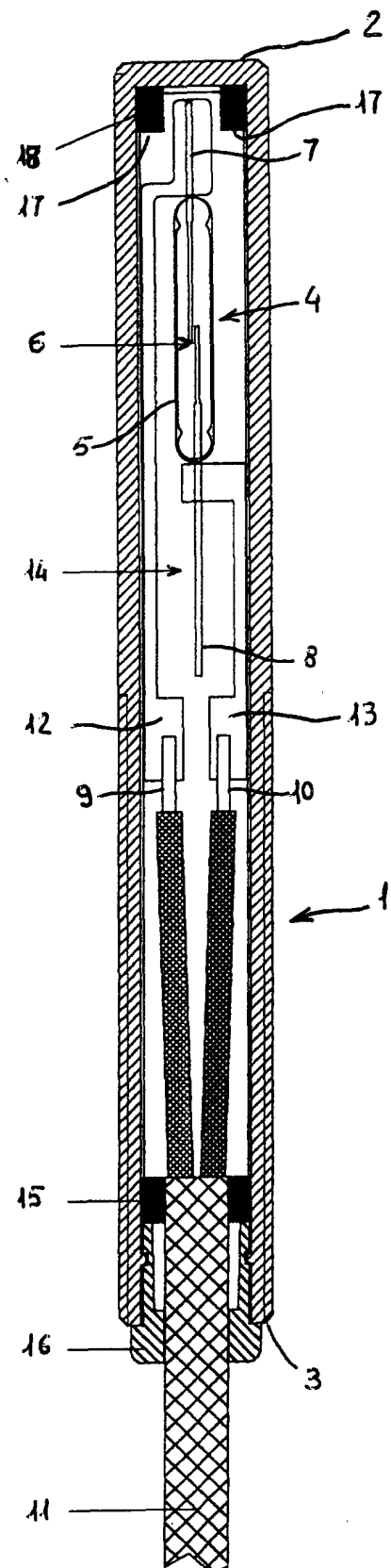
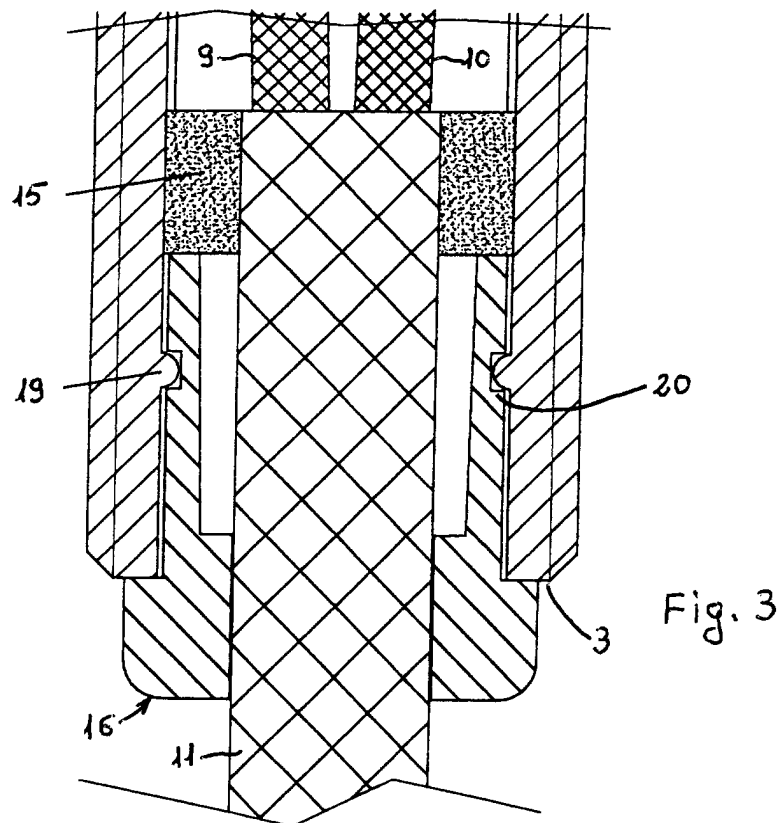
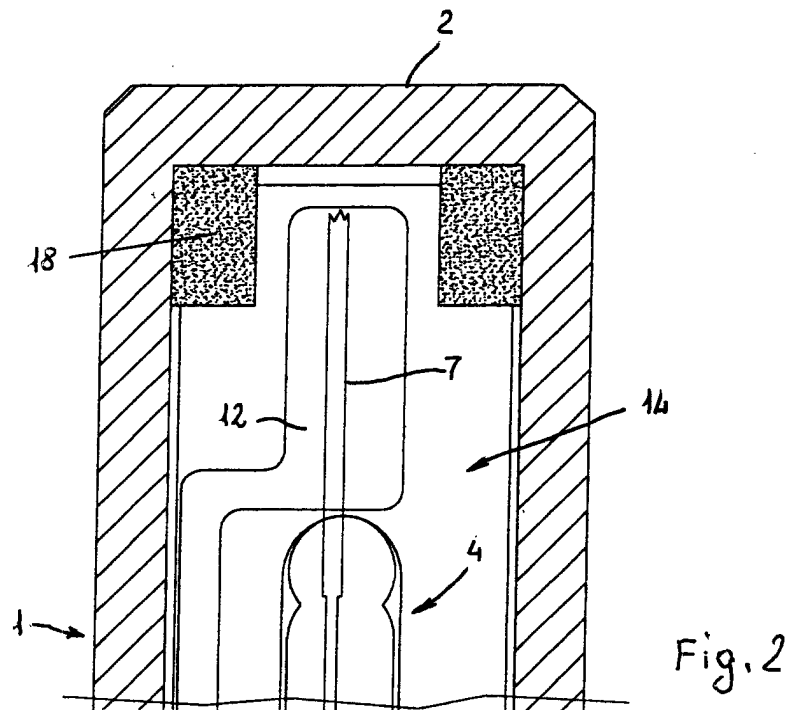


Fig. 1



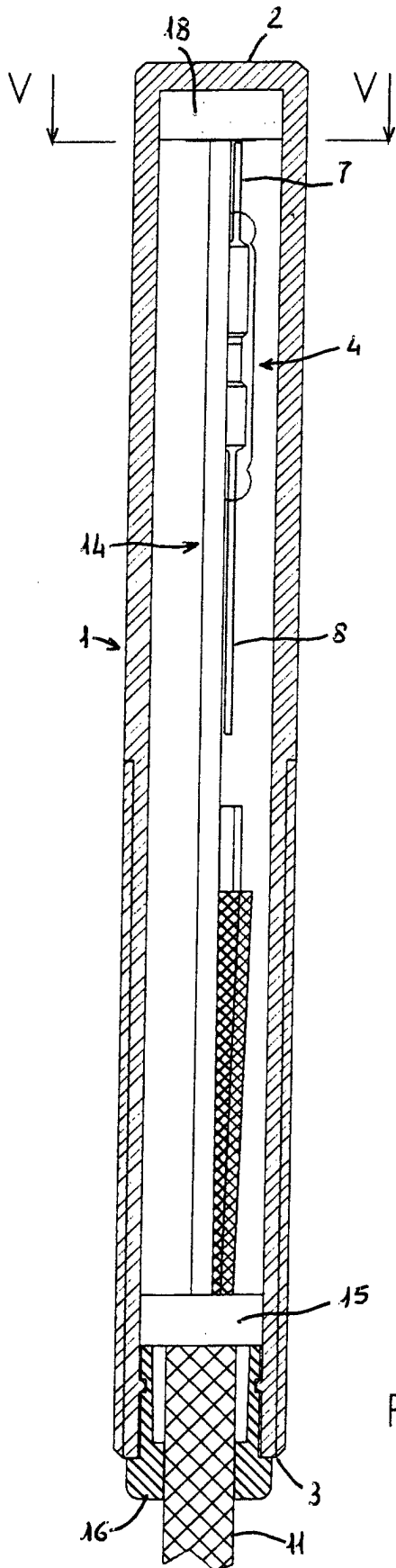


FIG. 4

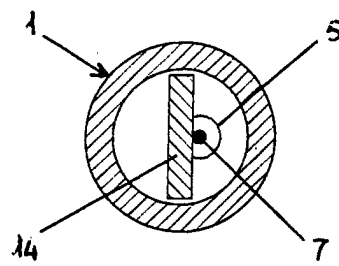


FIG. 5