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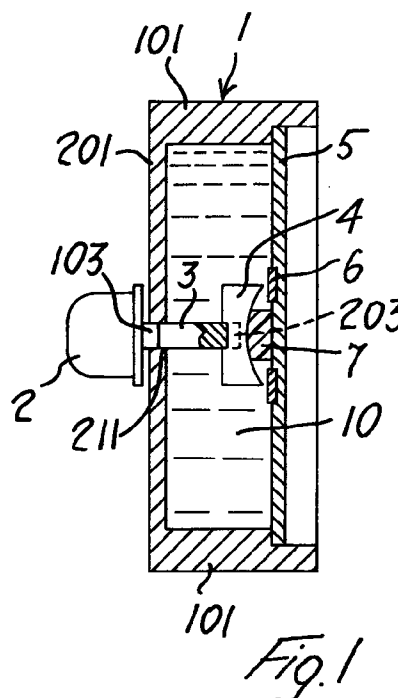
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(54) **Push-button switch**

(57) Push-button switch, in particular for electronic underwater devices, comprising: a push-button, including a bar (3) coupled at one end with a key (2) and provided, at the opposite end, with a bridge element (4) for the connection of two contacts (6); being said bar and said bridge element mounted in a tight chamber (1), completely filled with insulating fluid or gel (10), on which the support (5) of the said contacts (6) faces, said bar (3), being sealingly sliding in a hole (211) made on the wall of said chamber (1) and orthogonal to said support (5); being provided, on said support (5), elastic returning means (7) facing said bridge element (4).



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Description

[0001] The present invention refers to a push-button switch, and in particular, a switch to be used preferably in circuits for electronic underwater devices, such as immersion computers or the like.

[0002] In the modern divers equipments are commonly used the so-called immersion computers which, by processing the data of immersion pressure and time, give the datum about the stay time allowed at a certain depth. Such devices are generally provided with a keyboard, more or less large, by which the different computer functions can be activated. Such keys are normally magnetic; that exposes them to some disadvantages.

[0003] In particular, said keys tend to stick, that is to say not to break the contact once the key is released. Their reaction time, moreover, can be quite slow, and this impairs the functioning efficiency of the device.

[0004] Object of the present invention is to provide a push-button switch having a great response constancy and extremely short reaction times; in particular such a push-button switch is to be fitted for its use on electronic underwater devices.

[0005] Scope of the invention is thus a push-button switch, in particular for electronic underwater devices, comprising: a push-button, including a bar coupled at one end with a key and provided, at the opposite end, with a bridge element for the connection of two contacts; said bar and said bridge element being put in a tight chamber, completely filled with insulating fluid or gel, on which the support of the said contacts faces, said bar being sealingly sliding in a hole made on the wall of said chamber and at right angles to said support; being provided, on said support, elastic returning means facing said bridge element.

[0006] In particular, said elastic returning means can be a pawling element of elastomeric material set between the two contacts, to keep said contacts and said bridge element separated when there is no pressure on the push-button.

[0007] Moreover, said key can be coupled to said bar with flexible coupling means, such as, for instance, a cylindrical joint of elastomeric material.

[0008] Alternatively, said key can be coupled with said bar through a pilot sleeve, in which the same key is set, provided in its inside of elastic returning means.

[0009] Further advantages and characteristics of the device according to the present invention will be evident from the following description of some preferred embodiments of the invention, made with reference to the enclosed drawing, in which:

Fig. 1 is a sectional view of a device according to a first embodiment the present invention;

Fig. 2 is a top plan view of the device of Fig 1;

Fig. 3 is a sectional view taken along the line III-III of figure 1;

Fig. 4 is a partially sectioned enlarged view of a

detail of the device of figure 1;

Fig. 5 is a view similar to that of figure 4, of a second embodiment of the switch according to the present invention; and

Fig. 6 is a sectional view of a further embodiment of the device according to the present invention.

[0010] In Fig. 1 a sectional view of a first embodiment of the device according to the present invention is shown; reference numeral 1 is the box constituting the chamber in which the push-button switch, according to the invention, is set. Said box is open on one side, where it is coupled with the circuit contacts 6 support, that is the printed circuit card 5 or the like, and has the side walls 101 and the bottom wall 201, this last being provided with an axial hole 211, where it is slidingly and sealingly inserted, the bar 3 connected with the key 2 by flexible coupling means 103. At the end opposite the one connected to said key 2, the bar 3 has a fork 203 in which it is set the leading plate 4 having a plane-concave profile, whose two ends are connected with the two contacts 6 set on the card 5. Between said two contacts 6 it is provided a rubber pawling element 7 opposing the plate 4 concavity. The inside of the box 1 is filled with fluid 10, normally an oily high viscosity fluid.

[0011] In figure 2 is represented the device of Fig. 1 in plan view, from the side opposite that where the key 2 is. It can be noticed the layout of the components, whose numbers are those used in the figure described above. An analogous view is given in figure 3, showing the bar 3 sectioned and the position of the contacts 6 and of the pawling element 7 on the card 5.

[0012] In figure 4 is represented a detail of the device of figure 1 about the end of the bar 3 connected with the key 2 by flexible coupling means 103. Said coupling means include a cylindrical element 103 provided, at its ends, with two shanks 113 axially projecting from its surface, the whole made with one piece of elastomeric material. One of said shanks is to be set in a cavity 303 axially made in the bar 3 and complementary to it, the other is to be set in an analogous cavity 102 axially made in the key 2.

[0013] In figure 5 is represented another embodiment of the switch according to the invention. According to this embodiment, the bar 3 and the key 2 are not directly connected with each other. The key 2 is set within the bushing 301, connected with the wall 201, having its peripheral flange 202 a diameter greater than the hole 311 which is axially made on said bushing. Between the wall 201 and the key 2 is set an helical spring 401.

[0014] In figure 6 is represented a still further embodiment of the switch according to the invention; to same parts correspond same numbers. The key 2' is connected with the bar 3 by means of a diaphragm 403 of elastomeric material, provided with a hollow cylindrical axial sleeve 423, whose closed end is inserted within an hole 102' made on the key 2', while in the open end is set the bar 3. Along its peripheral rims the diaphragm

403 has the flanges 413 allowing their seal connection with the wall 201. The bar 3 has, at the end which is oriented towards the card 5, an extension 503, destined to be set in the through hole 105 made on said card; as a consequence, the pawling element 7 has an axial hole 107.

[0015] The operation of the device according to the present invention will be evident. In order to close the card 5 circuit, the plate 4 is to be set on the contacts 6; in order to do that, a pressure able to overcome the resistance of the pawling element 7 must be exerted. By pushing the key 2, the bar 3 slides towards the card 5 and the plate 4 connects the two contacts 6. The action of the user on the key 2 is mediated by the flexible coupling means 103, absorbing the pressure exerted on the key 2 and transmitting it back to the bar 3. This contrivance allows to set the plate 4 at an extremely short distance from the contacts 6.

[0016] Advantageously, the elastomeric material constituting the flexible coupling means 103 is softer than that of the pawling element 7. This allows, on one side a more progressive pressure transmission and on the other side ensures the hydraulic sealing of the hole 211 on the wall 201 of the box 1, apart from preventing the sliding of the bar 3 to the outside. As said before, the box 1 is filled with fluid, in particular an oily high viscosity fluid, such as silicone oil or the like, and with high dielectric constant, to ensure the insulation of the contacts 6 even if the distance between them and the plate 4 is minimal. Alternatively, the chamber can be filled with a gel having characteristics analogous to those described above.

[0017] In the embodiment of the invention shown in figure 5, the coupling of the key 2 and the bar 3 is made in a different way, but with substantially analogous results; in fact, even in this case, the key 2, after a short idle stroke, transfers the thrust, exerted on it by the bar 3, leading the plate 4 to connect the contacts 6. The helical spring 401 ensure the quick reopening of the circuit, since the key 2, once released, could hamper the coming back of the bar 3 caused by the pawling element 7.

[0018] In the embodiment of figure 6, a further improvement of the seal conditions of the bar 3 as to the hole 211 is shown. In fact, the diaphragm 403, besides representing a flexible coupling mean with the same effectiveness of the element 103, is able to provide a better control of the hole 211, thanks to the flanges 413 overlapping the wall 201. Moreover, for guiding the movement of the bar 3, the same is provided, at its distal end, with an extension 503, sliding in the through hole 105 made on the card 5.

[0019] The push-button switch, devised in this way, will be swift in its response time, and is particularly suitable to electronic devices for underwater use, such as immersion computers and the like.

Claims

1. A push-button switch, in particular for electronic underwater devices, characterised in that said switch comprises: a push-button, including a bar (3) coupled at one end with a key (2) and provided, at the opposite end, with a bridge element (4) for the connection of two contacts (6); said bar and said bridge element being put in a tight chamber (1), completely filled with insulating fluid or gel (10), on which the support (5) of the said contacts (6) faces, said bar (3) being sealingly sliding in a hole (211) made on the wall of said chamber (1) and at right angles to said support (5); being provided, on said support (5), elastic returning means (7) facing said bridge element (4).
2. A switch according to claim 1, where said bridge element includes a metallic plate (4) having plane-concave profile, being the concavity oriented towards said support (5).
3. A switch according to claim 1 or 2, where said elastic returning means include a pawling element (7) of elastomeric material.
4. A switch according to any one of the preceding claims 1 to 3, where said key (2) is coupled to said bar (3) by flexible coupling means, such as a cylindrical joint (103) of elastomeric material.
5. A switch according to the preceding claims 3 and 4, where the elastomeric material used to make said cylindrical joint (103) is relatively softer than the elastomeric material used to make the pawling element (7).
6. A switch according to any preceding claims 1 to 3, characterised in that said key (2) is slidingly inserted in a bushing (301) coaxial to said bar and connected to the wall (201) of the said chamber, being provided, between said wall (201) and said key (2), elastic returning means (401).
7. A switch according to claim 4, characterised in that said flexible coupling means include a diaphragm (403) of elastomeric material, axially provided with an hollow sleeve (423) closed at the end which is oriented towards said key (2) and coupled with it, being the bar 3 inserted in the cavity of the said sleeve (423), being said diaphragm sealingly inserted in said hole (211) made on the wall (201).
8. A switch according to claim 7, where the bar (3) has on the end oriented towards the card (5) cylindrical axial extension (503), slidingly inserted in a through hole (105) made on said card, being said pawling element (7) provided with an axial through hole

(107).

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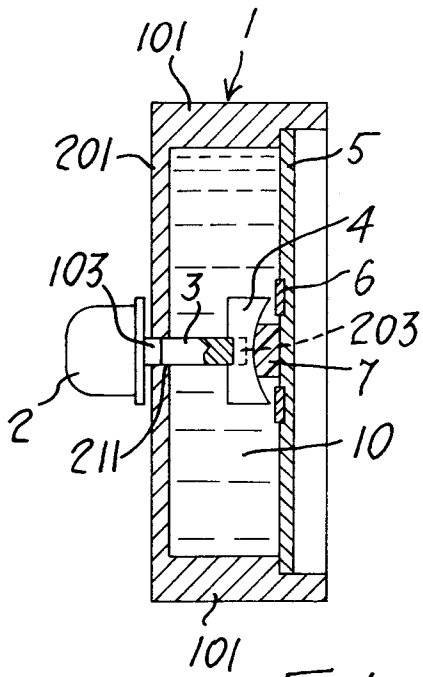


Fig. 1

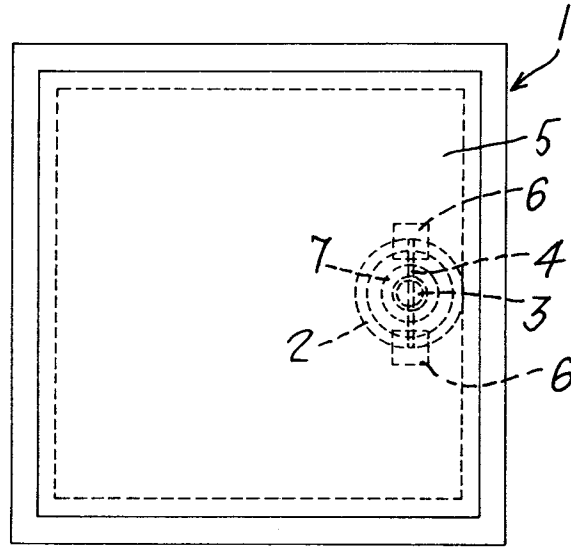


Fig. 2

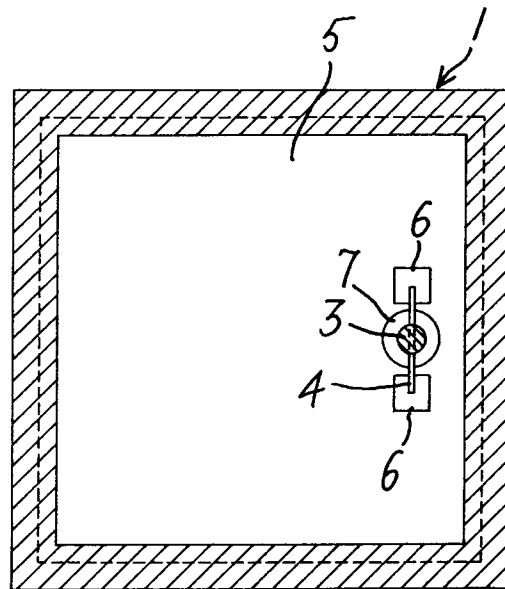
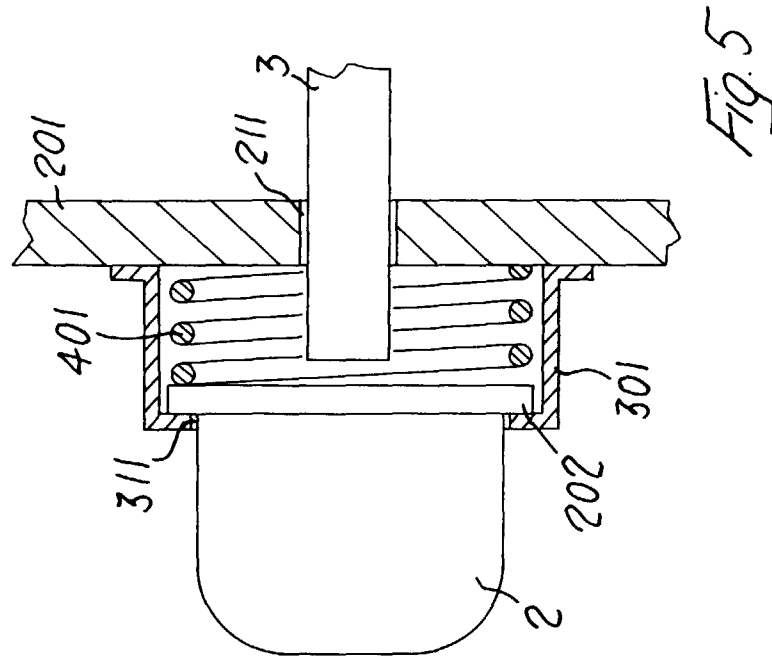
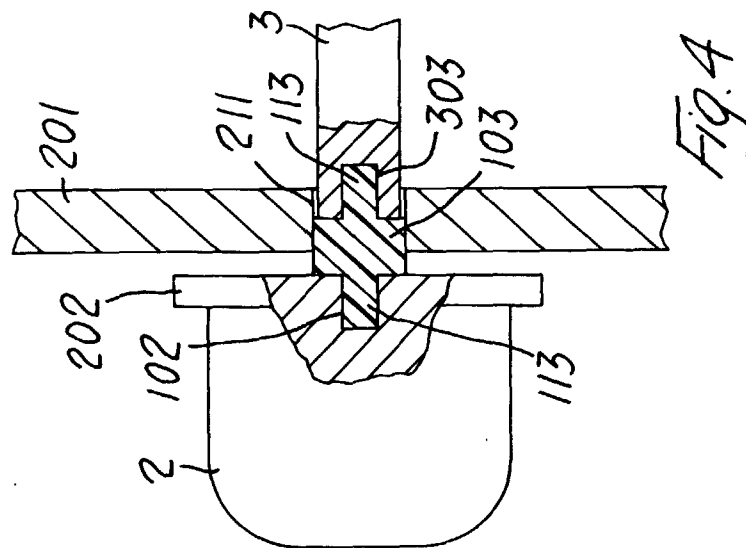


Fig. 3



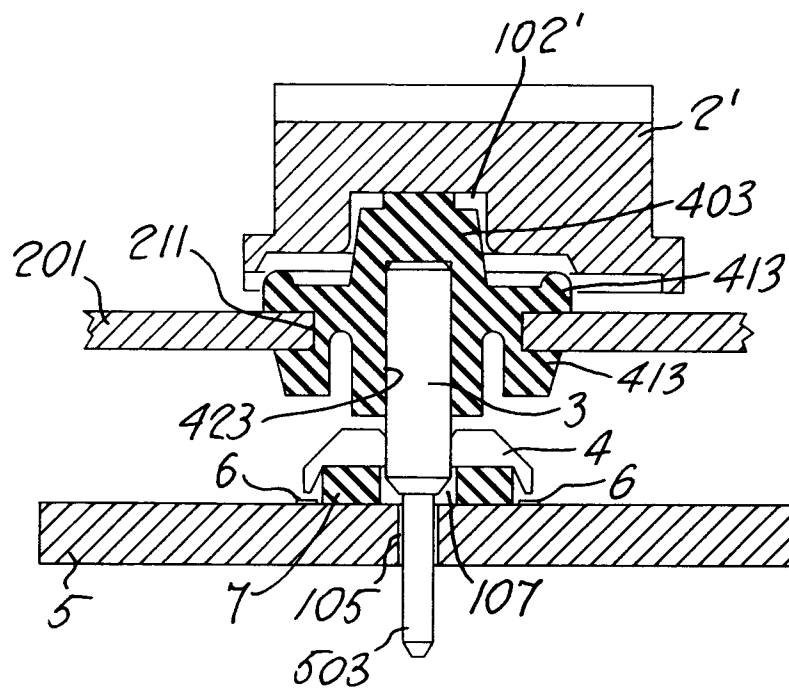


Fig 6



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EUROPEAN SEARCH REPORT

Application Number
EP 98 12 2366

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB 983 813 A (SIMPLEX) * page 3, line 21-54; figures * ---	1	H01H9/04
Y	DE 44 24 560 A (WERMELINGER AG) 18 January 1996 * claim 14; figures * ---	1	
Y A	US 2 321 012 A (J.D.CRECCA) 8 June 1943 * claim 2; figures * ---	1 2,7	
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A	US 2 952 754 A (JOEPH R. TOMLINSON) 13 September 1960 * the whole document * ---	1,3-5	
A	FR 1 216 717 A (JEAN MANTELET) 27 April 1960 * figures 1-7 * ---	1,7	
A	DE 16 67 541 U (MACHELER & KAEGE) * the whole document * ---	6	TECHNICAL FIELDS SEARCHED (Int.Cl.6) H01H
A	US 4 420 665 A (CONRAD RICHARD A) 13 December 1983 * abstract; claims; figures * -----	1,3-5	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15 April 1999	Examiner Durand, F
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 98 12 2366

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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